TECHNICAL APPROACH
ECOLOGICAL RISK ASSESSMENT
MATTHIESSEN AND HEGLER ZINC COMPANY SITE
OPERABLE UNIT 2
LASALLE, ILLINOIS

INTRODUCTION

SulTRAC has prepared this technical approach for the ecological risk assessment for the Matthiessen and Hegeler Zinc Company Site (M&H Site), Operable Unit (OU) 2, in LaSalle, LaSalle County, Illinois, under the U. S. Environmental Protection Agency (EPA) Remedial Action Contract (RAC) II for Region 5, Contract No. EP-S5-06-02, Work Assignment (WA) No. 032-RICO-B568. The M&H Site is being addressed under three separate remedial investigation/feasibility study (RI/FS) WAs. For the purposes of remedial investigation, EPA has divided the M&H Site into two OUs, OU1 and OU2. OU1 consists of the Carus Chemical Company and areas to the east, including the LVR, and OU2 mainly consists of the former M&H facility (Figures 1 and 2).

SulTRAC is currently providing technical support for both the potentially responsible party (PRP)-lead RI/FS (WA 015-RSBD-B568) and this fund-lead RI/FS (WA016-RICO-B568, WA032-RICO-B568). As part of the remedial investigation and feasibility study, an ecological risk assessment will be performed for the M&H Site, based on the data collected during the two phases of the field activities. On October 22 and 23, 2007, SulTRAC personnel conducted field investigations as part of the Phase 1 RI to evaluate ecological habitats at the M&H Site (EPA No. IL0000064782). Formulation of this technical approach was based on information from those field investigations in October 2007, along with results of the Phase I RI activities during summer and fall 2007 that encompassed field and other activities to characterize and identify contamination at OU2. Additional data to be collected during Phase II during summer 2008 will provide further support for this risk assessment.

This document includes brief site and habitat descriptions to provide a context for the technical approach. Descriptions of approaches to the screening level ecological risk assessment (SLERA) and the baseline ecological risk assessment (BERA) follow.

SITE DESCRIPTION

The entire M&H Site, encompassing 160 acres, is located in the City of LaSalle, Illinois, (population 9,646). The M&H Site includes a former primary zinc smelting facility, a rolling

facility, and the Carus Chemical Company. The M&H Site is surrounded by the LVR on the north and east sides, and by private residences on the south and west sides. North and east of the M&H Site and across the LVR are farmland and a limestone quarry, respectively. An abandoned and collapsed storm sewer line runs across the property and serves as a mechanism to transport surface water runoff directly to the LVR, which then flows south into the Illinois River. A wetland is located approximately 0.5 mile upstream of the M&H Site on the LVR. Also, the Lake DePue Fish and Wildlife Area and the Spring Lake Heron Colony, which provides breeding habitat for the state endangered Great Egret, are situated about 15 miles downstream of the M&H Site

The Matthiessen and Hegeler Zinc Co. began operations in 1858. Raw materials such as zinc ore and various grades of coal were transported onto the M&H Site in order to smelt zinc. Coal was also provided from mines at the site. A rolling mill was built on the M&H Site in 1866 to produce zinc sheets. The furnace used in this process used producer gas as fuel; any sulfur dioxide that was generated was recovered, converted into sulfuric acid, stored in tanks on-site, and sold. The M&H Site also had an ammonium sulfate fertilizer plant that utilized some of the sulfuric acid generated, but operated only for a few years during the early 1950s. Coal mining on-site was discontinued in 1937 and zinc smelting ceased in 1961. Sulfuric acid manufacture was stopped in 1968, and from this time until declaration of bankruptcy in 1978, the facility performed only the rolling mill operations. The land where the rolling mill was located was purchased by Fred and Cynthia Carus in 1980, either directly or through a land trust, and became the LaSalle Rolling Mills. The LaSalle Rolling Mills worked under contract to the U.S. Mint to generate metal blanks for pennies. This area is approximately 12 acres and operated on the M&H Site until 2000, when bankruptcy was declared. In 2003, EPA conducted an emergency removal at the LaSalle Rolling Mills to address cyanide contamination, the old plating line, and various other chemicals and storage tanks that had remained on-site. This removal has been completed.

Carus Chemical has been operating at the M&H Site since 1915 and is located on the southern portion of the property. Various chemicals are produced at the chemical plant, including potassium permanganate. Wastewater generated during production of potassium permanganate is discharged to a treatment pond, and eventually into the LVR pursuant to a National Pollutant Discharge Elimination System (NPDES) permit. Solid wastes generated from manufacturing activities are transported off-site to a permitted landfill used solely by Carus Chemical.

The M&H Site was listed on the National Priorities List (NPL) on September 29, 2003, pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 105, 42 *U.S. Code* (U.S.C.) Section 9605. Two primary sources located on the property were used to score this M&H Site for the NPL. The first source (Source #1) scored at the M&H Site is a 6-acre waste pile located in the southeast portion of the former smelting facility property, along the bank of the LVR. Source #1 is included within OU1. This waste pile is composed of waste material generated from the primary zinc smelting process. Exactly when the pile began to accumulate is unknown, but wastes have not been added to the pile since the primary smelter ceased operations circa 1961. Runoff from the waste pile flows directly into the river. Documentation that the waste pile (Source #1) has been in contact with the LVR since at least 1988 is evident in a 1988 aerial photograph, photographs taken during a 1991 CERCLA screening site inspection (SSI) at Carus Chemical, and an Illinois Environmental Protection Agency (IEPA) CERCLA integrated assessment sampling event (1993 Assessment). The waste pile had actually been in contact with the LVR for many years prior to 1988, because the waste pile resulted from dumping waste materials during the time when the smelter was in operation. It has been observed that a portion of this slag is now located in the LVR.

During the (December) 1993 Assessment, the IEPA collected three samples from the waste pile. The materials sampled consisted of slag material that had been a byproduct of the on-site smelting operations. The material sampled did not contain any soil and was described as "coarse, black, [and] coal-like." The hazardous substances detected in these three samples include: cadmium (maximum 181 milligrams per kilogram [mg/kg]), chromium (maximum 43.3 mg/kg), copper (maximum 4,340 mg/kg), lead (maximum 1,370 mg/kg), nickel (maximum 118 mg/kg), and zinc (maximum 42,000 mg/kg).

The second source (Source #2) scored at the M&H Site is a shallow waste pile located on the former smelter property and included within the scope of OU2. The contaminants discovered in the samples that characterize Source #2 appear to have resulted from activities associated with the former zinc smelter and ancillary operations. The current limits of Source #2 were defined by five samples collected from portions of the former smelter property during the 1993 Assessment. The material sampled consisted of black, cindery slag material that had been a byproduct of the on-site smelting operations. The hazardous substances detected in these five samples include: pentachlorophenol (maximum 36 mg/kg), cadmium (maximum 1,320 mg/kg), copper (maximum 3,650 mg/kg), lead (maximum 4,310 mg/kg), and zinc (maximum 71,200 mg/kg). Some of the hazardous substances detected at the M&H Site may have migrated into the LVR. During the

November 1991 CERCLA SSI and the 1993 Assessment conducted by IEPA, an observed release to surface water was documented by chemical analysis—several sediment samples collected from the LVR were found to contain elevated levels of cadmium, copper, chromium, lead, nickel, and zinc. Runoff from the shallow waste pile (Source #2) flows into the LVR through natural drainage pathways and also through drainage that enters an old abandoned and collapsed storm sewer line formerly used by the City of LaSalle.

SITE HABITATS

In October 2008, SulTRAC conducted a habitat evaluation of OU2 in order to gather data necessary to identify potential ecological receptors and develop a conceptual site model (CSM) for the ecological risk assessment (ERA) to be conducted for OU2. Specifically, SulTRAC evaluated the following parameters: (1) water features and wetlands, (2) habitat types, (3) sensitive environments, (4) soils and land use, and (5) wildlife species.

SulTRAC observed several different water features, but these are not considered jurisdictional wetlands because no hydric soil characteristics were observed at any location. Furthermore, no soils mapped are classified as hydric soils (see Figure 3). Most moist areas are present because the disturbed landscape contains numerous small depressions.

SulTRAC identified the following five different habitat types shown in Figure 4: (1) highly disturbed—little or no vegetation, (2) disturbed with vegetation (woodland-grassland), (3) savannah, (4) oak-hickory woodland, and (5) riverine.

The first habitat type specifies highly disturbed areas where only bare ground exists. These areas are concentrated around the former facility infrastructure remnants. Commonly, only slag piles and building debris are present, with no soil or organic matter to support vegetation. Thus, these areas have little habitat value in their current state.

SulTRAC also identified disturbed with vegetation (woodland-grassland) areas that show some habitat recovery. Enough soil or organic material exists in these areas to support a mixture of woody and herbaceous species. The woody vegetation is typically young and predominantly black locust, American elm, catalpa, big-tooth aspen, smooth sumac (*Rhus glabra*), and Japanese honeysuckle (*Lonicera japonica*). Herbaceous vegetation is mainly big bluestem (*Andropogon gerardii*), tall goldenrod (*Solidago altissima*), and Kentucky bluegrass. Toward the northern boundary of OU2, the disturbed wooded area thickens and transitions into a more mature

woodland. The woody species are similar, but the understory is predominately white snakeroot (*Ageratina altissima*).

The savannah areas have also formed on fairly disturbed ground located on topographic high points. These areas are typically composed of big bluestem, tall goldenrod, Illinois bundleflower (*Desmanthus illoiensis*), switchgrass (*Panicum virgatum*), and Canada wildrye (*Elymus canadensis*). Mature cottonwoods and smooth sumac occur along the savannah fringe, as well as black locust and big-tooth aspen saplings.

The mature oak-hickory woodlands habitat is located along the LVR valley slope and floodplain. The dominant species are bur oak (*Quercus macrocarpa*), white oak (*Quercus alba*), black oak (*Quercus velutina*), red oak (*Quercus rubra*), shingle oak (*Quercus imbricaria*), chinkapin oak (*Quercus muhlenbergii*), and bitternut hickory (*Carya cordiformis*). Also present in lesser quantities are American elm, big-tooth aspen, catalpa, and sugar maple (*Acer saccharum*). Close to the LVR, SulTRAC observed box elder and black willow. Within the woodland, SulTRAC found several small areas where water is seeping out of the bedrock outcrops; unidentified mosses and reed canarygrass (*Phalaris arundinacea*) were observed in these areas. Overall, these areas had good vegetative composition and age diversity, reflecting good terrestrial habitat conditions.

The riverine habitat associated with the LVR has diversity created by the riffle/pool sequences that should provide good quality habitat for a variety of fish, macroinvertebrates, and mussel species. During normal flows, the LVR, below the dam located at the northern edge to the M&H Site, varies from 30 to 50 feet in width and from less than 1 to 3 feet in depth. The substrate appeared diverse, with silts, gravels, cobbles, and some boulders. Large woody debris was also observed scattered about the stream. These features also provide good habitat and refuge for aquatic species. The State of Illinois characterizes the LVR as a fishery with smallmouth bass (*Micropterus dolomieu*), bluegill (*Lepomis macrochirus*), sunfish (*Lepomis sp.*), crappie (*Pomoxis sp.*), channel catfish (*Ictalurus punctatus*), bullhead (*Ictalurus sp.*), carp (*Cyprinus carpio*), and drum (*Aplodinotus grunniens*) fish populations (EPA 2003). The riverine habitat is part of OU1, and will not be directly evaluated as part of the ecological risk assessment for OU2, but will be directly evaluated in the OU1 ecological risk assessment.

SulTRAC also documented wildlife species observations during the habitat evaluation, including direct visual species observations or other species evidence such as tracks or scat. SulTRAC observed mammals including white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*). SulTRAC also observed and heard several birds but could not

identify each species. Birds that SulTRAC did identify include red-tailed hawk (*Buteo jamaicensis*), turkey vulture (*Cathartes aura*), and cedar waxwings (*Bombycilla cedrorum*). On October 22, 2008, SulTRAC also observed a large winter flock of blackbirds, grackles, and starlings within OU2.

SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

The SLERA will be conducted consistent with EPA ecological risk assessment guidance (ERAGS) for Superfund (EPA 1997). Below is a description of the two steps involved in conducting a SLERA: (1) problem formulation and (2) screening level exposure estimate and risk calculation.

Problem Formulation

The objective of the problem formulation step is to collect sufficient information concerning the M&H Site so a CSM can be developed. The CSM will include a fate and transport diagram that traces the contaminants' movements through the ecosystem, and identifies potential exposure pathways and potential receptors. One of the major goals of the CSM is to identify complete exposure pathways and receptors at potential risk. As noted in the site description, already collected information on the environmental setting has led to identification of the M&H Site's sources of contamination and habitats. The data collected during the RI Phase I provide a general understanding of contaminants present in the various media at OU2 and concentration levels. Additional data will be collected during Phase II to fill the data gaps identified after evaluating the available data. The major contaminants of potential ecological concern (COPEC) currently identified include metals (cadmium, copper, lead, mercury, and zinc), polynuclear aromatic hydrocarbons (PAH), trichloroethene (TCE), and polychlorinated biphenyls (PCB). All the available data will be reviewed to identify all contaminants detected at OU2 and identify definitive COPECs to carry into the SLERA. The soils are the major contaminated media identified at the site. Surface water on OU2 is limited to depressions that collect surface water runoff. Groundwater is believed to discharge to the LVR.

During the ecological habitat evaluation, a variety of receptors were observed at the M&H Site, and other receptors, although not observed directly, are likely present. This information has been used to develop a preliminary CSM for the ecological risk assessment (Figure 5). If necessary, the CSM will be reviewed and modified following reception and review of the Phase II data. The

CSM notes a number of complete exposure pathways for terrestrial receptors, including plants, invertebrates, avians and mammals.

Assessment endpoints for a screening level are any adverse effects on ecological receptors. For OU2, the focus will be on plant, invertebrate, avian, and mammalian receptors. The general ecological management goal that will guide selection of assessment endpoints is:

> *Ensure adequate protection of ecological systems within the impacted areas of OU2 M&H Site by protecting them from the deleterious effects of acute and chronic exposures to site-related COPECs.*

The assessment endpoints for the SLERA are the following:

- Ensure adequate protection of terrestrial plant and soil communities, including native plant communities, by protecting them from the deleterious effects of acute and chronic exposures to site-related COPECs.
- Ensure adequate protection of mammal and bird populations by protecting them from the deleterious effects of acute and chronic exposures to site-related COPECs.
- Ensure adequate protection of threatened and endangered species (including candidate species) and species of special concern and their habitat by protecting them from the deleterious effects of acute and chronic exposures to site-related COPECs.

"Adequate protection" is generally defined as protection of growth, reproduction, and survival of local populations. That is, the focus is on ensuring sustainability of the local population, rather than on protection of every individual in the population, although federal and state identified threatened and endangered species will be considered.

It is anticipated that exposure will occur via direct contact, ingestion, and to a lesser degree dermal contact and inhalation. The endpoint measures for the terrestrial communities at OU2 will be soil screening values available from the following sources, in the order of preference:

1. EPA's Ecological Soil Screening Levels (EPA 2005a)
2. EPA Region 5 Ecological Screening Levels (EPA 2005a)
3. Oak Ridge National Laboratory (Efroymson, Will, and Suter. 1997 and Efroymson and others 1997)
4. Other regulatory agencies or general literature.

Screening-level concentrations protective for each of the major terrestrial receptor groups noted above will be identified.

Screening-Level Exposure Estimates and Risk Calculations

As noted earlier, OU2 contains four unique terrestrial habitats: (1) disturbed, (2) disturbed with vegetation, (3) savannah, and (4) oak-hickory woodland. The sampling will focus on the most biologically active portion of the surface soils—0 to 12 inches below ground surface (bgs). The soils data will be segregated by each habitat and evaluated to identify the maximum concentration for each contaminant. This concentration will be used as the screening level exposure estimate. SulTRAC will assume that the area use factor is 1, that all contaminants are 100 percent bioavailable, and that the most sensitive life stage will be exposed. Assumedly, these assumptions will be used in the development of the screening levels noted above. A hazard quotient (HQ) will be calculated for each contaminant for each receptor group by determining the ratio of the exposure concentrations to the screening values for each receptor group. If the HQ is greater than 1, a potentially unacceptable risk will be identified. For those habitats that do not have a COPEC HQ that exceeds 1, the HQs for COPECs with the same toxic mechanism will be added together to determine the Hazard Index (HI) for the habitat; if the HI is greater than 1, a potentially unacceptable risk will be identified. This will likely be limited to PAH- or dioxin-like chemicals.

Based on a preliminary review of the available data, each of the habitats is expected to show HQs greater than 1 for at least one and likely several receptor groups. Anticipation is that management will decide to conduct a BERA for OU2 .

One of the final objectives of the SLERA is to identify those potential ecological risks that should be further characterized and refined in the BERA. This is accomplished through collection of additional data and development of more refined and realistic exposure assumptions to estimate exposures, toxicities, and related risks. In order to effectively evaluate the ecological risks associated with a site, understanding the ecological management goals for that site is important. Significant portions of the M&H Site, including both OU1 and OU2, have been used solely for industrial operations since the mid 1800s. Land use for portions of OU1 is not anticipated to change in the future. Long-term land use associated with OU2 is less certain, although a portion of OU2 likely will remain industrial or commercial for the foreseeable future.

The ecological evaluation identified two habitats—disturbed and disturbed with vegetation—that represent the areas of OU2 used for past industrial purposes and now contain the highest levels of contamination. As noted earlier, the SLERA is expected to identify risks in these areas with HQs greater than 500 to 1,000. The disturbed area habitat quality is very low, in part due to soils composition that limits ability to support vegetation. The soils in this habitat are composed primarily of slag, cinders, and building rubble from the smelting operation that had been located in this area. The disturbed area with vegetation habitat quality is slightly improved, as noted by its ability to support limited vegetation. The composition of the soil is still dominated by slag and cinders. This has resulted in a sparse and degraded habitat for ecological receptors.

SulTRAC recommends excluding from the BERA the two habitats, disturbed and disturbed with vegetation. The current high levels of contamination and the physical nature of the soil identified in these two habitats clearly represent a degraded habitat quality capable of supporting only limited growth of opportunistic species that will present no value as foraging habitat for wildlife. The SLERA will clearly show unacceptable risks, and further evaluation will not provide significant additional refinement of potential risks. These two areas have a long history of industrial use, and their status is not likely to change because of their proximity to the current industrial operations on OU1. Thus, the ecological management goal for these habitats will likely continue to be industrial use. The information collected during the SLERA will be sufficient to identify an unacceptable ecological risk for these areas to support a management decision to remediate the site or place an institutional control on the site limiting its use to industrial or commercial land use. The focus of the BERA will be the risks associated with the contamination identified in the savannah and oak-hickory woodland, the two habitats with the highest quality.

BASELINE ECOLOGICAL RISK ASSESSMENT

The BERA will be conducted on the savannah and oak- hickory forest habitats consistent with EPA's ERAGS (EPA 1997). Below is a description of the steps involved in conducting a BERA: problem formulation, study design, and risk characterization.

Problem Formulation

The objective of the BERA problem formulation is to establish the risk assessment goals and focus, update the CSM, establish the assessment endpoints, refine exposure pathways, and characterize potential ecological effects. The first step in the BERA problem formulation will be to re-evaluate the COPECs identified during the SLERA. The SLERA results will be reviewed to

determine if it is appropriate for the BERA to focus on a reduced number of COPECs. The COPECs not carried forward into the BERA may include those that pose a negligible risk based on the maximum concentration or were detected in a very low percentage of samples (< 5 percent) and do not represent a hot spot.

As part of the problem formulation, SulTRAC will review the toxicity literature for the COPECs that are included in the BERA to identify both no observed adverse effect level (NOAEL) and lowest observed adverse effect level (LOAEL) based toxicity reference values (TRV). The toxicity mechanism and function (acute or chronic) for each of the TRVs will also be identified.

The fate and transport of each COPEC significantly affect potential exposures at the site and potential toxicity response. Metals are anticipated to be one of the prominent contaminant groups at the site, and several major fate and transport factors may influence their movement at the site. The overriding concern for the fate and transport of metals is their bioavailability and their ultimate movement within and through the food chain. Soil oxidation-reduction conditions and pH impact metals solubility and bioavailability. Also, condition of the soil matrix, how tightly the metals are bound within the slag materials, will impact bioavailability. This availability will be reflected in the bioaccumulation of contaminants in soil invertebrates and plants.

The focus of the BERA will be the two habitats of highest quality at OU2: savannah and oak-hickory woodland. As noted earlier, the riverine habitat is part of OU1 and will not be directly evaluated as part of the ecological risk assessment. However, information collected by the responsible party during its evaluation of ecological risks associated with releases from the site to the LVR, such as aquatic life tissue data, will be referenced to assess risks to terrestrial receptors that use the riverine habitat as an additional food source.

The next phase of the problem formulation is to identify the assessment endpoints for the risk assessment. The assessment endpoints identified as part of the SLERA will be reviewed and modified if needed based on additional data collected as part of the RI Phase II. The BERA assessment endpoints will focus on specific exposure pathways for a variety of receptors, such as:

- Function and viability of the terrestrial plant community
- Function and viability of the soil invertebrates community
- Function and viability of herbivores mammalian community
- Function and viability of soil invertebrate consuming mammalian community
- Function and viability of omnivores mammalian community
- Function and viability of carnivores mammalian community
- Function and viability of soil invertebrate consuming avian community

- Function and viability of omnivores avian community
- Function and viability of carnivores avian community
- Function and viability of piscivores avian community.

The next step is to prepare a study design based on the problem formulation. The design will clearly identify the lines of evidence and the endpoint measures to verify achievement and maintenance of assessment endpoints. For the plants and soil invertebrates, SulTRAC will use the soil concentration data and compare these concentrations to screening level concentrations. Media-specific exposure concentrations will be calculated using EPA's ProUCL 4.0 statistical program. Both the median and 95 percent upper confidence limit values will be identified and used in the BERA. A HQ, based on soil concentration and screening values, will be determined for each COPEC and receptor group to assess potential impacts.

To assess the potential impacts to other terrestrial receptors, SulTRAC will use a food chain model to estimate the potential exposures; these receptors will include primary consumers, omnivores, and carnivores. The food chain model will focus on mammalian and avian receptors. SulTRAC will collect additional information as part of the Phase II RI to properly characterize movements of some of the contaminants from the soils up the food chain. To make the food chain model more site-specific, SulTRAC will collect information on the uptake of soil-bound COPECs into vegetation, a significant food source for a number of site receptors. This information will be used to more accurately characterize potential exposures to receptors in the food chain model. SulTARC will use two methods to collect this data—(1) laboratory soil bioaccumulation tests with earthworms and lettuce seedlings, and (2) collection of site vegetation samples from areas with a range of known soil contamination levels. Soil samples will be collected from several locations within each habitat of concern and sent to the lab for 28-day bioaccumulation tests with both earthworms and lettuce seedlings. SulTRAC will also identify locations at OU2 with elevated contamination and collect native herbaceous vegetation samples from these locations; the relevant part(s) of the browse will be sampled. Each plant collected will be divided into two separate portions, above ground and below ground, and each portion will be analyzed separately to determine COPECs concentrations in the roots and leafy parts of the plant. These data will provide an understanding of the bioaccumulation of the COPECs in the soils and their potential to move within the food chain, and an understanding of food source contamination. Because some of the terrestrial receptors on OU2 are expected also to use the LVR as a food source, SulTRAC will obtain aquatic life tissue contamination data collected by the potentially responsible party at the LVR within OU1.

The food chain model (FCM) for birds and mammals assumes exposure to COPECs primarily through ingestion of contaminated soil and prey. Exposure models estimate the mass of a COPEC internalized daily by a receptor per kilogram of body weight per day (the daily COPEC dosage). Estimates of exposure are generally based on knowledge of the spatial and temporal distribution of both COPECs and receptors, and on specific natural and life history characteristics that influence exposure to COPECs. Results for soil samples collected from 0 to 1 foot bgs at will be used in FCMs to estimate doses to avian and mammalian receptors.

Daily doses will be estimated for each COPEC and representative receptor where adequate data are available and these models are appropriate. These doses will then be compared with high and low TRVs to estimate the potential adverse biological effects on the receptor. The risk to each representative species will be characterized using a HQ approach based on this comparison.

The total exposure from ingestion for each receptor of concern will be calculated as the sum of the dietary exposure estimates. The following generic equation was adapted for each representative receptor:

$$\text{Dose}_{\text{total}} = \frac{([\text{IR}_{\text{prey}} \times \text{C}_{\text{prey}}] + [\text{IR}_{\text{soil}} \times \text{C}_{\text{soil}}]) \times \text{SUF}}{\text{BW}}$$

where:

$\text{Dose}_{\text{total}}$	=	Estimated dose from ingestion (milligrams per kilogram body weight-day [mg/kg/day])
IR_{prey}	=	Ingestion rate of prey (kilograms per day [kg/day])
C_{prey}	=	Concentration in dry weight of COPEC in prey (mg/kg)
IR_{soil}	=	Ingestion rate of soil (kg/day)
C_{soil}	=	Concentration in dry weight of COPEC in soil (mg/kg)
SUF	=	Site use factor (unitless)
BW	=	Adult body weight (kilogram)

The risk estimates will ensure that the assessment does not indicate little or no risk when a risk actually exists; therefore, conservative assumptions will be used in this analysis in the absence of site- or species-specific data. Exposure will be assessed within the context of the following linear food chains to evaluate potential ecological effects on secondary consumer birds and mammals:

Soil → Plants and Invertebrates → American Robin

Soil → Small Mammals → American Kestrel

Soil → Plants → Meadow Vole

Soil → Plants and Invertebrates → Deer Mouse

Soil → Small Mammals → Red Fox

Soil → Plants, Invertebrates, Small Mammals and Aquatic life → Raccoon.

Site-specific prey data may not be not available for use in the dose calculation described above. Therefore, bioaccumulation models will be used to estimate the concentrations of COPECs in prey tissue based on the concentrations of COPECs in soil. Soil-to-biota bioaccumulation models for small mammals may be used, either as simple bioaccumulation factors (BAF) that can be multiplied by the concentration in the soil, or as regression models that incorporate the concentration in soil to estimate the COPEC concentration in prey.

Updated ecological soil screening level (Eco-SSL) BAFs and regressions will be used whenever available (U.S. Environmental Protection Agency [EPA] 2005b). Additional regression models and simple BAFs (Bechtel-Jacobs 1998; Oak Ridge National Laboratory [ORNL] 2006; Sample and Arenal 1999; Sample, Opresko, and Suter 1998; Baes 1984) will be chosen if no Eco-SSL regression is available. A regression model will be applied only if the model is significant (the slope differs significantly [$p < 0.05$] from 0), and the coefficient of determination (R^2) is greater than or equal to 0.2. If these criteria are not met, another regression model or BAF will be selected to estimate bioaccumulation. The Eco-SSL (EPA 2005b) BAFs will be retained in lieu of a default BAF for chemicals without any alternative invertebrate BAFs. A default of 1 will be used for those chemicals without any available BAFs.

The overall risks to the ecological receptors will be presented in a weight of evidence approach. This approach considers the various COPECs present, the uncertainties associated with the data collection methods, toxicity data, and methods to estimate risks. It will also evaluate the laboratory and field data and consistency between them, and how they reflect on the estimated risks. By presenting the estimated risks based on both NOAEL and LOAEL TRVs, it will provide risk managers with understanding of the potential range of risks for the ecological receptors at the site. This understanding may also be used to develop site-specific remediation goals that could depend on the quality of the habitat to be protected or rehabilitated.

REFERENCES

Baes, C.F., III, R.D. Sharp, A.L. Sjoreen, and R.W. Shor. 1984. A review and analysis of parameters for assessing transport of environmentally released radionuclides through agriculture. ORNL-5786, Health and Safety Research Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee. 150pp.

Bechtel-Jacobs. 1998. Empirical models for the uptake of inorganic COPECs from soil by plants. Bechtel Jacobs Company LLC, Oak Ridge, TN.BJC/OR-133.

Efroymson, R.A., M.E. Will, and G. W. Suter. 1997. Toxicological Benchmarks for Contaminants of Potential Concern for Effects on Soils and Litter Invertebrates and Heterotrophic Processes: 1997 Revision. Oak Ridge National Laboratory. Oak Ridge, Tennessee. ES/ER/TM-126/R2.

Efroymson, R.A., M.E. Will, G. W. Suter and A.C. Wooten. 1997. Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Terrestrial Plants: 1997 Revision. Oak Ridge National Laboratory. Oak Ridge, Tennessee. ES/ER/TM-85/R3.

Oak Ridge National Laboratory (ORNL). 2006. Risk Assessment Information System. On-line address: http://risk.lsd.ornl.gov/homepage/benchmark.shtml

Sample, B.E., and C.A. Arenal. 1999. "Allometric Models for Interspecies Extrapolation of Wildlife Toxicity Data." Oak Ridge National Laboratory, Environmental Sciences Division. Oak Ridge, Tennessee. April 21.

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

U.S. Environmental Protection Agency (EPA). 1997. *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments*. Interim Final. Office of Solid Waste and Emergency Response. EPA-540-R-97-006. June

EPA. 2003. NPL Site Narrative for Matthissen and Hegeler Zinc. Co. Accessed online at http://www.epa.gov/superfund/sites/npl/nar1635.htm.

EPA. 2005a. U.S. EPA Region 5 Ecological Screening Levels. On-line address: www.epa.gov/reg5rcra/ca/edql.html/

EPA. 2005b. Interim Ecological Soil Screening Levels. March. On-line address: http://www.epa.gov/ecotox/ecossl/

Legend

Stream

Operable Unit Boundary

N
W E
S

0 750 1,500

Feet

Source: 2006 USDA National Agriculture Imagery Program, LaSalle County, Illinois

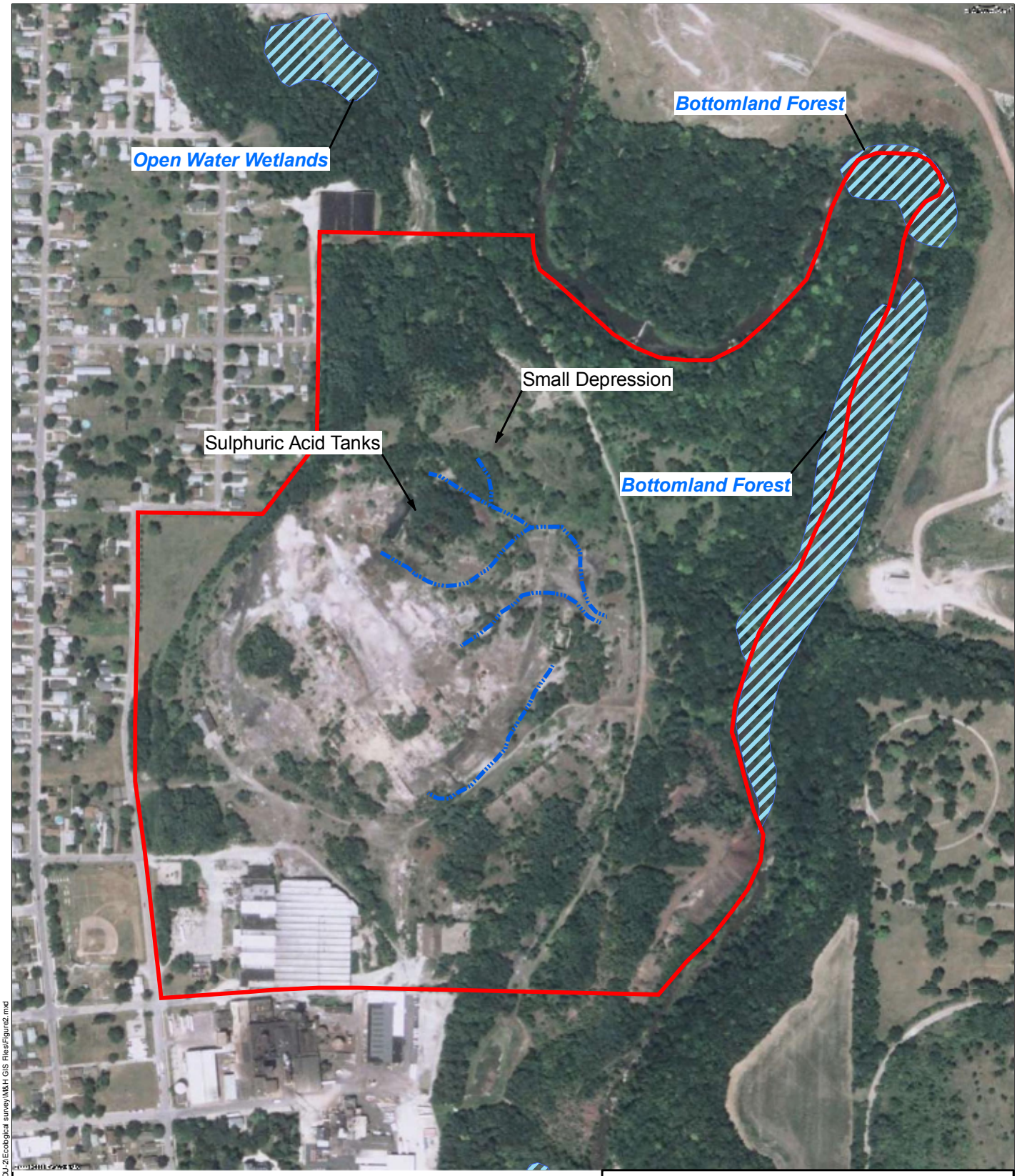
M&H Ecological Evaluation
LaSalle, Illinois

Figure 1
Site Layout

SulTRAC

Date: 05/28/08 Drawn By: BAE Project No: G9021016.103

S:\PROJECTS\RAC Region5\Mattheissen & Hegeler Zinc\OU-2\Ecological survey\M&H GIS Files\Figure1.mxd



Legend

- Ephemeral Channels
- OU2 Boundary
- NWI Wetlands

N
W E
S

0 250 500
Feet

Source: 2006 USDA National Agriculture Imagery Program, LaSalle County, Illinois
2007 USFWS National Wetland Inventory, Illinois

M&H Ecological Evaluation
LaSalle, Illinois

Figure 2
OU2 Water and
Potential Wetland Features

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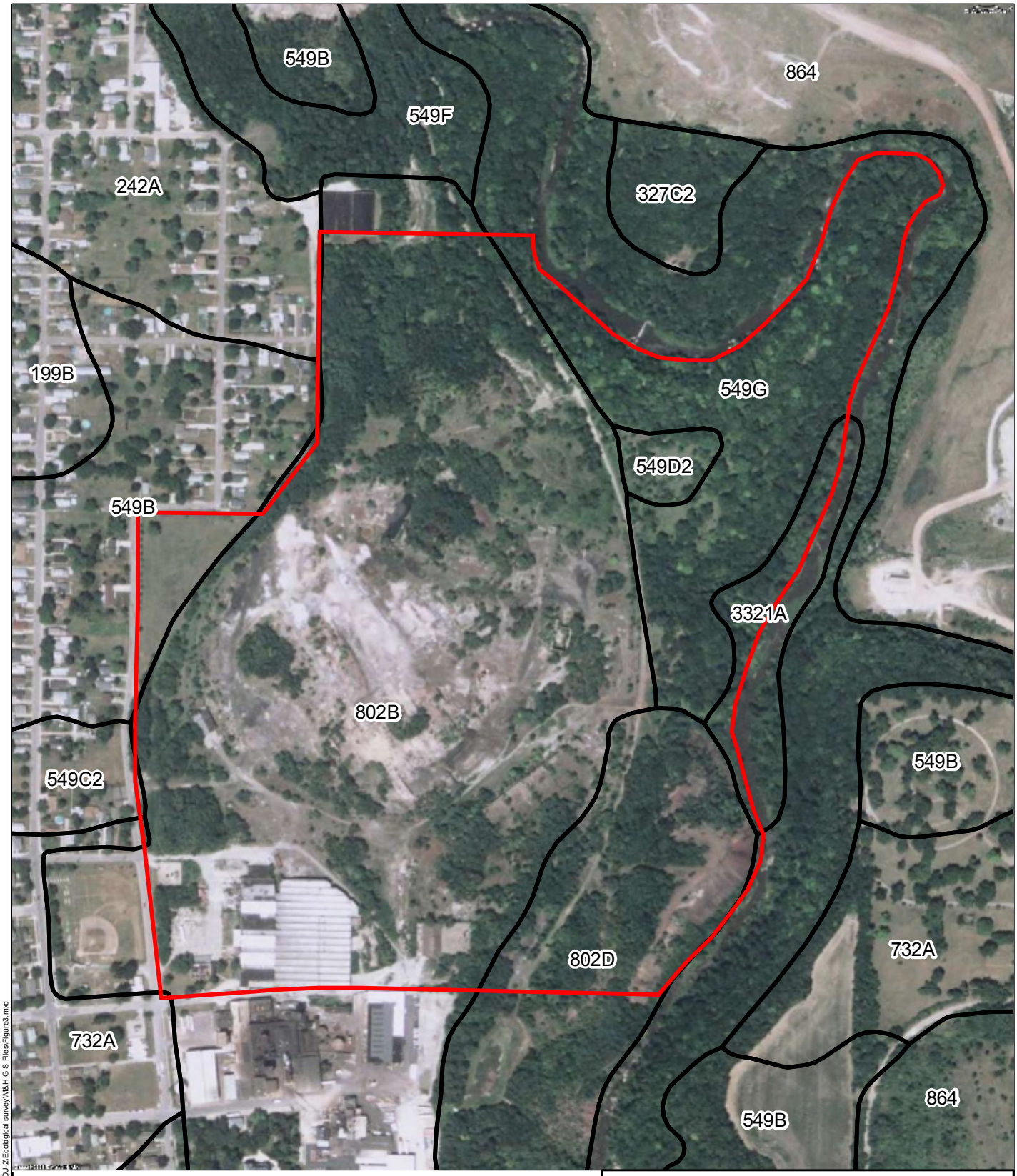
S:\PROJECTS\RAC Region5\Mattheissen & Hegeler Zinc\OU-2\Ecological survey\M&H GIS Files\Figure2.mxd



Legend

OU2 Boundary

Map Units

549D2 Marseilles Silt Loam (10 to 18 %)
549G Marseilles Silt Loam (35 to 60 %)
802B Loamy, Undulating Orthents
802D Loamy, Rolling Orthents
3321A Du Page Silt Loam

N W E S

0 250 500
Feet

Source: 2006 USDA National Agriculture Imagery Program, LaSalle County, Illinois
2007 USFWS National Wetland Inventory, Illinois

M&H Ecological Evaluation
LaSalle, Illinois

Figure 3
OU2 Soils

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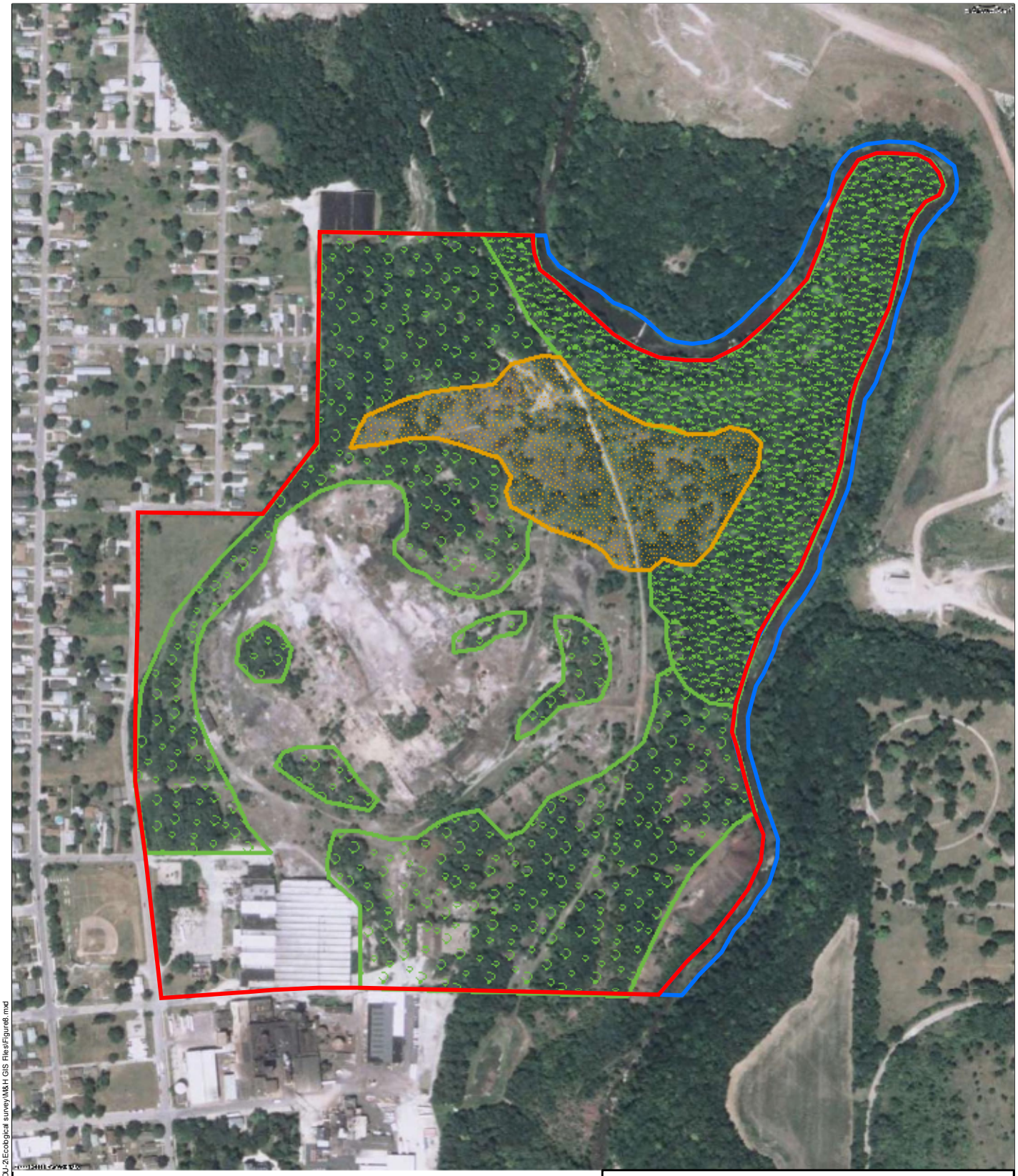
S:\PROJECTS\RAC Region5\Mattheissen & Hegeler Zinc\OU-2\Ecological survey\M&H GIS Files\Figure3.mxd



Legend

- Disturbed Woodland-Grassland
- Oak-Hickory Woodland
- Savannah
- Riverine
- OU2 Boundary

N W E S

0 250 500
Feet

Source: 2006 USDA National Agriculture Imagery Program, LaSalle County, Illinois

M&H Ecological Evaluation
LaSalle, Illinois

Figure 4
OU2 Habitat Types

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Date: 05/28/08 Drawn By: Bill Spiking Project No: G9021016.103

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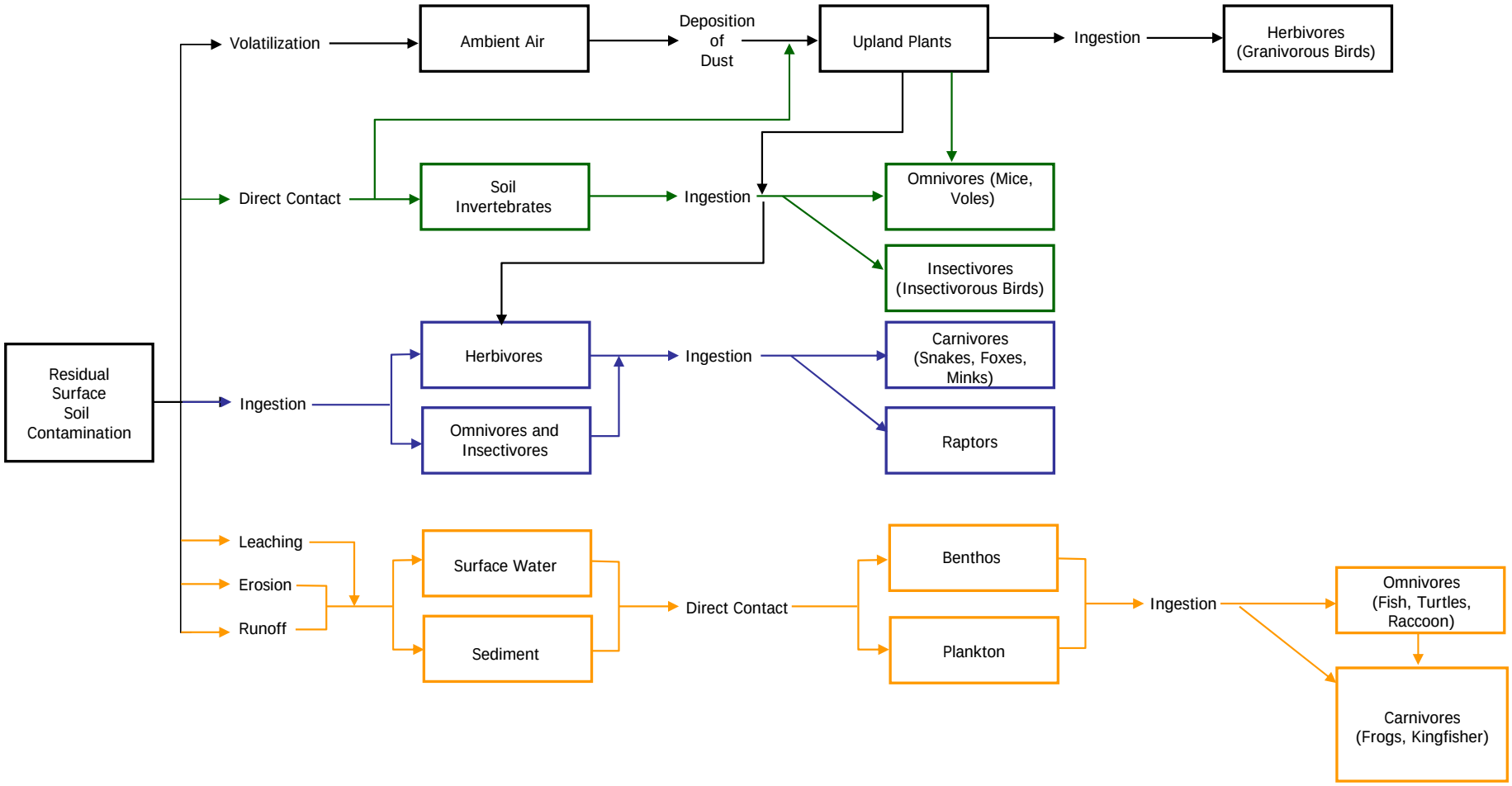

MATTHIESSEN & HEGLER ZINC SITE
LASALLE, ILLINOIS

FIGURE 5
OU2 **SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT CONCEPTUAL SITE MODEL**

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