



Demonstrating the Value of Freeware Risk Assessment Tools: A Case Study from the Southeastern United States

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Abstract

Freeware software tools are readily available for use by professionals to conduct both Human Health Risk Assessments and Ecological Risk Assessments. A case study is presented, demonstrating the value of these tools. In this case study, a human health risk assessment was performed for a portion of a former industrial site in the southeastern United States. Potential risk was estimated for a range of exposure scenarios and exposure media for an approximately 1,000 acre portion of the site using no-cost risk assessment software. ProUCL, a software program developed by Lockheed Martin under a contract with the USEPA, was used to calculate 95th percent Upper Confidence Limits (UCLs) and estimate exposure point concentrations (EPCs) for exposure media. The Risk Assessment Information System (RAIS; <http://rais.ornl.gov>) was used to obtain toxicity profiles and values, chemical-specific parameters, and to perform Excess Lifetime Cancer Risk (ELCR) and Hazard Index (HI) calculations for the study site. RAIS is a product of the University of Tennessee's Institute for Environmental Modeling (TIEM) funded by the Department of Energy's (DOE) Oak Ridge Reservation through DOE's prime contractor, UCOR LLC. RAIS provides databases and tools for risk assessment including toxicity value and other databases, guidance documents, tutorials, screening levels, and risk models. Spatial Analysis and Decision Assistance (SADA; <http://www.tiem.utk.edu/~sada>) was used to evaluate contaminant distribution and to perform statistical analysis of data. SADA was developed and is maintained by The Institute for Environmental Modeling at the University of Tennessee, and is free geospatial software that incorporates tools from environmental assessment fields into an effective decision making software package. SADA tools include integrated modules for visualization, geospatial analysis, statistical analysis, human health risk assessment, ecological risk assessment, cost/benefit analysis, sampling design, and decision analysis. Comprehensively, these tools were utilized to generate a human health risk assessment for the study site. Output from these freeware risk assessment tools will be used extensively in making future risk management and remediation decisions for the site. Since these tools are freely available to the regulated and regulatory community, use of these free tools allows for transparency to the public and enhances communication with the Regulatory Community.

Introduction

A Baseline Human Health Risk Assessment (BHHRA) was performed for portions of a former industrial site by the team of BHE Environmental, Inc. and Fred Dolislager, a UT-TIEM risk assessor. The study areas investigated are referred to as "Area A" and "Area B" with Area B being comprised of two portions. The operational history and anticipated future land use of the two areas are similar so they were evaluated as a single unit. Sampled media types included soil, surface water, groundwater, and sediment. Samples analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, herbicides, organophosphates (OPs), metals, polychlorinated biphenyls (PCBs), dioxins, furans, phosphorus compounds, and/or chloride were used. Reasonably anticipated future land uses of the study areas are recreation and industrial. Although it is highly unlikely that the property will be used for residential purposes; as is typical practice when conducting BHHRA, a baseline assessment for residential land use was completed.

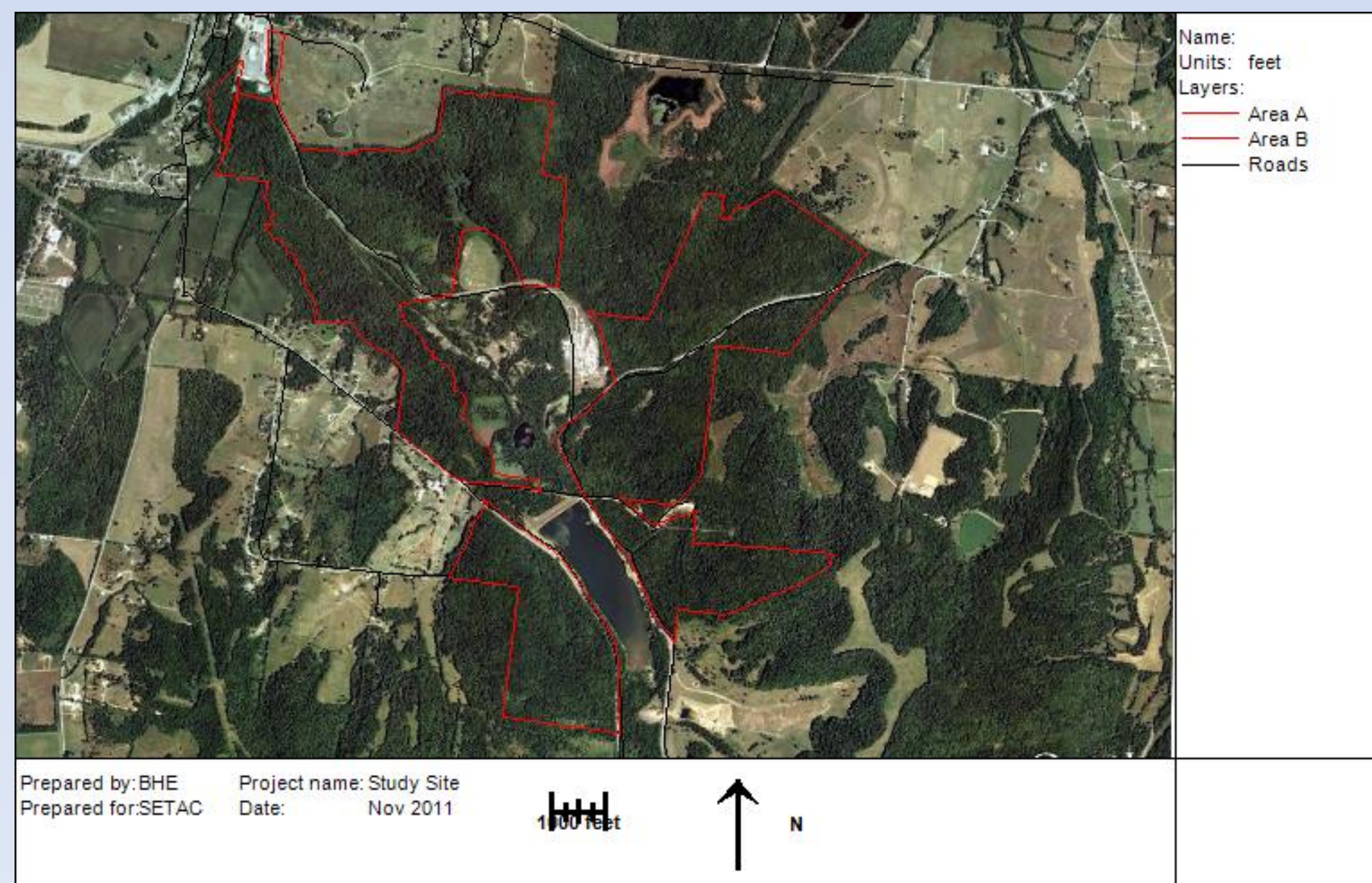


Figure 1. Boundaries of Area A and Area B of Study Site (Prepared in SADA).

Data Assessment

The main function of the data assessment is to determine the chemicals of potential concern (COPCs). The determination focuses on the relevant and significant risk contributing COPCs and various analytes are successively screened out of the data set by comparison against human health screening levels, applicable or relevant and appropriate requirements (ARARs), frequency of detection, and essential nutrients. Geospatial visualization and analysis of data was done within SADA.

Multiple data screening steps were performed in SADA and ProUCL. One freeware program was selected over the other on a case-by-case basis for each of the screening steps.

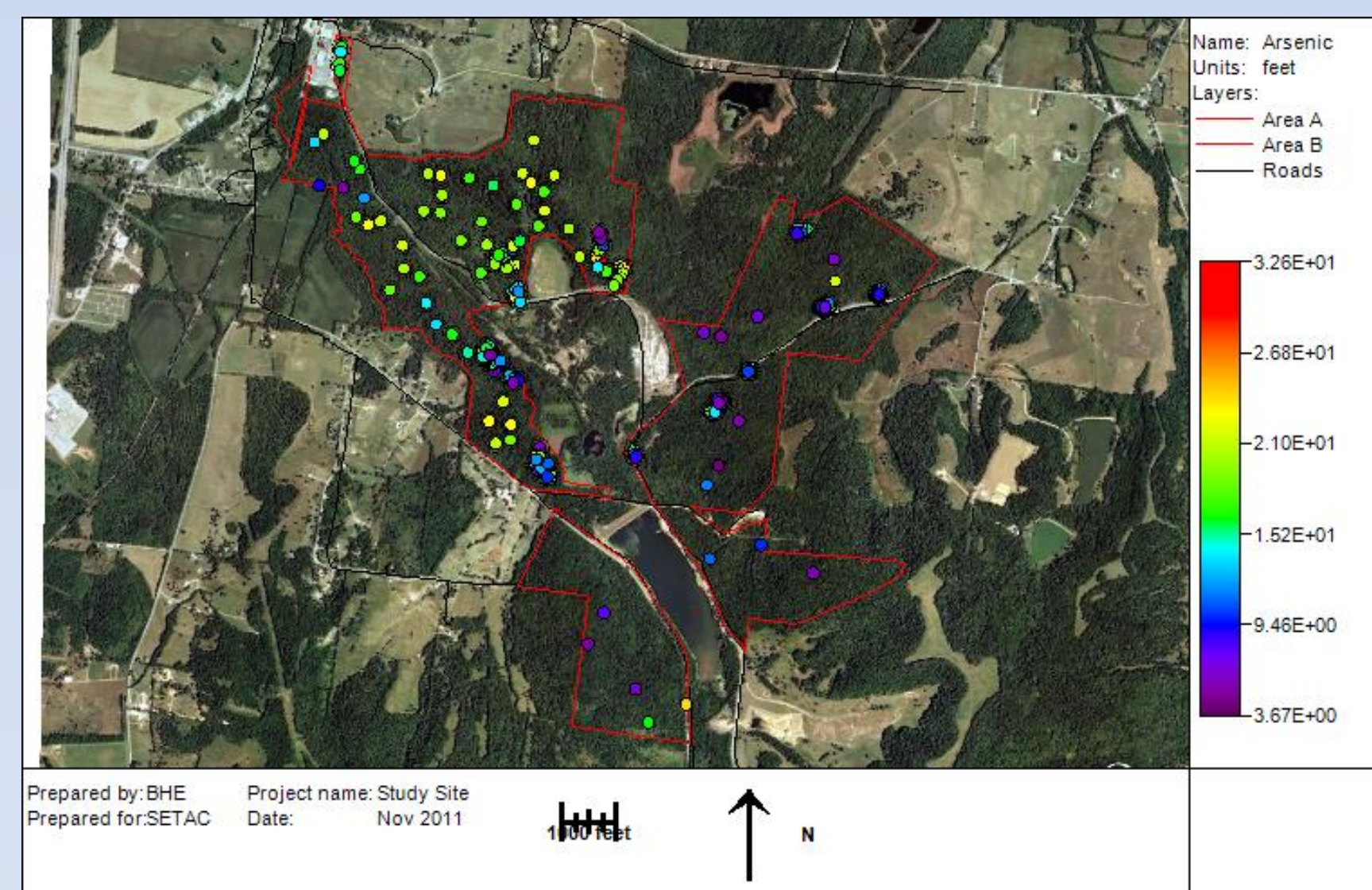
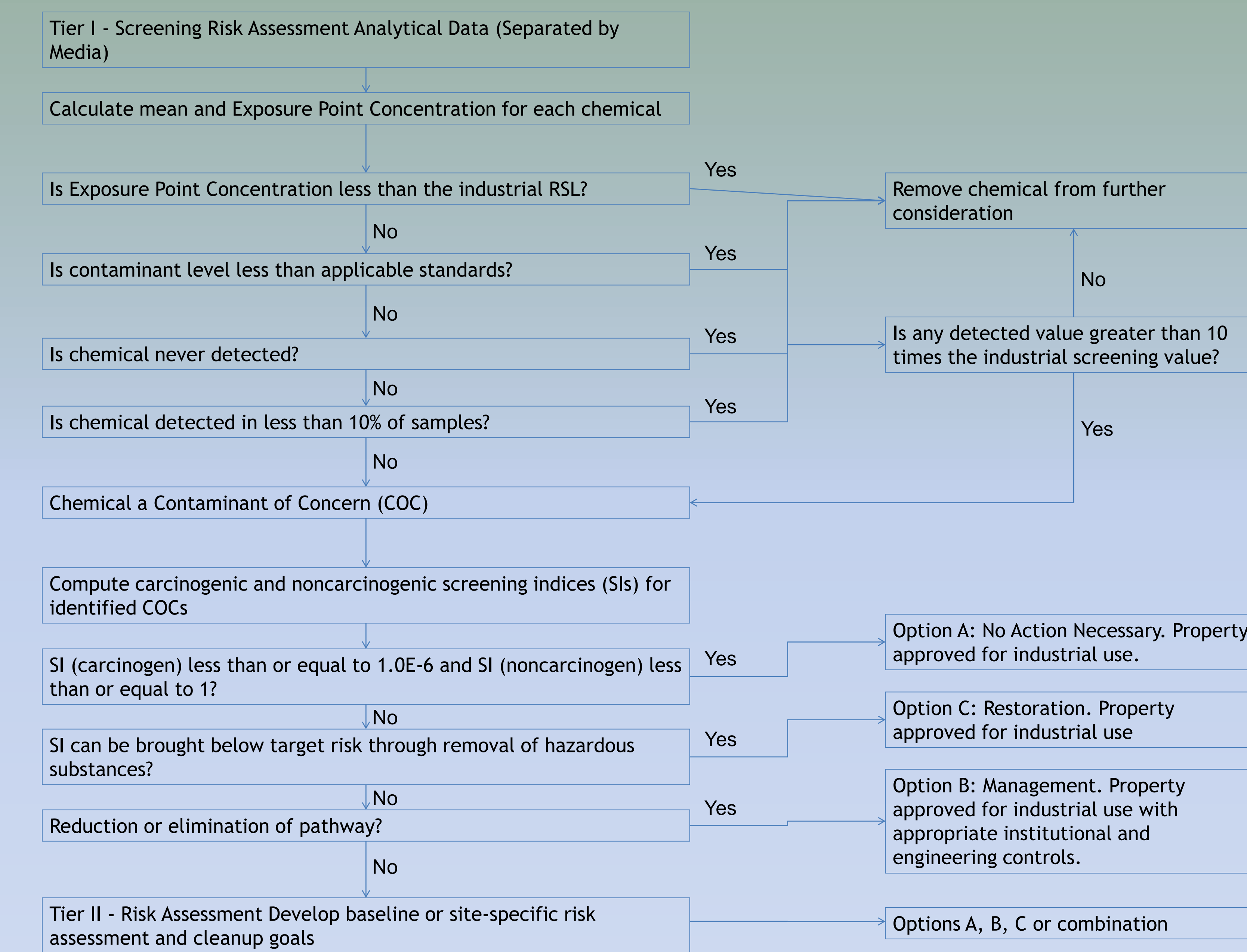


Figure 2. Arsenic in soil (Prepared in SADA).

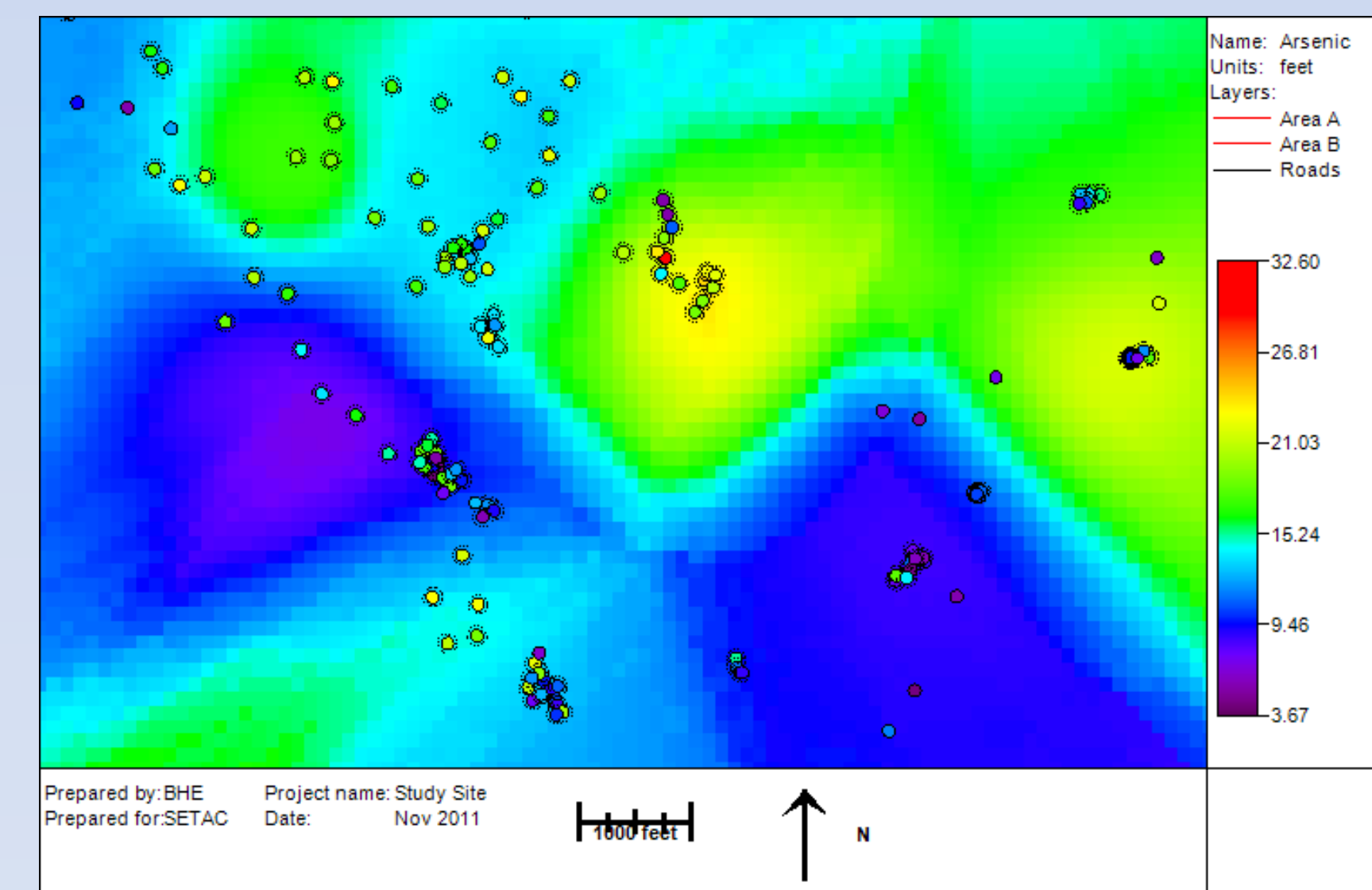


Figure 3. Interpolation of arsenic in soil (Prepared in SADA).

Exposure Assessment

Future land uses assessed include future recreator, future industrial worker, and hypothetical future resident. Primary and secondary exposure media included soil, air, groundwater, surface water, sediment, and biota (fish from surface water). Exposure routes included ingestion, dermal contact, and inhalation as appropriate for each medium.

Default exposure parameters (exposure duration, exposure frequency, exposure times, etc.) were used in this BHHRA for hypothetical resident surface soil, hypothetical resident groundwater, industrial surface soil, recreator sediment, recreator surface water, recreator surface soil, and recreator fish. These parameters were constant across a land use. Chronic daily intakes (CDIs) for each exposure route for each COPC for each land use were calculated.

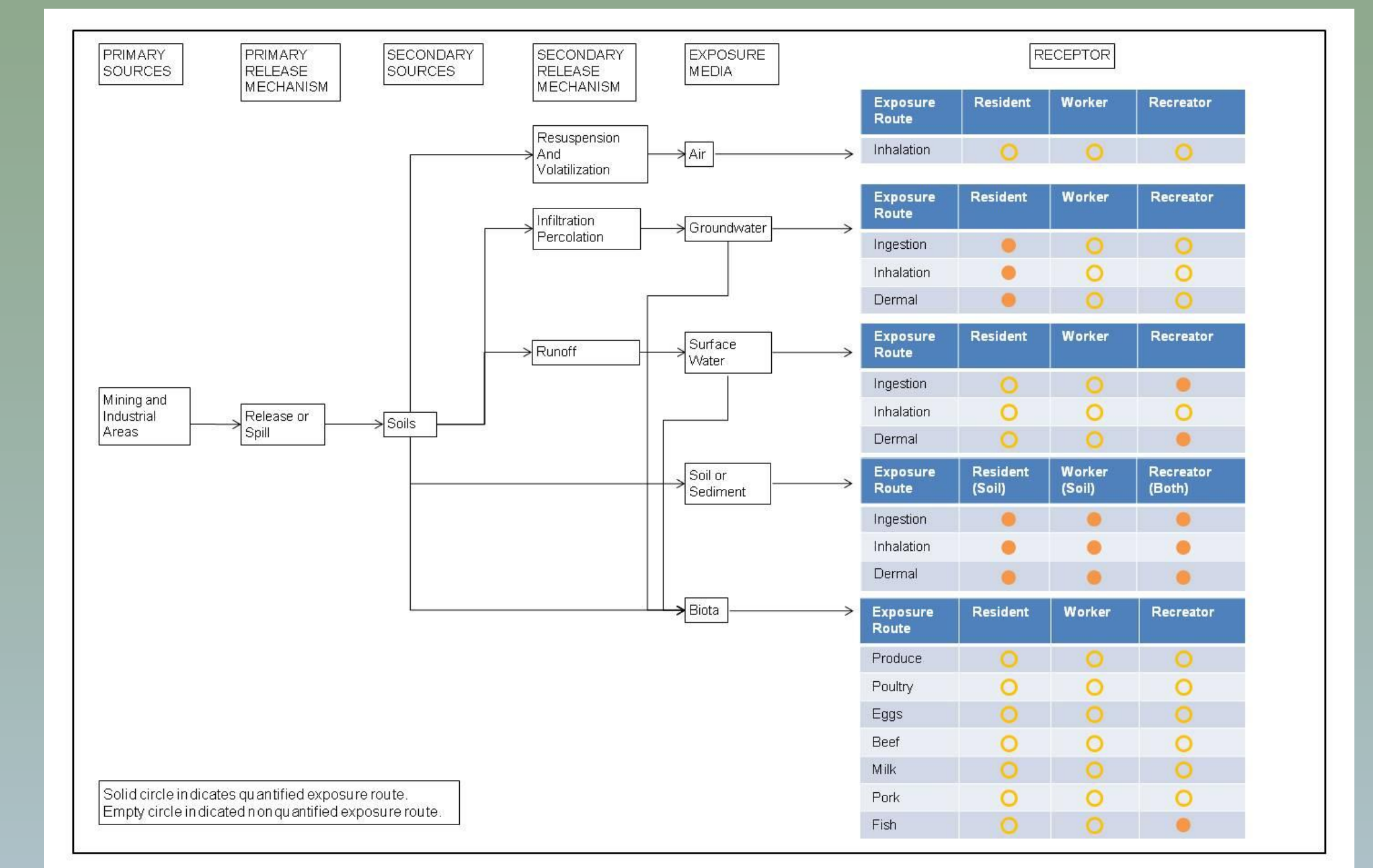


Figure 4. Conceptual Site Model of exposure pathways.

Toxicity Assessment

Chemical-specific toxicity values and chemical-specific parameters (e.g., Henry's Law values, molecular weight, density) were obtained from the RSL and RAIS websites.

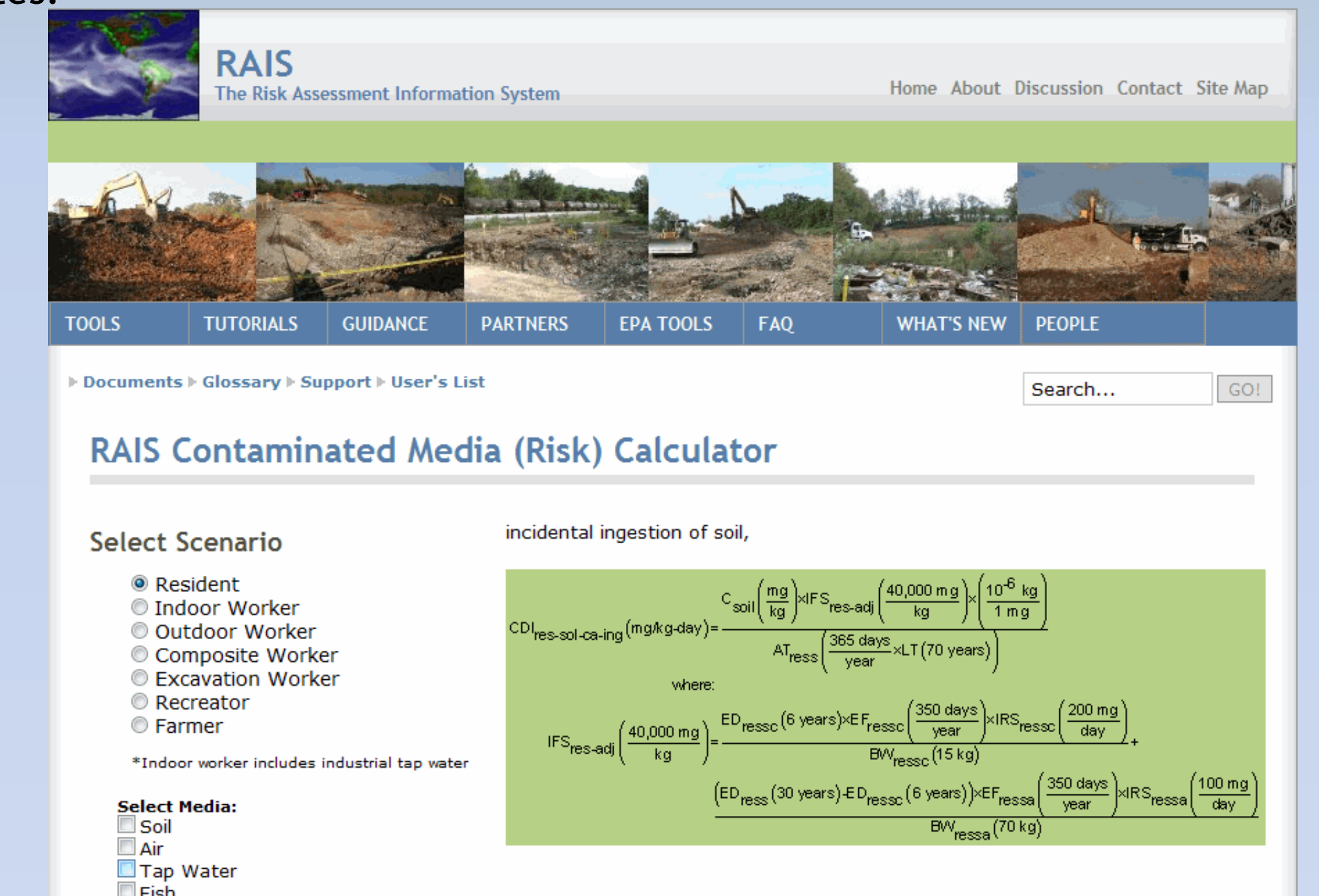


Figure 5. RAIS Contaminated Media (Risk) Calculator.

Risk Characterization & Results

For this BHHRA, risk was defined as the lifetime probability of excess cancer incidence for carcinogens and the estimate of daily intake exceeding intake that may lead to toxic effects for noncarcinogens. The risk characterization identified chemicals of concern (COCs) for each land use based on regulator guidance regarding acceptable risk levels. The RAIS was used to perform the risk calculations because it contained more recent EPA models. The risk models within SADA, while accurate, are not as up-to-date as the RAIS. SADA is more user friendly than the RAIS when it comes to saving analysis results and SADA also has spatial risk modeling capabilities not found within the RAIS.

Hypothetic Future Resident: 5 soil COCs & 8 groundwater COCs

Future Industrial Worker: 1 surface soil COC

Future Recreator: No surface water COCs, 2 biota (fish) COCs, & 2 sediment COCs

Conclusions

The freeware risk assessment tools utilized in this case study (ProUCL, RAIS, and SADA) were found to be tremendously valuable. These freeware tools provided all of the required functionality to complete a thorough BHHRA; thus cost savings over more traditional approaches can then be passed on to clients. Output from these freeware risk assessment tools will be used extensively in making future risk management and remediation decisions for the study site. Since these tools are freely available to the regulated and regulatory community, use of these free tools allows for transparency to the public and enhances communication with the Regulatory Community. Additionally, BHE's training in the use of these tools and partnership with freeware developers allows us to be uniquely prepared to utilize these tools to their full value.