California Abandoned Mines Prioritization Tool

Phase I Technical and Business Process Report

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Table of Contents

Figures

Tables

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Executive Summary

California has over 47,000 potential legacy abandoned mine sites which vary considerably in the risks and hazards they pose to the public and the environment. The Department of Conservation's (DOC) Division of Mine Reclamation (DMR) led the California Abandoned Mine Prioritization Tool (CAMPT) project to help develop a proposed work flow that could prioritize and rank legacy abandoned mine sites in California for further study and clean-up based on relative risks and hazards. Such a work flow could be the basis for a new system that could be used by multiple federal and state land, resource, environmental and public health management agencies and departments to prioritize funding to address physical and chemical contamination challenges at abandoned mines. A statewide system for priority ranking will:

- Help identify where to perform new inventories of Abandoned Mine Lands (AML);
- Select mine sites that should be assessed for potential environmental contamination;
- Identify which sites should be considered for clean up; and
- Determine which physical hazards generate the highest risk.

The goal of Phase I of CAMPT is to support development of a comprehensive and flexible ranking tool that encompasses the needs and interests of multiple entities and provides the ability to rank AML sites based on specific criteria, and includes the ability to apply the tool to data residing in different data systems at multiple agencies and departments. Phase I resulted in a work flow that encompasses both physical safety and chemical contamination risks. Agencies use a three-point framework for evaluating chemical risks from abandoned mines:

1) Are there contaminants that pose a hazard?
2) Is the contamination carried off site?
3) Can the contamination impact human or ecological receptors?

The framework for physical hazards involves 2 factors:

1) Depth, height, or condition of mine features.
2) Ease and manner (i.e., distance, vehicle, hike) of public access to the mine site.

The work flow for the proposed tool is based on attributes and guidelines developed previously by agency experts participating in the California Abandoned Mine Lands Agency Group (CAMLAG). These attributes were separated into "tiers" which describe different successive steps in prioritizing mine sites for further investigation. Tier 1 takes available information in GIS for the tens of thousands mine sites in the state and would result in prioritization of sites that may pose immediate risk to the public, or that may pose a risk and need further investigation. Tier 2 would take information from site visits to each of the prioritized Tier 1 sites and would result in a set of prioritized sites that pose a potential risk and that need in-depth investigation or remediation of physical safety hazards. Tier 3 would take the information from in-depth investigations and prioritize the mine sites that are most likely to need contamination cleanup to protect public and environmental well-being. The workflow also recognizes that the prioritization process

should allow space for identification of mine sites that pose an acute risk and the inclusion of expert opinion in prioritization.

This document outlines important steps in the work flow, the client base for risk and hazard reduction, a prioritization model, next steps, potential financial requirements, and benefits of taking action.

1.0 Project Overview

1.1 Background

The California Abandoned Mines Prioritization Tool (CAMPT) project originated from various federal, state and local agencies participating in the California Abandoned Mine Lands Agency Group (CAMLAG), including DOC, that have examined different ways of investigating potential impacts, prioritizing and remediating legacy abandoned mine sites in California posing the most risk. In many ways, this project formalizes discussion over the last decade among members of CAMLAG about how to formalize steps in prioritizing mine sites for further study and remediation. The CAMLAG charter identifies the group's role in developing the CAMPT system with two objectives:

- *Supports a more efficient and effective implementation of programs and tools used to address California's abandoned mine land problems.*
- *Develops criteria for selecting and addressing abandoned mine sites for remediation.*

In addressing these two objectives, CAMLAG created a problem statement detailing the challenge agencies face in prioritizing mine sites and coordinating resources to achieve remediation.

> *"Various state and federal programs exist to identify and remediate the physical and chemical hazards from legacy mines in California. Such mines may endanger human health and the environment, posing risks from low to high. In addition, the risk is not known for every mine site. Funding to remediate mine sites is limited and therefore requires choosing amongst sites. One of the barriers to making choices is not having a way to rank sites statewide. Such a ranking would enable regulators and land management agencies to select sites according to risk and endangerment and apply various fund sources based on a prioritization."*

DOC, the Sierra Nevada Conservancy (SNC), and the University of California, Davis (UCD) partnered in CAMPT to address this problem statement. Phase I resulted in a work flow that encompasses both physical safety and chemical contamination risks. Agencies use a three-point framework for evaluating chemical contamination and a two-point framework for evaluating physical safety risks from abandoned mines, presented in Table 1.

Table 1. Agency risk framework.

Chemical Risk Framework	Physical Safety Risk Framework
1) Are there contaminants that pose a hazards? 2) Is the contamination carried off-site? 3) Can the contamination impact human or ecological receptors?	1) Depth, height, or condition of mine features. 2) Ease and manner (i.e., distance, vehicle, hike) of public access to the mine site.

The partners obtained criteria input based on the CAMLAG agencies current process for evaluating abandoned mines, meeting regularly over a year and a half to review products, as well as to map out strategic approaches to prioritization (Table 2). Focused work team and individual meetings were held periodically with agencies listed in Table 2. In addition, as part of aligning the project, agencies were surveyed about their desired benefits and uses of a prioritization tool, and the project has been developed with that input in mind. Survey results are found in Appendix 2.

Table 2. State and federal agencies participating in CAMPT.

State	Federal
Department of Conservation (DOC) Department of Toxic Substances Control (DTSC) Central Coast Regional Water Quality Control Board (CCRWQCB) Central Valley Regional Water Quality Control Board (CVRWCB) Lahonton Regional Water Quality Control Board (LRWQCB) San Francisco Regional Water Quality Control Board (SFRWQCB) State Water Resources Control Board (SWRCB)	Bureau of Land Management (BLM) National Park Service (NPS) U.S. Environmental Protection Agency (USEPA) U.S. Forest Service (USFS) U.S. Geological Survey (USGS)

DOC staff compiled an all-inclusive spreadsheet of the criteria, known as attributes, and information provided by CAMLAG agency members. In addition, with CAMLAG input, DOC has defined a work flow with three screening levels or tiers. Each tier has associated attributes for screening abandoned mines for physical hazard and contaminant hazard risk. Concurrently, DOC began reviewing a prioritization tool under development by the USEPA, called MineShaft, that may be useful in the framework. USEPA has accepted input from CAMLAG with the intent that the tool may be flexibly used for USEPA's particular purposes and for CAMLAG's work flow, particularly at the initial GIS-based screening level (Tier 1 and CAMPT).

In addition, DOC has identified two phases for completing this project.

- Phase I – Tool planning and design
- Phase II – Tool development and implementation

This report covers the first phase and describes the design of a framework that forms the basis for a computational model to prioritize mine sites for further investigation and remediation. It is intended to form the bridge between the work completed to date by DOC and others in listing the

types of attributes that could be used to prioritize mine sites and the development of a tool that results in lists of mine sites prioritized for action. This bridging role also included many opportunities for CAMLAG agencies to introduce new ideas, check inclusion of important attributes, and verify utility of the tool for their institutional purposes.

The next phase, if implemented, would result in creation of a spatially-explicit decision-support tool that uses available information about mine sites to develop a list of mine sites for implementing further investigation, or for immediate in-depth investigation and remediation for sites that appear to pose immediate risk to the public or environment.

1.2 Approach and Progress

The CAMPT builds upon existing knowledge and priorities of multiple agencies and stakeholders. Existing prioritization guidance from agencies has been incorporated in the project, including a computerized analytical tool called the Preliminary Assessment and Ranking model (PAR) created in 1998 by DOC with input from the Abandoned Mine Lands Task Force, consisting of various agencies, as an in-house method to analyze the types of data collected by DOC during preliminary screening-level field site visits. The PAR served as the basis for creating a more flexible, data-specific, and spatially based model. The PAR model scored and ranked sites based on observable data collected in the field and limited analytical data collected with field meters. While the PAR model did rank all sites across multiple agencies, it did not use more detailed information that is typically gathered with site investigation or characterization activities, limiting the usefulness of the PAR model in prioritizing sites for remedial actions. The PAR model also was developed at a time when acid mine drainage (AMD) was the prevalent contamination issue of concern with abandoned mines. Since that time, mercury, a complex contamination issue, and other heavy metals associated with many abandoned mines have gained increasing attention, and the PAR model underrepresents the contamination hazards that might be present. Appendix 1 lists all of the guidance and technical documents used to provide the initial criteria used in CAMPT.

The development of the tool represents the first major step in the overall path to eventual remediation of California's abandoned mine sites that pose the most risks to humans, wildlife, and the environment. The tool provides a work flow involving a series of decision points or screening tiers based on data available at the time to produce prioritized lists of mine sites. Attributes used in each of the screening tiers are defined to identify whether there is the potential to cause impacts, and thus to score and rank sites based on hazard they present. Figure 1 shows the inputs and outputs for each tier in a work flow for a system using explicit data for prioritizing hazards from abandoned mines.

The objective of Tier 1 is to select potential areas or sites that may have an elevated risk of either physical or contamination impacts to humans, wildlife or the environment and for which no site-specific data is available. This selection Tier is a desktop GIS analysis only and no site-specific information is used in the analysis. Data used for this tier would be readily available in GIS format and GIS analysis would be applied to potential areas or sites to rank for performing future preliminary inventory. The objective of Tier 2 is to

select sites with potential risk to humans, wildlife or the environment based on data collected during a preliminary inventory and where additional information is needed to determine the actual risk associated with the site. Data collected for this tier consists of qualitative and quantitative information, but not sampling, collected during the preliminary inventory process that can be used to determine if a site will need further investigation. The objective of Tier 3 is to select sites identified to have actual risk to humans, wildlife or the environment based on data collected during an initial site investigation and where additional data is needed to fill critical data gaps before a final decision on a remedial action is taken. Attributes used in Tier 3 focus on the framework for chemical contamination in Table 1. In addition, Tier 3 includes a set of supplemental attributes, called Supplemental Considerations in Appendix 6, that agencies use to identify special impacts or sites that are more suitable for clean up, such as sites that impact tribal, low-income or minority communities, or sites that have clean up projects already partially funded. Data collected through a Preliminary Assessment/Site Investigation (PASI) or equivalent process will help determine which sites need a more thorough full site characterization or which sites have enough information to determine remedial action.

Risk Screening Levels

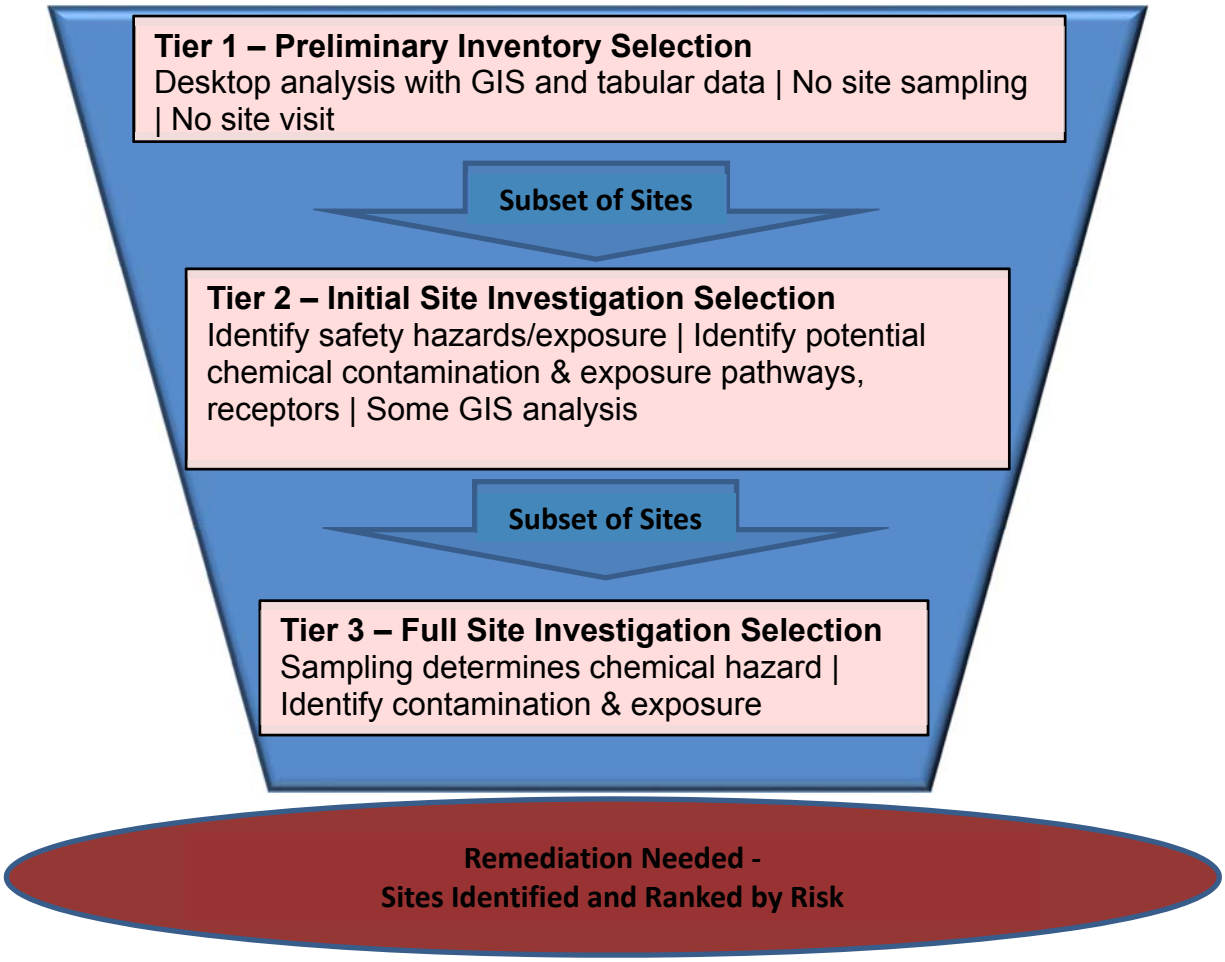


Figure 1. Work flow for Tiers 1, 2, and 3.

CAMLAG has selected ranking attributes that are relevant to physical safety hazards and human health and environment contaminant hazards. DOC and partners compiled and organized the attribute sets provided by CAMLAG agency members. The attributes use data about mine sites to evaluate risk, which will result in a score and rank for each site. Attributes have different types of associated data, such as geospatial data, other data in electronic format, and data in non-electronic format (reports or literature, for example). Important data gaps were also identified such as there not being broad coverage of water quality data for smaller watersheds where many abandoned mines are located.

1.3 Scope of Work

DOC and the SNC, with technical guidance and expertise from UCD, completed the Phase I (Table 3) development of the criteria (called attributes in the model), business processes, and scores and weights for each attribute. This report contains the documentation for all three of these tasks in Phase I.

Table 3. – Phase I – Planning.

TASK 1: Coordinate with CAMLAG participants to further refine and define a uniform set of criteria for the transparent and consistent application across agencies in the state. This will result in a final set of criteria, criteria definitions, and grouping of criteria into appropriate screening levels. Activities include: • Develop consensus between CAMLAG participants on data definitions for each criteria. • Identify the most appropriate foundation data set(s) of mines to which the tool would be applied. • In coordination with CAMLAG participants, gather and evaluate existing geospatial or other data sets that could be used to support the criteria, identify other sources (outside of CAMLAG) of pertinent data or information that may add benefit, and make recommendations for how best to use geospatial or other data sets that may be incomplete or inconsistent, but may be the best data available. Identify data gaps in criteria and geospatial data. • Refine criteria based on identified foundation data.
TASK 2: In coordination with CAMLAG participants, develop an integrated business process for using this tool with available data sets that will meet stakeholders usage needs.
TASK 3: Develop numerical scores and weights for each criteria. Review and incorporate, when appropriate, elements from the U.S. EPA's Hazard Ranking System (HRS) and site selection tool, DOC's Preliminary Appraisal and Ranking System (PAR), Department of Toxic Substance Control's Priority Setting Procedures for Cleanup of State-Funded Hazardous Substances Release Sites, and the Montana Department of State Lands Abandoned and Inactive Mines Scoring System into the algorithm.

Source: Scope of work for DOC-UCD-SNC Agreement # 6014-012.

Programming, platform identification, and implementation tasks of Phase II were not performed as part of this project, but are outlined here for informational purposes (Table 4).

Table 4. Phase II - Tool development and implementation.

TASK 1: Develop an algorithm using the scores and weights defined in Phase I into an algorithm that produces a weighted rank for each identified mine site in a data set. The algorithm should allow for statewide ranking of abandoned mine sites as well as targeted ranking based on selected criteria from the user.
TASK 2: Develop a computer-based spatial modeling tool that uses the criteria and datasets identified in Phase I to prioritize mine sites for management action. Activities may include: • Determine software and or programming needs necessary for creating a tool usable by multiple agencies. • Test tool on foundation data set identified during Phase I to produce an initial rankings of sites statewide. • Conduct user testing with CAMLAG agencies. • Adjust scores or weights of individual criteria to reflect the professional judgment of how types of mine sites or contaminant problems should rank, as needed. • Finalize tool and algorithm.

2.0 Model Objectives and Requirements

2.1 Tool Services

The goal of the tool is to provide a series of prioritized lists of mine sites in three tiers of prioritization to inform decision-making about sites that may pose a risk or hazard to the public or environment, sites needing further study, and sites for which remediation engineering plans should be carried out. One important service of the tool is that it encourages multiple agencies to use similar prioritization rules and criteria across California's diverse abandoned mine sites. This is likely to assure that abandoned mine sites selected for remediation are the most in need, when compared to other such sites within the state. A transparent and information-based presentation of the state's abandoned mine threats will assure decision-makers and funders that resources will be applied to identified priorities, similar to states that administer federal funds for abandoned coal mine clean up and reclamation where ranked risks are a requirement.

The output of CAMPT Tier 1 will be a list of priority areas or mine sites to focus future preliminary inventory efforts that may pose a risk or hazard to the public or environment. Tier 2 results in a list of priority sites where additional information is needed which is gathered during an initial site investigation, such as a PASI or equivalent process. Tier 3 results in a prioritized list of sites that need a full site characterization before a remedial action can take place.

2.2 Model Client-Base Summary

State and federal agencies have pursued abandoned mine cleanup and remediation for many years. The rate of cleanup has been limited by a variety of challenges, including – lack of a standardized tool for prioritizing mines throughout the state and funding for clean up and reclamation of high priority mine sites. This project covers the former in order to inform the latter.

CAMLAG, which is composed of local, state and federal agencies, offers a forum for improving how to use new tools for ranking the risks posed by different mine sites. The clientele for the

plan and modeling is primarily agencies, but also includes non-governmental organizations and the private sector that have expressed interest in the topic. One of the critical aspects of CAMPT is that it has been developed to meet the existing remediation decision-support needs of state and federal agencies. Table 5 presents the proposed alignments of the three CAMPT screening tiers with federal and state site investigation and cleanup process activities. Understanding this alignment helps agencies and departments further standardize and collect data that can be used in a prioritization tool work flow, such as envisioned with CAMPT.

Within agencies and organizations, the client base includes both policy-makers in management and technical staff charged with developing recommended priorities to support policies. The aim of the prioritization tool is to support the efforts to inform decision-makers with reducing the number of physical and chemical hazards on humans and the environment from abandoned mines.

Table 5. Correspondence between CAMPT screening tiers and state and federal site investigation and cleanup process activities.

CAMPT TIER	STATE WATER RESOURCES CONTROL BOARD PROCESS	CERCLA PROCESS (Federal)	STATE PROCESS	Remarks Federal CERCLA/STATE PROCESS
Tier 1 (GIS Based Data)	Discovery	Discovery	Discovery	Same process No sampling
Tier 2 (Site Visit w/ some GIS data, limited sampling)	Preliminary site assessment [b]	Site Screening	Site Screening	Same process Limited sampling
Tier 3 (Site Investigation)	Soil and water investigation [b,c,g,d]	PA/SI [1]	PSP [1] PEA [1]	Characterization & Assessment
Remediation Process	Proposal and selection of cleanup and abatement action [b,e,f]	RI/FS EE/CA [2]	RI/FS	Characterization & Assessment Remedy Evaluation
	Implementation of action [b,e]	ROD or RAM [3]	RAP or RAW [4]	Decision Document Site Remedy/Response Action Selection

Key:
[a] Water Code – Porter-Cologne Water Quality Control Act.
[b] Resolution 92-49 (Water Code Section 13304): State Water Resources Control Board Resolution No. 92-49 "Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304." Resolution applies if site has been issued a Cleanup and Abatement Order per Water Code Section 13304.
[c] Water Code Section 13304 – *Cleanup and Abatement.* Ch. 5 Enforcement & Implementation, Art. 1. Administrative Enforcement and Remedies.

[d] Water Code Section 13267 – *Investigations; Inspections.* Regional Water Board authority to investigate the quality of any waters of the state. Ch. 4. Regional Water Quality Control, Article 4. Waste Discharge Requirements.
[e] Water Code Section 13365 – *Definitions; billing; cost recovery; requirements.* Ch. 5 Enforcement and Implementation, Art.7 Hazardous Substance Removal and Remedial Action Charges.
[f] Water Code Sections 13397-13398.9 – *Legislative findings; Definitions; Remediating agency responsibilities; Remediation plan; Oversight agency responsibilities; Approval of remediation plans; Remediating agency liability;* respectively. Ch. 5.7. Drainage From Abandoned Mines.
[g] Title 27 – California Code of Regulations Ch. 7, Subch.1, Art.1. SWRCB – Mining Waste Management Regulations.

Acronyms
CERCLA – Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EE/CA - Engineering Evaluation/ Cost Analysis includes human risk assessment and ecological risk assessment for CERCLA removal actions
PA/SI - Preliminary Assessment/Site Inspection, includes scoring criteria for NPL listing
PEA - Preliminary Endangerment Assessment, includes screening level human risk assessment and ecological scoping assessment
PSP - Priority Setting Procedures for Cleanup of State Funded Hazardous Substances Release Sites, includes scoring criteria.
RAM – Removal Action Memorandum
RAP - Remedial Action Plan
RAW - Removal Action Workplan
RI/FS - Remedial Investigation/Feasibility Study, includes human risk assessment and ecological risk assessment for CERCLA remedial actions
ROD - Record of Decision

Notes:
[1] Response actions may be implemented following PA/SI, PSP, or PEA (e.g., interim actions such as: fence/post, diversions, containment, and excavation/off-site disposal activities).
[2] EE/CAs are performed for sites that are being addressed under CERCLA's removal authorities and a RI/FS is performed at a site that is being addressed under CERCLA remedial authorities.
[3] An RAM is prepared for CERCLA removal action sites and a ROD is prepared for CERCLA remedial action sites.
[4] A RAP and RAW are based on the scope/cost of project. A RAW is a combined feasibility/decision document. A RAP is a decision document.

2.3 Model Development

The implementation of the model requires several important steps, three of which have been accomplished with the current project (2.3.1, 2.3.3, and 2.3.5) and contained in Appendices 4 - 6):

- Choose a modeling approach and software that fits the needs of CAMPT (2.3.1).
- Develop an algorithm for the modeling software (2.3.2).
- Design the relationships among model components, including evaluation rules for each attribute (2.3.3).
- Anticipate the types of deliverables that will aid decision-support by the final implementation of the model (2.3.4).
- Describe how implementation of the model could be carried out (2.3.5).

2.3.1 Prioritization Model Types & Characteristics

There are several possible classes of models that could be used to help prioritize mine sites for more investigation or remediation. Probabilistic models return information about the likelihood of different kinds of events occurring (e.g., slope failure) and combinations of probabilities about risks and hazards. Physical models are designed to predict actual conditions and usually require a lot of data for model "training" and model validation. Rank/prioritization models usually are used to compare projects/objects with each other, based on user-defined criteria and are most useful when data varies in availability across topic areas and among the places/objects of concern.

The recommended model type for CAMPT is the latter type, rank/prioritization model, because it results in outputs that address the problem of prioritizing mine sites for further action. This type of model also tends to be more forgiving of unevenness in data availability, which is typical for abandoned mine sites in California. The primary modeling program employed is the Ecosystem Management Decision Support (EMDS; Reynolds, 2001), which after more than 15 years is on its 5th update and works with ArcGIS 10.4. Other systems have been developed that mimic EMDS (e.g., Environmental Evaluation Modeling System, Conservation Biology Institute), but lack the breadth of use that EMDS has enjoyed, including in CA (e.g., Bleier et al., 2003; Girvetz and Shilling, 2003; Dai et al., 2004).

The same model approach is used by many organizations for making rank-based decisions. The Nature Conservancy uses a similar model for land acquisition decisions, the U.S. Army Corps of Engineers for managing dredging and spoils, and restoration, on the Mississippi River, and the U.S. Forest Service's Tahoe National Forest in California for road rehabilitation and retirement decisions.

Developing an EMDS-based abandoned mines prioritization tool will require three main characteristics to be successful:

- User/expert engagement in developing the attributes and evaluation rules that drive the model,
- Spatial or tabular data corresponding to the attributes selected,
- Clear association between the spatial outputs and policy and management needs of user entities.

Running the model will also require development of several precursor analyses that use spatial data and result in secondary datasets. For example, one way of estimating physical risk to the public from mine features is calculating in GIS the linear or route distance between points of access (e.g., trailheads) and the features. This distance calculation would be the raw material used in the model. Key features of EMDS are its ability to handle disparate types of information in the same modeling environment and its ability to take advantage of intermediate attribute values, where an attribute is not directly measured (i.e., a quantity or concentration), but is represented by conditions, such as site conditions that promote transport of contamination off-site. The algorithm for the CAMPT model was developed with these characteristics in mind and is described below.

2.3.2 Basis for Prioritization Model Algorithm

A decision about prioritizing remediation of any physical safety or contamination hazards at a mine depends on a variety of factors for which data is available or can be collected. Because it is difficult to conduct this operation mentally and because one may want to tackle the decision-making with varying weights attached to the various data, a decision-support system, like CAMPT, is an essential component in effective planning assessment. Such a system captures and makes explicit the rule sets or preferences the decision-maker is actually using.

The algorithm basis for a prioritization model was developed using past guidance from CAMLAG and feedback from member agencies. Individual attributes describing mine sites and impacts were grouped according to regulatory and other concerns (e.g., water quality; physical safety). Evaluation strategies and data sources were developed and described for each attribute.

The combination of the attributes grouped by area of hazard concern along with evaluation ranges forms the basis of the algorithm that could be used to build the spatially-explicit, prioritization model. A hazard concern is composed of a Risk Category and a Component specifying a hazard or exposure pathway. The evaluation range represents the 'score' resulting from the evaluation of the attribute. Thus, the Evaluation Range 'scores', the potential impact of the Attribute on human or ecological receptors.

Table 6 Attributes are organized according to Risk Category (chemical or physical hazard or exposure) and Component (the hazard or exposure pathway). Evaluation Ranges are normalized between 0 and 1. They can be continuous, where a numeric value from data is available (e.g., distance, concentration of contaminant); stepped, where data is tabulated as a range (e.g., trailhead distance); or binary where the value is a 'yes' or 'no' statement (e.g., fish consumption waterbodies). The resulting evaluation provides values that can be used to rank risk associated with the Attribute, with higher numeric values, or 'yes' values signifying higher risk, and therefore higher priority score for that Attribute.

Table 6. Example attributes and evaluation values.

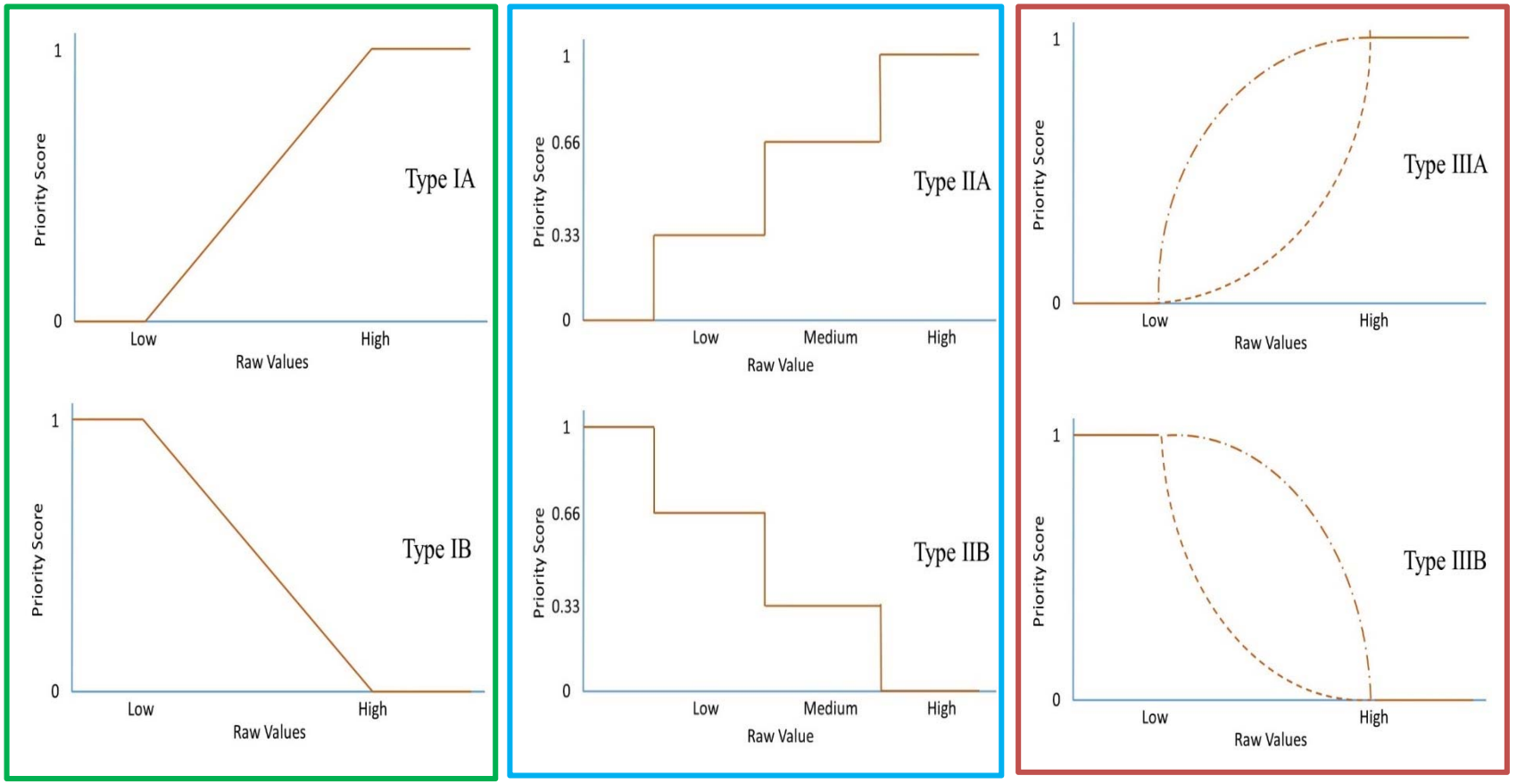
Risk Category	Component	Attribute	Evaluation Range	Range Type	Data Source
Chemical Hazard	Water, Food, Air, Soil, Sediment Quality	The density of potential mine related features (TOMS) within a defined geographic area (2 km diameter from each TOMS symbol).	1 = Number of potential mine related features within 2 km. 0 = There are no potential mine related features within 2 km.	Continuous (Linear)	Topographically Occurring Mine Symbols (TOMS) Data Type: spatial and tabular
Chemical Exposure	Food Quality	Potential mine site is located within a watershed that supports fishing and fish consumption or feeds into a water body that supports fishing and fish consumption.	Yes – Mine site falls within watershed known to support fish consumption No – Mine site does not fall within watershed known to support fish consumption.	Binary(Yes /No)	Fishing locations available from CDFW at https://map.dfg.ca.gov/fishing/ Fish advisories are contained in the 303d list at http://www.mywaterquality.ca.gov/safe_to_eat/impaired_waters/ Data Type: spatial

Risk Category	Component	Attribute	Evaluation Range	Range Type	Data Source
Chemical Hazard	Water, Air, Soil Quality	Volume of potentially contaminated waste rock.	1 = Number of cubic yards of contaminated waste rock on the mine site. 0 = There is no contaminated waste rock on the mine site.	Continuous (Linear)	Data based on measurements and data interpretations from site investigation Data Type: tabular
Physical Exposure	Recreation	Recreational access: Trails and trailheads	**1 =** Mine site lies <¼ mile from a trailhead or <100 yards from a trail. **0.5 =** Mine site lies >1/4 mile or >100 yd and <1 mile or <200 yd from a trailhead/trail. **0 =** Mine site lies > 1 mile from a trailhead, or >200 yards from a trail	Continuous data evaluated in a stepped range (Step Change)	Topographically Occurring Mine Symbols (TOMS); BLM, USFS, NPS Statewide Trails or Trailhead Layer Data Type: spatial

In addition, Figure 2 presents graphical representations of three evaluation range types that have numerical values – linear, stepped, or nonlinear. Type IA and IB represent 2 possible slopes of the continuous or linear range. One where higher values correspond with more risk from the mine resulting in a higher priority score, or one where higher values result in lower risk. This model includes attributes in both situations. For example, continuous values can be the number of cubic yards of tailings or waste rock at a mine site, or the concentration of a contaminant obtained from sampling in soil, sediment, surface water, or groundwater. Also, California Rapid Assessment Method scores result in an index where the lowest values represent the worst condition of stream habitat (Type IB).

In examples IIA and IIB, stepped values are not continuous and work well to represent scenarios or conditions of attributes where there is not a directly measured quantity or concentration. The model includes several attributes matching type IIA where the highest of values correspond to higher risk from the mine and a higher priority score. Stepped values can be bracketed distances such as the distance the mine lies from a trailhead, population center, or road (see Appendix 5, Tier 2 Physical Risk Attributes 1, 2, and 3, for examples), or they can be conditions under which a contaminant would be more likely to be mobilized and transported to a receptor (see Appendix 6 Tier 3 Chemical Risk Attributes 3A – 3DC, for example). Stepped values, are a good substitute for attributes where sampling or geographic data is not readily or widely available, or complex chemical processes are involved, or where resorting to a yes or no binary result would introduce unnecessary imprecision in the ranked results. Professional expertise, or judgement, about processes or risks at the site form the basis for evaluation of the attribute. Having a stepped range of values preserves precision in the results when it is vital to include the attribute. Types IIIA and IIIB are not currently used in this model as none of the attributes involve non-linear data.

Figure 2. Evaluation range types.



Linear change - Priority with Value

Step change - Priority with Value

Non-linear change - Priority with Value

The model algorithm includes 17 chemical and 8 physical attributes for hazard, exposure, and risk in Tier 1 (Appendix 4); 22 chemical and 12 physical attributes in Tier 2 (Appendix 5); and 220 chemical attributes in Tier 3 (Appendix 6), of which 92 are combinations of 23 contaminants and 4 media, and another 92 are combinations of the same 23 contaminants and background levels in the 4 media (see Table 7); all organized according to type of concern (e.g., water quality; physical safety).

Table 7. Constituents of concern and media included in Tier 3.

Constituent of Concern list		**Media**[1]
CAM 17	Other	
Antimony	Asbestos	Waste rock, Tailings, Soil
Arsenic	Cyanide	Sediment
Barium	Nitrate	Groundwater
Beryllium	Phenolic Compounds	Surface water
Cadmium	Silica	
Chromium	Sulphuric Acid	
Cobalt		
Copper		
Lead		
Mercury		
Molybdenum		
Nickel		
Selenium		
Silver		
Thallium		
Vanadium		
Zinc		

[1] Air is addressed in separate attributes where it can be associated with tailings or soil disturbance.

2.3.3 Model Design

The model depends on a knowledge base, obtained from CAMLAG agencies, that lays out the relationships among different Components and Attributes. The EMDS modeling software incorporates the knowledge base in a companion software (Netweaver) that lays out the relationships among different Components and Attributes. The knowledge base contains the relationships, rules for evaluating Attributes, and connection points for spatial data organized in a hierarchical fashion. The nature of the model output is that users can select different levels of the evaluation output, from the individual Attribute to combined system Components. What this means in practice for CAMPT is that priority scores of individual mine sites (or mine site areas) could be viewed based on individual Attributes (e.g., chemical hazard posed to adjacent habitats of concern), groups of Attributes (e.g., water quality), or aggregated risk and hazards from all chemical sources. Some of these will have either/or types of relationship (called “OR” in EMDS). An example of this would be if the model prioritized sites if they posed physical risks OR chemical risks. In other words, either type of risk could result in the site being a priority. Some of the relationships will be additive (called “AND” or “+” in EMDS). An example of this would be if the model prioritized sites if they posed multiple risks to water, air, and food

characteristics. Thus, a site that posed multiple types of risk would get a higher priority than a site with only one type of risk.

The knowledge base also explicitly lays out how attributes would be evaluated (introduced above). For each Attribute, the model would use the specified Evaluation Ranges and input data to determine how much each mine site contributed to a Risk Category, Component and Attribute and therefore how much of a priority it was. In most cases, this would be partial risk, resulting in an intermediate priority score. The desired result of these evaluation steps is that mine sites would fall across a somewhat normal distribution curve, with some sites given high priority for further investigation or remediation, most given intermediate values, and other sites receiving low priority for further investigation or remediation.

During development of Evaluation Ranges, the project team and CAMLAG agencies found it helpful to sketch out how various attributes might work together to formulate an evaluation, an exercise that would be more fully fleshed out in a future phase developing a complete algorithm. Certain attributes were complex and in order to correctly identify and describe them, it was helpful to 'look ahead' as to how Attributes might work in combination. Several Attributes that should to be evaluated together to evaluate risk according to the risk framework in Table 1 are included as examples in this report and described further below.

Risk to a receptor is a product of hazard and exposure. If you have a hazard and no exposure pathway, then the risk is less. If you have a hazard and exposure pathway, then risk is greater. In addition, because some attributes are intrinsically linked there needs to be a way to combine them meaningfully without introducing a large number of additional attributes, or subsidiary models. Examples include attributes related to chemical processes such as solubility or leachability, or adding attributes with yes/no evaluation ranges, which reduces precision of mine rankings. For example, it's not possible to say whether a given volume of tailings is a threat or not without knowing the type of contaminant in the tailings since some contaminants are more mobile or more toxic. In other cases, the concern will be about soil discharge (e. g., mercury without acid mine drainage), or about leaching (e.g., selenium), so it's not possible to say that one type of geology or hydrogeology is good or bad without pairing it to the contaminant, and how mobile and toxic those are depends on geochemical conditions, as well. There are several Attributes that are dependent on each other in this way. With input from CAMLAG agency technical experts, the following examples (Figures 3 through 8) show Attributes that can be evaluated in combination with other Attributes in the model using "AND" and "OR" relationships involving contaminants, pathways, and receptors, or physical safety hazards. Appendix 3 presents the relationships in a more detailed outline format with the corresponding Attributes numbered to match the Tier tables in Appendices 4, 5, and 6.

Figure 3. Imminent risk to human or ecological health – Tier 2 Physical Hazard.

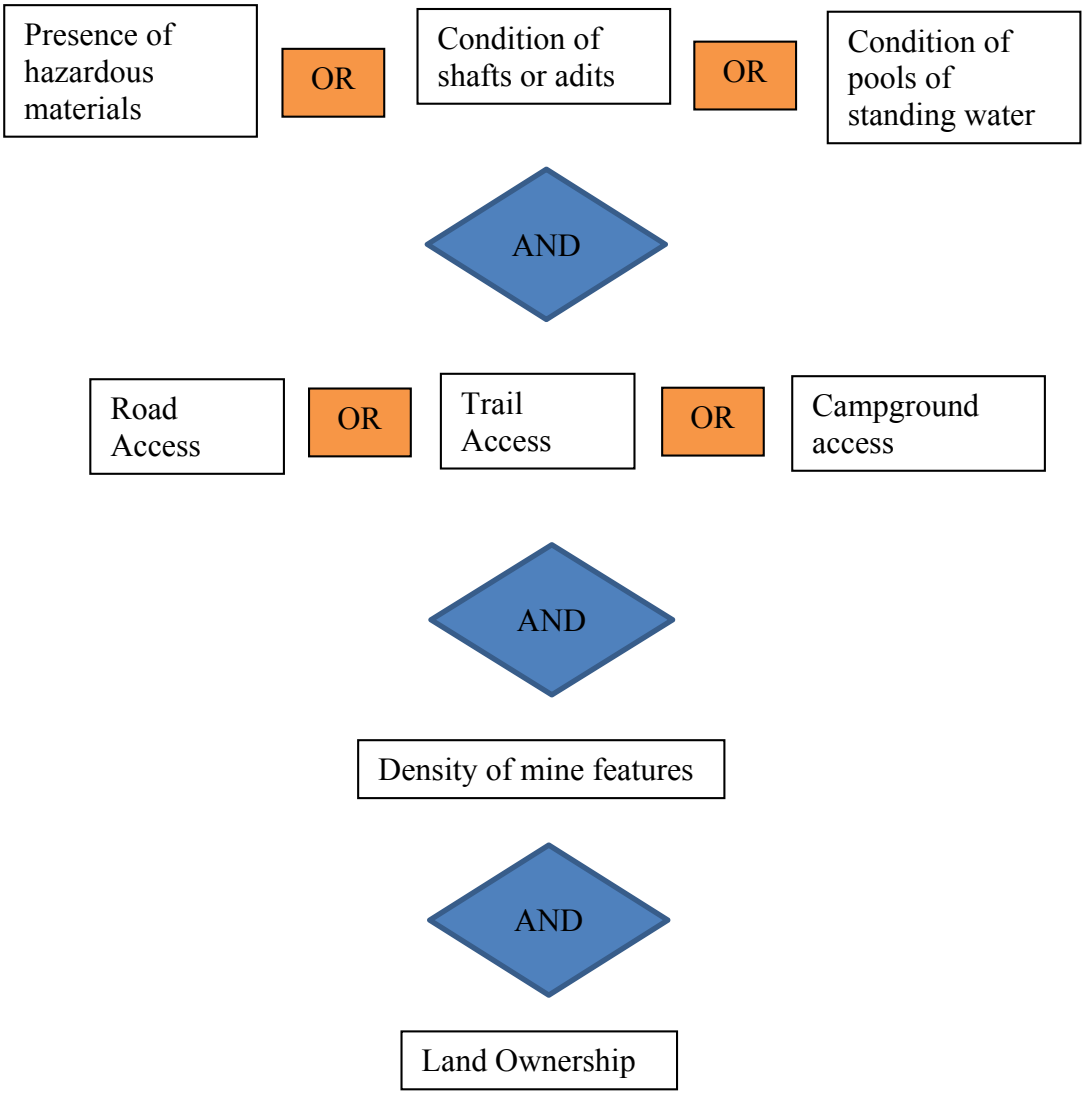


Figure 4 Risk from detection of elevated Constituents of Concern – Tier 2 Chemical Hazard.

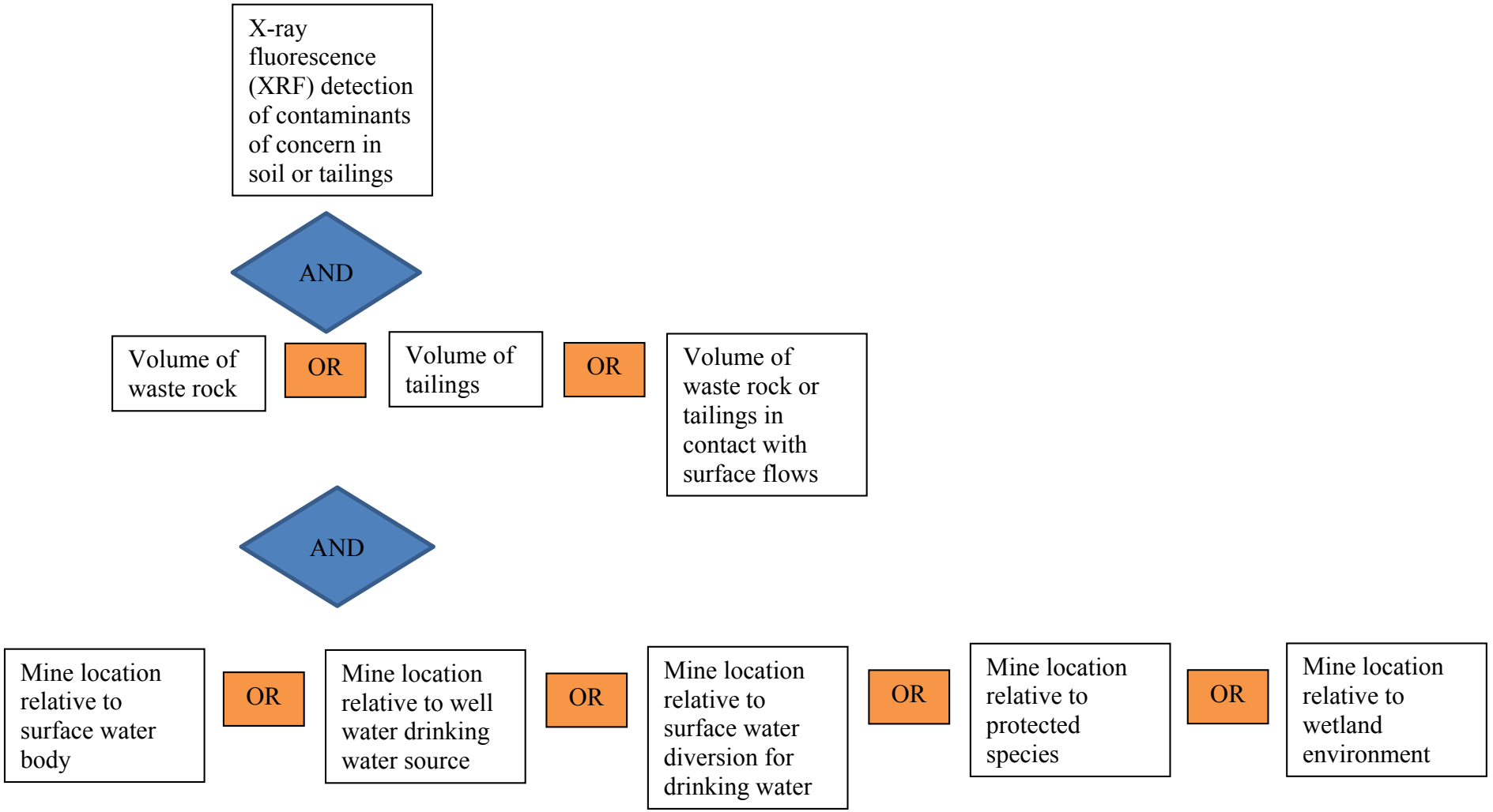


Figure 5. Imminent risk to humans or ecological health – Tier 3.

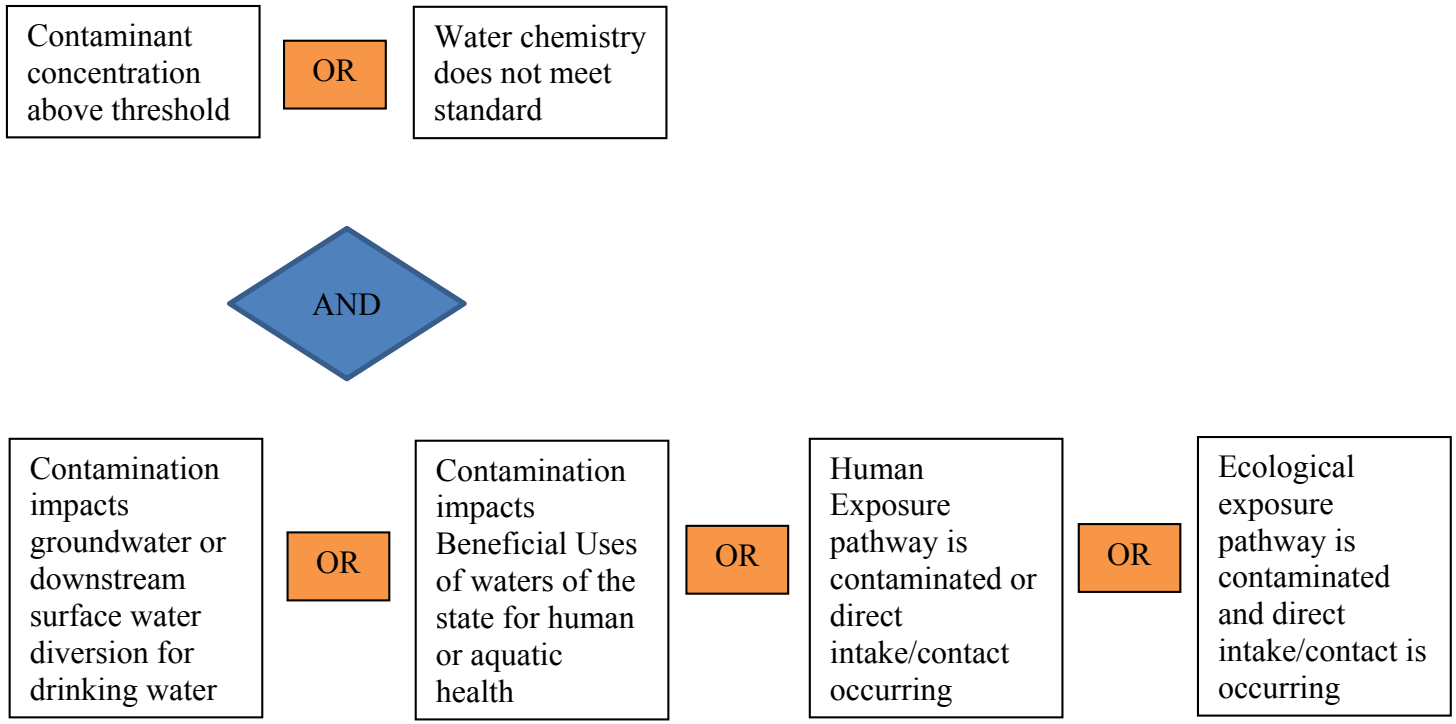


Figure 6. Risk from type and concentration of constituent in media (soil, sediment, groundwater, surface water) – Tier 3.

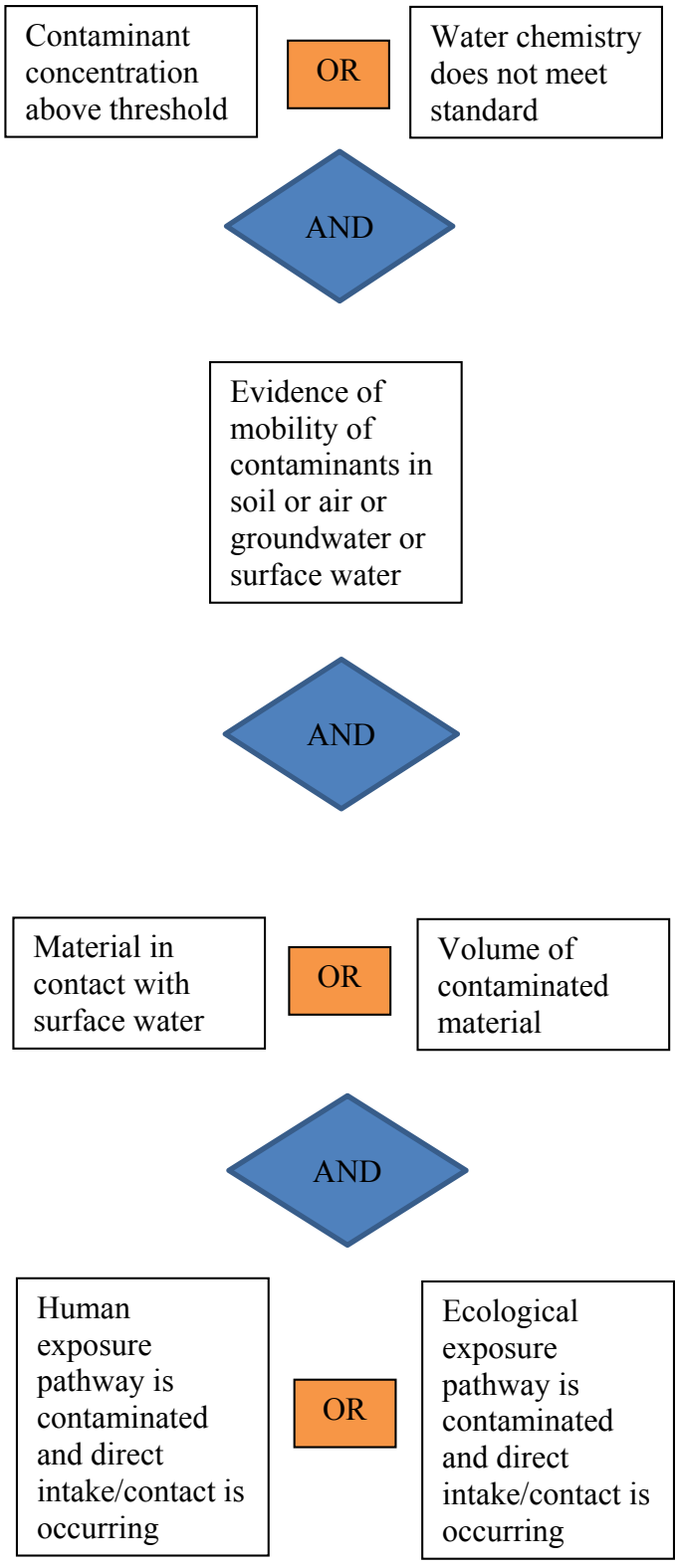


Figure 7. Risk from volume of contaminated material – Tier 3.

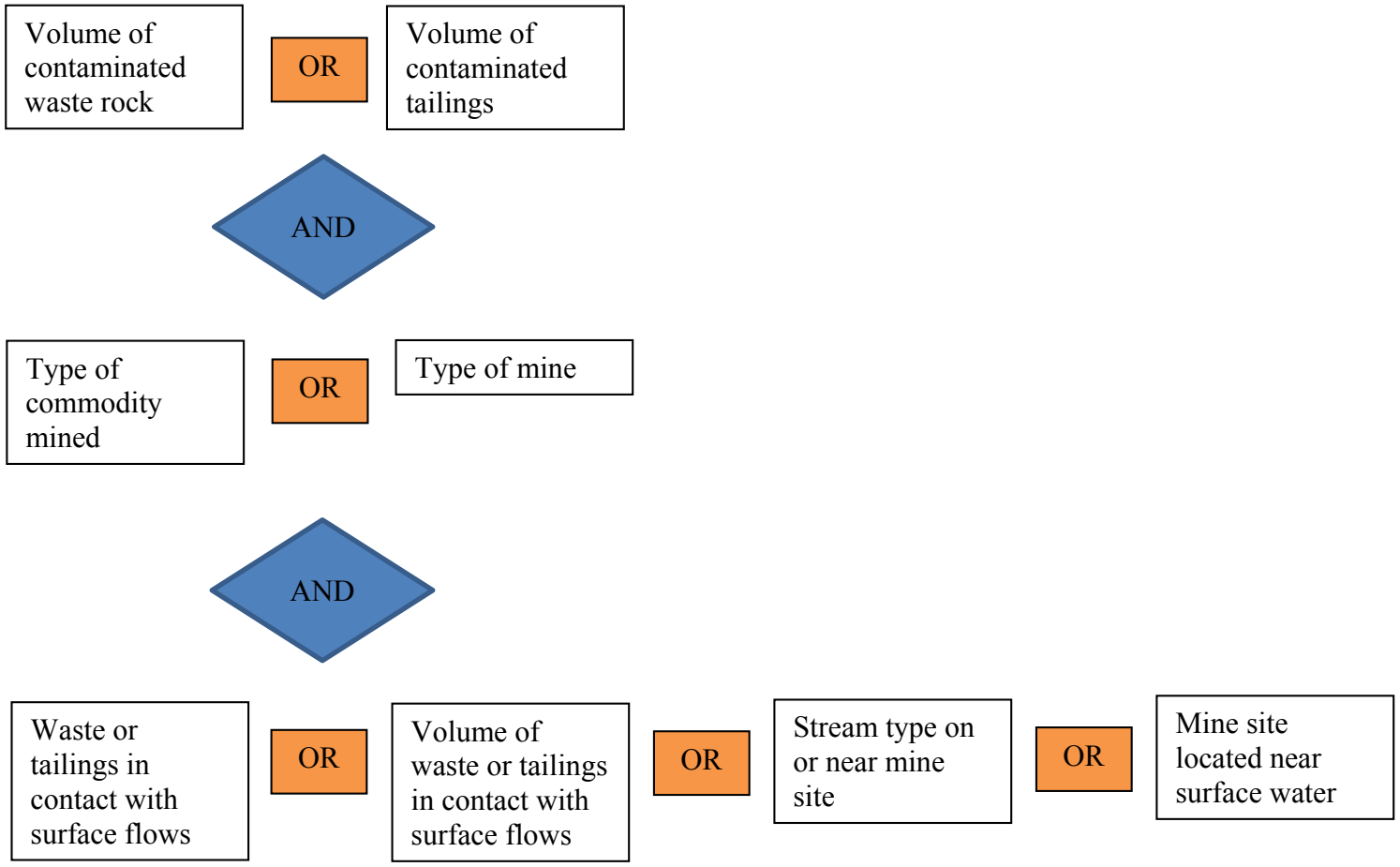
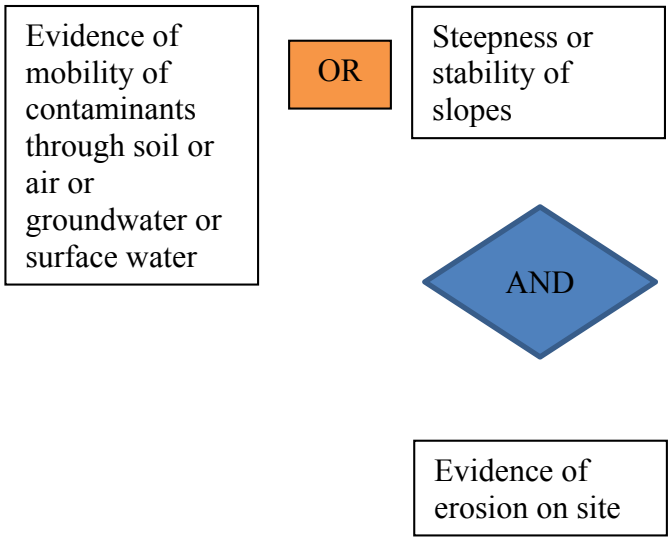


Figure 8. Risk from mobility of contaminants – Tier 3.



In addition, some attributes recommended for identifying chemical hazards were complex to define and introduced the potential for including submodels within the model, such as for the processes for solubility, leachability, mobility, and mercury methylation. Each of these was handled in the model as follows.

Solubility

Solubility, in the context of CAMPT, is about how easily source material (e.g., rock, waste rock, tailings) is dissolved, resulting in making contaminants available, particularly metals, to leaching or transport processes. Solubility depends on several factors (such as pH of water and type of metal) that are not all included in the CAMPT model. There are multiple types of tests for solubility (e.g., Toxic Characteristic Leaching Procedure, Citric Acid Waste Extraction Test (WET), deionized water WET test). Test values can be compared to drinking water and ecological standards. The higher the test value, the more soluble the material. This would require attributes in the model for each test in order to capture continuous test values (more precision) and compare to applicable standards.

Resorting to a single yes/no evaluation for whether the test value indicates high solubility or not introduces an attribute with much less precision. Recall that using continuous values (i.e. evaluation types IA or IB in Figure 2), versus a yes/no response, provides more precision for the model rank results. Since solubility is a model on its own, and incorporating a subsidiary model into CAMPT would make CAMPT more complex than necessary, the decision was made to not include solubility directly in the model. Rather, solubility will be evaluated through other attributes related to mobility of detected contaminants in media (soil, air, groundwater, surface water) and contaminant detection in sediment pathways that can impact receptors. The rationale is that if source material is soluble, and metals have leached and been detected in pathway media, the final question is, are those leached contaminants being transported to receptors. This will ultimately maintain a higher degree of precision for CAMPT rank results.

Leachability

Leaching is the process by which inorganic - organic contaminants or radionuclides are released from the solid phase into the water phase under the influence of mineral dissolution, desorption, complexation processes as affected by pH, redox, dissolved organic matter and (micro) biological activity. The process itself is universal, as any material exposed to contact with water will leach components from its surface or its interior depending on the porosity of the material considered (source: Surface and Aqueous Geochemistry Group, Stanford, USA. http://www.leaching.net/leaching/the-leaching-process). Leaching depends on several factors (parent material, presence of water, type of mineral) that are not all included in the CAMPT model. There are different leaching tests, usually conducted in a laboratory setting, (e.g., pH, column, tank, granular) and thresholds for the amount of metals leached by the test. This would require attributes in the model for each test in order to capture continuous test values (more precision) and compare to applicable test standards.

Resorting to a single yes/no evaluation for whether the test value indicates high leachability or not introduces an attribute with much less precision. Recall that using continuous values, versus a yes/no response, provides more precision for the model rank results. Since leachability can be a model on its own, and incorporating a subsidiary model into CAMPT would make CAMPT more complex than necessary, the decision was made to not include solubility directly in the model.

Rather, leachability is represented by two Attributes in the model at two points in the work flow, Tier 2 and Tier 3. One (see Appendix 5, Tier 2 Chemical Risk - Attribute 4) is evaluated using a Type IIA Step range about seven different evidence of leaching for which data can be collected via observation in a screening level site visit. The other (see Appendix 6, Tier 3 Chemical Risk - Attribute 13) is evaluated with a yes/no response about the degree to which constituents are leachable from source material. This evaluation is based on professional interpretation of a larger scope of sample and test results about whether constituents are highly leachable from the material or not and could become available for transport off site.

Mobility

Mobility, in the context of CAMPT, is the ability of contaminants to be transported off the mine site or off the mine feature toward receptors. Mobility depends on several factors such as slope of waste rock or tailings piles, water erosion, wind erosion, pH of water, or permeability through surfaces to groundwater. Many of these attributes are included in the CAMPT model, and data is obtained in the field or through existing geo datasets already available for use. Because media (soil, sediment, surface water, groundwater, and fish) are analyzed for contaminants conclusions can directly be drawn about the source and transportation of contaminants and potential impacts on receptors, without having to model chemical processes, mineral deposits (although this data is under development by USGS, and should be included in CAMPT later), or geology within the model.

Mobility is represented by four attributes in the model specific to the potential for contaminants to move or migrate toward a receptor through soil, air, groundwater, or surface water. The attributes are evaluated with a three step range (i.e., evaluation type IIA in the Figure 2), based on site investigation results and interpretation, which maintains more model precision than a yes/no response.

Mercury methylation

Mercury is a constituent of concern included in CAMPT. Mercury must become methylated in order to be absorbed into the food chain, where it can impact fish and wildlife and human receptors. Methylation of mercury can occur in streams, lakes, reservoirs, and wetlands downstream of mines where mercury was mined and produced as well as locations where mercury was used to process mined ores and released into the environment. Mercury methylation involves a complex set of factors that are being modeled elsewhere, and which would be unwieldy to include in CAMPT. DOC staff recommends including a summary attribute to reflect whether mercury from the mine is being transported to a methylating environment in a yes/no format. This information may or may not be known for the mine or downstream surface waters, and may not be able to be directly related back upstream. Therefore, mobility factors and presence of methylating environments downstream may be two attributes of interest. More information is needed about the extent of data available about downstream methylating environments that could be used in CAMPT. Data about the presence of mercury in fish consumed by wildlife and humans, the detection or concentration of mercury found in soil, sediment or water, and mobility factors are included in CAMPT and can be used together to evaluate potential impact to receptors from mercury contamination.

2.3.4 Model Output

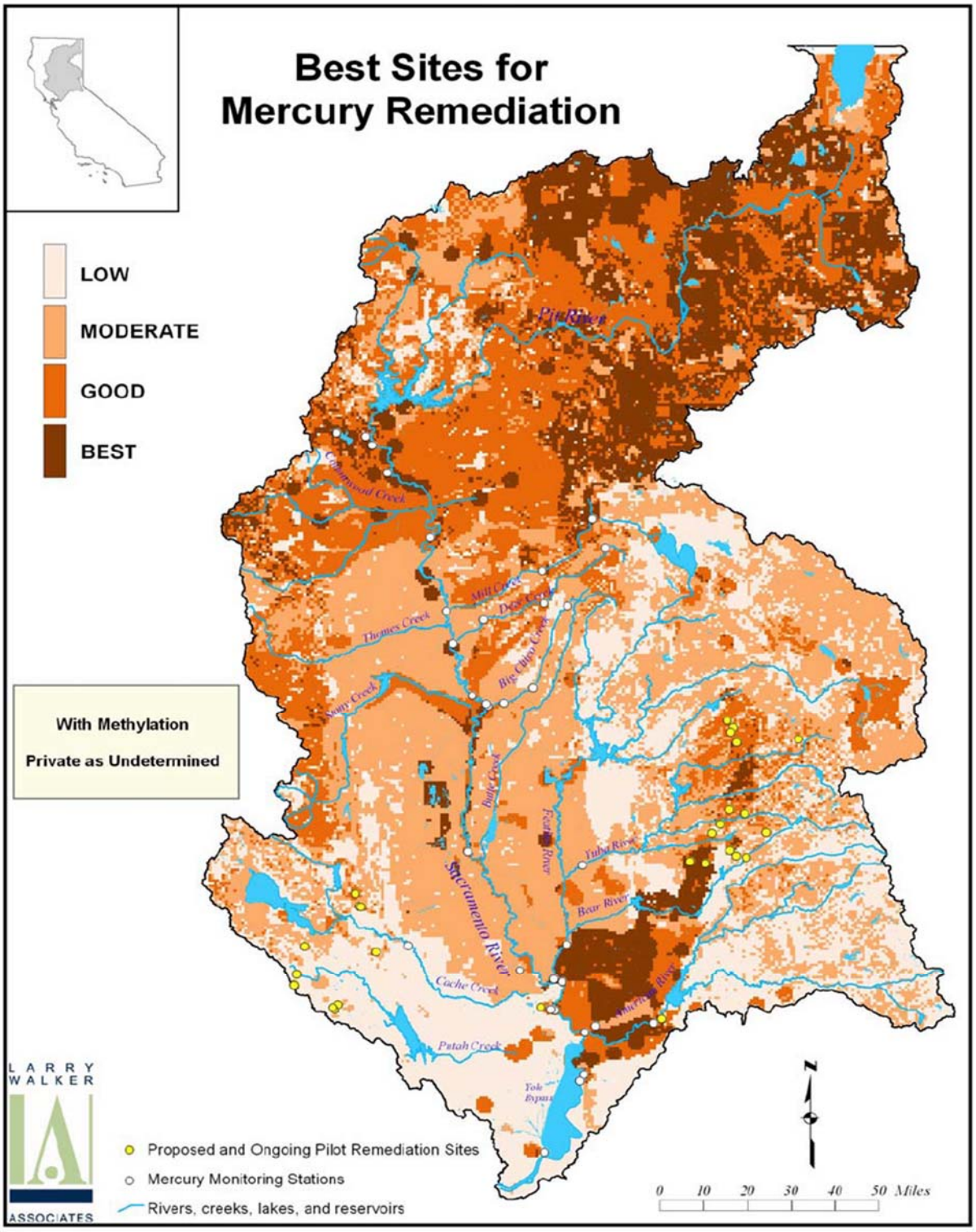
The fully-implemented model would provide several information types useful in prioritizing mines for further investigation and/or remediation. Agencies often have concerns unique to specific types of risks or hazards found at or originating from mine sites. The model would provide disaggregated information about specific types of risks allowing agencies to hone in on concerns important to them (e.g., water quality impacts; physical safety). Two main types of problems that mine sites can pose to the public are physical risk and chemical risk. The model will provide prioritization based on either type of risk. Finally, cumulative risk across all attributes and concerns is useful when prioritizing mine sites at the state-level and can also result from the model.

The model is intended to be spatially-explicit, meaning that it is informed by spatial/map data and can produce prioritization results in map form. Figure 8 provides an example of a map output from a similar rule-based prioritization model created for the report *Reduction of mercury in the Sacramento River watershed and San Francisco Bay-Delta* (Shilling et al., 2002). This means that prioritization can take into account downstream and other externalized forms of impact through waterway connections. It also means that watersheds with multiple mine sites can be prioritized either because of greater cumulative impacts, or because it would be more efficient to work on mine sites near each other, or both. Priorities can also be summarized and shared at a variety of boundary scales (e.g., Forest District, or county), which can help with planning for additional work and funding needs.

Because the model is based upon physical and chemical attributes of mine sites, prioritization scores represent real risks and hazards that mines may pose. This means that priority scores are more than just a way to rank mine sites, they may also be used to judge imminent risks, or be used to drill down and discover what exact risk a mine site poses. The latter is particularly useful in testing the model's finding against other methods for prioritization, as well as for testing model sensitivity to specific types of risks.

Another way that model findings can be used is to pose scenarios for remediation of specific mine sites and discover what types of effects this would have on a mine's priority score or rank. For example, if a mine site is primarily a risk to the public because of a number of openings that pose a physical risk, then closing these opening may result in the mine being "taken off the list". If the cost of specific remediation actions are known or estimable, then mine-specific, jurisdiction-specific, or total costs could be estimated to bring mines into compliance with the regulatory standards. Even at an order of magnitude level, this is critical planning and policy information.

Figure 9. Example of model output showing range of scores for the best sites for remediation in the Sacramento River watershed, including consideration of the risk of methylation and private property. (Shilling et al., 2002).



3.0 Project Summary

There are several heavy-lift steps in developing spatially-explicit decision-support tools like CAMPT. Developing a model algorithm and design based on stakeholder input is one of the

biggest tasks, and was accomplished with the present project phase. Future steps should include data acquisition and analysis, model testing/validation, and model rollout with critical decision-makers. Implementing the CAMPT in a computer-supported software and developing outputs should continue to use outside collaboration forums such as CAMLAG to ensure utility and applicability of the tool. Phase I of CAMPT provides a foundation for what a decision-making system could do for identifying and prioritizing risks from abandoned mines. Such tools require consistent collection and input of data over time to make a dynamic model that can be used into the future to guide decision-making.

3.1 Next Steps for Model Implementation

Phase I focused on identifying and defining the work flow, Attributes, and Evaluation Ranges. The tables containing the attributes for Tiers 1, 2, and 3 present the definitions and Evaluation Ranges for each unique Attribute, placed at the tier level where the appropriate data would be applied or collected. Some Attributes will be used more than once in the model, and sometimes across Tiers depending on what is needed to appropriately evaluate an individual attribute. An example is provided in Appendix 3 under Risk from Mobility of Contaminants where a Tier 3 Attribute is evaluated using some Attributes from Tier 2. Likewise, population center can be evaluated in Tier 1 or Tier 2 with various attributes such as a population density, community, or campground or trailhead locations defined in Tier 2 since these are all geodatasets that already exist without having to collect new field data.

Additional work for developing an implementation tool beyond Phase I would likely include the following activities and schedule noted below in Table 8. No funding has been identified for completing these tasks.

Table 8. Breakdown of logical implementation phases.

Tier	Activity	Timeframe
Tier 1 (spatial data analysis)	• Perform software programming • Run program and produce ranked list of hazards • Validate data results with existing data from known mine hazards	1 – 1 ½ years
Tier 2 and 3 (data from site investigations)	• Identify contaminant sample aggregation protocol (95th percentile, for example) • Perform software programming • Complete and use site data from prior investigations • Collect more data over time as more mines are investigated • Input data required by the model into statewide abandoned mine database (for example, the Abandoned Mine Database at DOC) • Validate data once sufficient data has been obtained for a number of mines	Initiate in 2nd year

Preliminary technological and cost considerations include:

- Location where data and analytical tool would be hosted and maintained;
- Building and contributing a robust long-term dataset;
- Refining cost estimates and obtaining funding.

From a technology perspective the data that would be analyzed by a modeling tool can be hosted in one location/agency and the modeling tool itself can be hosted in another location/agency, contributing to flexibility in leveraging existing information storage or data analysis computing capabilities, responsibilities and costs. For example, DOC confirmed it will continue hosting the abandoned mine database within the Division of Mine Reclamation, including data for mines that is collected by other organizations, as well as the data for mines we inventory for federal and state agencies on a routine basis.

An important aspect of creating modeling tools is adding data in early years, and continuing to add data over the long-term while managing activity on abandoned mines. The more data that is collected from site investigations and added to an abandoned mine database, the more meaningful the rankings and decisions made based on rankings. CAMPT Tiers 2 and 3 are logically a later phase of tool implementation because they rely on actual data collected from investigations, which takes time to accumulate. Data from investigations that have already been performed are currently being added to the abandoned mine database at DOC as a step toward having a more robust state-wide dataset for any analyses. Such a dataset would be available to agencies working in California who need to track and identify abandoned mine infrastructure and remediation status in the state.

The model could be implemented either as desktop-based application or a web-based application. As a desktop application, the hosting organization would have to receive a request to analyze abandoned mine data using the model and then output that analysis (ranked list) to the Internet or some other service (like Drop Box) for the requesting organization to receive. As a web-based application, the model would be accessed via a web portal and be used online, where an agency could log in and access the model to analyze the data set on their own. The preference expressed by CAMLAG agencies is to use a web-based application.

4.0 Glossary of Terms

The purpose of these definitions is to promote understanding among users of the California Abandoned Mines Prioritization Tool (CAMPT) of common terms and concepts. There may be other definitions and terms, but for the purpose of the CAMPT, these are the definitions used.

303d list – A state's list of impaired and threatened waters (e.g. stream/river segments, lakes) as designated under the federal Clean Water Act Section 303(d).
Acid Rock Drainage (ARD) – The acidic water that is created when sulphide minerals are exposed to air and water and, through a natural chemical reaction, produce sulphuric acid.
Abandoned Mine Lands (AML) – Collections of mine sites and features on public or private lands that were previously used for mineral commodity production, but which have been abandoned, usually without current, liable owners.
Attribute – Qualitative or quantitative attributes of a mine feature or site that can be used by itself or in combination with other criteria to help characterize a component.
Basin Plan – A Water Quality Control Plan (Basin Plan) is a legal document that the State Water Resources Control Board and Regional Water Quality Control Boards use to designate beneficial uses and water quality objectives, methods used to attain those objectives, for waters of the state, including surface waters and groundwater.
Category – A grouping of one or more components that are all related based on both chemical or physical hazard and exposure to humans, wildlife, or the environment.
Chemical/Constituent/Pollutant – An element (e.g., copper, arsenic) or compound (e.g., iron sulphide, methyl mercury) that may leach or leak from mine lands/features into adjacent soils and waterbodies.
Commodity – An economic mineral or mined material.
Commodity group – Groups of minerals or mined materials that have similar properties (ie, metallic minerals, nonmetallic minerals, aggregate materials, etc.).
Component – A grouping of one or more attributes that are used to characterize a category.
Containment structures – Buildings, dams, tanks, vats, ponds or other structures designed and built to contain potential contamination on a mine site.
Data input – The spatial, quantitative, and/or qualitative information used to evaluate the attribute.
Ease of access – The relative difficulty of accessing a mine site.
Environmental justice – The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.
EPA – U.S. Environmental Protection Agency.
Evaluation Range – The quantitative positive and negative values to evaluate attributes for each mine feature or landscape component.
Exposure – Contact with a potentially harmful place/feature or ingestion/inhalation of a potentially harmful substance.
Fish advisory – Advisories that provide "safe eating guidelines" to help you choose the safest fish to eat and avoid fish species with high levels of chemicals in them.
Hazard – Any mine feature or mine related sources of potential harm.
IDLH (Immediately Dangerous to Life and Health) - Exposure to airborne contaminants that is "likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.
Imminent and substantial endangerment – Mine lands, features, or products of mine leaching that pose immediate and serious risks and hazards to people and wildlife.

Metal leaching – The process of loss of metals and their salts from mine wastes and features
Mine Land Features – Physical features related to the production of mineral commodities.
Shaft – A vertical or near vertical passage into a mine for the purpose accessing mineral commodities or ventilation.
Adit – A horizontal or near horizontal passage into a mine for the purpose of accessing mineral commodities or drainage of water.
Pit – A large excavation in the ground for the purpose of accessing mineral commodities.
Subsidence – An opening at the ground surface created by the collapse of underground workings.
Tailings – The non-economic residual material remaining after ore has been processed and the economic fraction has been removed.
Waste Rock – Unprocessed mined material with little or no economic value.
Mill/Kiln/Structures – The buildings and other structures used to move and process ore containing rock.
Mobility – The ease at which a contaminant can travel from onsite to offsite environments.
Mode of access – The type of transportation used to access a mine site.
National Priorities List (NPL) – The list of national priorities among the known releases or threatened releases of hazardous substances, pollutants, or contaminants throughout the United States and its territories. The NPL is intended primarily to guide the EPA in determining which sites warrant further investigation.
Physical/Injury – Properties of mine lands/features that could cause injury or death among members of the public that come in contact with, or enter the features.
Potentially Responsible Party - Any individual or organization—including owners, operators, transporters or generators—potentially responsible for, or contributing to, a spill or other contamination under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund.
Preliminary Appraisal and Ranking System (PAR) - An empirically-derived system for assigning a numerical score to abandoned mines based on readily quantifiable measures of chemical and physical properties and associated exposure potentials.
Prioritization – The act of deciding the order in which mine lands and features should be investigated and/or remediated.
Remediation – The act of stopping or reducing environmental damage by cleaning up or reducing chemical and physical hazards on mine sites or lands impacted by mine sites.
Risk – actual or potential probability of adverse effects on humans, wildlife or the environment by mines or mined areas.
Screening Tier – A data-driven decision point encompassing the data required to make specific decisions.

- Tier 1: Preliminary Inventory Selection – The purpose of this tier is to select potential areas or sites that may have an elevated risk of either physical or chemical impacts to humans, wildlife or the environment and for which no site-specific data is available. This selection Tier is a desktop GIS analysis only and no site-specific information is used in the analysis. Data used for this tier would be readily available in GIS format and GIS analysis would be applied to potential areas or sites to rank for performing future preliminary inventory using existing methodologies employed by DOC's AMLP. Tier 1 results in a list of priority areas or sites to focus future preliminary inventory efforts.
- Tier 2: Initial Site Investigation Selection–The purpose of this tier is to select sites with potential risk to humans, wildlife or the environment based on data collected during a

preliminary inventory and where additional information is needed to determine the actual risk associated with the site. Data collected for this tier consists of qualitative and quantitative information, but not sampling, collected during the preliminary inventory process that can be used to determine if a site will need further investigation. Tier 2 results in a list of priority sites that needs an initial site investigation, such as a Preliminary Assessment/Site Investigation (PASI) or equivalent process.

- Tier 3: Full Site Investigation Selection – The purpose of this tier is to select sites identified to have actual risk to humans, wildlife or the environment based on data collected during an initial site investigation and where additional data is needed to fill critical data gaps before a final decision on a remedial action is taken. Data collected through a PASI or equivalent process will help determine which sites need a more thorough full site characterization or which sites have enough information to determine remedial action. Tier 3 results in a prioritized list of sites that need a full site characterization before a remedial action can take place.

Sensitive environments – Environments that are easily impacted by people visiting or contamination from mined areas. Could include cultural environments, unique/ sole source habitats, wetlands, or presence of T&E species, for example.
Stability – A mine feature that has the quality of being stable and therefore less likely to erode or otherwise lose material off-site.
Threatened and Endangered (T&E) species – Any species that is likely or in danger of becoming extinct throughout a significant portion of its range.
Total Maximum Daily Load (TMDL) – Allowable numeric thresholds for chemical constituents and physical properties (e.g., temperature) to reduce impairment and achieve water quality objectives.
Toxicity - The degree to which a substance (a toxin or poison) can harm humans or animals.

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6.0 Appendices

Appendix 1 California Abandoned Mine Lands Agency Group (CAMLAG) – Agency Survey Responses

Summary of Results
Abandoned Mine Lands (AML) Priority Criteria Survey Results

There were 11 agency respondents to the on-line survey conducted by the Sierra Nevada Conservancy in 2014. Below is a synopsis of the responses for each question in bulleted form interfused to avoid duplication.

What benefits do you envision for CAMLAG members and others from creating a comprehensive AML ranking system?

- A consistent system
- A comprehensive list
- An easier method for cross-agency information exchange
- A means to facilitate a more collaborative approach between agencies
- A good tool for site comparisons
- A means to capture specific interests
- The creation of an up to date ranking system
- The ability to match sites with current funding opportunities
- The ability for CAMLAG to review sites as a group
- The ability to focus on the largest polluters
- A tool to find consensus
- A tool for relative ranking

How would you use a system that contains cross-agency ranking criteria?

- To develop and identify priority sites
- To explore additional information
- To exchange information
- To identify sites for cooperative and collaborative efforts
- To create individualized or specific needs lists
- To evaluate impacts by watershed and landownership

What filters would you most likely use when searching a database for priority AML sites?

- Location
- Localized or larger geographic area impact (e.g. Watershed)
- Proximity and impact on populations, water bodies, historic resources, and recreation facilities (including numbers of people, users, etc)
- Number of incidents/accidents
- Estimated cost of cleanup
- Landownership
- Watershed
- Threats and impacts to and on human health and safety, wildlife and habitat, and water quality

- Types and concentrations of physical and chemical hazards
- Beneficial uses of impacted water bodies
- Volume of discharge
- Generation and transport mechanism for chemical hazards

What benefits do you envision for CAMLAG members and others from creating a comprehensive AML ranking system?

- A consistent ranking system in the state
- Certainly a ranking system is essential to any AML program. National Park Service (NPS) has our own, which CAMLAG used in completing the AML inventory for California NPS units over the past 4 years. Not sure how your new system will compare to that of NPS, but unless you don't like it, uniformity of systems would be a good plan. Not sure if the other feds have prioritization schemes.
- It would allow for ease of information exchange among agencies. You would be able to compare AMLs throughout the state and determine mines with similar issues to those within your jurisdiction. Then you could connect with others to gather information about they're reclamation work and exchange ideas.
- The comprehensive list would allow the participants of the CAMLAG group to discuss specific sites based on ranking system criteria which could facilitate a collaborative effort on a site(s) or an individual member taking on the task of addressing a site(s).
- Ability to compare sites within watersheds or other planning areas, regardless of land ownership and management.
- I envision that the specific interests of each applicable agency can be expressed this way, and the priorities for reclamation could be organized based on this comprehensive list.
- From U.S. EPA's perspective, there would be benefit of ranking private/tribal land sites. A comprehensive list of all sites is of little use to EPA because we have limited authority on non-private, non-tribal land. I think state and federal legislators, non-governmental organizations and others may find the comprehensive list useful.
- We could more easily produce a list of ranked sites based on different criteria, based on what the needs for a prioritized list are. We can match sites that rank high with various funding and program purposes. We can review sites together at our CAMLAG meetings, make this a regular part of our meetings.
- The State Water Board no longer has a staff member that specializes in mining impacts. A comprehensive database would help make sure we are all (federal, state, local agencies) on the same page. Since resources are difficult to find, this type of ranking system could help assure we get the most bang for the buck.
- At the State Water Board, we are creating a project to address mercury-impaired reservoirs statewide. One element of the project is to identify and prioritize mine site cleanups to reduce erosion of mercury-contaminated waste into the reservoir. While there may be 1000's of mine sites, we need to focus efforts on those sites that are the largest polluters. The ranking system will be a useful tool for this- even better if there is a general consensus on what the criteria should be for both public and private lands.
- A uniform ranking /scoring system compares AML sites relative to one another (e.g., relative ranking).

How would you use a system that contains cross-agency ranking criteria?

- Develop priorities (with DOC) in ranking specific sites to my agency
- Not sure, exactly, since we have our own. If yours were more elaborate or had fields other than those in the NPS database, your system could provide us with good additional information.
- I would use it like I mentioned in Question 1.
- I would look at applicable ranking criteria to identify a site(s) that our Department could potentially work on.
- Planning tool to identify and cooperate on high priority AML sites.
- We could prioritize our reclamation goals to coincide with the most highly ranked hazards, and try to schedule a reclamation list that fits best with the priorities of the other agencies involved in the reclamation list.
- EPA would prioritize private land and tribal sites for NPL listing or removal actions.
- Look for high risk sites based on ownership, clean up status, watershed, legislative district, pollutant type, hazard type. I would look at the funds DOC has available for remediation and match them to sites and partners in order to develop projects for clean up.
- The system should be flexible and allow each user/agency to set up customized rankings suitable to specific needs. Once the data is input, different queries could be developed by the individual to pull the data they need.
- Useful in addressing AML sites in watersheds. Useful in addressing AML sites within a watershed having different ownership (e.g., federal, state, private).

What filter(s) would you most likely use when searching a database for priority AML sites?

- Locations to nearest populations (schools, homes, high use areas), incidents/accidents, costs to close the sites, risk, and number of features at the AML site.
- Well of course, we'd be interested in which sites are on NPS lands, for starters. To see where sites overlap onto other agencies' lands or into common watersheds would be helpful.
- I would like to see a filter for its impact on the surrounding environment. For example, does it have a large impact on the watershed or is its impact more localized to the site?
- Threats to human health, water quality, or ecological receptors.
- Human safety, wildlife habitat (bats).
- Physical and chemical hazards. Presence of historic resources.
- Land ownership, then pollutant (Mercury, AMD and Other [mostly arsenic]).
- Hazard type (chemical and physical), pollutant type, clean up status, ownership, proximity to recreation facilities (roads, campgrounds, trailheads), proximity to water way, proximity to city/town.
- Chemical constituent of concern (COC), how is COC generated (erosion, oxidation, natural, etc) and transported, impact on water quality (surface and groundwater), potential/actual impact on human population, including how many people potentially exposed, proximity to surface waters, beneficial uses of water body impacted by discharge, volume (solid or liquid) of discharge.
- Amount of onsite mine waste; amount of onsite mine waste contacting surface waters; mercury concentration in mine waste runoff; distance to surface water (creek, river); distance to reservoir; percentage of vegetative cover on mine wastes; degree of existing

erosion (visual evidence of rills, channels, off site waste, movement, etc.); erosion potential of mine waste piles; site access.

- Highest concentration of a given contaminant of concern, human health impact, and environmental impacts - including ecological and water quality impacts.

Appendix 2 Guidance Used to Generate Attributes for CAMPT

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Appendix 3 Outline of Select Attribute Combinations for Risk Evaluation

Tier 2 Relationships

IMMINENT RISK TO HUMAN OR ECOLOGICAL HEALTH – Physical Hazards Only

Concept: Attribute 1 evaluates endangerment from physical safety hazards based on certain Chemical Hazards and Physical Hazards in Tier 2. Tier 2 does not evaluate imminent risk to human or ecological health from chemical hazards because it is assumed not enough data would be collected to determine endangerment at this stage of site investigation.

Physical Risk

Tier 2 Chemical Risk Attribute 1 (presence of hazardous materials) OR Attributes 1A or 1B (condition of adits or shafts) OR Attribute 3 (condition of high walls) OR Attribute 7 (condition of pools of standing water)

+ Tier 1 Attribute 1 (road access) OR Attribute 2 (Trails access) OR Attribute 3 (campground access)

+ Tier 1 Chemical Risk Attribute 5 (density of mine features)

+ Tier 1 Chemical Risk Attribute 16 (land ownership)

DETECTION OF ELEVATED CONSTITUENTS OF CONCERN

Concept:
1. Are there contaminants that may produce a hazard?
2. Is the contamination going anywhere?
3. Can it impact a receptor?

Chemical Risk

Tier 2 Attribute 22 (detection of contaminant of concern in soil or tailings using XRF)

+ Tier 2 Attribute 2 OR Attribute 3 (volume of waste OR tailings) OR Tier 2 Attribute 15A OR 15B (volume of waste OR tailings in contact with surface flows)

AND

+ Tier 1 Attribute 6 (mine location relative to surface water body) OR Attribute 10 (mine location relative to ground water drinking water source) OR Attribute 11 (mine location relative to surface water diversion for drinking water) OR Attribute 13 (mine location relative to protected species) OR Attribute 14 (mine location relative to wetland environment)

Tier 3 Relationships

IMMINENT RISK TO HUMAN OR ECOLOGICAL HEALTH

Concept: To ascertain evaluation for Attribute 1 certain attributes in Tier 3 should be flagged.

Chemical Risk

Tier 3 Attributes 2ACOC to 2DCOC (concentration of any contaminant in any of 4 media above threshold) OR Attributes 9A to 9E (water chemistry parameters that do not meet standards)

AND

Tier 3 Attribute 10A OR Attribute 10B (Contaminant impacts ground water OR downstream surface water diversion for drinking water)

OR

Tier 3 Attribute 6AHumWater OR Attribute 6AHumSoil OR Attribute 6AHumSediment OR Attribute 6BHumFood (Human exposure pathway is contaminated and direct intake/contact is occurring)

OR

Tier 3 Attribute 6AEcoWater OR Attribute 6aEcoSoil OR Attribute 6AEcoSediment OR Attribute 6BEcoFood (Ecological exposure pathway is contaminated and direct intake/contact is occurring)

TYPE AND CONCENTRATION OF CONSTITUENT IN MEDIA (SOIL, SEDIMENT, GROUNDWATER, SURFACE WATER)

Concept:
1. Are there contaminants that may produce a hazard?
2. Is the contamination going anywhere?
3. Can it impact a receptor?

Chemical Risk

Tier 3 Attributes 2ACOC to 2DCOC (concentration of any contaminant in any of 4 media above threshold) OR Attributes 9A to 9E (water chemistry parameters that do not meet standards)

+ Tier 3 Attribute 3A OR Attribute 3B OR Attribute 3C OR Attribute 3D (mobility of contaminants in soil, air, groundwater, surface water) OR Tier 2 Attribute 13 OR Attribute 14 (evidence of erosion on site) OR Attribute 15 (waste in contact with surface flows)

+ Tier 2 Attributes 15A OR 15B (volume of waste OR Tailings in contact with surface water) OR Tier 3 Attribute 5A OR Attribute 5B (volume of contaminated material on site)

+ Tier 3 Attribute 10A OR Attribute 10B (Contaminant impacts ground water or downstream surface water diversion for drinking water) OR Attribute 6AHumWater OR Attribute

6AHumSoil OR Attribute 6AHumSediment OR Attribute 6BHumFood (Human exposure pathway is contaminated and direct intake/contact is occurring)

OR

+ Tier 3 Attribute 6AEcoWater OR Attribute 6aEcoSoil OR 6AEcoSediment OR Attribute 6BEcoFood (Ecological exposure pathway is contaminated and direct intake/contact is occurring)

RISK FROM VOLUME OF CONTAMINATED MATERIAL

Concept: The amount of contaminated waste rock should be evaluated along with the type of commodity mined.

Chemical Risk

Tier 3 Attribute 5A OR Attribute 5B (volume of contaminated waste rock OR tailings)

+ Tier 2 Attribute 6 OR Attribute 8 (commodity mined OR type of mine)

+ Tier 2 Attribute 14 (waste or tailings in contact with surface flows) OR Attributes 15A OR 15B (volume of waste OR tailings in contact with surface flows) OR Attribute 16 (stream type on or near mine site) OR Attribute 17 (mine site located near surface water)

RISK FROM MOBILITY OF CONTAMINANTS

Concept: Is the contamination going anywhere?

Chemical Risk

Tier 3 Attribute 3A OR Attribute 3B OR Attribute 3C OR Attribute 3D (evidence of mobility of contaminants through 4 different media)

OR

Tier 2 Physical Risk Attribute 5 (steepness/stability of slopes)

+ Tier 2 Attribute 12 OR Attribute 13 (evidence of water or wind erosion on site) OR Attribute 14 (waste or tailings in contact with surface flows)

Appendix 4 Tier 1 Attributes and Evaluation Ranges

Tier 1: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range & Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
1	Chemical Risk	Chemical Hazard	Water/Air/ Food/Soil/ Sediment Quality	Potential mine site has a commodity that is associated with a COC.	Source	The potential mine site has a commodity, deposit type or processing type that is associated with a COC.[18]	Geospatial	**1** = Mine site has a commodity associated with these COCs: Arsenic, Asbestos, Chromium, Lead, Mercury, Selenium, Thallium, Cadmium, Copper, Cobalt, Beryllium, Radionuclides (Uranium, Radon, Tritium, Strontium, Radium, Gross Alpha, Gross Beta) **0.5 =** Mine site has a commodity associated with these COCs: – Antimony, Barium, Molybdenum, Nickel, Vanadium, Zinc, Silica, Silver, Cyanide **0** = Mine site does not have a commodity associated with a COC.[46] Evaluation Type: Step	MRDS[19] PAMP[20] TOMS[24]	46-47
2	Chemical Risk	Chemical Hazard	Water/Air/ Food/Soil/ Sediment Quality	Potential production took place at the site.	Source	The potential mine site has a production status listed in MRDS	Geospatial	**1** = mine site is listed as past producer or producer, indicating high potential for production on the site. **0.5** = mine site is listed as developed deposit or unknown, indicating potential for production on the site. **0 =** Mine site is listed as exploration prospect, mineral location, or raw prospect, indicating low. potential for production on the site. Evaluation Type: Step	MRDS[19] TOMS[24]	46
3	Chemical Risk	Chemical Hazard	Water/Air/ Food/Soil/ Sediment Quality	Type of Mine	Source	The potential mine site has a production type listed in MRDS	Geospatial	**1** = Mine site is listed as placer, processing plant, underground, or surface underground. **0.5** = Mine site is listed as surface, brine operation, leach, or unknown. **0** = Mine site is listed as geothermal, offshore or well. Evaluation Type: Step	MRDS[19] TOMS[24]	46
4	Chemical Risk	Chemical Hazard	Water/Air/ Food/Soil/ Sediment Quality	Mine site lies in a geologic formation with a potential for contamination.	Source	The potential mine site lies within a geologic layer or formation identified that has a possibility to create potential contamination if rock is exposed to air and or water.	Geospatial	**1** = Iron sulfides mineral deposit or other deposit with high potential for contamination. **0.5** = > 0 and < 1 for mineral deposits associated with potential for contamination. **0** = Other mineral deposits associated with low potential for contamination. Evaluation Type: Step Note: USGS is currently compiling GIS layer of significant deposits data that will be useful in evaluation this attribute. Evaluation range may change depending on the type of information contained in this dataset. Evaluation Type: Step	TOMS[24] USGS Significant Deposit Dataset CGS 750K Geologic Map	48

Tier 1: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range & Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
5	Chemical Risk	Chemical Hazard	Water/Air/ Food/Soil/ Sediment Quality	The density of potential mine related features within a certain area.	Source	The density of potential mine related features (TOMS) within a defined geographic area (2 km diameter from each TOMS symbol).	Geospatial	**1** = Number of potential mine related features within 2 km. **0** = There are no potential mine related features within 2 km. Evaluation Type: Linear (Continuous)	TOMS[24]	48
6	Chemical Risk	Chemical Hazard	Water/Soil/ Sediment/ Food Quality	The mine site or features lie within a certain distance of a mapped hydrologic feature.	Pathway	The mine site or features lie within a certain distance of a mapped hydrologic feature such as creek, stream, river, reservoir, lake, etc.	Geospatial	**1** = Mine site lies 0 to <499 feet from a surface waterbody, indicating high potential impact on surface waterbody. **0.5** = Mine site lies 500 to 1000 feet from a surface waterbody, indicating potential impact on surface waterbody. **0** = Mine site lies > 1,000 feet from a surface waterbody, indicating low potential impact on surface waterbody. Evaluation Type: Step	TOMS[24] USGS NHD and WBD[23]	48
7	Chemical Risk	Chemical Hazard	Water Quality	Potential mine site is located within a watershed that contains an impaired waterbody due to mining.	Pathway	Potential mine site is located within a watershed that contains a 303(d) listing for a stream segment or water body for contaminants relevant to mining that occurred in the watershed.	Geospatial	**1** = Potential mine site falls within impacted watershed(s) listed on 303(d) list. **0** = Potential mine site does not fall within an impacted watershed(s) listed on the 303(d). Evaluation Type: Binary (Yes/No)	Impaired Waterbodies (303(d))[17] *Report Data/Info: Lisa Holmes (916) 341-5557* *GIS Questions: Stephanie Bucknam (916) 558-1708 (email: gis@waterboards.ca.gov).*	32
8	Chemical Risk	Chemical Exposure	Food/Soil/ Sediment Quality	Potential mine site may impact fishing or fish consumption.	Receptor	Potential mine site is located within a watershed that supports fishing and fish consumption or feeds into a water body that supports fishing and fish consumption.	Geospatial	**1** = Potential mine site falls within fish-consumption watershed(s), or that feeds into fish-consumption watershed. **0** = Potential mine site does not fall within a fish-consumption watershed. Evaluation Type: Binary (Yes/No)	CDFW Fishing locations/activities - Fish advisories contained in the 303d list which is viewable.	53
9	Chemical Risk	Chemical Exposure	Drinking Water Quality	Drinking water source(s) are impacted by contaminants associated with mining in watershed.	Receptor	Drinking water source(s) have elevated contaminants related to mining that may have occurred in the watershed.	Geospatial	**1** = Drinking water source(s) are impacted by mining related contaminants. **0** = Drinking water source(s) are not impacted by mining related contaminants. Evaluation Type: Binary (Yes/No)	SWRCB Division of Drinking Water (DDW) Drinking Water Quality Standards Database[27] *DDW Contact: Mark Bartson* *Mark.Bartson@waterboards.ca.gov* *(916) 449-5622*	54

Tier 1: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range & Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
10	Chemical Risk	Chemical Exposure	Drinking Water Quality	Potential mine site is a certain distance from a groundwater drinking water source.	Receptor	Potential mine site lies within a certain distance, upgradient from a documented ground water drinking water source.	Geospatial	**1** = Domestic well within ¼ mile downgradient from mine site. **0.5** = Domestic well between >1/4 mile to 1 mile downgradient from mine site. **0** = Domestic well <1 mile downgradient from mine site. Evaluation Type: Step	SWRCB Drinking Water Supply Service Area Lookup Tool Geotracker GAMA dataset CDWR Water Data Library CDWR - Groundwater Information Center Interactive Map SWRCB Public Drinking Water System TOMS[24] *GeoTracker GAMA: Groundwater Ambient Monitoring & Assessment Program: Diane Barclay, GAMA@waterboards.ca.gov or call (916) 341-5585* *SWRCB DDW Contact: Mark Bartson Mark.Bartson@waterboards.ca.gov (916) 449-5622*	42, 43, 55-57
11	Chemical Risk	Chemical Exposure	Water Quality	Potential mine site is a certain distance from a surface water drinking water source.	Receptor	Potential mine site lies within a certain distance, upgradient from a documented surface water diversion for potable water.	Geospatial	**1** = Surface water diversion within ¼ mile from mine site. **0.5** = Surface water diversion between >1/4 mile to 1 mile from mine site. **0** = Surface water diversion <1 mile from mine site. Evaluation Type: Step	SWCRB Electronic Water Rights Information Management System[28] TOMS[24]	
12	Chemical Risk	Chemical Exposure	Water/Soil/ Sediment Quality	Potential impact on culturally sensitive areas.	Receptor	Potential mine site lies within, adjacent to or downgradient from a culturally important area.	Geospatial, Tabular?	**1** = Mine site lies within 1 mile of a culturally sensitive site. **0.5** = Mine site lies <1 mile and >10 mile from culturally sensitive site. **0** = Mine site lies more than 10 mile from a culturally sensitive site. Evaluation Type: Step	National Register of Historic Places DB CHRIS[29] TOMS[24]	58
13	Chemical Risk	Chemical Exposure	Water/Soil/ Sediment Quality	Potential impact to threatened, endangered or sensitive species.	Receptor	Threatened, endangered or sensitive species are located at, adjacent or downgradient from a potential mine site	Geospatial	**1** = Mine site lies <1 mile upstream from occurrences. **0.5** = Mine site lies >1 mile and does not lie upstream from sensitive site. **0** =Mine site does not lie upstream from occurrences. Evaluation Type: Step	CNDDB[21] TOMS[24]	49

Tier 1: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range & Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
14	Chemical Risk	Chemical Exposure	Water/Soil/ Sediment Quality	potential impact to a wetland environment.	Receptor	Potential mine site is located in, adjacent to or down gradient from a wetland environment.	Geospatial	**1** =Mine site lies <1 mile upstream from sensitive site. **0.5** = Mine site lies >1 mile away from sensitive site and does not lie upstream of sensitive site. **0** = Mine site does not lie upstream from occurrences. Evaluation Type: Step	USFWS National Wetland Inventory USGS NHD[23] TOMS[24]	59
15	Chemical Risk	Chemical Exposure	Human Exposure	Recreational Access: Roads	Receptor	The degree to which the potential mine site is accessible by the public	Geospatial	**1** = Mine site lies <¼ mile from a paved or designated open route. Sites in open play and OHV areas should be considered high risk. **0.5** = Mine site lies >1/4 mile and <1 mile from a paved or designated open route. **0** = Mine site lies more than 1 mile from a paved or designated open route Evaluation Type: Step	USFS FSTOPO[31] NPS IRMA[32] BLM Roads[33] TOMS[24]	60, 64
16	Chemical Risk	Chemical Exposure	Human Exposure	Ownership	NA	Potential mine is located on state, federal, local agency land or private land.	Geospatial	**1** = Public land with freely available access. **0.5** = Public access is controlled/limited on public land. **0** = Private land assumed to have no public access. Evaluation Type: Step	BLM Land Status[34] CPAD[35] TOMS[24]	61, 62
17	Chemical Risk	Chemical Exposure	Human Exposure	Potential mine site impacts a population center.	Receptor	Population density associated with a potential mine site.	Geospatial	**1** = Population density associated with the mine site. **0** = Mine site is associated with 0 population density. Evaluation Type: Binary (Yes/No)	US Census Bureau TIGER dataset[36] TOMS[24]	63

Tier 1: Physical Risk

Attribute Number	Priority Concern	Risk Category	Component	Attribute	Source/ Pathway/ Receptor	Data Description	Data Type	Evaluation Range & Evaluation Type	Data source (see endnotes for more details)	Reference
1	Physical Risk	Physical Exposure	Recreation	Recreational Access: Roads	Receptor	Potential mine site lies within a certain distance from a certain kind of vehicle access type (roads, OHV area, etc.).	Geospatial	**1** = Mine site lies <¼ mile from a paved or designated open route. Sites in open play and OHV areas should be considered high risk. **0.5** = Mine site lies >1/4 mile and <1 mile from a paved or designated open route. **0** = Mine site lies more than 1 mile from a paved or designated open route. Evaluation Type: Step	USFS FSTOPO[31] Transportation Line NPS IRMA[32] BLM Roads[33] TOMS[24] Note: Description of other layers to be used will be provided by the appropriate agencies.	60, 64
2	Physical Risk	Physical Exposure	Recreation	Recreational Access: Trails/ Trailheads	Receptor	Potential mine site lies within a certain distance from a certain kind of hiking access type (roads, OHV area, etc.).	Geospatial	**1** = Mine site lies <¼ mile from a trailhead, or <100 yards from a trail. **0.5** = Mine site lies >1/4 mile/100 yd and <1 mile/200 yd from a trailhead/trail. **0** = Mine site lies > 1 mile from a trailhead, or >200 yards from a trail. Evaluation Type: Step	USFS FSTOPO[31] RecFacility Point and Line (for trails/trailheads) TOMS[24] Note: Description of other layers to be used will be provided by the appropriate agencies.	60
3	Physical Risk	Physical Exposure	Recreation	Recreational Access: Campgrounds	Receptor	Potential mine site lies within a certain distance from a campground.	Geospatial	**1** = Mine site lies <¼ mile from a campground. **0.5** = Mine site lies >1/4 mile and <1 mile from a campground. **0** = Mine site lies > 1 mile from a campground. Evaluation Type: Step	USFS FSTOPO[31] RecFacility Point (for campgrounds) TOMS[24] Note: Description of other layers to be used will be provided by the appropriate agencies.	60
4	Physical Risk	Physical Exposure	Recreation	Recreational Use: Trails/ Trailheads	Receptor	The number of visitors using a specific trail/trailhead per year	Geospatial	**1** = Number of people/year per trail or trailhead. **0** = Zero people/year per trail or trailhead. Evaluation Type: Linear (Continuous)	USFS National Visitor Use Monitoring[37] NPS IRMA[32] BLM Geocommunicator	65
5	Physical Risk	Physical Exposure	Recreation	Recreational Use: Campgrounds	Receptor	The number of visitors using a specific campground per year	Geospatial	**1** = Number of people/year per campground. **0** = Zero people/year per campground Evaluation Type: Linear (Continuous)	USFS National Visitor Use Monitoring[37] NPS IRMA[32] BLM Geocommunicator	65
6	Physical Risk	Physical Hazard	Potential Hazard	Potential of mine site to have a large number of hazards.	Source	Potential mine site has multiple openings or indication of a large volume of workings.	Geospatial	**1** = Mine site is listed as past producer or producer, indicating high potential for having multiple openings and large volume openings. **0.5** = Mine site is listed as developed deposit or unknown, indicating potential for having multiple openings and large volume openings. **0** = Mine site is listed as exploration prospect, mineral location, or raw prospect, indicating low potential for having multiple openings and large volume openings. ~~Evaluation Type: Step~~	MRDS[19] TOMS[24]	46, 48

Tier 1: Physical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range & Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
7	Physical Risk	Physical Hazard	Potential Hazard	Type of mine	Source	The potential mine site has a production type listed in MRDS	Geospatial	**1** = Mine site is listed as underground, surface-underground. **0.5** = Mine site is listed as placer, processing plant, surface, or unknown. **0** = Mine site is listed as brine operation, geothermal, leach, offshore, or well. Evaluation Type: Step	MRDS[19] TOMS[24]	46, 48
8	Physical Risk	Physical Exposure	Exposure	Distance to residence	Receptor	Potential mine site lies within a certain distance from a residence.	Geospatial	**1** = Mine site lies <¼ mile from a residence. **0.5** = Mine site lies >1/4 mile and <1 mile from a residence. **0** = Mine site lies more than 1 mile from a residence. Evaluation Type: Step	TOMS[24]	46, 48

Appendix 5 Tier 2 Attributes and Evaluation Ranges

Tier 2: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range and Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
1	Chemical Risk	Chemical Hazard	Water Quality, Air Quality/ Soil/ Sediment	Potential hazardous materials exist on site.	Source	Presence of drums, laboratory chemicals, explosives.	Observed	**1** = There is a presence of drums, lab chemicals, explosives on site. **0** = There is not a presence of drums, lab chemicals, explosives on site. Evaluation Type: Binary (Yes/No)	AML Database – DOC Divsion of Mine Reclamation	45
2	Chemical Risk	Chemical Hazard	Water Quality/ Soil/ Sediment	Volume of **waste rock** on site.	Source	The volume of waste rock on site, based on a range of volumes. Estimated in the field or by measuring from LiDAR (if available) or aerial photography.	Observed, geospatial	**1** = Number of cubic yards of waste rock on the mine site. **0** = There is no waste rock on the mine site. Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation	45
3	Chemical Risk	Chemical Hazard	Water Quality, Air Quality/ Soil/ Sediment	Volume of **tailings** on site.	Source	The volume of tailings on site, based on a range of volumes. Estimated in the field or by measuring from LiDAR (if available) or aerial photography.	Observed, Geospatial	**1** = Number of cubic yards of tailings on the mine site. **0** = There is no tailings on the mine site. Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation	45
4	Chemical Risk	Chemical Hazard	Water Quality/ Soil/ Sediment	Evidence of metal leaching.	Pathway	Evidence of metal leaching on site based on evidence of seven leaching factors: • EC (electrical conductivity) •high redox potential •low pH •precipitates in the surface waters •staining •lack of invertebrates •corrosion Measured onsite using handheld meters during inventory.	Observed	**1** = 7 metal leaching factors are elevated or observed. **0.858 =** 6 metal leaching factors are elevated or observed. **0.715 =** 5 metal leaching factors are elevated or observed. **0.572 =** 4 metal leaching factors are elevated or observed. **0.429 =** 3 metal leaching factors are elevated or observed. **0.286 =** 2 metal leaching factors are elevated or observed. **0.143 =** 1 metal leaching factors are elevated or observed. **0** = No metal leaching factors are elevated or observed. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45

Tier 2: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range and Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
5	Chemical/ Contaminant Risk	Chemical Hazard	Water/ Food Quality/ Soil/ Sediment	Number of incidents of metal leaching.	Pathway	Total number of locations where metal leaching has been found on site regardless of their condition. Evaluation is based on actual number of observed incidents.	Observed	**1** = Number of observed incidents. **0** = No incidents observed. Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation	45
6	Chemical/ Contaminant Risk	Chemical Hazard	Water/Food/Air Quality/Soil/ Sediment	Mine site has a commodity that is associated with a Constituent of Concern.	Source	Site has a commodity, deposit type and/or processing type associated with a Constituent of Concern.[18]	Geospatial, Observed	**1** = Mine site has a commodity associated with these COCs: Arsenic, Asbestos, Chromium, Lead, Mercury, Selenium, Thallium, Cadmium, Copper, Cobalt, Beryllium, Radionuclides (Uranium, Radon, Tritium, Strontium, Radium, Gross Alpha, Gross Beta) **0.5 =** Mine site has a commodity associated with these COCs: – Antimony, Barium, Molybdenum, Nickel, Vanadium, Zinc, Silica, Silver, Cyanide **0** = Mine site does not have a commodity associated with a COC.[46] Evaluation Type: Step	MRDS19 PAMP20 AML Database – DOC Divsion of Mine Reclamation	45-47
7	Chemical/ Contaminant Risk	Chemical Hazard	Water/Food/Air Quality/Soil/ Sediment	Potential processing of minerals took place at the site.	Source	Evidence of processing of minerals is observed at the site.	Observed	**1** = Evidence of processing of minerals observed onsite. **0** = No evidence of processing of minerals onsite. Evaluation Type: Binary (Yes/No)	AML Database – DOC Divsion of Mine Reclamation	45
8	Chemical/ Contaminant Risk	Chemical Hazard	Water/Food/Air Quality/Soil/ Sediment	The type of mineral production at the site.	Source	The type of mineral production that took place at the site based on MRDS and observed features.	Geospatial, Observed	**1** = Mine site is listed as placer, processing plant, underground, or surface underground. **0.5** = Mine site is listed as surface, brine operation, leach, or unknown. **0** = mine site is listed as geothermal, offshore or well. Evaluation Type: Step	MRDS19 AML Database – DOC Divsion of Mine Reclamation	45-46

Tier 2: Chemical Risk										
Attribute Number	Priority Concern	Risk Category	Component	Attribute	Source/ Pathway/ Receptor	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
9	Chemical Risk	Chemical Hazard	Water/Food Quality	Evidence of manmade water features on site.	Pathway	Evidence of man-made water features (berms, depressions,) that may indicate pit lakes, tailings impoundments, or seasonal water ponding on site.	Observed, Geospatial	**1** = Large permanent or perennial man-made water features on-site, with or without observations of seasonal water ponding. **0.5** = Small permanent or perennial man-made water features on-site, with or without observations of seasonal water ponding. **0** = No evidence of man-made water features on-site.[50] Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
10	Chemical Risk	Chemical Hazard	Water/Food Quality	Number of pit manmade water features onsite.	Pathway	Total number of locations where manmade water features have been found on site during wet season regardless of their condition. Evaluation is based on actual number of observed water features.	Observed	**1** = Number of man-made water features are on-site. **0** = No manmade water features are onsite. Evaluation Type: Linear (Continuous)	DOC	45
11	Chemical Risk	Chemical Exposure	All Components	Mine site conditions threaten state or federal listed ESA species or sensitive environments within 1 mile radius of site.	Receptor	Site conditions threaten species, environments, or habitats utilized by listed species designated as such by state or federal government within 1 mile radius. Based on observations by investigating agency and listings in CNDDB or other dataset in BIOS.	Observed, geospatial	**1** = > 1 species onsite of contamination and 1 sensitive environment impacted. **0.8** = > 1 species within 1 mile of contamination OR 1 sensitive environment impacted. **0.6** = 1 or more species suspected within 1 mile of contamination and no sensitive environment impacted. **0.4** = No species suspected within 1 mile of contamination and >1 sensitive environment potentially impacted. **0.2** = No species suspected within 1 mile of contamination and one sensitive environment potentially impacted. **0** = No species suspected within 1 mile of contamination and no sensitive environment impacted. Evaluation Type: Step	CDFW - California Natural Diversity Database[21] and Biogeographic Information and Observation System	49-50

Tier 2: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range and Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
12	Chemical Risk	Chemical Exposure	Water/Soil/ Sediment Quality	Degree of water erosion on site.	Pathway	Evidence of water erosion on the mine site (gullies, channels, downcuts).	Observed	**1** = Large proportion of the volume of waste rock or tailings have been eroded. **0.75** = Deep erosional channels on site. **0.5** = Erosional channels, large amount of rills on site. **0.25** = Localized rills. **0** = No evidence of water erosion on site. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
13	Chemical Risk	Chemical Exposure	Air/Soil/ Sediment Quality	Degree of wind erosion on site.	Pathway	Evidence of wind erosion (dunes, scour, dust in air or on surfaces.	Observed	**1** = Large area of loose windblown tailings on site. **0.66** = Moderate amount of windblown tailings are on site. **0.33** = Little windblown tailings are on site. **0** = No evidence of wind erosion on site. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
14	Chemical Risk	Chemical Hazard	Soil/Sediment Quality	Mine waste and tailings in contact with surface flows.	Pathway	Streams, ponds, or surface runoff flow over, under or at base of waste or tailings piles.	Observed	**1** = Mine waste or tailings in contact with large perennial features (river) **0.66** = Mine waste or tailings in contact with small perennial features (creeks, streams, ponds). **0.33** = Mine waste or tailings in contact with ephemeral features (wash, intermittent stream or pond). **0** = No mine waste or tailings in contact with surface flow. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamat	45
15a	Chemical Risk	Chemical Exposure	Soil/Sediment Quality	Volume of **mine waste** in contact with surface water flows.	Pathway	Amount of mine waste in contact with surface water flows.	Observed	**1** = Volume of mine waste in contact with surface water flows in cubic yards. **0** = No mine waste in contact with surface water flows. Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation	45
15b	Chemical Risk	Chemical Exposure	Soil/Sediment Quality	Volume of **tailings** in contact with surface water flows.	Pathway	Amount of tailings in contact with surface water flows.	Observed	**1** = Volume of tailings in contact with surface water flows in cubic yards. **0** = No tailings in contact with surface water flows. Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation	45

Tier 2: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range and Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
16	Chemical/Contaminant Risk	Chemical Exposure	Water/Food/ Soil/Sediment Quality	Type of stream on or near mine site.	Pathway	The mine site or features lie within a certain distance of a mapped hydrologic feature	Observed, geospatial	**1** = Large perennial features on or near site (rivers). **0.66** = Small perennial feature on or near site (creeks, streams). **0.33** = Ephemeral features on or near site (small intermittent streams, washes). **0** = No water course on or near site. Evaluation Type: Step	USGS NHD and WBD23 AML Database – DOC Divsion of Mine Reclamation	31, 45, 51
17	Chemical/ Contaminant Risk	Chemical Exposure	Water/Food/ Soil/Sediment Quality	The mine site lies within a certain distance from a surface waterbody.	Pathway	The National Hydrography Dataset (NHD) and Watershed Boundary Dataset (WBD) are used to portray surface water on The National Map. The NHD represents the drainage network with features such as rivers, streams, canals, lakes, ponds, coastline, dams, and stream gages.	Observed, geospatial	**1** = Mine site lies less than 500 feet from surface waterbody. High potential impact on surface waterbody. **0.5** = Mine Site lies between 2500 and 500 Feet from surface water body. Intemediate potential impact on surface waterbody. **0** = Mine site lies greater than 2500 feet from surface waterbody. Low potential impact on surface waterbody. Evaluation Type: Step	USGS NHD and WBD23 AML Database – DOC Divsion of Mine Reclamation	31, 45, 51
18	Chemical Risk	Chemical Exposure	Water/Soil/ Sediment Quality	Degree of surface water sedimentation from mine site.	Pathway	The amount of observed surface water sedimentation from a mine site.	Observed	**1** = Large amount of surface water sedimentation observed. **0.5** = Moderate amount surface water sedimentation observed. **0** = No to low surface water sedimentation from the site is observed.[49] Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
19	Chemical Risk	Chemical Hazard	Water Quality	Discharging mine portals on site.	Source	Evidence of discharging mine portals on site.	Observed	**1** = Evidence of discharging mine portals onsite. **0** = No evidence of discharging mine portals onsite. Evaluation Type: Binary (Yes/No)	AML Database – DOC Divsion of Mine Reclamation	45
20	Chemical Risk	Chemical Hazard	Water Quality	Seepage from mine site other than from portals.	Source	Evidence of water or acid mine drainage (AMD) seepage on site from locations other than mine portals.	Observed	**1** = Evidence of water or AMD seepage on site other than from mine portals. **0** =No evidence of seepage was observed on site. Evaluation Type: Binary (Yes/No)	AML Database – DOC Divsion of Mine Reclamation	45

Tier 2: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Source/ Pathway/ Receptor**	**Data Description**	**Data Type**	**Evaluation Range and Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
21	Chemical Risk	Chemical Exposure	Water Quality	Site has aquatic invertebrates present on site.	Receptor	The presence or absence of invertebrate assemblages in the adjacent aquatic environment, such as aquatic insects, worms, mollusks.	Observed	**1** = Evidence onsite of sensitive aquatic invertebrates, native fish or amphibians. **0** = No evidence onsite of sensitive aquatic invertebrates, native fish or amphibians. Evaluation Type: Binary (Yes/No)	AML Database – DOC Divsion of Mine Reclamation	45
22	Chemical Risk	Chemical Hazard	Water/Soil/Air Quality	Detection of elevated Constituents of Concern.	Source	XRF (x-ray fluorescence) readings collected on specific features onsite indicate certain constituents are elevated above residential levels	Observed	**1** = XRF readings indicate certain constituents are elevated above residential levels. **0** = XRF readings indicate certain constituents are NOT elevated above residential levels. Evaluation Type: Binary (Yes/No)	AML Database – DOC Divsion of Mine Reclamation EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO)	45

Tier 2: Physical Risk

Attribute Number	Priority Concern	Risk Category	Component	Attribute	Source/ Pathway/ Receptor	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
1a	Physical Risk	Physical Hazard	Potential threat	Condition of shafts, declines found on site.	Source	Condition of shafts and declines onsite.	Observed	**1** = Any shaft or decline that can be entered by a person, either intentionally or unintentionally. **0.75** = Any shaft or decline that requires some level effort to reopen. Also could apply to breached, vandalized, or poorly built gates or other remediations. **0.5** = Any shafts and declines that appears to be completely closed. Also used for cupolas, bat gates and other remediations if intact and built correctly. **0.25** = Any shafts or declines that has been professionally closed (backfill, PUF, concrete, etc). **0** = No shafts or declines are on site. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
1b	Physical Risk	Physical Hazard	Potential threat	Condition of adits found on site.	Source	Condition of adits onsite.	Observed	**1** = Any adit that can be entered by a person. **0.75** = Any adit that requires some level effort to reopen. Also could apply to breached, vandalized, or poorly built gates or other remediations. **0.5** = Any adit that appears to be completely closed. Also used for cupolas, bat gates and other remediations if intact and built correctly. **0.25** = Any adit that has been professionally closed (backfill, PUF, concrete, etc). **0** = No adits are on site. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
2a	Physical Risk	Physical Hazard	Potential threat	Number of shafts and declines found on site.	Source	The total (true) number of shaft and decline locations found on site regardless of the condition.	Observed	**1** = Number of shafts or declines are on-site. **0** = No shafts or declines are onsite. Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation	45
2b	Physical Risk	Physical Hazard	Potential threat	Number of adits found on site.	Source	The total (true) number of adit locations found on site regardless of the condition.	Observed	**1** = Number of adits are on-site. **0** = No adits are onsite. Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation	45

Tier 2: Physical Risk

Attribute Number	Priority Concern	Risk Category	Component	Attribute	Source/ Pathway/ Receptor	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
3	Physical Risk	Physical Hazard	Potential threat	Condition of highwalls over 10 feet tall found on site.	Source	Condition for highwalls over 10 feet tall onsite.	Observed	**1** = Vertical highwalls with severe instability, easy access to the top, excessive height. **0.75** = High angle highwalls with some instability, easy access to the top, and moderate height. **0.5** = Moderate angle highwalls with low instability, moderate access to the top and lower height. **0.25** = Low angle highwalls with little hazard or difficult access to the top. **0** = No highwalls or no highwalls over 10 feet tall found on site. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
4	Physical Risk	Physical Hazard	Potential threat	Highwall length	Source	The total length of all highwall(s) regardless of condition.	Observed, geospatial, LiDar, aerial interpretation	**1** = Total high wall length divided by 100. **0** = No highwall length on site. Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation LiDAR	45
5	Physical Risk	Physical Hazard	Potential threat	Evidence of steep, unstable slopes, rock falls, or debris flows.	Source	Condition of the site that has steepness or instability of the slopes or if the site is prone to erosion.	Observed	**1** = Steep canyons with significant evidence of rock fall or debris flows. **0.75** = Hillside with soil showing evidence of slumps, or unstable slopes. **0.5** = Slumps or rock falls onto road cuts. **0.25** = Minor soil movement over steepened slopes. **0** = No steep, unstable slopes, rock falls, or debris flows onsite. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
6	Physical Risk	Physical Hazard	Surface/Underground Workings	Stability of the site as evidenced by ground cracks, slumps, or subsidence features.	Source	Condition of the ground surface as an indicator of site stability.	Observed	**1** = All features display evidence of instability such as large tension cracks, major collapse of features, collapsed roofs of large stopes, etc. **0.75** = Some features display evidence of instability such as collapsed shafts or adits and large subsidence features. **0.5** = A few features display evidence of minor to moderate instability such as partially collapsed openings or small subsidence features. **0.25** = The site is generally stable but one or two features show evidence of minor instability such as portal creep and small amount of rock fall underground. **0** = No ground cracks, slumps or subsidence features onsite. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45

Tier 2: Physical Risk

Attribute Number	Priority Concern	Risk Category	Component	Attribute	Source/ Pathway/ Receptor	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
7	Physical Risk	Physical Hazard	Surface Workings	Condition of pools of standing water greater than 3 feet deep.	Source	Condition of pools of standing water greater than 3 feet deep found on site.	Observed	**1** = Deep pools of water with evidence of swimming by the public. **0.75** = Deep pools of water with submerged obstacles, vertical sides, or limited visibility. **0.5** = Pools of water over 3 feet deep with steeper sides or submerged obstacles. **0.25** = Pools of water over 3 feet deep; shallow sides and easy to escape. **0** = No pools of water deeper than 3 feet on site. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
8	Physical Risk	Physical Hazard	Surface Workings	Total surface area of pools of standing water.	Source	Total surface area of pools of standing water found on site.	Observed Lidar, Geospatial, aerial interpretation	**1** = Total surface area of pools of standing water on site. **0** = No pools of standing water on site.[49] Evaluation Type: Linear (Continuous)	AML Database – DOC Divsion of Mine Reclamation LiDAR	45
9	Physical Risk	Physical Hazard	Potential threat	Condition potentially hazardous structures, machinery, scrap or trash.	Source	The average condition of the structures machinery or trash that could hurt a visitor to the site.	Observed	**1** = Large unstable structures that may collapse or containers of unidentified chemicals. **0.75** = Small unstable structures or large stable structures that pose a fall hazard to visitors. **0.5** = Large amounts of sharp debris or large collapsed structures **0.25** = Small amounts of sharp debris. **0** = No hazardous structures, machinery, scrap or trash on site. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45
10	Physical Risk	Physical Hazard	Potential threat	Number of potentially hazardous structures, machinery, scrap or trash.	Source	The total number of areas with hazardous structures, machinery, scrap or trash regardless of their condition.	Observed	**1** = 5 – 10 areas with large unstable structures that may collapse or containers of unidentified chemicals. **0.75** = 5 – 10 areas with small unstable structures or large stable structures that pose a fall hazard to visitors. **0.5** = 5-10 areas with large amounts of sharp debris or 1 large collapsed structures. **0.25** = 1-5 areas with small amounts of sharp debris **0** = No areas with hazardous structures, machinery, scrap or trash onsite. Evaluation Type: Step	AML Database – DOC Divsion of Mine Reclamation	45

Appendix 6 Tier 3 Attributes and Evaluation Ranges

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
1	Chemical Risk	Chemical Hazard	All Components	All	Imminent risk to human or biological health on site.	The following attributes will be flagged for the mine site if evaluation exceeds zero for contamination concentration, pathway, or receptor. Tier 3: Attributes 2ACOC - 2DCOC, 6AHum, 6BEco, 10A, 10B	Data collected from site.	This attribute will not be evaluated directly. Rather, attributes that are highly relevant to a risk of endangerment to human health or biological health will be flagged to indicate that the attribute has a value greater than 0 for that mine site. This will allow for professional review of the technical information for site to determine if an imminent threat exists.		
2aCOC	Chemical Risk	Chemical Hazard	Soil Quality	Source	Type and concentration of Constituents of Concern (COC) in soil.	Type and concentration of COCs (CAM 17 metals and other reagents and compounds related to mining) found in **waste piles, tailings piles, or soil** onsite.[18]	Data based on sampling of CAM 17 metals and other reagent and compounds during site investigation.	1 = Concentration of COCs found in the soil onsite. 0 = No detectable concentration of COCs were found in the soil onsite. [51] Evaluation Type: Linear (Continuous)	Water Boards: •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Office of Environmental Health Hazard Assessment (OEHHA) - Proposition 65 List[9] EPA Regional Screening Levels (RSLs) EPA Ecological Soil Screening Levels (SSLs) DTSC Human Health Risk Assessment (HERO) DTSC Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	1-12, 17-22

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
2aBack	Chemical Risk	Chemical Hazard	Soil Quality	Source	Type and concentration of Constituents of Concern (COC) in background soils.	Type and concentration of COCs (CAM 17 metals and other reagents and compounds related to mining) found in **background** samples for soil.[18]	Data based on sampling of CAM 17 metals and other reagent and compounds during site investigation.	1 = Concentration of COCs found in background soils onsite. 0 = No detectable concentration of COCs were found in background soils onsite. [52] Evaluation Type: Linear (Continuous)	Water Boards: •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Office of Environmental Health Hazard Assessment (OEHHA) - Proposition 65 List[9] EPA Regional Screening Levels (RSLs) EPA Ecological Soil Screening Levels (SSLs) DTSC Human Health Risk Assessment (HERO) DTSC Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	1-12, 17-22
2bCOC	Chemical Risk	Chemical Hazard	Sediment Quality	Source	Type and Concentration of Constituents of Concern (COC) in sediment.	Type and concentration of COCs (CAM 17 metals and other reagents and compounds related to mining) found in **sediment.**[18]	Data based on sampling of CAM 17 metals and other reagent and compounds during site investigation.	1 = Concentration of COCs found in sediment. 0 = No detectable concentration of COCs were found in sediment. [51] Evaluation Type: Linear (Continuous)	Water Boards: •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Office of Environmental Health Hazard Assessment (OEHHA) - Proposition 65 List[9] EPA Regional Screening Levels (RSLs) EPA Ecological Soil Screening Levels (SSLs) DTSC Human Health Risk Assessment (HERO) DTSC Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	1-12, 17-22

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
2bBack	Chemical Risk	Chemical Hazard	Sediment Quality	Source	Type and concentration of Constituents of Concern (COC) in background sediment.	Type and concentration of COCs (CAM 17 metals and other reagents and compounds related to mining) found in **background** samples for sediment.[18]	Data based on sampling of CAM 17 metals and other reagent and compounds during site investigation.	1 = Concentration of COCs found in background sediments. 0 = No detectable concentration of COCs were found in background sediments. [52] Evaluation Type: Linear (Continuous)	Water Boards: •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Office of Environmental Health Hazard Assessment (OEHHA) - Proposition 65 List[9] EPA Regional Screening Levels (RSLs) EPA Ecological Soil Screening Levels (SSLs) DTSC Human Health Risk Assessment (HERO) DTSC Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	1-12, 17-22
2cCOC	Chemical Risk	Chemical Hazard	Water Quality	Source	Type and Concentration of Constituents of Concern (COC) in surface water and storm water runoff.	Type and concentration of COCs (CAM 17 metals and other reagents and compounds related to mining) found in **surface water** or **storm water runoff.**[18]	Data based on sampling of CAM 17 metals and other reagent and compounds during site investigation.	1 = Concentration of COC found in sediment. 0 = No detectable concentration of COCs were found in sediment. [51] Evaluation Type: Linear (Continuous)	Water Boards: •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Office of Environmental Health Hazard Assessment (OEHHA) - Proposition 65 List[9] EPA Regional Screening Levels (RSLs) EPA Ecological Soil Screening Levels (SSLs) DTSC Human Health Risk Assessment (HERO) DTSC Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	1-12, 17-22

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
2cBack	Chemical Risk	Chemical Hazard	Water Quality	Source	Type and concentration of Constituents of Concern (COC) in background surface water or storm water runoff.	Type and concentration of COCs (CAM 17 metals and other reagents and compounds related to mining) found in **background** samples for surface water or storm water runoff**.**[18]	Data based on sampling of CAM 17 metals and other reagent and compounds during site investigation.	1 = Concentration of COCs found in background water samples for surface water or storm water runoff. 0 = No detectable concentration of COCs were found in background samples for surface water or storm water runoff. [52] Evaluation Type: Linear (Continuous)	Water Boards: •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Office of Environmental Health Hazard Assessment (OEHHA) - Proposition 65 List[9] EPA Regional Screening Levels (RSLs) EPA Ecological Soil Screening Levels (SSLs) DTSC Human Health Risk Assessment (HERO) DTSC Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	1-12, 17-22
2dCOC	Chemical Risk	Chemical Hazard	Water Quality	Source	Type and Concentration of Constituents of Concern (COC) in groundwater.	Type and concentration of COCs (CAM 17 metals and other reagents and compounds related to mining) found in **groundwater.**[18]	Data based on sampling of CAM 17 metals and other reagent and compounds during site investigation.	1 = Concentration of COC found in surface water or storm water runoff.. 0 = No detectable concentration was found in surface water or storm water runoff. [51] Evaluation Type: Linear (Continuous)	Water Boards: •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Office of Environmental Health Hazard Assessment (OEHHA) - Proposition 65 List[9] EPA Regional Screening Levels (RSLs) EPA Ecological Soil Screening Levels (SSLs) DTSC Human Health Risk Assessment (HERO) DTSC Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	1-12, 17-22

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
2dBack	Chemical Risk	Chemical Hazard	Water Quality	Source	Type and concentration of Constituents of Concern (COC) in background groundwater.	Type and concentration of COCs (CAM 17 metals and other reagents and compounds related to mining) found in **background** samples for groundwater.[18]	Data based on sampling of CAM 17 metals and other reagent and compounds during site investigation.	1 = Concentration of COCs found in background water samples for groundwater. 0 = No detectable concentration of COCs were found in background samples for groundwater. [52] Evaluation Type: Linear (Continuous)	Water Boards: •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Office of Environmental Health Hazard Assessment (OEHHA) - Proposition 65 List[9] EPA Regional Screening Levels (RSLs) EPA Ecological Soil Screening Levels (SSLs) DTSC Human Health Risk Assessment (HERO) DTSC Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	1-12, 17-22
3a	Chemical Risk	Chemical Hazard	Soil Quality	Pathway	Mobility of contaminants with soil.	Potential for contaminants to move or migrate toward a receptor with soil.	Data based on site investigations or laboratory data assessment, and geodata including site topography/elevation, precipitation/climate, site soil type.	**1** = Contaminant in soil has potential to migrate off site through water-based erosion, characterized by high precipitation, steep topography, and highly erodible soil type. **0.66** = Contaminant in soil has potential to migrate off site through water-based erosion, characterized by high precipitation, moderately steep topography and not very erodible soil. **0.33** = Contaminant in soil has potential to migrate off site through water-based erosion, characterized by low precipitation, variable topography, and highly erodible soil. **0** = Contaminant in soil tends to remain onsite. Site has minimal or no erosion OR site characterized by low precipitation, variable topography, and not very erodible soil. Evaluation Type: Step	Desert Research Institute (DRI) - Precipitation data Natural Resource Conservation Service (NRCS)- Soil survey data for California USGS - topography and land surface elevation data	23-26

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
3b	Chemical Risk	Chemical Hazard	Air Quality	Pathway	Mobility of contaminants through air.	Potential for contaminants to move or migrate toward a receptor through air.	Data based on site investigations or laboratory data assessment, and geodata including existing prevailing wind datasets.	**1** = Contaminant in soil at the site has potential to be mobilized into air on-site through human -induced surface disturbance (vehicles, walking, riding bikes or horses) with potential for direct inhalation of contaminated soil by humans. OR, air quality data available indicating contaminants in soil are detected in the air at or near the site. **0.66** = Contaminate in soil at the site has potential to be mobilized into air and blow offsite. Soil movement into air is characterized by high wind speed and highly erodible soil. **0.33** = Contaminate in soil at the site has potential to be mobilized into air and blows offsite. Soil movement into air is characterized by high wind speed and low erodibility of soil. **0** = Contaminate in soil at the site has low potential to move into air. Site is characterized by low or infrequent wind speed and low erodibility of soil. Evaluation Type: Step	California Air Resources Board – Meteorology Data National Oceanic and Atmospheric Administration - Wind Speed data (1950 – present) BLM, USFS, DTSC – air quality and wind speed data collected at the site as part of investigation.	27-28
3c	Chemical Risk	Chemical Hazard	Groundwater Quality	Pathway	Mobility of contaminants with groundwater.	Potential for contaminants to move or migrate toward a receptor with groundwater.	Data based on site investigations or laboratory data assessment, and geodata including precipitation.	**1** = Contaminate in groundwater has potential to migrate offsite, characterized by wet climate, and high permeability of geologic formation underlying the site. **0.5** = Contaminate in groundwater has potential to migrate offsite, characterized by wet climate and low permeability of geologic formation underlying the site. **0** = Contaminate in groundwater has low or no potential to migrate offsite, characterized by dry climate and low permeability of geologic formation underlying the site. Evaluation Type: Step	USGS - National Geologic Map Database Desert Research Institute - precipitation for California	23-24, 29

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
3d	Chemical Risk	Chemical Hazard	Surface Water Quality	Pathway	Mobility of contaminants through surface water or storm water runoff	Potential for contaminants to move or migrate toward a receptor through surface water or storm water runoff.	Data based on site investigations and laboratory data assessment, including site geology, hydrology, hydrogeology and geochemistry.	**1** = Surface water or storm water runoff is characterized by high concentration of contaminant, high precipitation or wet climate, and no inhibition of off-site movement by surface barriers or no surface barriers. **0.66** = Surface water or storm water runoff is characterized by high concentration of contaminant, low precipitation or dry climate, and no inhibition of off-site movement by surface barriers or no surface barriers. **0.33** = Surface water or storm water runoff is characterized by high concentration of contaminant, low precipitation or dry climate, and inhibition of off-site movement by surface barriers. **0** = Surface water or storm water runoff is characterized by low concentration of contaminant, low precipitation or dry climate, and inhibition of off-site movement by surface barriers. Evaluation Type: Step	Determined from site investigations & laboratory data assessment, including site geology, hydrology, hydrogeology and geochemistry. Desert Research Institute - precipitation for California USGS National Geochemical Survey database	23-24, 30
4	Chemical Risk	Chemical Exposure	Water Quality	Pathway	Site drains to a 303(d) listed or TMDL water body.	TMDL findings tracing water quality impairment to a specific mine. The pollutant in the water is same as that found at the mine.	Data based on sampling during site investigation, both filtered and total (unfiltered) water.	**1** = Mine impacted water of the state is on 303(d) list or has a TMDL. **0** = Mine impacted water of the state is not on 303 (d) list or does not have a TMDL linking water quality impairment to upstream mines. Evaluation Type: Binary (Yes/No)	Water Board •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Impaired Water Bodies[17] •Water Quality Goals[4] EPA •California Toxics Rule (filtered and total) •National Toxics Rule (filtered and total)	2-12, 32, 34-35
5a	Chemical Risk	Chemical Hazard	Water/Air/Soil Quality	Source	Volume of potentially contaminated waste rock.	Volume or quantity of contaminated waste rock on site to be addressed.	Data based on measurements and data interpretations from site investigation	**1** = Number of cubic yards of contaminated waste rock on the mine site. **0** = There is no contaminated waste rock on the mine site. Evaluation Type: Linear (Continuous)	Measurements representing the total volume of potentially contaminated waste rock on the site.	
5b	Chemical Risk	Chemical Hazard	Water/Air/Soil Quality	Source	Volume of potentially contaminated tailings.	Volume or quantity of contaminated tailings on site to be addressed.	Data based on measurements and data interpretations from site investigation.	**1** = Number of cubic yards of contaminated tailings on the mine site. **0** = There is no contaminated tailings on the mine site. Evaluation Type: Linear (Continuous)	Measurements representing the total volume of potentially contaminated tailings on the site.	

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
6aHum Wat	Chemical Risk	Chemical Exposure	Water Quality	Receptor	Actual human exposure to contaminated water under current conditions.	Exposure pathway (water) is contaminated above human health standards and direct intake/contact is occurring.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in water to which humans are exposed through direct contact or consumption exceeds the standard OR background level. **0** = Concentration of contaminant in water to which humans are exposed through direct contact or consumption does not exceed threshold or background level. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan	1-12, 18-21, 36-39
6aHum Soil	Chemical Risk	Chemical Exposure	Soil Quality	Receptor	Actual human exposure to contaminated soil under current conditions.	Exposure pathway (soil) is contaminated above human health standards and direct intake/contact is occurring.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in soil to which humans are exposed through direct contact or inhalation exceeds the standard OR background level. **0** = Concentration of contaminant in soil to which humans are exposed through direct contact or inhalation does not exceed threshold or background level. Evaluation Type: Linear (Continuous)	EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	17, 19-21, 39

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
6aHum Sed	Chemical Risk	Chemical Exposure	Sediment Quality	Receptor	Actual human exposure to contaminated sediment under current conditions.	Exposure pathway (sediment) is contaminated above human health standards and direct intake/contact is occurring.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in sediment to which humans are exposed through direct contact or consumption exceeds the standard OR background level. **0** = Concentration of contaminant of sediment to which humans are exposed through direct contact or consumption does not exceed threshold or background level. Evaluation Type: Linear (Continuous)	EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	17, 19-21, 39
6aEco Wat	Chemical Risk	Chemical Exposure	Water Quality	Receptor	Actual ecological receptor exposure to contaminated water under current conditions.	Exposure pathway (water) is contaminated above ecological standards and direct intake/contact is occurring.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in water to which ecological receptors are exposed through direct contact or consumption exceeds the standard OR background level. **0** = Concentration of contaminant in water to which ecological receptors are exposed through direct contact or consumption does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan	1-12, 18-21, 36-39

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
6aEco Sed	Chemical Risk	Chemical Exposure	Sediment Quality	Receptor	Actual ecological receptor exposure to contaminated sediment under current conditions.	Exposure pathway (sediment) is contaminated above ecological standards and direct intake/contact is occurring.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in sediment to which ecological receptors are exposed through direct contact or consumption exceedsthe standard OR background level. **0** = Concentration of contaminant in sediment to which ecological receptors are exposed through direct contact or consumption does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	17, 19-21, 39
6aEco Soil	Chemical Risk	Chemical Exposure	Soil Quality	Receptor	Actual ecological receptor exposure to contaminated soil under current conditions.	Exposure pathway (soil) is contaminated above ecological standards and direct intake/contact is occurring.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in soil to which ecological receptors are exposed through direct contact or inhalation exceeds the standard OR background level. **0** = Concentration of contaminant in soil to which ecological receptors are exposed through direct contact or inhalation does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	17, 19-21, 39

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
6bHum Food	Chemical Risk	Chemical Exposure	Food Quality	Receptor	Actual exposure of humans to contaminated fish under current conditions.	Exposure pathway is contaminated above human health standards and direct intake/contact is occurring.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in aquatic organisms in waterbody exceeds the standard OR background level AND humans consume the organisms. **0** = Concentration of contaminant in aquatic organisms in waterbody does not exceed threshold, OR no humans consume the organisms. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Regional Screening Levels (RSLs) DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan CDFW creel survey	1-12, 19-21, 36
6bEco Food	Chemical Risk	Chemical Exposure	Food Quality	Receptor	Actual exposure of ecological receptors to contaminated fish under current conditions.	Exposure pathway is contaminated above ecological standards and direct intake/contact is occurring.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in aquatic organisms in waterbody exceeds threshold X number of times AND biota consume the organisms. **0** = Concentration of contaminant in aquatic organisms in waterbody does not exceed threshold. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Regional Screening Levels (RSLs) DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan CDFW creel survey	1-12, 19-21, 36

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
7aHum Wat	Chemical Risk	Chemical Exposure	Water Quality	Receptor	Potential human exposure to contaminated water under future conditions	Exposure pathway is not currently contaminated above human health standards, but could become so and direct intake/contact/exposure is likely to occur.[38]	Data based on sampling from site investigation.	**1** = Concentration of contaminant in soil to which humans are exposed through direct contact or inhalation exceeds the standard OR background level. **0** = Concentration of contaminant in soil to which humans are exposed through direct contact or inhalation does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan Local agency data or general plans for future development	1-12, 18-21, 36-39
7aHum Sed	Chemical Risk	Chemical Exposure	Sediment Quality	Receptor	Potential human exposure to contaminated sediment under future conditions.	Exposure pathway is not currently contaminated above human health standards, but could become so and direct intake/contact/exposure is likely to occur.[38]	Data based on sampling from site investigation.	**1** = Concentration of contaminant in sediment to which humans are exposed through direct contact or consumption exceedsthe standard OR background level. **0** = Concentration of contaminant in sediment to which humans are exposed through direct contact or consumption does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring Local agency data or general plans for future development	17, 19-21, 39

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
7aHum Soil	Chemical Risk	Chemical Exposure	Soil Quality	Receptor	Potential human exposure to contaminated soil under future conditions.	Exposure pathway is not currently contaminated above human health standards, but could become so and direct intake/contact/exposure is likely to occur.[38]	Data based on sampling from site investigation.	**1** = Concentration of contaminant in soil to which humans are exposed through direct contact or inhalation exceeds the standard OR background level. **0** = Concentration of contaminant in soil to which humans are exposed through direct contact or inhalation does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring Local agency data or general plans for future development	17, 19-21, 39
7aEco Wat	Chemical Risk	Chemical Exposure	Water Quality	Receptor	Potential ecological receptor exposure to contaminated water under future conditions.	Exposure pathway is not currently contaminated above ecological standards, but could become so and direct intake/contact/exposure is likely to occur.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in water to which ecological receptors are exposed through direct contact or consumption exceeds the standard OR background level. **0** = Concentration of contaminant in water to which ecological receptors are exposed through direct contact or consumption does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan Local agency data or general plans for future development	1-12, 18-21, 36-39

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
7aEco Soil	Chemical Risk	Chemical Exposure	Soil Quality	Receptor	Potential ecological receptor exposure to contaminated soil under future conditions.	Exposure pathway is not currently contaminated above ecological standards, but could become so and direct intake/contact/exposure is likely to occur.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in soil to which ecological receptors are exposed through direct contact or inhalation exceeds the standard OR background level. **0** = Concentration of contaminant in soil to which ecological receptors are exposed through direct contact or inhalation does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	17, 19-21, 39
7aEco Sed	Chemical Risk	Chemical Exposure	Sediment Quality	Receptor	Potential ecological receptor exposure to contaminated soil under future conditions.	Exposure pathway is not currently contaminated above ecological standards, but could become so and direct intake/contact/exposure is likely to occur.	Data based on sampling from site investigation.	**1** = Concentration of contaminant in soil to which ecological receptors are exposed through direct contact or inhalation exceeds the standard OR background level. **0** = Concentration of contaminant in soil to which ecological receptors are exposed through direct contact or inhalation does not exceed thresholds or background level. Evaluation Type: Linear (Continuous)	EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan USFS Soil Quality Monitoring	17, 19-21, 39

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
7bHum Food	Chemical Risk	Chemical Exposure	Food Quality	Receptor	Potential exposure of humans to contaminated fish under future conditions.	Exposure pathway is not currently contaminated above human health standards, but could become so and direct intake/contact/exposure is likely to occur.[38]	Data based on sampling from site investigation.	**1** = Concentration of contaminant in aquatic organisms in waterbody exceeds the standard OR background level AND humans consume the organisms, OR a human population that consumes fish is located near the contaminated water body. **0** = Concentration of contaminant in aquatic organisms in waterbody does not exceed thresholds, OR no humans consume the organisms, OR no human population that consumes fish is located near the contaminated water body. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Regional Screening Levels (RSLs) DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan CDFW creel survey Local agency data or general plans for future development	1-12, 19-21, 36
7bEco Food	Chemical Risk	Chemical Exposure	Food Quality	Receptor	Potential exposure of ecological receptors to contaminated fish under future conditions.	Exposure pathway is not currently contaminated above ecological standards, but could become so and direct intake/contact/exposure is likely to occur.	Data based on sampling from site investigation	**1** = Concentration of contaminant in aquatic organisms in waterbody exceeds the standard OR background level AND biota consume the organisms, OR a wildlife population that consumes fish is located near the contaminated water body. **0** = Concentration of contaminant in aquatic organisms in waterbody does not exceed thresholds, OR no biota consume the organisms, OR no wildlife population that consumes fish is located near the contaminated water body. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Regional Screening Levels (RSLs) DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan CDFW creel survey	1-12, 19-21, 36

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
8	Chemical Risk	Chemical Exposure	Water/Air/Soil/ Sediment/Food Quality	Source	Contaminated sediment discharges to surface water/	Sediment containing contaminants from the mine site are discharging into surface water.[53]	Data based on sampling and observation during site investigation.	**1** = Sediment containing contaminants from the mine site are discharging into surface water. **0** = Sediment containing contaminants from the mine site are not discharging into surface water. Evaluation Type: Binary (Yes/No)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA: •Regional Screening Levels (RSLs) •Ecological Soil Screening Levels (SSLs) •Regulated Drinking Water Contaminants DTSC •Human Health Risk Assessment (HERO) •Ecological Risk Assessment (HERO) Risk Management Criteria for Metals at BLM Mining Sites NOAA Screening Quick Reference Tables (SQuiRTs) Human Health and Ecological Risk Assessment Work Plan	1-12, 18-21, 36-39
9a	Chemical Risk	Chemical Hazard	Water Quality	Source	Impact on human health or aquatic life from pH of water discharging from mine portal.	pH of water discharging from mine portal potentially impacts human health (drinking water) or aquatic life.	Data based on sampling during site investigation.	**1** = pH of discharged water <=5 and >=9. **0** = pH of discharged water >5 and <9. Evaluation Type: Stepped	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Ambient Water Quality Criteria for aquatic life in surface water NOAA Screening Quick Reference Tables (SQuiRTs) - sediment and water quality DTSC Ecological Risk Assessment (HERO)	1-14, 20, 22, 40

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
9b	Chemical Risk	Chemical Hazard	Water Quality	Source	Impact on human health or aquatic life from Eh, reduction potential, of water discharging from mine portal.	Eh, reduction potential, of water discharging from mine portal potentially impacts human health (drinking water) or aquatic life.	Data based on sampling during site investigation.	**1** = Eh, reduction potential, of discharged water exceeds threshold for drinking water or aquatic life. **0** = Eh, reduction potential, of discharged water does not exceed threshold for drinking water or aquatic life. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Ambient Water Quality Criteria for aquatic life in surface water NOAA Screening Quick Reference Tables (SQuiRTs) - sediment and water quality DTSC Ecological Risk Assessment (HERO)	1-14, 20, 22, 40
9c	Chemical Risk	Chemical Hazard	Water Quality	Source	Impact on human health or aquatic life from Total dissolved solids, TDS, in water discharging from mine portal.	Total dissolved solids, TDS, in water discharging from mine portal potentially impacts human health (drinking water) or aquatic life.	Data based on sampling during site investigation.	**1** = Total dissolved solids in discharged water exceed threshold for drinking water or aquatic life. **0** = Total dissolved solids in discharged water do not exceed threshold for drinking water or aquatic life. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Ambient Water Quality Criteria for aquatic life in surface water NOAA Screening Quick Reference Tables (SQuiRTs) - sediment and water quality DTSC Ecological Risk Assessment (HERO)	1-14, 20, 22, 40
9d	Chemical Risk	Chemical Hazard	Water Quality	Source	Impact on human health or aquatic life from temperature of water discharging from mine portal.	Temperature of water discharging from mine portal potentially impacts human health (drinking water) or aquatic life.	Data based on sampling during site investigation.	**1** = Temperature of discharged water exceed threshold for drinking water or aquatic life. **0** = Temperature of discharged water does not exceed threshold for drinking water or aquatic life. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Ambient Water Quality Criteria for aquatic life in surface water NOAA Screening Quick Reference Tables (SQuiRTs) - sediment and water quality DTSC Ecological Risk Assessment (HERO)	1-14, 20, 22, 40

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
9e	Chemical Risk	Chemical Hazard	Water Quality	Source	Impact on human health or aquatic life from dissolved oxygen level, DO, in water discharging from mine portal.	Dissolved oxygen level, DO, in water discharging from mine portal potentially impacts human health (drinking water) or aquatic life.	Data based on sampling during site investigation.	**1** = Dissolved oxygen level, DO, in discharged water exceed threshold for drinking water or aquatic life. **0** = Dissolved oxygen level, DO, in discharged water do not exceed threshold for drinking water or aquatic life. Evaluation Type: Linear (Continuous)	Water Board •San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs)[2] •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] EPA Ambient Water Quality Criteria for aquatic life in surface water NOAA Screening Quick Reference Tables (SQuiRTs) - sediment and water quality DTSC Ecological Risk Assessment (HERO)	1-14, 20, 22, 40
10a	Chemical Risk	Chemical Exposure	Water Quality	Source	Pollutants from mine site impact groundwater used for drinking water supply.	Pollutants from the mine site have the potential to impact groundwater used for drinking water supply.	Observed, geospatial	**1** = Constituent of Concern associated with mine contamination found in groundwater has a primary or secondary drinking water standard AND the COC exceeds standards. **0.50** = Constituent of Concern associated with mine and found in groundwater does not exceed threshold for primary or secondary drinking water standard. **0** = No consumptive water use from groundwater source. Evaluation Type: Step	Department of Water Resources - Groundwater basin geo dataset; Groundwater Information Center Interactive Map Water Board: Groundwater Ambient Monitoring and Assessment (GAMA)	41, 42, 43

Tier 3: Chemical Risk

Attribute Number	Priority Concern	Risk Category	Component	Source/ Pathway/ Receptor	Attribute	Data Description	Data Type	Evaluation Range and Evaluation Type	Data source (see endnotes for more details)	Reference
10b	Chemical Risk	Chemical Exposure	Water Quality	Source	Pollutants from mine site impact downstream diversion for drinking water supply.	Pollutants from the mine site have the potential to impact downstream diversions for drinking water supply.	Observed, geospatial including location of drinking water diversions, locations of streams and tributaries.	**1** = Downstream water purveyor is treating water for potable use and is treating it for Constituent of Concern associated with upstream mine. **0.75** = Constituent of Concern associated with the mine and found in the dowstream receiving water has a primary or secondary drinking water standard AND the COC exceeds standards. **0.5** = Consumptive water use diversion located downstream of mine in nearest receiving water where COC concentration exceeds drinking water standard, and diversion is upstream of tributaries, resulting in no dilution of pollutant in the receiving water. **0.25** = Consumptive water use diversion located in nearest receiving water that has Constituent of Concern associated with mine which does not exceed drinking water standard. **0** = No consumptive water use diversion is located in the nearest receiving water downstream of the mine or upstream of any confluences. Evaluation Type: Step	Water Board •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4] Drinking Water primary and secondary standards 54 USGS Watershed Boundary Dataset SWCRB Electronic Water Rights Information Management System EPA Regulated Drinking Water Contaminants	2-12, 31, 38, 44
11	Chemical Risk	Chemical Hazard	Soil Quality	Source	Steepness of contaminated tailings or waste rock piles.	The angle of the steepest slope of contaminated tailings or waste rock piles on the mine site.	Data based on site investigations.	**1** = Angle of the steepest slope. **0** = There are no contaminated tailings or waste rock piles on the site, and therefore no slope angle. Evaluation Type: Linear (Continuous)	Agency overseeing the site investigation.	
12	Chemical Risk	Chemical Exposure	Biota/Habitat Quality	Receptor	Mine site may impact biotic communities or habitats down stream.	Bioassessment data collected for surface water bodies shows aquatic habitat or species are stressed; however, the stressor and its source may not be known.[54]	Data based on scores from bioassessment surveys of associated surface water bodies, such as California Rapid Assessment Methodology (CRAM).	**1** = 0.25 to 0.7, which indicates degrading condition. **0** = CRAM score of 0.7 and above, which indicates not degrading condition.[55] Evaluation Type: Linear (Continuous)	California Stream Condition Index (CSCI) California Rapid Assessment Methodology (CRAM) scores SWAMP Data	14

Tier 3: Chemical Risk										
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Source/ Pathway/ Receptor**	**Attribute**	**Data Description**	**Data Type**	**Evaluation Range and Evaluation Type**	**Data source (see endnotes for more details)**	**Reference**
13	Chemical Risk	Chemical Exposure	Water/Soil/ Sediment/Air Quality	Pathway	Constituent of Concern is highly leachable from source material.	The degree to which constituents are leachable from source material, and based on professional interpretation of the results, whether constituents are highly leachable from the material or not and could become available.	Leach test data	**1** = Test results show constituents are highly leachable from source material. **0** = Test results show constituents are NOT highly leachable from source material. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation	
14	Chemical Risk	Chemical Exposure	Water Quality	Receptor	Pollutants from mine site impact drinking water wells.	Pollutants from the mine site have the potential to impact wells used for drinking water supply.	Geospatial, well sampling data during site investigation.	**1** = Constituent of Concern from the mine site found in well water has a primary or secondary drinking water standard AND the COC exceeds the threshold. **0.5** = Constituent of Concern from the mine site is found in well water and does not exceed threshold for drinking water quality or human consumption. **0**= No Constituent of Concern related to contamination from the mine site is found in well water. Evaluation Type: Step	Water Board Groundwater basin geo dataset Groundwater Ambient Monitoring and Assessment data (GAMA) •Basin Plan Beneficial Uses & Water Quality Objectives[3] •Water Quality Goals[4]	2-12, 41, 43

Supplemental Considerations								
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Data Description**	**Data Type**	**Evaluation Range[39] and Evaluation Type**	**Data source (see endnotes for more details)**
1	Chemical Risk	NA	Program Management Considerations	Funding available for next steps	Does the site have funding designated for the current and next stage of remediation?	Data about status and site remediation	**1** = Funding is designated for next stage of remediation. **0** = No funding is designated for next stage of remediation. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation
2	Chemical Risk	NA	Program Management Considerations	Has work commenced onsite?	What is the percentage completion of remediation project at the site?[40]	Data about status and site remediation	**1** = remediation project is completed. **0** = remediation project has not started. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation
3	Chemical Risk	NA	Program Management Considerations	Project inter-dependence	Project is interdependent with another site or other projects at same site	Input from agency, partners or consulting professionals	**1** = project is interdependent with another site or other projects. **0** = project is not interdependant with another site or project. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation
4	Chemical Risk	NA	Program Management Considerations	Cost of delay	Delaying action will result in significant increase in dollar costs for project if not funded in current year.	Input from agency, partners or consulting professionals	**1** = delaying action will result in significant cost increase if not funded.[41] **0** - delaying action will not result in significant cost increase if not funded. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation
5	Chemical Risk	NA	Program Management Considerations	Potential Responsible Parties are identified	Potential Responsible Parties (PRP) have been identified and are available to cover further studies/cleanup costs	Data about status of site PRP search	**1** = a PRP has been identified associated with the site.[42] **0** = a PRP has not been identified associated with the site. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation
6	Chemical Risk	NA	Program Management Considerations	Innovative cleanup technologies	The project site has the ability to utilize innovative clean up technologies	Input from agency, partners or consulting professionals	**1** = the project has the ability to use innovative technologies.[43] **0** = the project does not have the ability to use innovative technologies. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation
7	Chemical Risk	Chemical Exposure	Program Management Considerations	Site in an environmental justice community	Does the site impact public health in a disadvantaged community?	DAC dataset	**1** = the site impacts public health in a disadvantaged community.[44] **0** = the site does not impact public health in a disadvantaged community. Evaluation Type: Binary (Yes/No)	Department of Water Resources - Disadvantaged Community geo dataset
8	Chemical Risk	Chemical Exposure	Program Management Considerations	Tribal Lands or traditionally used lands or waters	Does the site impact Tribal lands or impact lands or waters that drain onto or through tribal lands that were traditionally used for cultural or subsistence purposes (e.g. fisheries)?	Data from inquiry to NAHC	**1** = the site impacts the use of tribal lands or waters.[45] **0** = the site does not impact the use of tribal lands or waters. Evaluation Type: Binary (Yes/No)	Native American Heritage Commission

Supplemental Considerations								
Attribute Number	**Priority Concern**	**Risk Category**	**Component**	**Attribute**	**Data Description**	**Data Type**	**Evaluation Range[39] and Evaluation Type**	**Data source (see endnotes for more details)**
9	Chemical Risk	NA	Program Management Considerations	Partnerships available	Are partnerships available to maximize clean up or operations and maintenance costs?	Input from agency and community partners	**1** = partnerships are available to leverage for clean up or operations and maintenance. **0** = partnerships are not available to leverage for clean up or operations and maintenance. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation
10	Chemical Risk	NA	Program Management Considerations	Multi-agency/stakeholder interest	Are there high community, tribal, county, state or federal interest/concerns about the site?	Input from agency and community partners	**1** = there are great concerns about the site from community, tribal, county, state or federal entities. **0** = there are no great concerns about the site from community, tribal, county, state or federal entities. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation
11	Chemical Risk	Chemical Hazard	Program Management Considerations	Proposed Technology	Would technology proposed for action result in a permanent remedy?	Input from agency, academic or private consultant professionals	**1** = Proposed technology would result in a permanent remedy (no ongoing operations and maintenance). **0** = proposed technology would not result in a permanent remedy. Evaluation Type: Binary (Yes/No)	Agency overseeing the site investigation

Appendix 7 End Notes and References for Tier 1, 2, and 3 Tables

End Notes are associated with the Data Description, Evaluation Range and Evaluation Type, and Data Source columns in each table.

References are associated only with the Reference column in each table.

Endnotes

Endnote #	Endnote
1	Porter-Cologne Water Quality Control Act (Water Code), Division, Chapter 5, Section 13304, Cleanup and Abatement; Beneficial Use Policy (Resolution No. 88-63, Adoption of Policy Entitled "Source of Drinking Water"); and Anti-degradation Policy (Resolution No. 68-16, Statement of Policy with Respect to maintaining High Quality of Waters in California). Authorizes the State Water Board or Regional Water Board to issue a cleanup and abatement order to a person who has discharged or discharges waste into the waters of the state in violation of any waste discharge requirement or other order or prohibition issued or who has caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the state and creates, or threatens to create, a condition of pollution or nuisance, shall, upon order of the regional board, clean up the waste or abate the effects of the waste, or, in the case of threatened pollution or nuisance, take other necessary remedial action, including, but not limited to, overseeing cleanup and abatement efforts.
2	San Francisco Bay Regional Water Quality Control Board Environmental Screening Levels (ESLs): Greater than 100 chemicals commonly found at site with contaminated soils & groundwater. ESL's address a range of media (soil, groundwater, soil gas, and indoor air). Can be used to screen sites or to aid the development of cleanup numbers.
3	Basin Plan Beneficial Uses & Water Quality Objectives: There are nine (9) Regional Water Quality Control Boards Basin Plans (Basin Plans) in the state that designate beneficial uses for surface water & groundwater. The Plans set narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses (Source of Drinking Water Policy R88-63) and conform to the state's Antidegradation Policy R68-16.
4	North Coast Region Basin Plan (Region 1)
5	SWAMP - Surface Water Ambient Monitoring Program, Water Quality Indicators list & Water Quality Goals Online database.
6	CEDEN - California Environmental Data Exchange Network
7	CCAMP - Central Coast Regional Water Quality Control Board, Central Coast Ambient Monitoring Program
8	NWIS - USGS National Water Information System
9	Office of Environmental Health Hazard Assessment (OEHHA) – Risk Evaluation – Proposition 65 List. The list contains a wide range of naturally occurring and synthetic chemicals that are known to cause cancer or birth defects or other reproductive harm.
10	EPA Regional Screening Levels, Human Health Risk Assessment (HERO) guidance - Used by DTSC.
11	EPA Ecological Risk Assessment (HERO) guidance - Used by DTSC.
12	EPA Regional Screening Levels guidance and screening levels - Used for human health screening level for BLM, DTSC, BLM, etc.
13	EPA Ambient Water Quality Criteria for surface water - Used for ecological aquatic screening and as federal ARAR's for larger BLM sites.
14	EPA ecological soil screening values - Used as guidance but not used directly as federal ARARs for BLM.

Endnotes

Endnote #	Endnote
15	Screening Assessment Approaches for Metals in Soil at BLM HazMat/AML Sites - A memo used by BLM that contains some EPA RSL values as well as BLM derived recreational visitor values.
16	Background Levels will be determined by the investigating agency.
17	Impaired Water Bodies: A waterbody that has been determined under state policy and federal law to be not meeting water quality standards. An impaired water is a water that has been listed on the California 303(d) list or has not yet been listed but otherwise meets the criteria for listing. A water is a portion of a surface water of the state, including ocean, estuary, lake, river, creek, or wetland. The water currently may not be meeting state water quality standards or may be determined to be threatened and have the potential to not
18	Constituents of Concern related to mine sites typically sampled for are **CAM17:** Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Copper, Lead, Mercury, Molybdenum, Nickel, Selenium, Silver, Thallium, Vanadium, Zinc; **Other and reagents:** Asbestos, Cyanide, Nitrate, Phenolic compounds, Silica, Sulphuric acid, Radionuclides.
19	MRDS - USGS Mineral Resource Data System. A collection of reports describing metallic and nonmetallic mineral resources throughout the world. Included are deposit name, location, commodity, deposit description, geologic characteristics, production, reserves,
20	PAMP - Principal Areas of Mine Pollution. A dataset is a compilation of 2,422 mining operations and their potential water-quality problems. This information was originally compiled in 1972 by the Division of Mines and Geology for the State Water Resources Control Board. It was published in a series of volumes of tabular data. The data set includes operations where production exceeded $100,000 or where other factors indicated a high potential for pollution.
21	CNDDB - California Natural Diversity Database. The CNDDB dataset represents reported locations of sensitive, threatened or
22	BIOS - Biogeographic Information and Observation System
23	USGS National Hydrography Dataset (NHD) and Watershed Boundary Dataset (WBD) are used to portray surface water on The National Map. The NHD represents the drainage network with features such as rivers, streams, canals, lakes, ponds, coastline, dams, and stream
24	USGS Significant Deposits Dataset - USGS is currently compiling GIS layer of significant deposits data.
25	TOMS - Topographically Occurring Mine Symbol
26	Fishing locations/activities- A waterbody that has been determined to support fishing activity where consumption of the fish is likely. A waterbody that supports recreational, subsistence, or tribal fishing activity where fish consumption has been estimated or is likely. Fishing activity may be determined based upon DFW creel surveys, or other surveys conducted and/or supported by tribal, federal, state, or private entities.
27	Drinking Water Quality Standards Database: The Division of Drinking water website includes lists for regulated contaminates and drinking water standards (Maximum Contaminant Levels), i.e. federal and California MCLs and notifications levels of unregulated contaminants.

Endnotes

Endnote #	Endnote
28	SWRCB Divisions of Water Rights and Drinking Water has geospatial data for location of potable water diversions in their eWRIMS dataset.
29	California Historical Resources Information System (CHRIS)- The CHRIS Inventory includes the State Historic Resources Inventory maintained by the OHP as defined in California Public Resources Code § 5020.1(p), and the larger number of resource records and research reports managed under contract by the nine Information Centers. The information centers have varying levels of gis digitization completed. Most have paper maps and reports available. This is a fee for service and only contains information reported to SHPO through the CEQA/NEPA process. Access is restricted (not public).
30	National Register of Historic Places Database - Compiled by the National Park Service, (yearly updates; would need to get permission to use dataset with sensitive or restricted data).
31	USFS FSTOPO - USFS site for geodatasetsTransportation Line is the dataset that contains all trails and roads.
32	NPS IRMA - Data Portal
33	BLM Roads - Ground Transportation Linear Feature (GTLF) is the data standard for linear features in BLM's GIS system. Routes is the roads and OHV trails layer. So GTLF_*Region*_Routes is the likely file structure. This data is not publicly available.
34	BLM Land Status - contains information on ownership for federal, state, local and private lan ownership.
35	CPAD - California Protected Areas Data Portal contains GIS data about lands that are owned in fee and protected for open space purposes by over 1,000 public agencies or non-profit organizations.
36	US Census Bureau TIGER dataset - Topographically Integrated Geographic Encoding and Referencing dataset contains a variety of data including 2010 census data.
37	USFS National Visitor Use Monitoring - The National Visitor Use Monitoring program surveys over 100,000 visitors to National Forest System lands every five years, with 20% of the national forests conducting surveys each year. This nationwide visitor use survey provides statistically sound estimates of visitation to each national forest and to each site type. The surveys also provide information about who these visitors are demographically, why they come to the national forests, how satisfied they are with the facilities and services provided, and how much money they spend on their visit.
38	Use human proximity attributes to complement 9AHum and 9BHum attributes.
39	For all management considerations – recommend giving a multiplier base on how many of these considerations are encompassed by the site.

Endnotes

Endnote #	Endnote
40	Consider previous interim actions- e.g., emergency response actions. Interim actions previously taken would rank the site higher.
41	Should not be a high scoring factor unless there is need for immediate action.
42	Should not be a factor in ranking a site, relevant to site consideration for cleanup. However, identification of a PRP is not an indicator of risk and so can't be evaluated for its contribution to risk from the hazards.
43	Do clean up technologies available for the site result in higher levels of contaminant removal, less costly contaminant removal, or more extensive site reclamation than other available technologies?
44	This should also take in consideration whether the contaminant pathway affects community lifestyle, for example fishing from mine impacted water bodies, in addition to any risks from direct contact with contaminants or consumption of contaminated water.
45	Contamination that affects traditional indigenous uses of land or water may extend beyond the tribal land base itself. An off – tribal land impact should be taken into consideration in order to understand the full risk of contamination to human health and the environment on tribal land.
46	Phenolic compounds, nitrates, some radionuclides and sulphuric acid will not be know until site investigation activities occur, thus those contaminants are not included in Tier 1.
47	USGS is currently compiling GIS layer of significant deposits data that will be useful in evaluation this attribute. Evaluation range may change depending on the type of information contained in this dataset.
48	Phenolic compounds and nitrates will not be know until site investigation activities occur, thus those contaminants are not included in Tier 2.
49	Timing of visit can produce a false negative.
50	Wet or dry climate could factor into the level of concern for man-made impoundments on the site. In addition the stable or unstable condition of impoundments would also be a factor for level of concern. This attribute could be evaluated in an 'AND' relationship with climate and feature condition attributes.
51	This attribute uses the actual concentration value for each COC, compared to background and normalized against all other existing concentration values for a specific COC.
52	This attribute uses the actual concentration value for each COC found in background soil, sediment, surface water or groundwater samples (as appropriate) normalized against all other existing concentration values for background.
53	This attribute could be a duplicate to those for sediment in attribute 3. However recommend maintaining this attribute for use when information for sediment values in attribute 3 do not exist.
54	This attribute requires assessment along with contamination and or water quality data.

Endnotes

Endnote #	Endnote
55	If no data available from these sources, then conduct surveys according to the protocols for streams on or immediately upstream and downstream of site.

References

Reference Number	Reference	Reference Link
1	San Francisco Bay Regional Water Quality Control Board ESLs:	http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/esl.shtml
2	Water Quality Goals Database	http://www.waterboards.ca.gov/water_issues/programs/water_quality_goals/
3	Regional Water Board Basin Plans:	http://www.waterboards.ca.gov/plans_policies/#plans
4	North Coast Region Basin Plan (Region 1)	http://www.waterboards.ca.gov/northcoast/water_issues/programs/basin_plan/
5	San Francisco Bay Region Basin Plan (Region 2)	http://www.waterboards.ca.gov/sanfranciscobay/basin_planning.shtml
6	Central Coast Region Basin Plan (Region 3)	http://www.waterboards.ca.gov/centralcoast/publications_forms/publications/basin_plan/
7	Los Angeles Region Basin Plan (Region 4)	http://www.waterboards.ca.gov/losangeles/water_issues/programs/basin_plan/
8	Central Valley Region Basin Plan (Region 5)	http://www.waterboards.ca.gov/centralvalley/water_issues/basin_plans/
9	Lahontan Region Basin Plan (Region 6)	http://www.waterboards.ca.gov/lahontan/water_issues/programs/basin_plan/index.shtml
10	Colorado River Basin Region Basin Plan (Region 7)	http://www.waterboards.ca.gov/coloradoriver/water_issues/programs/basin_planning/
11	Santa Ana Region Basin Plan (Region 8)	http://www.waterboards.ca.gov/santaana/water_issues/programs/basin_plan/index.shtml
12	San Diego Region Basin Plan (Region 9)	http://www.waterboards.ca.gov/sandiego/water_issues/programs/basin_plan/index.shtml
13	Central Coast Ambient Monitoring Program (CCAMP)	http://www.ccamp.info/ca/view_data.php?org_id=rb3
14	Surface Water Ambient Monitoring Program (SWAMP) – Water Quality Indicators	http://www.waterboards.ca.gov/water_issues/programs/swamp/wqindicators.shtml
15	California Environmental Data Exchange Network (CEDEN)	http://www.ceden.org/
16	USGS National Water Information System (USGS NWIS)	http://waterdata.usgs.gov/nwis

References

Reference Number	Reference	Reference Link
17	U.S. EPA Regional Screening Levels (RSLs), generic tables (May 2016)	https://www.epa.gov/risk/
18	U.S. EPA Ecological Soil Screening levels (SSLs)	https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents
19	DTSC Human Health Risk Assessment (HERO)	http://www.dtsc.ca.gov/assessingrisk/humanrisk2.cfm
20	DTSC Ecological Risk Assessment (HERO)	https://dtsc.ca.gov/ecological-risk-assessment-hero/
21	BLM Risk Management Criteria for Metals at BLM Mining Sites	https://www.blm.gov/documents/national-office/blm-library/technical-note/risk-management-criteria-metals-blm-mining
22	NOAA SQuiRTs	http://response.restoration.noaa.gov/environmental-restoration/environmental-assessment-tools/squirt-cards.html
23	Desert Research Institute Annual average precipitation for California (1961 – 1990)	https://wrcc.dri.edu/Climate/comp_table_show.php?stype=ppt_avg
24	Desert Research Institute historical precipitation for CA:	http://www.wrcc.dri.edu/cgi-bin/divplot2_form.pl?0405 Soils map for CA
25	NRCS Soil survey data:	https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/geo/?cid=nrcs142p2_053627
26	USGS The National Map - elevation data	https://nationalmap.gov/elevation.html
27	California Air Resources Board – Meteorology Data	https://www.arb.ca.gov/aqmis2/metselect.php
28	National Oceanic and Atmospheric Administration - Wind Speed data (1950 – present)	https://www.ncdc.noaa.gov/societal-impacts/wind/overview
29	USGS National Geologic Map Database	https://ngmdb.usgs.gov/ngmdb/ngmdb_home.html
30	USGS National Geochemical Survey	https://mrdata.usgs.gov/geochem/
31	USGS Watershed Boundary Dataset	http://nhd.usgs.gov/wbd.html
32	State Water Resource Control Board - Impaired Water Bodies: Final 2012 California Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report)	http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml

References

Reference Number	Reference	Reference Link
33	Sate Water Resources Control Board - Total Maximum Daily Load Program	http://www.waterboards.ca.gov/water_issues/programs/tmdl/
34	U.S. EPA - California Toxic Rule	http://www.ladpw.org/wmd/watershed/dc/DCMP/docs/Appendix%20A%20California%20Toxic%20Rule%20Water%20Quality%20Standards.pdf
35	U.S EPA - National Toxic Rule	https://www.epa.gov/wqs-tech/federal-water-quality-standards-applicable-multiple-states#national
36	Human Health and Ecological Risk Assessment Work Plan	https://www.epa.gov/risk
37	USFS Soil Quality Monitoring	https://www.fs.fed.us/soils/monitoring.shtml
38	U.S. EPA Table of Regulated Drinking Water Contaminants	https://www.epa.gov/ground-water-and-drinking-water/table-regulated-drinking-water-contaminants
39	U.S. EPA Interim Ecological Soil Screening Level Documents	https://www.epa.gov/chemical-research/interim-ecological-soil-screening-level-documents
40	U.S. EPA Ambient Water Quality Criteria	https://www.epa.gov/wqc/national-recommended-water-quality-criteria-aquatic-life-criteria-table
41	CDWR Groundwater Basin data	https://water.ca.gov/Programs/Groundwater-Management/Bulletin-118
42	CDWR - Groundwater Information Center Interactive Map	https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer#gwlevels
43	Groundwater Ambient Monitoring and Assessment (GAMA)	http://www.waterboards.ca.gov/gama/geotracker_gama.shtml
44	SWCRB Electronic Water Rights Information Management System	http://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/index.shtml
45	DOC PAR developed with AML Task Force in 1998.	http://www.conservation.ca.gov/dmr/abandoned_mine_lands/AML_Report/Pages/volume_1.aspx
46	USGS Mineral Resource Data System (MRDS)	https://mrdata.usgs.gov/mrds/
47	CA SWRCB Principal Areas of Mine Pollution	http://www.conservation.ca.gov/dmr/abandoned_mine_lands
48	CA DOC Topographically Occurring Mine Symbol (TOMS)	http://www.conservation.ca.gov/dmr/abandoned_mine_lands
49	CDFW California Natural Diversity Database (CNDDB)	https://www.wildlife.ca.gov/Data/CNDDB

References

Reference Number	Reference	Reference Link
50	CDFW Biogeographic Information and Observation System (BIOS)	https://www.wildlife.ca.gov/Data/BIOS
51	USGS National Hydrography Dataset (NHD)	https://nhd.usgs.gov/
52	Interactive map of lakes, streams, or ocean locations that are listed by the State as impaired:	http://www.mywaterquality.ca.gov/safe_to_eat/impaired_waters/
53	CDFW Fishing locations/activities	https://map.dfg.ca.gov/fishing/
54	DDW Chemicals and Contaminants in Drinking Water	http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.shtml
55	SWRCB Drinking Water Supply Service Area Lookup Tool	http://www.waterboards.ca.gov/waterrights/water_issues/programs/drought/water_supplier.shtml
56	CDWR Water Data Library	http://www.water.ca.gov/waterdatalibrary/
57	SWRCB Public Drinking Water System	http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/publicwatersystems.shtml
58	CHRIS - California Historical Resources Information System	http://ohp.parks.ca.gov/?page_id=1068
59	USFWS - National Wetland Inventory	http://www.fws.gov/wetlands/Data/State-Downloads.html
60	USFS FSTOPO	https://data.fs.usda.gov/geodata/edw/datasets.php?xmlKeyword=FSTopo
61	BLM Land Status geodataset	https://www.blm.gov/site-page/services-geospatial-gis-data-california
62	CPAD	https://www.calands.org/
63	US Census Bureau TIGER dataset	https://tigerweb.geo.census.gov/tigerwebmain/TIGERweb_main.html
64	NPS IRMA	https://irma.nps.gov/Portal/
65	USFS National Visitor Use Monitoring	https://www.fs.usda.gov/about-agency/nvum/
66	BLM Geocommunicator	https://navigator.blm.gov/home