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Subject: Topock Compressor Station – Technical Memorandum 3: Ecological Comparison Values for Metals and Polycyclic Aromatic Hydrocarbons in Soil

Dear Dr. Eichelberger and Ms. Marr:

Enclosed is a technical memorandum prepared as part of the RCRA Facility Investigation/Remedial Investigation (RFI/RI) process to support the soil investigation and site characterization at the Pacific Gas and Electric (PG&E) Topock Compressor Station. This technical memorandum describes the methods used to develop soil ecological comparison values (ECVs) for the currently defined chemicals of potential ecological concern (COPECs) potentially associated with activities at the Topock site. The currently identified COPECs are metals and polycyclic aromatic hydrocarbons (PAHs). The ECVs, while based on information developed during the ecological risk assessment (ERA) scoping, are to be applied only to soil investigation planning in conjunction with background values. Specifically, the ECVs are not intended for use as either cleanup goals or as screening levels to eliminate COPECs. This technical memorandum provides the background and objectives for this effort, the approach used to develop the ECVs, and the recommended ECVs for the current COPECs. Note that the COPEC list may be expanded or contracted based on the results of planned site investigation activities, including the development of soil background levels.

If you have any questions regarding this technical memorandum, please call me at (805) 546-5243.

Sincerely,

Yvonne Meeks
Topock Project Manager

Enclosures: Technical Memorandum 3: Ecological Comparison Values for Metals and Polycyclic Aromatic Hydrocarbons in Soil.

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ARCADIS Project No.:
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Subject:
Technical Memorandum 3: Ecological Comparison Values for Metals and Polycyclic Aromatic Hydrocarbons in Soil

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The purpose of this technical memorandum is to describe the methods used to develop soil ecological comparison values (ECVs) for the currently defined chemicals of potential ecological concern (COPECs) potentially associated with activities at the Pacific Gas and Electric (PG&E) Topock Compressor Station, located in San Bernardino County, California, 15 miles southeast of Needles (site). The currently identified COPECs are metals and polycyclic aromatic hydrocarbons (PAHs). The ECVs, while based on information developed during the ecological risk assessment (ERA) scoping, are to be applied only to soil investigation planning in conjunction with background values. Specifically, the ECVs are not intended for use as either cleanup goals or as screening levels to eliminate COPECs. The following sections provide the background and objectives for this effort, the approach used to develop the ECVs, and the recommended ECVs for the current COPECs. Note that the COPEC list may be expanded or contracted based on the results of planned site investigation activities, including the development of soil background levels.

Background and Objectives

The Topock Compressor Station began operations in December 1951, compressing natural gas supplied from the southwest United States for transport through pipelines to PG&E's service territory in central and northern California. This site is currently active and will continue operating into the foreseeable future.

PG&E is currently conducting investigative and remedial activities at the site. Historically, chromium was added to cooling water, and from 1951 to 1964, untreated wastewater was discharged to Bat Cave Wash. In 1996, PG&E entered into a Corrective Action Consent Agreement with the California Department of Toxic Substances Control (DTSC) to govern the investigation and remediation of the site. In July 2005, a Consent Agreement was executed with U.S. Department of Interior agencies that outlined the process by which PG&E would comply with the Comprehensive Environmental Response, Compensation, and Liability Act requirements for remediation of the site.

As part of the remedial investigation, soil data are being collected and analyzed for site characterization. The primary objective of soil ECVs, along with background data and Preliminary Remediation Goals (PRGs), is to assist in evaluating the adequacy of the site characterization. The ECVs, PRGs, and background concentrations will be used to evaluate the data collected for the Part A Phase I soil investigation and assist in identifying data gaps that may require Phase II soil sampling. As explained by CH2M HILL (2006a), developing soil ECVs can provide a tool for (1) confirming data adequacy and quality; and (2) evaluating the need for, and designing the sampling and analysis program for, the Part A Phase 2 soil investigation. Procedures for field sampling, chain of custody, laboratory analysis, reporting, and data validation are designed to provide an accurate measure of site characterization. However, technical issues exist that may impair the sampling and analysis process (e.g., typical laboratory-proposed detection limits may be elevated relative to risk-based comparison values). The soil ECVs developed herein can be used for additional soil data quality assessment such as to evaluate the use of appropriate method detection limits. The soil ECVs can also be used to evaluate the data collected to define the extent of the site-related constituents in soil and assess the need for additional site characterization data. Furthermore, the soil ECVs can also be used to optimize the selection of sampling locations to limit disturbing the existing habitat and evaluate the program for additional sampling, if deemed necessary.

The soil ECVs, which are risk-based values, were developed based on conservative exposure and effects assumptions using the standard hazard quotient (HQ) model for assessing risk to ecological receptors (USEPA,1997). The soil ECVs are not strictly site-specific but are relevant to the site. The approach is generic ecological assessment to the extent that off-the-shelf exposure parameters and toxicity values were used. The exposure assumptions and effect levels or toxicity values used in the model were obtained from guidance documents and widely accepted literature sources. The exposure assumptions were based on representative species likely present at the site based on species observation records, habitat, and feeding guilds. The toxicity values were based on endpoints measuring survival, growth, and reproduction to meet the assessment endpoint such as protection of ecological receptor populations. Details of the model are described below.

Approach

In this technical memorandum, soil ECVs were developed for metals and PAHs identified as preliminary COPECs in the *Human Health and Ecological Risk Assessment Work Plan* (RAWP) (ARCADIS, 2008).

The preliminary COPECs include Title 22 metals, hexavalent chromium, manganese, total petroleum hydrocarbons (TPH), and PAHs. Toxicity values are not available for TPH, and therefore, soil ECVs were not developed for TPH. The Title 22 metals include antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc. The PAHs include total low molecular weight (LMW) PAHs and total high molecular weight (HMW) PAHs. The National Oceanic and Atmospheric Administration (NOAA) defines LMW PAHs as PAHs with less than or equal to 3 rings and with molecular weight less than or equal to 192 atomic mass units (amu) (NOAA, 2000). Parent LMW PAHs include naphthalene, acenaphthylene, acenaphthene, fluorene, anthracene, and phenanthrene. HMW PAHs are defined as PAHs with greater than or equal to 4 rings and with molecular weight greater than or equal to 202 amu (NOAA, 2000). Parent HMW PAHs include pyrene, fluoranthene, benz(a)anthracene, chrysene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, and dibenz(a,h)anthracene.

For the objectives of this memorandum, soil ECVs were calculated for metals and PAHs using both lowest observed adverse effect levels or concentrations (LOAELs or LOAECs) and no-adverse effect levels or concentrations (NOAELs or NOAECs). The soil ECVs selected were based on the target toxicity values (i.e., values below which no unacceptable risk is expected; NOAELs or NOAECs) for the protection of the ecological receptors based on the representative receptors selected for the ecological risk assessment (ARCADIS, 2008) and include:

- Plants
- Invertebrates
- Birds
  - Gambel's Quail (granivore)
  - Cactus Wren (insectivore)
  - Red-Tailed Hawk (carnivore)
- Mammals
  - Desert Shrew (insectivore)
  - Merriam's Kangaroo Rat (granivore)
  - Desert Kit Fox (carnivore).

Soil Ecological Comparison Values Based on Plants and Invertebrates

For plants and invertebrates, although more than one exposure pathway is considered complete, generally route-specific doses are not quantified for plants and invertebrates. Exposures to soil are expressed in milligrams per kilogram (mg/kg), rather than doses, and generally encompass all potential exposure pathways for plants and invertebrates. Therefore, the screening values for the protection of plants and invertebrates discussed in the RAWP (ARCADIS, 2008) were used as soil ECVs, as presented in Table 1. The sources of screening values for plants and soil invertebrates used to develop soil ECVs are listed in order of preference:

- *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)* (USEPA, 2008b)

- Oak Ridge National Laboratory (ORNL) documents (Efroymson et al., 1997a,b).

Confidence in certain screening values presented in the ORNL documents is low, as indicated in Table 1. Confidence in plant screening values for antimony, barium, beryllium, hexavalent chromium, mercury, molybdenum, thallium, and vanadium is low due to the low number of studies on which the screening values are based or other factors (Efroymson et al., 1997a). The soil type and test species (typically agricultural) may also vary significantly from site-specific conditions, or the toxic effects may be unspecified in the source study. There may be significant variability in the toxic responses noted. Similarly, confidence in the invertebrate screening values is low for arsenic, hexavalent chromium, and mercury because of the low number of studies on which they are based or other factors (Efroymson et al., 1997b).

In the RAWP, screening values were developed only for metals as presented in Table 1. These values were obtained from the sources listed above and are not discussed in this memorandum. To calculate soil ECVs for PAHs, screening values for plants and invertebrates were developed as described below.

Polycyclic Aromatic Hydrocarbon Screening Values for Plants

Plant screening values are not readily available for PAHs from literature sources, except for acenaphthene (Efroymson et al., 1997a), an LMW PAH, and benzo(a)pyrene (USEPA, 1999), an HMW PAH. Empirical toxicity data for naphthalene, another LMW PAH, are available in the U.S. Environmental Protection Agency (USEPA) ECOTOX database (USEPA, 2008a). A study reporting ecologically relevant adverse effects at the lowest concentration was used to develop plant screening values for naphthalene. Hulzebos et al. (1993) reported a 7-day EC50 of 100 mg/kg for reduced biomass in lettuce. This study tested nearly 40 organic contaminants in both soil and a nutrient solution to determine the relationship between toxicity thresholds in both matrices. In this study, an EC50 (i.e., concentration of a chemical causing an effect to 50 percent of the population) of 100 mg/kg was conservatively assumed to be equivalent to a lowest-observed adverse effects concentration (LOAEC) for more serious adverse effects. Following California Environmental Protection Agency (CalEPA) DTSC guidance (CalEPA, 1996), an uncertainty factor (UF) of

10 was applied to extrapolate to a no-observed adverse effects concentration (NOAEC) resulting in a value of 10 mg/kg, which was used as the plant screening value for naphthalene.

As naphthalene is a more common LMW PAH than acenapthene, the comparison value for total LMW PAHs for protection of plants was based on the NOAEC-based screening value of 10 mg/kg for naphthalene, and the comparison value for total HMW PAHs was based on the screening value of 1.2 mg/kg for benzo(a)pyrene (USEPA, 1999).

Polycyclic Aromatic Hydrocarbon Screening Values for Soil Invertebrates

PAH screening values for soil invertebrates are available in the USEPA's *Guidance for Developing Ecological Soil Screening Levels (EcoSSL)* (USEPA, 2008b). The EcoSSL for LMW PAH is 29 mg/kg and the EcoSSL for HMW PAH is 18 mg/kg (Table 1); these values were selected as comparison values for protection of soil invertebrates.

Soil Ecological Comparison Values Based on Wildlife Protection

For wildlife, soil ECVs were developed using a risk-based approach incorporating exposure pathways for food and soil ingestion, which are considered the most significant pathways for most sites (USEPA, 2008b). The wildlife indicator receptors were selected to represent a cross-section of feeding guilds for each assessment endpoint so that sufficient rates of survival, growth, and reproduction for their representative populations could be evaluated.

For each wildlife receptor (i.e., bird and mammal) listed above, soil ECVs were developed following USEPA guidance (USEPA, 1997; USEPA, 2008b) and were based on a food-web model integrating ecological receptor exposures and effects. The exposure assumptions and effects levels for wildlife described in the RAWP (ARCADIS, 2008) were used to develop soil ECVs. The exposure assumptions that were used to estimate exposure dose for the indicator species such as body weights, food ingestion rates, composition of diet, and bioaccumulation factors (BAFs) were obtained from guidance documents or widely accepted literature sources as described in the RAWP (ARCADIS, 2008). The exposure assumptions used in the soil ECV model for each wildlife receptor are presented in Attachment 1. The effects levels or toxicity reference values (TRVs) that were used in the soil ECV model were also obtained from guidance documents or widely accepted literature sources. A TRV is defined as a daily dose of a chemical expressed in milligrams of chemical per kilogram of body weight per day (mg/kg bw-day) and represents a dose associated with no-effect or lowest-effect at the population level of ecological organization, even if exposure occurs over an extended duration. The TRVs used in the model are presented in Tables 2 and 3 and the details are explained below.

Soil ECVs were developed by re-arranging the standard USEPA (1997) HQ model (Equation 1) to solve for a target HQ of 1, which is considered to be protective of ecological receptors. The model used to solve for ECVs is as follows:

$$HQ = \frac{Dose}{TRV} = \frac{(C_{soil} \times SIR) + (C_{tissue} \times FIR) \times SUF}{TRV \times BW} = \frac{(C_{soil} \times SIR) + (C_{soil} \times BAF \times FIR) \times SUF}{TRV \times BW} = 1$$

Equation 1

Or:

$$ECV = C_{soil} = \frac{HQ \times TRV \times BW}{(SIR + [FIR \times BAF]) \times SUF}$$

Equation 2

Where:

Dose = *exposure dose (mg/kgBW-day)*

HQ = *hazard quotient (unitless); set at a target value of 1*

TRV = *toxicity reference value (milligrams per kilogram body weight per day [mg/kgBW-day])*

C_{soil} = *concentration of constituent in soil (mg/kg soil)*

SIR = *soil ingestion rate (kilogram soil per day [kg soil/day])*

C_{tissue} = *concentration of constituent in biota or tissue (mg/kg tissue)*

FIR = *food or biota ingestion rate (kilograms tissue per day [kg tissue/day])*

BW = *body weight of receptor (kilograms [kgBW])*

BAF = *bioaccumulation factor or regression for media-to-biota uptake (kilogram tissue per kilogram soil [kg soil/kg tissue])*

SUF = *site use factor (unitless); represents the fraction of the exposure area for the receptor represented by the area of contamination generally calculated by dividing the area of contamination by the home or foraging range of the receptor.*

ECV = *ecological comparison value (mg/kg soil)*

Depending on the chemical, tissue concentrations (C_{tissue}) were calculated using different combinations of uptake regressions or uptake factors (referred to as soil-to-biota BAFs in the RAWP [ARCADIS, 2008]). Uptake regressions are linear exponential equations, while UFs are simple multipliers, as shown in Equation 3.

$$C_{tissue} = e^{a} \times \left(C_{soil}\right)^{b} \quad or \quad \ln\left(C_{tissue}\right) = a + b \times \ln\left(C_{soil}\right) \qquad \text{Equation 3}$$

Alternatively:

$$C_{tissue} = UF_{tissue} \times C_{soil}$$

Where:

C_{tissue} = *tissue concentration (mg/kg of tissue)*

C_{soil} = *soil concentration (mg/kg of soil)*

a = *compound specific regression equation constant (unitless)*

b = *compound specific regression equation constant (unitless)*

UF_{tissue} = *uptake factor from soil to tissue (unitless)*

Incorporating uptake regressions in lieu of a simple UF in the dose equation (Equation 2) significantly complicates the overall dose calculation. As the bioaccumulation regression places C_{soil} subject to an exponential term, solving for C_{soil} becomes extremely cumbersome. Because of the challenges associated with back-calculating ECVs with dose equations that rely on exponential regressions for modeling tissue concentrations, a forward-calculation methodology was developed to simplify the calculation steps and reduce the potential for mathematical error. An automated, iterative calculation algorithm was used to combine the dose equation and tissue regression equation(s) into a single forward calculation by using the Microsoft® Solver™ software. Solver™ is an add-on to Microsoft® Excel that finds a solution by iterative trial-and-error that satisfies calculation constraints introduced by having interdependent mathematical equations. In this case, the interdependent equations are the tissue uptake equation(s), which rely on a media concentration and a dose equation that rely on the same media concentration (as the tissue uptake equation) and the solution of the uptake equation(s). The media uptake regression(s) and dose equation were combined using Solver™ and used to calculate ECVs. Figure 1 depicts (as an example) a flowchart

of the iterative process that was followed, and the associated equations that were used to calculate ECV for the desert shrew.

An added benefit of using Solver™ to determine ECV is that it allows instant confirmation of accuracy. The spreadsheet cell representing C_{soil} (the results output from Solver™) is instantaneously fed back through the tissue uptake, dose, and HQ equations to calculate an HQ. As long as the resulting HQ value equals 1 (dose/TRV), it can be confidently concluded that the Solver™-based model performed the calculations correctly and that the resulting C_{soil} is the accurate ECV.

In the RAWP (ARCADIS, 2008), wildlife TRVs and BAFs were developed only for metals. To calculate soil ECVs for PAHs, wildlife TRVs and BAFs for PAHs were also developed as described below.

Bioaccumulation Factors for Polycyclic Aromatic Hydrocarbons

Bioaccumulation in animal tissue or uptake in plants is the process where COPECs in the surrounding media are accumulated within the tissues of ecological receptors, especially to concentrations higher than in the surrounding media. Any COPEC that is excreted or metabolized at a slower rate than its uptake through absorption and ingestion will increase in tissues over time, resulting in bioaccumulation. Constituents with high octanol-water partitioning coefficient (log K_{ow}) are more likely to bioaccumulate in tissues of prey (plants, invertebrates, and mammals) due to their lipophilic nature (USEPA, 2000). Additionally, some metals that are not readily excreted are also known to bioaccumulate (e.g., lead). COPECs that bioaccumulate have the potential to be passed up the food chain.

BAFs are multipliers that are used to estimate concentrations of constituents that can accumulate in tissues through any route of exposure (USEPA, 2000). For plants, the BAF is sometimes referred to as a plant uptake factor. In this memorandum, BAFs were used to estimate concentrations of COPECs in biota and food item tissue (i.e., prey) from soil.

The approach used to develop BAFs for metals in the RAWP (ARCADIS, 2008) was also used to develop soil-to-biota BAFs for PAHs. BAFs for soil-to-plants and soil-to-invertebrates for LMW and HMW PAHs are available in USEPA's EcoSSL guidance (USEPA, 2008b) and are not discussed in this memorandum. According to USEPA EcoSSL guidance, semivolatile organic compounds, including PAHs tend to metabolize rapidly in birds and mammals, and therefore, uptake of these constituents from soil-to-mammal were assumed to be zero (USEPA, 2008b). The BAFs for metals and PAHs used to develop soil ECVs are presented in Table 4.

Toxicity Reference Values

In the RAWP (ARCADIS, 2008), two sets of wildlife TRVs for metals were presented as shown in Tables 2 and 3, and these were:

- Proposed TRVs: these were primarily based on the TRVs used to develop USEPA's EcoSSLs (USEPA, 2008b); other sources included ORNL: Toxicological Benchmarks for Wildlife (Sample et al., 1996) and other published sources (e.g., USEPA Region 6 ERA Guidance [USEPA, 1999]).

- DTSC-recommended TRVs: these were preferably based on the Region 9 Biological Technical Assistance Group (BTAG) TRVs (CalEPA, 2002).

For each set of wildlife TRVs, a range of TRVs were developed to estimate a range of potential risks to wildlife (ARCADIS, 2008). The low TRVs were preferably based on chronic no observable adverse effects levels (NOAELs) and the high TRVs were preferably based on the lowest observed adverse effects levels (LOAELs). In the case of DTSC-recommended TRVs, the low BTAG TRVs are NOAEL-based and the high BTAG TRVs are based on a midpoint of a variety of adverse effects and are not necessarily LOAEL-based (CalEPA, 2002). Some of the TRVs were allometrically adjusted for account for significant difference in body weights between the test species and the representative indicator species based on CalEPA guidance (CalEPA, 1999). For the calculation of soil ECVs, the allometrically adjusted TRVs listed in Table 2 and 3 were used for the representative receptors.

Similarly, following the approach described in the RAWP (ARCADIS, 2008), a range of wildlife TRVs for PAHs were developed as described below.

Bird Toxicity Reference Values for Polycyclic Aromatic Hydrocarbons

The bird TRVs for PAHs used to develop soil ECVs are presented in Table 2 and 3. For birds, there are no TRVs for PAHs reported in the EcoSSL guidance (USEPA, 2007). Published TRVs are available in USEPA Region 6 guidance (USEPA, 1999). However, the study (Brunstrom et al., 1991) was based on egg injection tests that are not considered appropriate for developing TRVs (USEPA, 2008b). Several studies were reviewed, and the most appropriate study was selected to develop bird TRVs for PAHs.

For LMW PAHs, Patton and Dieter's study (1980) evaluating the effect of PAH mixtures on hepatic function in mallard duck livers using a mixture of paraffins and aromatic hydrocarbons was selected. There were visible signs of toxicity, indicated by significant increase in liver weight for the group that were administered 4,000 mg/kg PAH mixture, but livers appeared normal in texture and color. No effects were observed for the 400 mg/kg treatment group. Therefore, 400 mg/kg was selected as the NOAEC and the 4,000 mg/kg was selected as the LOAEC. The NOAEC and the LOAEC were then converted to a NOAEL-based TRV and a LOAEL-based TRV, respectively, using the standard dose equations shown below:

$$TRV_{NOAEL} = \frac{NOAEC \times IR}{BW} = \frac{400\ mg/kg \times 0.059\,kg/day}{1.04\,kgBW} = 22.8\,mg/kgBW - day$$

Equation 4

$$TRV_{LOAEL} = \frac{LOAEC \times IR}{BW} = \frac{4000\,mg/kg \times 0.059\,kg/day}{1.04\,kgBW} = 228\,mg/kgBW - day$$

Equation 5

Where:

TRV_{NOAEL}	*= no-observed adverse effects level based toxicity reference value (milligrams per kilogram body weight per day [mg/kgBW-day])*
TRV_{LOAEL}	*= lowest-observed adverse effects level based toxicity reference value (milligrams per kilogram body weight per day [mg/kgBW-day])*
IR	*= ingestion rate (kilogram soil per day [kg soil/day]); calculated from allometric equation for food ingestion rate in dry weight for all birds (USEPA,1993)*
BW	*= body weight of receptor (kilograms [kgBW]); assuming approximately 1.04 kg for the mallard ducks (from USEPA, 1993)*

For HMW PAHs, a study by Trust et al. (1994) reporting a NOAEL of 10 mg/kg bw-day and a LOAEL of 100 mg/kg bw-day for overt signs of toxicity, such as decreased body mass in European starlings exposed to 7,12-dimethylbenz(a)anthracene, was selected to develop TRVs. Immunosuppression was observed at higher doses. The exposures were via oral gavage, and the study was conducted on nestlings, a sensitive life-stage. No UFs were applied, and therefore, an avian low TRV of 10 mg/kg bw-day and an avian high TRV of 100 mg/kg bw-day were used for HMW PAHs.

There are no BTAG PAH TRVs for birds. Therefore, there are no separate DTSC-recommended PAH TRVs for birds.

Mammal Toxicity Reference Values for Polycyclic Aromatic Hydrocarbons

Mammal TRVs for PAHs are available in the EcoSSL guidance (USEPA, 2007). The NOAEL of 65.6 mg/kg bw-day was selected as the low TRV for LMW PAHs and the LOAEL of 0.6 mg/kg bw-day was selected as the low TRV for HMW PAHs. The EcoSSL guidance (USEPA, 2007; USEPA, 2008b) does not report LOAELs; therefore, LOAELs for PAHs were developed following the approach described in the RAWP (ARCADIS, 2008). For LMW and HMW PAHs, bounded NOAELs were reported as TRVs; therefore, the LOAELs from the same study and endpoint was selected.

BTAG TRVs are available for mammals (CalEPA, 2002). The BTAG TRVs for naphthalene was used for LMW PAHs and the BTAG TRVs for benzo(a)pyrene was used for HMW PAHs.

The mammal TRVs for metals and PAHs used to develop soil ECVs are presented in Table 3 and 4.

Selection of Soil Ecological Comparison Values

The soil ECVs based on plants and invertebrates are presented in Table 1. For wildlife, a range of soil ECVs were developed following the approach described above and presented in tables in Attachment 1. A summary of the soil ECVs developed, based on the proposed wildlife TRVs and the DTSC-recommended TRVs, is presented in Table 5. As discussed earlier, the purpose of this technical memorandum is to develop soil ECVs for data quality assessment and use in evaluating the Part A Phase 1 data and making further site characterization decisions. The ECVs are conservative values but are not intended to be used to screen out COPECs. ECVs are also specifically not intended to be used as cleanup goals.

In order to select the most appropriate soil ECVs for each constituent, the most conservative of all the ecological receptor-based soil ECVs was selected as the final soil ECV unless the screening value or TRVs used to calculate that soil ECV was low in confidence. In such cases, the next less conservative soil ECV was selected as the final (e.g., soil ECV for mercury). The minimum of all the soil ECVs from Table 1 (plants and invertebrates) and Table 5 (wildlife) for each constituent and the selected soil ECVs are presented in Table 6. It should be noted that certain ECVs (e.g. antimony, cadmium, lead, mercury, and selenium) are below the standard reporting limits defined in the *Quality Assurance Project Plan, PG&E Topock Program (*QAPP; CH2M HILL, 2004, 2006b, 2008). Additionally, certain ECVs will likely be lower than final background soil concentrations. In that case, background concentrations would be used to set analytical detection limits and to consider the need for additional characterization.

Tables

Figure

Attachment

1 Derivation of Wildlife Based Soil ECVs

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USEPA. 2008a. ECOTOX database. U.S. Environmental Protection Agency. Website updated daily: http://cfpub.epa.gov/ecotox/

USEPA. 2008b. *Guidance for Developing Ecological Soil Screening Levels (EcoSSLs)*. U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington D.C. 2005 Revision, updated December 2006. 85 pp. http://www.epa.gov/ecotox/ecossl.

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Tables

Table 1
Soil Ecological Comparison Values
Based on Plant and Invertebrate Screening Values

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Constituents	Plant (mg/kg)	Invertebrate (mg/kg)
Antimony	5*	78
Arsenic	18	60**
Barium	500*	330
Beryllium	10*	40
Cadmium	32	140
Chromium, trivalent	NA	NA
Chromium, hexavalent	1*	0.4**
Chromium, total	NA	NA
Cobalt	13	NA
Copper	70	80
Lead	120	1700
Manganese	220	450
Mercury	0.3*	0.1**
Molybdenum	2*	NA
Nickel	38	280
Selenium	0.52	4.1
Silver	560	NA
Thallium	1*	NA
Vanadium	2*	NA
Zinc	160	120
LMW PAHs	10	29
HMW PAHs	1.2	18

Notes:
*Confidence in this benchmark is low due to the low number of studies on which it is based or other factors. The soil type and test species (typically agricultural) may also vary significantly from site-specific conditions, or the toxic effects may be uncertain.
**Confidence in this benchmark is low due to the low number of studies on which it is based or other factors. The tests were conducted with earthworms.

Indicates USEPA EcoSSL
Indicates ORNL Screening Benchmark
Primary sources (see text).

LMW PAHs - low molecular weight polycyclic aromatic hydrocarbons
HMW PAHs - high molecular weight polycyclic aromatic hydrocarbons
mg/kg = milligrams per kilograms
ORNL - Oak Ridge National Laboratory
USEPA - U.S. Environmental Protection Agency

Sources:

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997a. *Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision* . Prepared for the Oak Ridge Laboratory. November 1997.

Efroymson, R.A., M.E. Will, G.W. Suter II, and A.C. Wooten. 1997b. *Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soil and Litter Invertebrates and Heterotrophic Process: 1997 Revision* . Prepared for the Oak Ridge Laboratory.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision* . Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.

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Table 2
Proposed Toxicity Reference Values

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Constituent	Wildlife TRVs (mg/kgBW-day)							
	Birds				Mammals			
	Low TRV (NOAEL)	Source	High TRV (LOAEL)	Source	Low TRV (NOAEL)	Source	High TRV (LOAEL)	Source
Antimony	NA	--	NA	--	0.059	USEPA, 2005	0.59	USEPA, 2005
Arsenic	2.24	USEPA, 2005	3.55	USEPA, 2005	1.04	USEPA, 2005	1.66	USEPA, 2005
Arsenic (allom adj)[a]	--	--	--	--	1.53	for desert shrew[a]	2.44	for desert shrew[a]
	--	--	--	--	1.46	for kangaroo rat[a]	2.33	for kangaroo rat[a]
Barium	NA	--	NA	--	51.8	USEPA, 2005	82.6	USEPA, 2005
Beryllium	NA	--	NA	--	0.532	USEPA, 2005	0.630	USEPA, 2005
Cadmium	1.47	USEPA, 2005	6.35	USEPA, 2005	0.770	USEPA, 2005	7.7	USEPA, 2005
Chromium	2.66	USEPA, 2005	15.6	USEPA, 2005	2.40	USEPA, 2005	9.62	USEPA, 2005
Hexavalent Chromium	NA	--	NA	--	9.24	USEPA, 2008	38.8	USEPA, 2008
Cobalt	7.61	USEPA, 2005	18.3	USEPA, 2005	7.33	USEPA, 2005	18.8	USEPA, 2005
Copper	4.05	USEPA, 2007	12.1	USEPA, 2007	5.60	USEPA, 2007	9.34	USEPA, 2007
Copper (allom adj)[a]	--	--	--	--	9.43	for desert shrew[a]	15.73	for desert shrew[a]
	--	--	--	--	9.04	for kangaroo rat[a]	15.07	for kangaroo rat[a]
Lead	1.63	USEPA, 2005	3.26	USEPA, 2005	4.70	USEPA, 2005	8.90	USEPA, 2005
Mercury	0.039	CalEPA BTAG, 2002	0.2	CalEPA BTAG, 2002	0.25	CalEPA BTAG,	4	CalEPA BTAG,
Molybdenum	3.5	Sample et al., 1996	35.3	Sample et al., 1996	0.26	Sample et al., 1996	2.6	Sample et al., 1996
Nickel	6.71	USEPA, 2007	18.6	USEPA, 2007	1.70	USEPA, 2007	3.40	USEPA, 2007
Selenium	0.290	USEPA, 2007	0.579	USEPA, 2007	0.143	USEPA, 2007	0.215	USEPA, 2007
Selenium (allom adj)[a]	--	--	--	--	0.23	for desert shrew[a]	0.35	for desert shrew[a]
	--	--	--	--	0.21	for kangaroo rat[a]	0.31	for kangaroo rat[a]
Silver	2.02	USEPA, 2006	20.2	USEPA, 2006	6.02	USEPA, 2006	60.2	USEPA, 2006
Silver (allom adj)[a]	--	--	--	--	8.77	for desert shrew[a]	87.68	for desert shrew[a]
	--	--	--	--	8.40	for kangaroo rat[a]	84.01	for kangaroo rat[a]
Thallium	0.35	USEPA, 1999	3.5	USEPA, 1999	0.48	CalEPA BTAG,	1.43	CalEPA BTAG,
Vanadium	0.344	USEPA, 2005	0.688	USEPA, 2005	4.16	USEPA, 2005	8.31	USEPA, 2005
Zinc	66.1	USEPA, 2007	171	USEPA, 2007	75.4	USEPA, 2007	298	USEPA, 2007
Total LMW PAHs	22.8	1980	228	1980	65.6	USEPA, 2007	328	USEPA, 2007
Total HMW PAHs	10	Trust et al., 1994	100	Trust et al., 1994	0.6	USEPA, 2007	3	USEPA, 2007

Table 2
Proposed Toxicity Reference Values

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Notes:
TRVs for metals presented in the *Human Health and Ecological Risk Assessment Work Plan* (RAWP; ARCADIS, 2008).
TRVs updated in guidance since the RAWP was submitted.
TRVs developed for this technical memorandum.

a. TRVs allometrically adjusted significant difference in body weights using the following equation (Sample and Arenal, 1999):

Aw - At * (BWt/BWw)^1-b

where:

Aw - toxicity value of wildlife species
At - toxicity value of test species (TRV)
BWt - body weight of test species
BWw - body weight of wildlife species
b - allometric scaling factor (1.2 for birds, 0.94 for mammals)

-- - not applicable
BTAG - Biological Technical Assistance Group
CalEPA - California Environmental Protection Agency
LOAEL - lowest observed adverse effects level
mg/kgBW-day - milligrams per kilogram of body weight per day
NA - not available
NOAEL - no observed adverse effects level
TRV - toxicity reference value
USEPA - U.S. Environmental Protection Agency

Sources:

CalEPA. 2002. *Currently Recommended U.S. Environmental Protection Agency Region 9 Biological Technical Assistance Group (BTAG) Mammalian and Avian Toxicity Reference Values (TRVs)* . Department of Toxic Substances Control: Human and Ecological Risk Division

Patton, J.F. and M.P. Dieter. 1980. *Effects of Petroleum Hydrocarbons on Hepatic Function in the Duck* . *Comp. Biochem. Physiol.* Vol. 65C pp. 33-36.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.

Sample, B.E. and C.A. Arenal. 1999. *Allometric Models for Interspecies Extrapolation of Wildlife Toxicity Data*. Bull. Environ. Contam. Toxicol. (1999) 62: 653-663.

Trust, K.A., A. Fairbrother, and M.J. Hooper. 1994. *Effects of 7,12-Dimethylbenz[a]anthracene on Immune Function and Mixed-Function Oxygenase Activity in the European Starling* . *Environmental Toxicology and Chemistry.* Vol. 13(5) pp. 821-830.

USEPA 1999. *Region 6 Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities: Appendix E Toxicity Reference Values*. August.

USEPA 2005-2008. *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)*. OSWER Directive 9285.7-55. United States Environmental Protection Agency Office of Solid Waste and Emergency Response. Washington, DC. November 2003, revised March, 2005

Table 3
DTSC-Recommended Toxicity Reference Values

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

	Wildlife TRVs (mg/kgBW-day)							
	Birds				Mammals			
Constituent	Low TRV (NOAEL)	Source	High TRV (LOAEL)	Source	Low TRV (NOAEL)	Source	High TRV (LOAEL)	Source
Antimony	NA	--	NA	--	0.059	USEPA, 2005	0.59	USEPA, 2005
Arsenic	5.5	CalEPA BTAG, 2002	22.0	CalEPA BTAG, 2002	0.32	CalEPA BTAG, 2002	4.7	CalEPA BTAG, 2002
Barium	NA	--	NA	--	51.8	USEPA, 2005	82.6	USEPA, 2005
Beryllium	NA	--	NA	--	0.532	USEPA, 2005	0.630	USEPA, 2005
Cadmium	0.08	CalEPA BTAG, 2002	10.4	CalEPA BTAG, 2002	0.060	CalEPA BTAG, 2002	2.64	CalEPA BTAG, 2002
Chromium	2.66	USEPA, 2005	15.6	USEPA, 2005	2.40	USEPA, 2005	9.62	USEPA, 2005
Hexavalent Chromium	NA	--	NA	--	9.24	USEPA, 2008	38.8	USEPA, 2008
Cobalt	7.61	USEPA, 2005	18.3	USEPA, 2005	1.2	CalEPA BTAG, 2002	20	CalEPA BTAG, 2002
Copper	2.30	CalEPA BTAG, 2002	52.3	CalEPA BTAG, 2002	2.67	CalEPA BTAG, 2002	632	CalEPA BTAG, 2002
Lead	0.014	CalEPA BTAG, 2002	8.75	CalEPA BTAG, 2002	1.0	CalEPA BTAG, 2002	241	CalEPA BTAG, 2002
Mercury	0.039	2002	0.18	CalEPA BTAG, 2002	0.25	CalEPA BTAG, 2002	4	2002
Molybdenum	3.5	Sample et al., 1996	35.3	Sample et al., 1996	0.26	Sample et al., 1996	2.6	Sample et al., 1996
Nickel	1.38	CalEPA BTAG, 2002	56.3	CalEPA BTAG, 2002	0.133	CalEPA BTAG, 2002	31.6	CalEPA BTAG, 2002
Selenium	0.23	2002	0.93	CalEPA BTAG, 2002	0.05	CalEPA BTAG, 2002	1.21	2002
Silver	2.02	USEPA, 2006	20.2	USEPA, 2006	6.02	USEPA, 2006	60.2	USEPA, 2006
Silver (allom adj)[a]	--	--	--	--	8.77	for desert shrew[a]	87.68	for desert shrew[a]
	--	--	--	--	8.40	for kangaroo rat[a]	84.01	for kangaroo rat[a]
Thallium	0.35	USEPA, 1999b	3.5	USEPA, 1999b	0.48	CalEPA BTAG, 2002	1.43	2002
Vanadium	0.344	USEPA, 2005	0.688	USEPA, 2005	4.16	USEPA, 2005	8.31	USEPA, 2005
Zinc	17.2	2002	172	CalEPA BTAG, 2002	9.60	CalEPA BTAG, 2002	411	2002
LMW PAHs	NA	--	NA	--	50	CalEPA BTAG, 2002	150	2002
HMW PAHs	NA	--	NA	--	1.31	CalEPA BTAG, 2002	32.8	CalEPA BTAG,

Table 3
DTSC-Recommended Toxicity Reference Values

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Notes:
TRVs for metals presented in the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).
TRVs updated in guidance since the RAWP was submitted.
TRVs developed for this technical memorandum.

a. TRVs allometrically adjusted significant difference in body weights using the following equation (Sample and Arenal, 1999):

Aw - At * (BWt/BWw)^1-b

where:

Aw - toxicity value of wildlife species
At - toxicity value of test species (TRV)
BWt - body weight of test species
BWw - body weight of wildlife species
b - allometric scaling factor (1.2 for birds, 0.94 for mammals)

-- - not applicable
BTAG - Biological Technical Assistance Group
CalEPA - California Environmental Protection Agency
DTSC - Department of Toxic Substances Control
kg - kilograms
LOAEL - lowest observable adverse effects level
mg/kgBW-day - milligram(s) per kilogram body weight per day
NA - not available
NOAEL - no observable adverse effects level
TRV - toxicity reference value
UF - uncertainty factor
USEPA - U.S. Environmental Protection Agency

Sources:

CalEPA 2002. *Currently Recommended U.S. Environmental Protection Agency Region 9 Biological Technical Assistance Group (BTAG) Mammalian and Avian Toxicity Reference Values (TRVs)*. Department of Toxic Substances Control: Human and Ecological Risk Division.

Sample, B.E., D.M. Opresko, and G.W. Suter II. 1996. *Toxicological Benchmarks for Wildlife: 1996 Revision*. Oak Ridge National Laboratory, Oak Ridge, TN. 227 pp. ES/ER/TM-86/R3.

Sample, B.E. and C.A. Arenal. 1999. *Allometric Models for Interspecies Extrapolation of Wildlife Toxicity Data*. Bull. Environ. Contam. Toxicol. (1999) 62: 653-663.

USEPA 1999. *Region 6 Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities: Appendix E Toxicity Reference Values*. August.

USEPA 2005 -2008. *Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs)*. OSWER Directive 9285.7-55. United States Environmental Protection Agency Office of Solid Waste and Emergency Response. Washington, DC. November 2003, revised March, 2007

Table 4
Bioaccumulation Factors

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Constituent	Soil-to-Biota Bioaccumulation Factors[a]		
	BAF_{plant} (dw) (kg soil/kg tissue)	BAF_{invert} (dw) (kg soil/kg tissue)	BAF_{mammal} (dw) (kg soil/kg tissue)
Antimony	$\ln(C_p) = 0.938 * \ln(C_s) - 3.233$	1.00	$0.05 * C_d$
Arsenic	0.03752	$\ln(C_i) = 0.706 * \ln(C_s) - 1.421$	$\ln(C_m) = 0.8188 * \ln(C_s) - 4.8471$
Barium	0.156	0.091	$0.0075 * C_d$
Beryllium	$\ln(C_p) = 0.7345 * \ln(C_s) - 0.5361$	0.045	$0.05 * C_d$
Cadmium	$\ln(C_p) = 0.546 * \ln(C_s) - 0.475$	$\ln(C_i) = 0.795 * \ln(C_s) + 2.114$	$\ln(C_m) = 0.4723 * \ln(C_s) - 1.2571$
Chromium, total	0.041	0.306	$\ln(C_m) = 0.7338 * \ln(C_s) - 1.4599$
Chromium, hexavalent	0.041	0.306	$\ln(C_m) = 0.7338 * \ln(C_s) - 1.4599$
Cobalt	0.0075	0.122	$\ln(C_m) = 1.307 * \ln(C_s) - 4.4669$
Copper	$\ln(C_p) = 0.394 * \ln(C_s) + 0.668$	0.515	$\ln(C_m) = 0.1444 * \ln(C_s) + 2.042$
Lead	$\ln(C_p) = 0.561 * \ln(C_s) - 1.328$	$\ln(C_i) = 0.807 * \ln(C_s) - 0.218$	$\ln(C_m) = 0.4422 * \ln(C_s) + 0.0761$
Mercury	$\ln(C_p) = 0.544 * \ln(C_s) - 0.996$	$\ln(C_i) = 0.3369 * \ln(C_s) - 0.078$	0.192
Molybdenum	0.25	5.50E-01	$\ln(C_m) = 0.006 * 50 * C_d$ [b]
Nickel	$\ln(C_p) = 0.748 * \ln(C_s) - 2.223$	1.059	$\ln(C_m) = 0.4658 * \ln(C_s) - 0.2462$
Selenium	$\ln(C_p) = 1.104 * \ln(C_s) - 0.677$	$\ln(C_i) = 0.733 * \ln(C_s) - 0.075$	$\ln(C_m) = 0.3764 * \ln(C_s) - 0.4158$
Silver	0.014	2.045	0.004
Thallium	0.004	5.50E-01	0.112
Vanadium	0.00485	0.042	0.0123
Zinc	$\ln(C_p) = 0.554 * \ln(C_s) + 1.575$	$\ln(C_i) = 0.328 * \ln(C_s) + 4.449$	$\ln(C_m) = 0.0706 * \ln(C_s) + 4.3632$
Total LMW PAH	ln(Cp) = 0.4544 * ln(Cs)-1.3205	3.04	0.0
Total HMW PAH	ln(Cp) = 0.9469 * ln(Cs)-1.7026	2.6	0.0

Notes:
BAFs for metals presented in the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).
BAFs developed for this technical memorandum.

a. All BAFs from USEPA's Guidance for Developing Ecological Soil Screening Levels (EcoSSLs). U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington D.C. 2005 Revision, updated December 2006. 85 pp. http://www.epa.gov/ecotox/ecossl., except as otherwise noted.

b. Baes, C.F., R. Sharp, A. Sjoreen and R. Shor. 1984. A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture. Prepared by Oak Ridge National Laboratory for U.S. Dept. of Energy. 150 pp.

BAF - bioaccumulation factor
BAF_{invert} - soil-to-invertebrate uptake bioaccumulation factor (unitless)
BAF_{plant} - soil-to-plant uptake bioaccumulation factor (unitless)
C_p - constituent concentration in plants
C_i - constituent concentration in invertebrates
C_s - constituent concentration in soil
C_m - constituent concentration in mammals
C_d - concentration in diet
dw - dry weight
HMW PAHs - high molecular weight polycyclic aromatic hydrocarbons
In - natural log
LMW PAHs - low molecular weight polycyclic aromatic hydrocarbons
USEPA - U.S. Environmental Protection Agency

Table 5
Summary of Soil Ecological Comparison Values
Based on Wildlife

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Ecological Receptor	Based on:	Antimony		Arsenic		Arsenic (Allometrically Adjusted)[e]		Barium		Beryllium		Cadmium	
		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)	
		Low[c]	High[d]	Low[c]	High[d]	High[d]	Low[c]	Low[c]	High[d]	High[d]	Low[c]	Low[c]	High[d]
Gambel's Quail	Proposed TRVs[a]	NA	NA	4.13E+02	6.54E+02	NA	NA	NA	NA	NA	NA	2.48E+02	1.29E+03
Cactus Wren		NA	NA	7.61E+01	1.28E+02	NA	NA	NA	NA	NA	NA	9.47E-01	5.93E+00
Red-tailed Hawk		NA	NA	1.76E+03	2.82E+03	NA	NA	NA	NA	NA	NA	8.37E+02	4.63E+03
Desert Shrew		2.85E-01	2.85E+00	NA	NA	8.90E+01	1.62E+02	2.30E+03	3.67E+03	4.03E+01	4.77E+01	3.74E-01	6.75E+00
Merriam's Kangaroo Rat		1.24E+01	1.35E+02	NA	NA	2.89E+02	4.62E+02	3.50E+03	5.58E+03	2.33E+01	2.91E+01	8.93E+01	2.18E+03
Desert Kit Fox		2.14E+01	2.14E+02	9.72E+02	1.56E+03	NA	NA	5.11E+04	8.14E+04	4.97E+02	5.89E+02	5.74E+02	7.11E+03
Gambel's Quail	DTSC-Recommended TRVs[b]	NA	NA	1.01E+03	4.06E+03	NA	NA	NA	NA	NA	NA	5.26E+00	2.21E+03
Cactus Wren		NA	NA	2.10E+02	9.60E+02	NA	NA	NA	NA	NA	NA	2.45E-02	1.10E+01
Red-tailed Hawk		NA	NA	4.41E+03	1.81E+04	NA	NA	NA	NA	NA	NA	1.05E+01	7.96E+03
Desert Shrew		2.85E-01	2.85E+00	1.14E+01	3.71E+02	NA	NA	2.30E+03	3.67E+03	4.03E+01	4.77E+01	1.51E-02	1.76E+00
Merriam's Kangaroo Rat		1.24E+01	1.35E+02	6.33E+01	9.29E+02	NA	NA	3.50E+03	5.58E+03	2.33E+01	2.92E+01	1.24E+00	5.37E+02
Desert Kit Fox		2.14E+01	2.14E+02	2.94E+02	4.47E+03	NA	NA	4.13E+04	6.58E+04	1.93E+02	2.28E+02	1.94E+01	2.27E+03

Table 5
Summary of Soil Ecological Comparison Values
Based on Wildlife

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Ecological Receptor	Based on:	Total Chromium		Hexavalent Chromium		Cobalt		Copper		Copper (Allometrically Adjusted)[e]		Lead	
		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)	
		High[d]	Low[c]	Low[c]	High[d]	High[d]	Low[c]	Low[c]	High[d]	High[d]	Low[c]	Low[c]	High[d]
Gambel's Quail	Proposed TRVs[a]	4.79E+02	2.81E+03	NA	NA	1.78E+03	4.28E+03	7.60E+02	2.62E+03	NA	NA	3.42E+02	7.16E+02
Cactus Wren		3.64E+01	2.13E+02	NA	NA	1.93E+02	4.64E+02	3.63E+01	1.09E+02	NA	NA	1.57E+01	3.59E+01
Red-tailed Hawk		5.95E+02	5.21E+03	NA	NA	9.00E+02	1.80E+03	2.00E+03	8.86E+03	NA	NA	3.90E+02	1.18E+03
Desert Shrew		3.63E+01	1.45E+02	1.40E+02	5.86E+02	2.54E+02	6.52E+02	NA	NA	8.69E+01	1.45E+02	6.02E+01	1.31E+02
Merriam's Kangaroo Rat		4.49E+02	1.80E+03	1.73E+03	7.26E+03	2.83E+03	7.26E+03	NA	NA	2.74E+03	5.26E+03	1.67E+03	3.45E+03
Desert Kit Fox		1.05E+03	5.26E+03	5.02E+03	2.51E+04	1.52E+03	3.22E+03	4.72E+03	8.42E+03	NA	NA	3.35E+03	7.05E+03
Gambel's Quail	DTSC-Recommended TRVs[b]	4.79E+02	2.81E+03	NA	NA	1.78E+03	4.28E+03	3.82E+02	1.24E+04	NA	NA	9.85E-01	2.01E+03
Cactus Wren		3.64E+01	2.13E+02	NA	NA	1.93E+02	4.64E+02	2.06E+01	4.69E+02	NA	NA	5.00E-02	1.15E+02
Red-tailed Hawk		5.95E+02	5.21E+03	NA	NA	9.00E+02	1.80E+03	6.65E+02	4.45E+04	NA	NA	1.66E-02	4.66E+03
Desert Shrew		3.63E+01	1.45E+02	1.40E+02	5.86E+02	4.16E+01	6.94E+02	2.46E+01	5.82E+03	NA	NA	9.02E+00	7.20E+03
Merriam's Kangaroo Rat		4.49E+02	1.80E+03	1.73E+03	7.26E+03	4.63E+02	7.72E+03	4.51E+02	3.08E+05	NA	NA	2.58E+02	1.15E+05
Desert Kit Fox		1.05E+03	5.26E+03	5.02E+03	2.51E+04	3.49E+02	3.38E+03	1.88E+03	6.36E+05	NA	NA	4.41E+02	2.34E+05

Table 5
Summary of Soil Ecological Comparison Values
Based on Wildlife

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Ecological Receptor	Based on:	Mercury		Molybdenum		Nickel		Selenium		Selenium (Allomterically Adjusted)[e]		Silver	
		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)	
		High[d]	Low[c]	Low[c]	High[d]	High[d]	Low[c]	Low[c]	High[d]	High[d]	Low[c]	Low[c]	High[d]
Gambel's Quail	Proposed TRVs[a]	3.15E+00	2.48E+01	2.58E+02	2.60E+03	1.44E+03	4.14E+03	1.01E+01	1.90E+01	NA	NA	4.47E+02	4.47E+03
Cactus Wren		1.25E-02	9.13E-01	2.97E+01	3.00E+02	3.18E+01	8.81E+01	1.78E+00	4.40E+00	NA	NA	5.15E+00	5.15E+01
Red-tailed Hawk		2.39E+00	1.10E+01	2.47E+02	2.49E+03	3.54E+03	1.23E+04	5.23E+01	1.85E+02	NA	NA	1.42E+03	1.42E+04
Desert Shrew		2.11E+00	5.89E+02	2.25E+00	2.25E+01	7.76E+00	1.55E+01	NA	NA	1.29E+00	2.17E+00	NA	NA
Merriam's Kangaroo Rat		2.96E+01	1.27E+03	1.15E+01	1.15E+02	4.36E+02	9.57E+02	NA	NA	4.13E+00	5.98E+00	NA	NA
Desert Kit Fox		3.21E+01	5.14E+02	3.81E+01	3.81E+02	1.01E+03	2.39E+03	4.54E+01	8.93E+01	NA	NA	5.32E+03	5.32E+04
Gambel's Quail	DTSC-Recommended TRVs[b]	3.15E+00	2.48E+01	2.58E+02	2.60E+03	2.76E+02	1.29E+04	8.15E+00	2.94E+01	NA	NA	4.47E+02	4.47E+03
Cactus Wren		1.25E-02	9.13E-01	2.97E+01	3.00E+02	6.54E+00	2.67E+02	1.31E+00	8.15E+00	NA	NA	5.15E+00	5.15E+01
Red-tailed Hawk		2.39E+00	1.10E+01	1.41E+02	1.42E+03	3.68E+02	4.27E+04	3.25E+01	3.92E+02	NA	NA	1.42E+03	1.42E+04
Desert Shrew		2.11E+00	5.89E+02	2.25E+00	2.25E+01	6.07E-01	1.44E+02	1.77E-01	1.06E+01	NA	NA	1.44E+01	1.44E+02
Merriam's Kangaroo Rat		2.96E+01	1.27E+03	1.15E+01	1.15E+02	2.19E+01	1.12E+04	1.13E+00	2.05E+01	NA	NA	1.93E+03	1.93E+04
Desert Kit Fox		3.21E+01	5.14E+02	2.24E+01	2.24E+02	2.04E+01	2.86E+04	5.56E+00	9.15E+02	NA	NA	5.32E+03	5.32E+04

Table 5
Summary of Soil Ecological Comparison Values
Based on Wildlife

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Ecological Receptor	Based on:	Silver (Allomterically Adjusted)[e]		Thallium		Vanadium		Zinc		LMW PAHs		HMW PAHs	
		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)		Soil ECVs (mg/kg dw)	
		High[d]	Low[c]	Low[c]	High[d]	High[d]	Low[c]	Low[c]	High[d]	High[d]	Low[c]	Low[c]	High[d]
Gambel's Quail	Proposed TRVs[a]	NA	NA	8.45E+01	8.45E+02	8.24E+01	1.65E+02	9.26E+03	2.92E+04	5.59E+03	5.68E+04	1.14E+03	1.22E+04
Cactus Wren		NA	NA	2.97E+00	2.97E+01	1.39E+01	2.78E+01	7.57E+01	1.05E+03	3.97E+01	3.97E+02	2.03E+01	2.03E+02
Red-tailed Hawk		NA	NA	3.50E+01	3.50E+02	1.65E+02	3.30E+02	4.76E+04	1.42E+05	2.05E+04	2.05E+05	9.01E+03	9.01E+04
Desert Shrew		2.09E+01	2.09E+02	2.32E+00	6.91E+00	3.31E+02	6.60E+02	8.67E+01	4.72E+03	1.06E+02	5.28E+02	1.16E+00	5.77E+00
Merriam's Kangaroo Rat		2.69E+03	2.69E+04	2.09E+02	6.21E+02	1.75E+03	3.50E+03	8.32E+03	6.08E+04	3.20E+04	1.64E+05	4.32E+01	2.33E+02
Desert Kit Fox		NA	NA	9.69E+01	2.89E+02	2.92E+03	5.83E+03	7.00E+04	2.94E+05	6.62E+04	3.31E+05	6.21E+02	3.10E+03
Gambel's Quail	DTSC-Recommended TRVs[b]	NA	NA	8.45E+01	8.45E+02	8.24E+01	1.65E+02	1.57E+03	2.93E+04	5.59E+03	5.68E+04	1.14E+03	1.22E+04
Cactus Wren		NA	NA	2.97E+00	2.97E+01	1.39E+01	2.78E+01	1.32E+00	1.06E+03	3.97E+01	3.97E+02	2.03E+01	2.03E+02
Red-tailed Hawk		NA	NA	3.50E+01	3.50E+02	1.65E+02	3.30E+02	5.23E+03	1.42E+05	2.05E+04	2.05E+05	9.01E+03	9.01E+04
Desert Shrew		2.09E+01	2.09E+02	4.15E+00	1.24E+01	3.31E+02	6.60E+02	1.64E-01	1.09E+04	8.05E+01	2.41E+02	2.46E+00	6.17E+01
Merriam's Kangaroo Rat		2.69E+03	2.69E+04	2.09E+02	6.21E+02	1.75E+03	3.50E+03	2.82E+02	9.39E+04	2.42E+04	7.42E+04	9.54E+01	2.78E+03
Desert Kit Fox		NA	NA	9.69E+01	2.89E+02	2.92E+03	5.83E+03	4.61E+03	4.08E+05	5.05E+04	1.51E+05	1.32E+03	3.31E+04

Notes:
Selected Final Soil ECV (see Table 6).

[1] Proposed TRVs based primarily on USEPA's EcoSSLs (USEPA, 2008b); from the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).
[2] DTSC-recommended TRVs based primarily on Region 9 Biological Technical Assistance Group (BTAG) TRVs (CalEPA, 2002); from the Risk Assessment Work Plan (ARCADIS, 2008).
[3] Low ECVs based on low TRVs or no-observed adverse effects level (NOAEL) TRVs.
[4] High ECVs based on high TRVs or lowest-observed adverse effects level (LOAEL) TRVs.
[5] TRVs allometrically adjusted for representative receptors (ARCADIS, 2008).

CalEPA - California Environmental Protection Agency
DTSC - Department of Toxic Substance Control
ECV - ecological comparison value
HMW PAHs - high molecular weight polycyclic aromatic hydrocarbons
LMW PAHs - low molecular weight polycyclic aromatic hydrocarbons
mg/kg dw - milligrams per kilogram dry weight
NA - not available
TRV - toxocity reference values
USEPA - U.S. Environmental Protection Agency

Table 6
Summary of Selected Soil Ecological Comparison Values

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Constituent	Lowest Wildlife ECV (mg/kg)	Based On	Lowest Plant/Invertebrate ECV (mg/kg)	Based On	Selected Final Soil ECV[a] (mg/kg)	Based On
Antimony	0.285	Desert Shrew	5	Plant*	0.285	Desert Shrew
Arsenic	11.4	Desert Shrew	18	Plant	11.4	Desert Shrew
Barium	2,299	Desert Shrew	330	Invertebrate	330	Invertebrate
Beryllium	23.3	Merriam's Kangaroo Rat	10	Plant*	23.3	Merriam's Kangaroo Rat
Cadmium	0.0151	Desert Shrew	32	Plant	0.0151	Desert Shrew
Trivalent Chromium	NA	NA	NA	NA	NA	NA
Hexavalent Chromiu	139.6	Desert Shrew	0.4	Invertebrate**	139.6	Desert Shrew
Total Chromium	36.3	Desert Shrew	NA	NA	36.3	Desert Shrew
Cobalt	41.6	Desert Shrew	13	Plant	13	Plant
Copper	20.6	Cactus Wren	70	Plant	20.6	Cactus Wren
Lead	0.0166	Red-tailed Hawk	120	Plant	0.0166	Red-tailed Hawk
Manganese	NA	NA	220	Plant	220	Plant
Mercury	0.0125	Cactus Wren	0.1	Invertebrate**	0.0125	Cactus Wren
Molybdenum	2.25	Desert Shrew	2	Plant*	2.25	Desert Shrew
Nickel	0.607	Desert Shrew	38	Plant	0.607	Desert Shrew
Selenium	0.177	Desert Shrew	0.52	Plant	0.177	Desert Shrew
Silver	5.15	Cactus Wren	560	Plant	5.15	Cactus Wren
Thallium	2.32	Desert Shrew	1	Plant*	2.32	Desert Shrew
Vanadium	13.9	Cactus Wren	2	Plant	13.9	Cactus Wren
Zinc	0.164	Desert Shrew	120	Invertebrate	0.164	Desert Shrew
LMW PAHs	39.7	Cactus Wren	10	Plant	10	Plant
HMW PAHs	1.16	Desert Shrew	1.2	Plant	1.16	Desert Shrew

Notes:

*Confidence in this benchmark is low due to the low number of studies on which it is based or other factors. The soil type and test species (typically agricultural) may also vary significantly from site-specific conditions, or the toxic effects may be uncertain.

**Confidence in this benchmark is low due to the low number of studies on which it is based or other factors. The tests were conducted with earthworms.

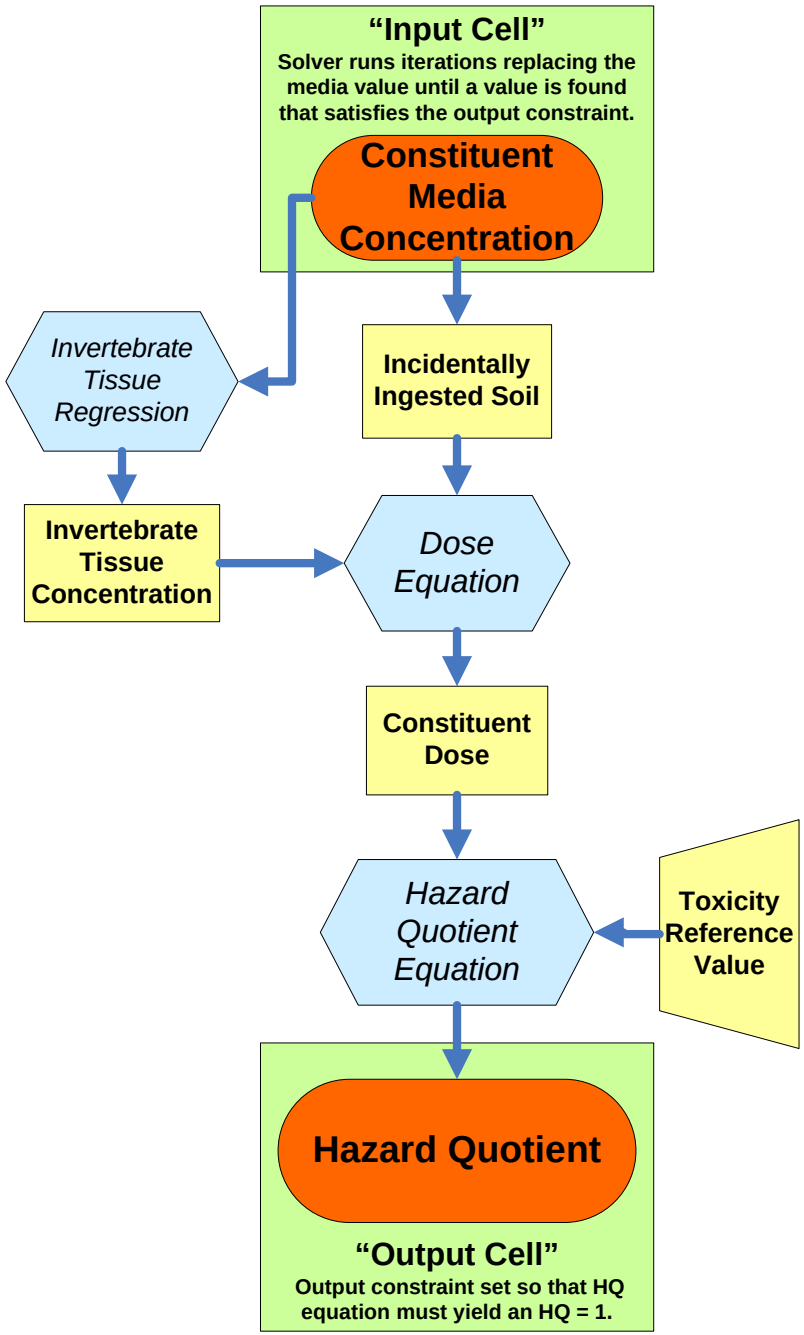
a. The final soil ECV selected based on minimum of soil ECVs based on plants and invertebrates and wildlife. If the minimum soil ECV was based toxicity valu low confidence, then the next minimum soil ECV was selected.

ECV - ecological comparison value
HMW PAHs - high molecular weight polycyclic aromatic hydrocarbons
LMW PAHs - low molecular weight polycyclic aromatic hydrocarbons
mg/kg dw - miligrams per kilogram dry weight
NA - not available

ARCADIS

Figures

Figure 1. Diagram Depicting ECV Derivation Methodology for the Desert Shrew



Formulae and Variables Description

Invertebrate Tissue Regression Equation

$$\ln(C_{tissue}) = a + b[\ln(C_{soil})] \therefore C_{tissue} = e^{a} \times (C_{soil})^{b}$$

Dose Equation

$$Dose = \frac{((C_{soil} \times SIR) + (C_{soil} \times BAF \times FIR)) \times SUF}{BW}$$

Hazard Quotient Equation

$$HQ = \frac{Dose}{TRV}$$

ECV Equation

$$ECV = C_{Soil} = \frac{HQ \times TRV \times BW}{(SIR + [FIR \times BAF]) \times SUF}$$

Where:

C_{tissue}	= concentration of constituent in biota or tissue (milligrams of constituent per kilogram tissue [mg/kg tissue])
a	= compound specific regression equation constant (unitless)
b	= compound specific regression equation constant (unitless)
C_{soil}	= concentration of constituent in exposure soil (mg/kg soil)
Dose	= daily exposure dose of constituent resulting from ingestion of media and invertebrates (milligrams per kilogram body weight per day [mg/kgBW-day])
SIR	= soil ingestion rate (kilograms soil per day [kg soil/day])
BAF	= bioaccumulation factor (kg soil/kg tissue)
FIR	= food or biota ingestion rate (kilograms tissue per day [kg tissue/ day])
SUF	= site use factor (unitless)
BW	= body weight of receptor (kilograms [kgBW])
HQ	= hazard quotient (unitless); set at target of 1
TRV	= toxicity reference value (milligrams per kilogram body weight per day)
ECV	= ecological comparison value (mg/kg soil)

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Attachment 1

Table A-1
Ecological Comparison Values Based on Gambel's Quail and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	NA	NA	4.1E+02	6.5E+02	NA	NA	NA	NA	2.5E+02	1.3E+03	4.8E+02	2.8E+03	NA	NA
Plant tissue	NA	NA	1.5E+01	2.5E+01	NA	NA	NA	NA	1.3E+01	3.1E+01	2.0E+01	1.2E+02	NA	NA
Invertebrate tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Prey (mammal) tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	ln(Cp) = 0.938 * ln(Cs) - 3.233		3.8E-02		1.6E-01		ln(Cp) = 0.7345 * ln(Cs) - 0.5361		ln(Cp) = 0.546 * ln(Cs) - 0.475		4.1E-02		4.1E-02	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	NA	NA	2.2E+00	3.5E+00	NA	NA	NA	NA	1.5E+00	6.4E+00	2.7E+00	1.6E+01	NA	NA
HQ	NA	NA	1.0E+00	1.0E+00	NA	NA	NA	NA	1.0E+00	1.0E+00	1.0E+00	1.0E+00	NA	NA

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.00649	kg tissue/day
Soil Ingestion Rate (SIR)	0.0006750	kg soil/day
Plant Ingestion Fraction (F_{food})	100%	Percent
Invertebrate Ingestion Fraction (F_{food})	0%	Percent
Mammal Ingestion Fraction (F_{food})	0%	Percent
Home Range	35.7	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	0.1693	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 3), respectively.

ECV	ecological comparison value for soil.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kgBW-day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-1
Ecological Comparison Values Based on Gambel's Quail and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	1.8E+03	4.3E+03	7.6E+02	2.6E+03	3.4E+02	7.2E+02	3.2E+00	2.5E+01	2.6E+02	2.6E+03	1.4E+03	4.1E+03	1.0E+01	1.9E+01
Plant tissue	1.3E+01	3.2E+01	2.7E+01	4.3E+01	7.0E+00	1.1E+01	6.9E-01	2.1E+00	6.4E+01	6.5E+02	2.5E+01	5.5E+01	6.5E+00	1.3E+01
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	7.5E-03		ln(Cp) = 0.394 * ln(Cs) + 0.668		ln(Cp) = 0.561 * ln(Cs) - 1.328		ln(Cp) = 0.544 * ln(Cs) - 0.996		2.5E-01		ln(Cp) = 0.748 * ln(Cs) - 2.223		ln(Cp) = 1.104 * ln(Cs) - 0.677	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	7.6E+00	1.8E+01	4.1E+00	1.2E+01	1.6E+00	3.3E+00	3.9E-02	1.8E-01	3.5E+00	3.5E+01	6.7E+00	1.9E+01	2.9E-01	5.8E-01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-1
Ecological Comparison Values Based on Gambel's Quail and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs												
Soil	4.5E+02	4.5E+03	8.5E+01	8.5E+02	8.2E+01	1.6E+02	9.3E+03	2.9E+04	5.6E+03	5.7E+04	1.1E+03	1.2E+04
Plant tissue	6.3E+00	6.3E+01	3.4E-01	3.4E+00	4.0E-01	8.0E-01	7.6E+02	1.4E+03	1.3E+01	3.9E+01	1.4E+02	1.3E+03
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	1.4E-02		4.0E-03		4.9E-03		ln(Cp) = 0.554 * ln(Cs) + 1.575		ln(Cp) = 0.4544 * ln(Cs)-1.3205		ln(Cp) = 0.9469 * ln(Cs)-1.7026	
Soil-to-Invertebrates	--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	2.0E+00	2.0E+01	3.5E-01	3.5E+00	3.4E-01	6.9E-01	6.6E+01	1.7E+02	2.3E+01	2.3E+02	1.0E+01	1.0E+02
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-2
Ecological Comparison Values Based on the Cactus Wren and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	NA	NA	7.6E+01	1.3E+02	NA	NA	NA	NA	9.5E-01	5.9E+00	3.6E+01	2.1E+02	NA	NA
Plant tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Invertebrate tissue	NA	NA	5.1E+00	7.4E+00	NA	NA	NA	NA	7.9E+00	3.4E+01	1.1E+01	6.5E+01	NA	NA
Prey (mammal) tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	1.0E+00		ln(Ci) = 0.706 * ln(Cs) - 1.421		9.1E-02		4.5E-02		ln(Ci) = 0.795 * ln(Cs) + 2.114		3.1E-01		3.1E-01	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	NA	NA	2.2E+00	3.6E+00	NA	NA	NA	NA	1.5E+00	6.4E+00	2.7E+00	1.6E+01	NA	NA
HQ	NA	NA	1.0E+00	1.0E+00	NA	NA	NA	NA	1.0E+00	1.0E+00	1.0E+00	1.0E+00	NA	NA

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.00713	kg tissue/day
Soil Ingestion Rate (SIR)	0.0006631	kg soil/day
Plant Ingestion Fraction (F_{food})	0%	Percent
Invertebrate Ingestion Fraction (F_{food})	100%	Percent
Mammal Ingestion Fraction (F_{food})	0%	Percent
Home Range	4.8	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	0.0389	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 3), respectively.

ECV	ecological comparison value for soil.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kgBW-day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-2
Ecological Comparison Values Based on the Cactus Wren and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	1.9E+02	4.6E+02	3.6E+01	1.1E+02	1.6E+01	3.6E+01	1.3E-02	9.1E-01	3.0E+01	3.0E+02	3.2E+01	8.8E+01	1.8E+00	4.4E+00
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	2.4E+01	5.7E+01	1.9E+01	5.6E+01	7.4E+00	1.4E+01	2.1E-01	9.0E-01	1.6E+01	1.6E+02	3.4E+01	9.3E+01	1.4E+00	2.7E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	1.2E-01		5.2E-01		ln(Ci) = 0.807 * ln(Cs) - 0.218		ln(Ci) = 0.3369 * ln(Cs) - 0.078		5.5E-01		1.1E+00		ln(Ci) = 0.733 * ln(Cs) - 0.075	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	7.6E+00	1.8E+01	4.0E+00	1.2E+01	1.6E+00	3.3E+00	3.9E-02	1.8E-01	3.5E+00	3.5E+01	6.7E+00	1.9E+01	2.9E-01	5.8E-01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-2
Ecological Comparison Values Based on the Cactus Wren and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs												
Soil	5.2E+00	5.2E+01	3.0E+00	3.0E+01	1.4E+01	2.8E+01	7.6E+01	1.0E+03	4.0E+01	4.0E+02	2.0E+01	2.0E+02
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	1.1E+01	1.1E+02	1.6E+00	1.6E+01	5.8E-01	1.2E+00	3.5E+02	8.4E+02	1.2E+02	1.2E+03	5.3E+01	5.3E+02
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	--		--		--		--		--		--	
Soil-to-Invertebrates	2.0E+00		5.5E-01		4.2E-02		ln(Ci) = 0.328 * ln(Cs) + 4.449		3.0E+00		2.6E+00	
Soil-to-Mammals	--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	2.0E+00	2.0E+01	3.5E-01	3.5E+00	3.4E-01	6.9E-01	6.6E+01	1.7E+02	2.3E+01	2.3E+02	1.0E+01	1.0E+02
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-3
Ecological Comparison Values Based on Red Tailed Hawk and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs														
Soil	NA	NA	1.8E+03	2.8E+03	NA	NA	NA	NA	8.4E+02	4.6E+03	5.9E+02	5.2E+03	NA	NA
Plant tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Invertebrate tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Prey (mammal) tissue	NA	NA	3.6E+00	5.3E+00	NA	NA	NA	NA	6.8E+00	1.5E+01	2.5E+01	1.2E+02	NA	NA
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	0.05 * Cd		ln(Cm) = 0.8188 * ln(Cs) -4.8471		0.0075 * Cd		0.05 * Cd		ln(Cm) = 0.4723 * ln(Cs) - 1.2571		ln(Cm) = 0.7338 * ln(Cs) - 1.4599		ln(Cm) = 0.7338 * ln(Cs) - 1.4599	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	NA	NA	2.2E+00	3.6E+00	NA	NA	NA	NA	1.5E+00	6.4E+00	2.7E+00	1.6E+01	NA	NA
HQ	NA	NA	1.0E+00	1.0E+00	NA	NA	NA	NA	1.0E+00	1.0E+00	1.0E+00	1.0E+00	NA	NA

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.08990	kg tissue/day
Soil Ingestion Rate (SIR)	0.0012586	kg soil/day
Plant Ingestion Fraction (F_{food})	0%	Percent
Invertebrate Ingestion Fraction (F_{food})	0%	Percent
Mammal Ingestion Fraction (F_{food})	100%	Percent
Home Range	2471	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	1.134	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 3), respectively.

ECV	ecological comparison value for soil.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kgBW-day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-3
Ecological Comparison Values Based on Red Tailed Hawk and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum[4] mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs														
Soil	9.0E+02	1.8E+03	2.0E+03	8.9E+03	3.9E+02	1.2E+03	2.4E+00	1.1E+01	2.5E+02	2.5E+03	3.5E+03	1.2E+04	5.2E+01	1.9E+02
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	8.3E+01	2.1E+02	2.3E+01	2.9E+01	1.5E+01	2.5E+01	4.6E-01	2.1E+00	4.1E+01	4.1E+02	3.5E+01	6.3E+01	2.9E+00	4.7E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	ln(Cm) = 1.307 * ln(Cs) - 4.4669		ln(Cm) = 0.1444 * ln(Cs) + 2.042		n(Cm) = 0.4422 * ln(Cs) + 0.0761		1.9E-01		0.006 * 50 * Cd		ln(Cm) = 0.4658 * ln(Cs) - 0.2462		n(Cm) = 0.3764 * ln(Cs) - 0.415	
Dose Calulations for Target Hazard Quotients (HQs)[2]					**0.0E+00**									
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	7.6E+00	1.8E+01	4.1E+00	1.2E+01	1.6E+00	3.3E+00	3.9E-02	1.8E-01	3.5E+00	3.5E+01	6.7E+00	1.9E+01	2.9E-01	5.8E-01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-3
Ecological Comparison Values Based on Red Tailed Hawk and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs												
Soil	1.4E+03	1.4E+04	3.5E+01	3.5E+02	1.6E+02	3.3E+02	4.8E+04	1.4E+05	2.1E+04	2.1E+05	9.0E+03	9.0E+04
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	5.7E+00	5.7E+01	3.9E+00	3.9E+01	2.0E+00	4.1E+00	1.7E+02	1.8E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--	
Soil-to-Mammals	4.0E-03		1.1E-01		1.2E-02		ln(Cm) = 0.0706 * ln(Cs) + 4.3632		0.0E+00		0.0E+00	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	2.0E+00	2.0E+01	3.5E-01	3.5E+00	3.4E-01	6.9E-01	6.6E+01	1.7E+02	2.3E+01	2.3E+02	1.0E+01	1.0E+02
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-4
Ecological Comparison Values Based on Desert Shrew and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	2.8E-01	2.8E+00	8.9E+01	1.6E+02	2.3E+03	3.7E+03	4.0E+01	4.8E+01	3.7E-01	6.8E+00	3.6E+01	1.5E+02	1.4E+02	5.9E+02
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.8E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	2.8E-01	2.8E+00	5.7E+00	8.8E+00	2.1E+02	3.3E+02	1.8E+00	2.1E+00	3.8E+00	3.8E+01	1.1E+01	4.4E+01	42.724563	1.8E+02
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	1.0E+00		ln(Ci) = 0.706 * ln(Cs) - 1.421		9.1E-02		4.5E-02		ln(Ci) = 0.795 * ln(Cs) + 2.114		3.1E-01		3.1E-01	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	5.9E-02	5.9E-01	1.5E+00	2.4E+00	5.2E+01	8.3E+01	5.3E-01	6.3E-01	7.7E-01	7.7E+00	2.4E+00	9.6E+00	9.2E+00	3.9E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR)	0.00102	kg tissue/day
Soil Ingestion Rate (SIR)	0.0000203	kg soil/day
Plant Ingestion Fraction (F_{food})	0%	Percent
Invertebrate Ingestion Fraction (F_{food})	100%	Percent
Mammal Ingestion Fraction (F_{food})	0%	Percent
Home Range	0.1	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	0.005	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 3), respectively.

ECV	ecological comparison value for soil.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kgBW-day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-4
Ecological Comparison Values Based on Desert Shrew and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum mg/kg (dw)		Nickel mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs												
Soil	2.5E+02	6.5E+02	8.7E+01	1.4E+02	6.0E+01	1.3E+02	2.1E+00	5.9E+02	2.2E+00	2.2E+01	7.8E+00	1.6E+01
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	3.1E+01	8.0E+01	4.5E+01	7.5E+01	2.2E+01	4.1E+01	1.2E+00	7.9E+00	1.2E+00	1.2E+01	8.2E+00	1.6E+01
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	--		--		--		--		--		--	
Soil-to-Invertebrates	1.2E-01		5.2E-01		ln(Ci) = 0.807 * ln(Cs) - 0.218		ln(Ci) = 0.3369 * ln(Cs) - 0.078		5.5E-01		1.1E+00	
Soil-to-Mammals	--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	7.3E+00	1.9E+01	9.4E+00	1.6E+01	4.7E+00	8.9E+00	2.5E-01	4.0E+00	2.6E-01	2.6E+00	1.7E+00	3.4E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-4
Ecological Comparison Values Based on Desert Shrew and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Selenium mg/kg (dw)		Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	1.3E+00	2.2E+00	2.1E+01	2.1E+02	2.3E+00	6.9E+00	3.3E+02	6.6E+02	8.7E+01	4.7E+03	1.1E+02	5.3E+02	1.2E+00	5.8E+00
Plant tissue	6.7E-01	1.2E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	2.1E-01	9.6E-01
Invertebrate tissue	1.1E+00	1.7E+00	4.3E+01	4.3E+02	2.3E+00	6.9E+00	1.4E+01	2.8E+01	3.7E+02	1.4E+03	3.2E+02	1.6E+03	3.0E+00	1.5E+01
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	ln(Ci) = 0.733 * ln(Cs) - 0.075		2.0E+00		5.5E-01		4.2E-02		ln(Ci) = 0.328 * ln(Cs) + 4.449		3.0E+00		2.6E+00	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	2.3E-01	3.5E-01	8.8E+00	8.8E+01	4.8E-01	1.4E+00	4.2E+00	8.3E+00	7.5E+01	3.0E+02	6.6E+01	3.3E+02	6.1E-01	3.1E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-5
Ecological Comparison Values Based on Kangaroo Rat and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	1.2E+01	1.4E+02	2.9E+02	4.6E+02	3.5E+03	5.6E+03	2.3E+01	2.9E+01	8.9E+01	2.2E+03	4.5E+02	1.8E+03	1.7E+03	7.3E+03
Plant tissue	4.2E-01	3.9E+00	1.1E+01	1.7E+01	5.5E+02	8.7E+02	5.9E+00	7.0E+00	7.2E+00	4.1E+01	1.8E+01	7.4E+01	7.1E+01	3.0E+02
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	ln(Cp) = 0.938 * ln(Cs) - 3.233		3.8E-02		1.6E-01		ln(Cp) = 0.7345 * ln(Cs) - 0.5361		ln(Cp) = 0.546 * ln(Cs) - 0.475		4.1E-02		4.1E-02	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	5.9E-02	5.9E-01	1.5E+00	2.3E+00	5.2E+01	8.3E+01	5.3E-01	6.3E-01	7.7E-01	7.7E+00	2.4E+00	9.6E+00	9.2E+00	3.9E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.00282	kg tissue/day
Soil Ingestion Rate (SIR)	0.0000677	kg soil/day
Plant Ingestion Fraction (F_{food})	100%	Percent
Invertebrate Ingestion Fraction (F_{food})	0%	Percent
Mammal Ingestion Fraction (F_{food})	0%	Percent
Home Range	0.13	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	0.0343	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 3), respectively.

ECV	ecological comparison value for soil.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kgBW-day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-5
Ecological Comparison Values Based on Kangaroo Rat and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum mg/kg (dw)		Nickel mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs												
Soil	2.8E+03	7.3E+03	2.7E+03	5.3E+03	1.7E+03	3.4E+03	3.0E+01	1.3E+03	1.2E+01	1.2E+02	4.4E+02	9.6E+02
Plant tissue	2.1E+01	5.4E+01	4.4E+01	5.7E+01	1.7E+01	2.6E+01	2.3E+00	1.8E+01	2.9E+00	2.9E+01	1.0E+01	1.8E+01
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	7.5E-03		ln(Cp) = 0.394 * ln(Cs) + 0.668		ln(Cp) = 0.561 * ln(Cs) - 1.328		ln(Cp) = 0.544 * ln(Cs) - 0.996		2.5E-01		ln(Cp) = 0.748 * ln(Cs) - 2.223	
Soil-to-Invertebrates	--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	7.3E+00	1.9E+01	9.0E+00	1.5E+01	4.7E+00	8.9E+00	2.5E-01	4.0E+00	2.6E-01	2.6E+00	1.7E+00	3.4E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-5
Ecological Comparison Values Based on Kangaroo Rat and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Selenium mg/kg (dw)		Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	4.1E+00	6.0E+00	2.7E+03	2.7E+04	2.1E+02	6.2E+02	1.8E+03	3.5E+03	8.3E+03	6.1E+04	3.2E+04	1.6E+05	4.3E+01	2.3E+02
Plant tissue	2.4E+00	3.7E+00	3.8E+01	3.8E+02	8.3E-01	2.5E+00	8.5E+00	1.7E+01	7.2E+02	2.2E+03	3.0E+01	6.2E+01	6.4E+00	3.2E+01
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	ln(Cp) = 1.104 * ln(Cs) - 0.677		1.4E-02		4.0E-03		4.9E-03		n(Cp) = 0.554 * ln(Cs) + 1.575		ln(Cp) = 0.4544 * ln(Cs)-1.3205		ln(Cp) = 0.9469 * ln(Cs)-1.7026	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	2.1E-01	3.1E-01	8.4E+00	8.4E+01	4.8E-01	1.4E+00	4.2E+00	8.3E+00	7.5E+01	3.0E+02	6.6E+01	3.3E+02	6.2E-01	3.1E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-6
Ecological Comparison Values Based on Desert Kit Fox and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony[4] mg/kg (dw)		Arsenic mg/kg (dw)		Barium[4] mg/kg (dw)		Beryllium[4] mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs														
Soil	2.1E+01	2.1E+02	9.7E+02	1.6E+03	5.1E+04	8.1E+04	5.0E+02	5.9E+02	5.7E+02	7.1E+03	1.1E+03	5.3E+03	5.0E+03	2.5E+04
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	1.1E+00	1.1E+01	2.2E+00	3.2E+00	3.5E+01	5.6E+01	1.1E+00	1.3E+00	5.7E+00	1.9E+01	3.8E+01	1.2E+02	1.2E+02	3.9E+02
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	0.05 * Cd		ln(Cm) = 0.8188 * ln(Cs) -8.4471		0.0075 * Cd		0.05 * Cd		ln(Cm) = 0.4723 * ln(Cs) - 1.2571		ln(Cm) = 0.7338 * ln(Cs) - 1.4599		ln(Cm) = 0.7338 * ln(Cs) - 1.4599	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	5.9E-02	5.9E-01	1.0E+00	1.7E+00	5.2E+01	8.3E+01	5.3E-01	6.3E-01	7.7E-01	7.7E+00	2.4E+00	9.6E+00	9.2E+00	3.9E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.07020	kg tissue/day
Soil Ingestion Rate (SIR)	0.0019656	kg soil/day
Plant Ingestion Fraction (F_{food})	0%	Percent
Invertebrate Ingestion Fraction (F_{food})	0%	Percent
Mammal Ingestion Fraction (F_{food})	100%	Percent
Home Range	3039	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	1.985	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 3), respectively.

ECV	ecological comparison value for soil.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kgBW-day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-6
Ecological Comparison Values Based on Desert Kit Fox and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum[4] mg/kg (dw)		Nickel mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs												
Soil	1.5E+03	3.2E+03	4.7E+03	8.4E+03	3.4E+03	7.0E+03	3.2E+01	5.1E+02	3.8E+01	3.8E+02	1.0E+03	2.4E+03
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	1.6E+02	4.4E+02	2.6E+01	2.8E+01	3.9E+01	5.4E+01	6.2E+00	9.9E+01	6.3E+00	6.3E+01	2.0E+01	2.9E+01
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--	
Soil-to-Mammals	ln(Cm) = 1.307 * ln(Cs) - 4.4669		ln(Cm) = 0.1444 * ln(Cs) + 2.042		ln(Cm) = 0.4422 * ln(Cs) + 0.0761		1.9E-01		0.006 * 50 * Cd		ln(Cm) = 0.4658 * ln(Cs) - 0.2462	
Dose Calulations for Target Hazard Quotients (HQs)[2]					**0.0E+00**							
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	7.3E+00	1.9E+01	5.6E+00	9.3E+00	4.7E+00	8.9E+00	2.5E-01	4.0E+00	2.6E-01	2.6E+00	1.7E+00	3.4E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-6
Ecological Comparison Values Based on Desert Kit Fox and Proposed TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Selenium mg/kg (dw)		Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs														
Soil	4.5E+01	8.9E+01	5.3E+03	5.3E+04	9.7E+01	2.9E+02	2.9E+03	5.8E+03	7.0E+04	2.9E+05	6.6E+04	3.3E+05	6.2E+02	3.1E+03
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	2.8E+00	3.6E+00	2.1E+01	2.1E+02	1.1E+01	3.2E+01	3.6E+01	7.2E+01	1.7E+02	1.9E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	ln(Cm) = 0.3764 * ln(Cs) - 0.4158		4.0E-03		1.1E-01		1.2E-02		ln(Cm) = 0.0706 * ln(Cs) + 4.3632		0.0E+00		0.0E+00	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Dose = TRV	1.4E-01	2.2E-01	6.0E+00	6.0E+01	4.8E-01	1.4E+00	4.2E+00	8.3E+00	7.5E+01	3.0E+02	6.6E+01	3.3E+02	6.2E-01	3.1E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-7
Ecological Comparison Values Based on the Gambel's Quail and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	NA	NA	1.0E+03	4.1E+03	NA	NA	NA	NA	5.3E+00	2.2E+03	4.8E+02	2.8E+03	NA	NA
Plant tissue	NA	NA	3.8E+01	1.5E+02	NA	NA	NA	NA	1.5E+00	4.2E+01	2.0E+01	1.2E+02	NA	NA
Invertebrate tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Prey (mammal) tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	ln(Cp) = 0.938 * ln(Cs) - 3.233		3.8E-02		1.6E-01		ln(Cp) = 0.7345 * ln(Cs) - 0.5361		ln(Cp) = 0.546 * ln(Cs) - 0.475		4.1E-02		4.1E-02	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	NA	NA	5.5E+00	2.2E+01	NA	NA	NA	NA	8.0E-02	1.0E+01	2.7E+00	1.6E+01	NA	NA
HQ	NA	NA	1.0E+00	1.0E+00	NA	NA	NA	NA	1.0E+00	1.0E+00	1.0E+00	1.0E+00	NA	NA

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.00649	kg tissue/day
Soil Ingestion Rate (SIR)	0.0006750	kg soil/day
Plant Ingestion Fraction (F_{food})	100%	Percent
Invertebrate Ingestion Fraction (F_{food})	0%	Percent
Mammal Ingestion Fraction (F_{food})	0%	Percent
Home Range	35.7	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	0.1693	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 4), respectively.

ECV	ecological comparison value for soil.
DTSC	Department of Toxic Substances Control.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kg-bw/day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-7
Ecological Comparison Values Based on the Gambel's Quail and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	1.8E+03	4.3E+03	3.8E+02	1.2E+04	9.8E-01	2.0E+03	3.2E+00	2.5E+01	2.6E+02	2.6E+03	2.8E+02	1.3E+04	8.2E+00	2.9E+01
Plant tissue	1.3E+01	3.2E+01	2.0E+01	8.0E+01	2.6E-01	1.9E+01	6.9E-01	2.1E+00	6.4E+01	6.5E+02	7.3E+00	1.3E+02	5.2E+00	2.1E+01
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	7.5E-03		ln(Cp) = 0.394 * ln(Cs) + 0.668		ln(Cp) = 0.561 * ln(Cs) - 1.328		ln(Cp) = 0.544 * ln(Cs) - 0.996		2.5E-01		ln(Cp) = 0.748 * ln(Cs) - 2.223		ln(Cp) = 1.104 * ln(Cs) - 0.677	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	7.6E+00	1.8E+01	2.3E+00	5.2E+01	1.4E-02	8.8E+00	3.9E-02	1.8E-01	3.5E+00	3.5E+01	1.4E+00	5.6E+01	2.3E-01	9.3E-01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-7
Ecological Comparison Values Based on the Gambel's Quail and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs												
Soil	4.5E+02	4.5E+03	8.5E+01	8.5E+02	8.2E+01	1.6E+02	1.6E+03	2.9E+04	5.6E+03	5.7E+04	1.1E+03	1.2E+04
Plant tissue	6.3E+00	6.3E+01	3.4E-01	3.4E+00	4.0E-01	8.0E-01	2.9E+02	1.4E+03	1.3E+01	3.9E+01	1.4E+02	1.3E+03
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	1.4E-02		4.0E-03		4.9E-03		ln(Cp) = 0.554 * ln(Cs) + 1.575		ln(Cp) = 0.4544 * ln(Cs)-1.3205		ln(Cp) = 0.9469 * ln(Cs)-1.7026	
Soil-to-Invertebrates	--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	2.0E+00	2.0E+01	3.5E-01	3.5E+00	3.4E-01	6.9E-01	1.7E+01	1.7E+02	2.3E+01	2.3E+02	1.0E+01	1.0E+02
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-8
Ecological Comparison Values Based on the Cactus Wren and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	NA	NA	2.1E+02	9.6E+02	NA	NA	NA	NA	2.5E-02	1.1E+01	3.6E+01	2.1E+02	NA	NA
Plant tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Invertebrate tissue	NA	NA	1.1E+01	3.1E+01	NA	NA	NA	NA	4.3E-01	5.6E+01	1.1E+01	6.5E+01	NA	NA
Prey (mammal) tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	1.0E+00		ln(Ci) = 0.706 * ln(Cs) - 1.421		9.1E-02		4.5E-02		ln(Ci) = 0.795 * ln(Cs) + 2.114		3.1E-01		3.1E-01	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	NA	NA	5.5E+00	2.2E+01	NA	NA	NA	NA	8.0E-02	1.0E+01	2.7E+00	1.6E+01	NA	NA
HQ	NA	NA	1.0E+00	1.0E+00	NA	NA	NA	NA	1.0E+00	1.0E+00	1.0E+00	1.0E+00	NA	NA

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.00713	kg tissue/day
Soil Ingestion Rate (SIR)	0.0006631	kg soil/day
Plant Ingestion Fraction (F_{food})	0%	Percent
Invertebrate Ingestion Fraction (F_{food})	100%	Percent
Mammal Ingestion Fraction (F_{food})	0%	Percent
Home Range	4.8	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	0.0389	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 4), respectively.

ECV	ecological comparison value for soil.
DTSC	Department of Toxic Substances Control.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kg-bw/day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-8
Ecological Comparison Values Based on the Cactus Wren and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	1.9E+02	4.6E+02	2.1E+01	4.7E+02	5.0E-02	1.2E+02	1.3E-02	9.1E-01	3.0E+01	3.0E+02	6.5E+00	2.7E+02	1.3E+00	8.1E+00
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	2.4E+01	5.7E+01	1.1E+01	2.4E+02	7.2E-02	3.7E+01	2.1E-01	9.0E-01	1.6E+01	1.6E+02	6.9E+00	2.8E+02	1.1E+00	4.3E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	1.2E-01		5.2E-01		ln(Ci) = 0.807 * ln(Cs) - 0.218		ln(Ci) = 0.3369 * ln(Cs) - 0.078		5.5E-01		1.1E+00		ln(Ci) = 0.733 * ln(Cs) - 0.075	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	7.6E+00	1.8E+01	2.3E+00	5.2E+01	1.4E-02	8.8E+00	3.9E-02	1.8E-01	3.5E+00	3.5E+01	1.4E+00	5.6E+01	2.3E-01	9.3E-01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-8
Ecological Comparison Values Based on the Cactus Wren and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs												
Soil	5.2E+00	5.2E+01	3.0E+00	3.0E+01	1.4E+01	2.8E+01	1.3E+00	1.1E+03	4.0E+01	4.0E+02	2.0E+01	2.0E+02
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	1.1E+01	1.1E+02	1.6E+00	1.6E+01	5.8E-01	1.2E+00	9.4E+01	8.4E+02	1.2E+02	1.2E+03	5.3E+01	5.3E+02
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	--		--		--		--		--		--	
Soil-to-Invertebrates	2.0E+00		5.5E-01		4.2E-02		ln(Ci) = 0.328 * ln(Cs) + 4.449		3.0E+00		2.6E+00	
Soil-to-Mammals	--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	2.0E+00	2.0E+01	3.5E-01	3.5E+00	3.4E-01	6.9E-01	1.7E+01	1.7E+02	2.3E+01	2.3E+02	1.0E+01	1.0E+02
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-9
Ecological Comparison Values Based on the Red-Tailed Hawk and on DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs														
Soil	NA	NA	4.4E+03	1.8E+04	NA	NA	NA	NA	1.0E+01	8.0E+03	5.9E+02	5.2E+03	NA	NA
Plant tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Invertebrate tissue	NA	NA	0.0E+00	0.0E+00	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	NA	NA
Prey (mammal) tissue	NA	NA	7.6E+00	2.4E+01	NA	NA	NA	NA	8.6E-01	2.0E+01	2.5E+01	1.2E+02	NA	NA
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	0.05 * Cd		ln(Cm) = 0.8188 * ln(Cs) -4.8471		0.0075 * Cd		0.05 * Cd		ln(Cm) = 0.4723 * ln(Cs) - 1.2571		ln(Cm) = 0.7338 * ln(Cs) - 1.4599		ln(Cm) = 0.7338 * ln(Cs) - 1.4599	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	NA	NA	5.5E+00	2.2E+01	NA	NA	NA	NA	8.0E-02	1.0E+01	2.7E+00	1.6E+01	NA	NA
HQ	NA	NA	1.0E+00	1.0E+00	NA	NA	NA	NA	1.0E+00	1.0E+00	1.0E+00	1.0E+00	NA	NA

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.08990	kg tissue/day
Soil Ingestion Rate (SIR)	0.0012586	kg soil/day
Plant Ingestion Fraction (F_{food})	0%	Percent
Invertebrate Ingestion Fraction (F_{food})	0%	Percent
Mammal Ingestion Fraction (F_{food})	100%	Percent
Home Range	2471	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	1.134	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 4), respectively.

ECV	ecological comparison value for soil.
DTSC	Department of Toxic Substances Control.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kg-bw/day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-9
Ecological Comparison Values Based on the Red-Tailed Hawk and on DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum[4] mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs														
Soil	9.0E+02	1.8E+03	6.7E+02	4.5E+04	1.7E-02	4.7E+03	2.4E+00	1.1E+01	1.4E+02	1.4E+03	3.7E+02	4.3E+04	3.3E+01	3.9E+02
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	8.3E+01	2.1E+02	2.0E+01	3.6E+01	1.8E-01	4.5E+01	4.6E-01	2.1E+00	2.3E+01	2.3E+02	1.2E+01	1.1E+02	2.4E+00	6.2E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	ln(Cm) = 1.307 * ln(Cs) - 4.4669		ln(Cm) = 0.1444 * ln(Cs) + 2.042		ln(Cm) = 0.4422 * ln(Cs) + 0.0761		1.9E-01		0.006 * 50 * Cd		ln(Cm) = 0.4658 * ln(Cs) - 0.2462		ln(Cm) = 0.3764 * ln(Cs) - 0.4158	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	7.6E+00	1.8E+01	2.3E+00	5.2E+01	1.4E-02	8.8E+00	3.9E-02	1.8E-01	2.0E+00	2.0E+01	1.4E+00	5.6E+01	2.3E-01	9.3E-01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	5.7E-01	5.7E-01	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-9
Ecological Comparison Values Based on the Red-Tailed Hawk and on DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs												
Soil	1.4E+03	1.4E+04	3.5E+01	3.5E+02	1.6E+02	3.3E+02	5.2E+03	1.4E+05	2.1E+04	2.1E+05	9.0E+03	9.0E+04
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	5.7E+00	5.7E+01	3.9E+00	3.9E+01	2.0E+00	4.1E+00	1.4E+02	1.8E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--	
Soil-to-Mammals	4.0E-03		1.1E-01		1.2E-02		ln(Cm) = 0.0706 * ln(Cs) + 4.3632		0.0E+00		0.0E+00	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	2.0E+00	2.0E+01	3.5E-01	3.5E+00	3.4E-01	6.9E-01	1.7E+01	1.7E+02	2.3E+01	2.3E+02	1.0E+01	1.0E+02
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-10
Ecological Comparison Values Based on the Desert Shrew and on DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	2.8E-01	2.8E+00	1.1E+01	3.7E+02	2.3E+03	3.7E+03	4.0E+01	4.8E+01	1.5E-02	1.8E+00	3.6E+01	1.5E+02	1.4E+02	5.9E+02
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	8.5E-01	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	2.8E-01	2.8E+00	1.3E+00	1.6E+01	2.1E+02	3.3E+02	1.8E+00	2.1E+00	3.0E-01	1.3E+01	1.1E+01	4.4E+01	4.27E+01	1.8E+02
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	1.0E+00		ln(Ci) = 0.706 * ln(Cs) - 1.421		9.1E-02		4.5E-02		ln(Ci) = 0.795 * ln(Cs) + 2.114		3.1E-01		3.1E-01	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	5.9E-02	5.9E-01	3.2E-01	4.7E+00	5.2E+01	8.3E+01	5.3E-01	6.3E-01	6.0E-02	2.6E+00	2.4E+00	9.6E+00	9.2E+00	3.9E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.00102	kg tissue/day
Soil Ingestion Rate (SIR)	0.0000203	kg soil/day
Plant Ingestion Fraction (F_{food})	0%	Percent
Invertebrate Ingestion Fraction (F_{food})	100%	Percent
Mammal Ingestion Fraction (F_{food})	0%	Percent
Home Range	0.1	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	0.005	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.
2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).
3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).
4 Low and High ECVs based on low and high TRVs (from Table 4), respectively.

ECV ecological comparison value for soil.
DTSC Department of Toxic Substances Control.
dw dry weight.
High lowest-observed adverse effects level (LOAEL).
HMW PAHs high molecular weight polycyclic aromatic hydrocarbons.
kg kilograms.
kg/day kilograms per day.
LMW PAHs low molecular weight polycyclic aromatic hydrocarbons.
Low no-observed adverse effects level (NOAEL).
mg/kg milligrams per kilogram.
mg/kg-bw/day milligrams per kilogram body weight per day.
NA not available or not applicable.

Table A-10
Ecological Comparison Values Based on the Desert Shrew and on DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	4.2E+01	6.9E+02	2.5E+01	5.8E+03	9.0E+00	7.2E+03	2.1E+00	5.9E+02	2.2E+00	2.2E+01	6.1E-01	1.4E+02	1.8E-01	1.1E+01
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	5.1E+00	8.5E+01	1.3E+01	3.0E+03	4.7E+00	1.0E+03	1.2E+00	7.9E+00	1.2E+00	1.2E+01	6.4E-01	1.5E+02	2.4E-01	5.7E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	1.2E-01		5.2E-01		ln(Ci) = 0.807 * ln(Cs) - 0.218		ln(Ci) = 0.3369 * ln(Cs) - 0.078		5.5E-01		1.1E+00		ln(Ci) = 0.733 * ln(Cs) - 0.075	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	1.2E+00	2.0E+01	2.7E+00	6.3E+02	1.0E+00	2.4E+02	2.5E-01	4.0E+00	2.6E-01	2.6E+00	1.3E-01	3.2E+01	5.0E-02	1.2E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-10
Ecological Comparison Values Based on the Desert Shrew and on DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs												
Soil	2.1E+01	2.1E+02	4.1E+00	1.2E+01	3.3E+02	6.6E+02	1.6E-01	1.1E+04	8.0E+01	2.4E+02	2.5E+00	6.2E+01
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.3E-01	9.0E+00
Invertebrate tissue	4.3E+01	4.3E+02	2.3E+00	6.8E+00	1.4E+01	2.8E+01	4.7E+01	1.8E+03	2.4E+02	7.3E+02	6.4E+00	1.6E+02
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	--		--		--		--		--		--	
Soil-to-Invertebrates	2.0E+00		5.5E-01		4.2E-02		ln(Ci) = 0.328 * ln(Cs) + 4.449		3.0E+00		2.6E+00	
Soil-to-Mammals	--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	8.8E+00	8.8E+01	4.8E-01	1.4E+00	4.2E+00	8.3E+00	9.6E+00	4.1E+02	5.0E+01	1.5E+02	1.3E+00	3.3E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-11
Ecological Comparison Values for Merriam's Kangaroo Rat and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony mg/kg (dw)		Arsenic mg/kg (dw)		Barium mg/kg (dw)		Beryllium mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	1.2E+01	1.4E+02	6.3E+01	9.3E+02	3.5E+03	5.6E+03	2.3E+01	2.9E+01	1.2E+00	5.4E+02	4.5E+02	1.8E+03	1.7E+03	7.3E+03
Plant tissue	4.2E-01	3.9E+00	2.4E+00	3.5E+01	5.5E+02	8.7E+02	5.9E+00	7.0E+00	7.0E-01	1.9E+01	1.8E+01	7.4E+01	7.1E+01	3.0E+02
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	4.6E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	ln(Cp) = 0.938 * ln(Cs) - 3.233		3.8E-02		1.6E-01		ln(Cp) = 0.7345 * ln(Cs) - 0.5361		ln(Cp) = 0.546 * ln(Cs) - 0.475		4.1E-02		4.1E-02	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	5.9E-02	5.9E-01	3.2E-01	4.7E+00	5.2E+01	8.3E+01	5.3E-01	6.3E-01	6.0E-02	2.6E+00	2.4E+00	9.6E+00	9.2E+00	3.9E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.00282	kg tissue/day
Soil Ingestion Rate (SIR)	0.0000677	kg soil/day
Plant Ingestion Fraction (F_{food})	100%	Percent
Invertebrate Ingestion Fraction (F_{food})	0%	Percent
Mammal Ingestion Fraction (F_{food})	0%	Percent
Home Range	0.13	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	0.0343	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 4), respectively.

ECV	ecological comparison value for soil.
DTSC	Department of Toxic Substances Control.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kg-bw/day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-11
Ecological Comparison Values for Merriam's Kangaroo Rat and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs														
Soil	4.6E+02	7.7E+03	4.5E+02	3.1E+05	2.6E+02	1.1E+05	3.0E+01	1.3E+03	1.2E+01	1.2E+02	2.2E+01	1.1E+04	1.1E+00	2.0E+01
Plant tissue	3.5E+00	5.8E+01	2.2E+01	2.8E+02	6.0E+00	1.8E+02	2.3E+00	1.8E+01	2.9E+00	2.9E+01	1.1E+00	1.2E+02	5.8E-01	1.4E+01
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	7.5E-03		ln(Cp) = 0.394 * ln(Cs) + 0.668		ln(Cp) = 0.561 * ln(Cs) - 1.328		ln(Cp) = 0.544 * ln(Cs) - 0.996		2.5E-01		ln(Cp) = 0.748 * ln(Cs) - 2.223		ln(Cp) = 1.104 * ln(Cs) - 0.677	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	1.2E+00	2.0E+01	2.7E+00	6.3E+02	1.0E+00	2.4E+02	2.5E-01	4.0E+00	2.6E-01	2.6E+00	1.3E-01	3.2E+01	5.0E-02	1.2E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-11
Ecological Comparison Values for Merriam's Kangaroo Rat and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]	Low[4]	High[4]
Sitewide ECVs												
Soil	2.7E+03	2.7E+04	2.1E+02	6.2E+02	1.8E+03	3.5E+03	2.8E+02	9.4E+04	2.4E+04	7.4E+04	9.5E+01	2.8E+03
Plant tissue	3.8E+01	3.8E+02	8.3E-01	2.5E+00	8.5E+00	1.7E+01	1.1E+02	2.7E+03	2.6E+01	4.4E+01	1.4E+01	3.3E+02
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	1.4E-02		4.0E-03		4.9E-03		ln(Cp) = 0.554 * ln(Cs) + 1.575		ln(Cp) = 0.4544 * ln(Cs)-1.3205		ln(Cp) = 0.9469 * ln(Cs)-1.7026	
Soil-to-Invertebrates	--		--		--		--		--		--	
Soil-to-Mammals	--		--		--		--		--		--	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	8.4E+00	8.4E+01	4.8E-01	1.4E+00	4.2E+00	8.3E+00	9.6E+00	4.1E+02	5.0E+01	1.5E+02	1.3E+00	3.3E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-12
Ecological Comparison Values Based on the Desert Kit Fox and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Antimony[4] mg/kg (dw)		Arsenic mg/kg (dw)		Barium[4] mg/kg (dw)		Beryllium[4] mg/kg (dw)		Cadmium mg/kg (dw)		Chromium mg/kg (dw)		Hexavalent Chromium mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs														
Soil	2.1E+01	2.1E+02	2.9E+02	4.5E+03	4.1E+04	6.6E+04	1.9E+02	2.3E+02	1.9E+01	2.3E+03	1.1E+03	5.3E+03	5.0E+03	2.5E+04
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	1.1E+00	1.1E+01	8.2E-01	7.7E+00	2.8E+01	4.5E+01	4.3E-01	5.1E-01	1.2E+00	1.1E+01	3.8E+01	1.2E+02	1.2E+02	3.9E+02
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	0.05 * Cd		ln(Cm) = 0.8188 * ln(Cs) -4.8471		0.0075 * Cd		0.05 * Cd		ln(Cm) = 0.4723 * ln(Cs) - 1.2571		ln(Cm) = 0.7338 * ln(Cs) - 1.4599		ln(Cm) = 0.7338 * ln(Cs) - 1.4599	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	5.9E-02	5.9E-01	3.2E-01	4.7E+00	4.2E+01	6.7E+01	2.1E-01	2.4E-01	6.0E-02	2.6E+00	2.4E+00	9.6E+00	9.2E+00	3.9E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	8.1E-01	8.1E-01	3.9E-01	3.9E-01	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Exposure Paramater[3]	value	units
Food Ingestion Rate (FIR	0.07020	kg tissue/day
Soil Ingestion Rate (SIR)	0.0019656	kg soil/day
Plant Ingestion Fraction (F_{food})	0%	Percent
Invertebrate Ingestion Fraction (F_{food})	0%	Percent
Mammal Ingestion Fraction (F_{food})	100%	Percent
Home Range	3039	Acres
Site Use Factor (SUF)	1.00	Unitless
Body Weight (BW)	1.985	kgBW

Microsoft Solver used to calculate ECVs based one re-arranging the standard HQ equation (USEPA, 1997) below:

$$ECV = \frac{HQ \times TRV}{Dose} = \left(\frac{1 \times TRV \times BW}{SIR + (FIR \times BAF) \times SUF} \right)$$

Notes:

soil ECV.

1 bioaccumulation factors (BAFs; kilograms soil per kilogram tissue [kg soil/kg tissue]); from Table 2.

2 exposure parameters from Table 6-3 of the *Human Health and Ecological Risk Assessment Work Plan* (ARCADIS, 2008).

3 dose caluated for a target HQ of 1 (NOAEL and LOAEL based).

4 Low and High ECVs based on low and high TRVs (from Table 4), respectively.

ECV	ecological comparison value for soil.
DTSC	Department of Toxic Substances Control.
dw	dry weight.
High	lowest-observed adverse effects level (LOAEL).
HMW PAHs	high molecular weight polycyclic aromatic hydrocarbons.
kg	kilograms.
kg/day	kilograms per day.
LMW PAHs	low molecular weight polycyclic aromatic hydrocarbons.
Low	no-observed adverse effects level (NOAEL).
mg/kg	milligrams per kilogram.
mg/kg-bw/day	milligrams per kilogram body weight per day.
NA	not available or not applicable.

Table A-12
Ecological Comparison Values Based on the Desert Kit Fox and DTSC-Recommended TRVs

Technical Memorandum 3: Ecological Comparison Values for Metals and PAHs in Soil
PG&E Topock
Needles, California

Protective Media Concentrations (mg/kg)	Cobalt mg/kg (dw)		Copper mg/kg (dw)		Lead mg/kg (dw)		Mercury mg/kg (dw)		Molybdenum[4] mg/kg (dw)		Nickel mg/kg (dw)		Selenium mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]
Sitewide ECVs														
Soil	3.5E+02	3.4E+03	1.9E+03	6.4E+05	4.4E+02	2.3E+05	3.2E+01	5.1E+02	2.2E+01	2.2E+02	2.0E+01	2.9E+04	5.6E+00	9.2E+02
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	2.4E+01	4.7E+02	2.3E+01	5.3E+01	1.6E+01	2.6E+02	6.2E+00	9.9E+01	3.7E+00	3.7E+01	3.2E+00	9.3E+01	1.3E+00	8.6E+00
Bioaccumulation Factors (BAFs)[1]														
Soil-to-Plants	--		--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--		--	
Soil-to-Mammals	ln(Cm) = 1.307 * ln(Cs) - 4.4669		ln(Cm) = 0.1444 * ln(Cs) + 2.042		ln(Cm) = 0.4422 * ln(Cs) + 0.0761		1.9E-01		0.006 * 50 * Cd		ln(Cm) = 0.4658 * ln(Cs) - 0.2462		ln(Cm) = 0.3764 * ln(Cs) - 0.4158	
Dose Calulations for Target Hazard Quotients (HQs)[2]														
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	1.2E+00	2.0E+01	2.7E+00	6.3E+02	1.0E+00	2.4E+02	2.5E-01	4.0E+00	1.5E-01	1.5E+00	1.3E-01	3.2E+01	5.0E-02	1.2E+00
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	5.9E-01	5.9E-01	1.0E+00	1.0E+00	1.0E+00	1.0E+00

Table A-12
Ecological Comparison Values Based on the Desert Kit Fox and DTSC-Recommended TRVs

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Protective Media Concentrations (mg/kg)	Silver mg/kg (dw)		Thallium mg/kg (dw)		Vanadium mg/kg (dw)		Zinc mg/kg (dw)		LMW PAHs mg/kg (dw)		HMW PAHs mg/kg (dw)	
	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low[5]	High[5]	Low	High
Sitewide ECVs												
Soil	5.3E+03	5.3E+04	9.7E+01	2.9E+02	2.9E+03	5.8E+03	4.6E+03	4.1E+05	5.0E+04	1.5E+05	1.3E+03	3.3E+04
Plant tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Invertebrate tissue	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Prey (mammal) tissue	2.1E+01	2.1E+02	1.1E+01	3.2E+01	3.6E+01	7.2E+01	1.4E+02	2.0E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00
Bioaccumulation Factors (BAFs)[1]												
Soil-to-Plants	--		--		--		--		--		--	
Soil-to-Invertebrates	--		--		--		--		--		--	
Soil-to-Mammals	4.0E-03		1.1E-01		1.2E-02		ln(Cm) = 0.0706 * ln(Cs) + 4.3632		0.0E+00		0.0E+00	
Dose Calulations for Target Hazard Quotients (HQs)[2]												
	Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Dose = TRV	6.0E+00	6.0E+01	4.8E-01	1.4E+00	4.2E+00	8.3E+00	9.6E+00	4.1E+02	5.0E+01	1.5E+02	1.3E+00	3.3E+01
HQ	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00	1.0E+00