Health Consultation

PUBLIC COMMENT VERSION

BERNHART PARK SITE
LAURELDALE AND MUHLENBERG TOWNSHIPS,
BERKS COUNTY, PENNSYLVANIA

EPA FACILITY ID: PAD990753089

Prepared for ATSDR by the
Pennsylvania Department of Health

APRIL 23, 2009

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Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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Division of Environmental Health Epidemiology
Under Cooperative Agreement with the
The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Executive Summary

In response to community concerns and a petition letter from the City of Reading, the Agency for Toxic Substances and Disease Registry (ATSDR) and the Pennsylvania Department of Health (PADOH) prepared this Health Consultation (HC) to determine if residents visiting Bernhart Park (The "Park") are being exposed to lead in the soil at levels that would pose a public health hazard. PADOH worked under a cooperative agreement with ATSDR to complete this Health Consultation document. PADOH and ATSDR reviewed the soil sampling results and risk assessment models conducted by the Environmental Protection Agency (EPA). Upon reviewing the petition letter, available sampling data and risk assessment models, this HC addresses the following:

1. Based on the EPA's Integrated Exposure Uptake Biokinetic Model (IEUBK) Childhood Blood Lead Model, are the soil lead clean-up levels of 650 ppm proposed by EPA in the eastern and southern portions of the park protective of public health, specifically children who might visit the Park?

2. Is the risk assessment and Adult Blood Lead model prepared by Exide (the "site") and evaluated by EPA for the Northwestern portions of the Park, and which addresses adolescent recreational use where lead levels exceed 650 ppm, protective of public health and potential park visitors?

3. Does the entire Park require active remediation, and not just the areas currently proposed by EPA?

ATSDR and PADOH reviewed the IEUBK model prepared by EPA for Bernhart Park. A soil lead cleanup value of 650 parts per million (ppm) in the eastern and southern portion of the Park derived by applying site-specific inputs resulted in a 5% chance or less of a child (aged 7 years or younger) exceeding the Centers for Disease Control and Prevention (CDC) blood lead standard of 10 ug/dL. Based on the soil sampling results, IEUBK model, and exposure frequency, EPA's proposed soil clean-up level of 650 ppm in the eastern and southern portion of the Park appears to be, and is supported by PADOH and ATSDR as, protective of human health, especially children, and poses ***no apparent public health hazard.***

In addition, PADOH and ATSDR expect that children under the age of 7 years would not frequent the northwest portion of the park on a regular basis due to the steep terrain and other geographic features as observed by PADOH and ATSDR staff during two site visits. Therefore, the use of the Adult Blood Lead Model is appropriate for this section of the Park. The results from the Adult Blood Lead Model show that recreational use by adolescent visitors of the northwestern portion of the Park would result in a slight increase in blood lead level over the baseline values. The highest predicted blood lead level estimated by the model is 7.3 ug/dL, which is well below the CDC intervention guideline of 10 ug/dL. Based on soil sampling results, Adult Blood Lead modeling results, the likely exposure frequency, and the steep terrain, the detected soil lead levels in this portion of the park currently poses ***no apparent public health hazard*** to potential Park visitors, with the following exception:

PADOH and ATSDR identified access points located in the northwestern section of Park that include a heavily wooded area and the reservoir spillway (Exposure Areas QQ, RR, SS, DDD, and MM) that are not currently proposed by EPA for remediation. These areas exceed 650 ppm and provide ***unrestricted access*** from the neighboring housing development. Due to the close proximity to the adjacent residential areas, the lack of access restrictions, and the environmental sampling data, there is a potential for the public, especially children, to be exposed to lead contaminated soil in these areas. Based on this information, the exposure scenarios in this area of the Park are more similar to the exposure assumptions currently being considered by the EPA in the southern and eastern portions of the park (IEUBK model), particularly for children, and pose a ***public health hazard, however*****;**

1. Since these Exposure Areas (QQ, RR, SS, DDD, and MM) are located in a portion of the Park that is heavily wooded and very steep it is unlikely, but possible, that children would recreate in these areas for an extended period.
2. PADOH and ATSDR do not have any direct evidence, only anecdotal accounts, that children are currently frequenting these areas of the Park, since the Park is currently closed.

PADOH and ATSDR recommend that ***EPA consider remedial, mitigation-type, or other-type appropriate activities or solutions*** in this area of the Park. Such activities could include but are not limited to any or all of the following possibilities: (1) erecting a fence, barrier, and/or signage; (2) addition of clean topsoil or other appropriate cover to the area: (3) diverting the public towards a "clean" alternative footpath, concourse, causeway, trail, or the like; and/or (4) other feasible measures that would minimize the likelihood of exposure and/or ingress and egress to these areas. ***If appropriate remedial, mitigation-type, or other activities or solutions are employed in the above-mentioned Exposure Areas of the Park (QQ, RR, SS, DDD, and MM) that minimize the likelihood of exposure and/or ingress and egress to these areas,*** PADOH and ATSDR believe that the exposure scenarios in this area of the Park would be similar to the exposure scenarios in the remainder of the Park and thus would pose ***no apparent public health hazard*** to potential Park visitors.

PADOH and ATSDR conclude that, overall, ***active remediation of the entire Park is not warranted*** at this time and EPA's proposed remediation plans are protective of public health, especially to potential visitors of the Park, with the exception of the above-mentioned areas. Any future use of the park that significantly alters the usage of the northwest portions of the Park could affect PADOH and ATSDR's public health conclusion. The interpretation, conclusions, and recommendations regarding Bernhart Park for this health consultation are site-specific and do not necessarily apply to any other site.

Background and Statement of Issues

Site Description and History

Bernhardt Park (the "Park") is an approximately 25-acre recreational-use park located in Laureldale and Muhlenberg Townships and owned by the city of Reading, Berks County, Pennsylvania. The Park lies just east of the Exide Technologies facility ("Exide" or the "Site")" (Figure 1). The eastern portion of the park consists of a mainly flat wooded area. Along the southern edge of the Park is a narrow strip of land adjacent to Spring Valley Road, which contains park benches and barbeque grills. On the northwest portion of The Park, the terrain slopes up steeply from the lake's edge and is heavily wooded. The center of the Park contains a man-made reservoir that is approximately 13-acres in size, with three islands on the northwestern side of the reservoir, an inlet to the east and an outlet spilling down a steep grade toward the west. A footbridge crosses over the spillway. St. Michael's Seminary (Convent Property) is situated to the west of the Park and Exide, along Kutztown Road. The Park is bordered by residential homes on the north and south, including a new housing development located west to northwest of the Park.

Exide is a 45 acre site located in Laureldale and Muhlenberg Township, at Nolan Street and Spring Valley Road, just west to northwest of the Park. A hill, that is approximately 100 feet in elevation, separates the Park and Exide. The site has operated as a lead battery recycling and smelting plant since 1935, under the ownership of the Bowers Battery Company. Prior to the mid-1930, the site was a dye manufacturing facility. General Battery Corporation purchased the facility in 1958, and Exide subsequently acquired the property in 1987. The site currently recycles batteries, by sending spent lead-acid batteries to a battery breaker unit where lead, plastic and acid are separated. The recycled lead is smelted and cast into lead-alloy bars to make new battery plates. The source of lead contamination in the Park and off-site soil samples is believed to be from general plant operations prior to the advent of the Clean Air Act of 1970 and introduction of air pollution control requirements.

The Park has been closed to the public since 1996, by the City of Reading, due to limited elevated soil lead levels detected in 1992-1995 by the Pennsylvania Department of Environmental Protection (PADEP). Signs are posted on the perimeter of the Park, by the City of Reading, which state, "Preliminary soil tests performed by the Department of Environmental Protections indicated the possibility of higher than normal concentrations of lead in the soil at Barnhart Park. Lead has not been detected in the water of the reservoir. Future soil samples will be analyzed to determine when the park will re-open." After the closure of the Park, Exide and its contractors, in agreement with EPA, performed extensive soil, sediment, and reservoir water sampling to delineate the lead contamination in the Park.

Site Visits

In June 2008, representatives of the PADOH Health Assessment Program and ATSDR viewed the Park with EPA's On-scene Coordinator (OSC). During this visit, PADOH and ATSDR staff walked through and around the Park, took notes and photographs, and discussed site background information with the EPA OSC. In October 2008, PADOH and PADEP staff, along with invited local officials and concerned community members, conducted a second site visit. PADOH, PADEP, and the invitees walked the site, discussed EPA's remediation plans, and gathered additional information and concerns from the officials and community members.

Sample Events

Park Sampling (prior to 2001)

Exide, in agreement with PADEP, conducted extensive sampling of residential properties adjacent to the site. In 1991, random soil sampling for lead was performed southwest of Exide (west of the Park). In 1992 to 1995, Exide collected limited soil samples within the park boundary (figure 2 and 3). Discrete samples were collected from the 0 to 3 inch and 3 to 10 inch depth increments and analyzed by x-ray fluorescence (XRF). Elevated lead levels in the park warranted closing the Park in 1996. As part of the Remedial Investigation, additional sampling in the Park was subsequently conducted in 2001. In addition, during this period, Exide performed extensive soil sampling of residential properties for phase I, II and III studies. It is beyond the scope of this HC, to review the extensive sampling and cleanup activities in the adjacent residential areas, since the focus of this HC is the Park.

Park Sampling

In June 2001, Exide and its contractor Advance GeoServices Corporation (AGC), in collaboration with the EPA and PADEP, conducted soil, reservoir sediment, and surface water sampling at Bernhart Park.

Soil Sampling

Composite sampling was performed by dividing the park into 56 grids (areas A through DDD), known as Exposure Areas (EA), with each EA encompassing approximately 0.5 acres. Three composite samples were collected from each EA, from the 0 to 3 inch soil horizon. All sampling was performed in accordance with EPA's surface water and sediment sampling procedures. The soil samples were analyzed for total lead, with 20% of the sampling sent to an off-site laboratory for total lead analysis for XRF correlation.

Sediment Sampling

Discrete sediment samples were collected from 15 random locations, with one duplicate sample, within the Park's reservoir. The samples were collected using a hand auger, ponar sampler, or similar sediment samplers. Sediment samples were collected from the 0 to 3 inch horizon from a boat. Upon completion of sample collection, the samples were homogenized and sent to the laboratory for total lead analysis.

Reservoir Sampling

Water samples were gathered from the Park reservoir at the same locations as the above-mentioned sediment samples. Sampling occurred at approximately 1 meter below the water surface and 1 meter above the sediment using a discrete water sampler, such as a Kemmerer Sampler, or similar device. The water samples were collected prior to the sediment sampling in order to minimize sediment disturbance. Water samples were also collected from the outlet and inlet of the reservoir and the sedimentation pond located near the inlet section of the reservoir, if standing water was present. Duplicate samples were collected. The water samples were analyzed for both total and dissolved lead at an off-site laboratory. Field measurement of dissolved oxygen, pH, Eh (activity of electrons), temperature, and conductivity were measured at approximately 1 meter below the water surface.

Blood Lead Study

In 2002, as part of the IEUBK Child Blood Lead Model, a voluntary blood lead study was conducted by Exide at Quest Diagnostics in Reading. The blood lead study measured blood lead levels in children aged 6 to 84 months (i.e. 6 months to 7 years) living in Muhlenburg Township and the Borough of Lauderdale, which are adjacent to the site. The purpose of the study was to determine if children living near Exide exhibit elevated Blood Lead Levels (BLL's) greater than CDC's intervention value of 10 *u*g/dL. Adult residents, especially pregnant and nursing women, could also voluntarily participate in the study. Samples were analyzed for lead, in duplicate, by Omega Laboratory. The average of the two duplicates was calculated and used as the reported BLL. Quality Assurance/Control measures employed included blind duplicated and split samples.

In addition to blood sampling, an exposure questionnaire was collected for study participants. The exposure survey included such topics as: time at current residence; time outdoors, at day care center, secondary residences, and playgrounds; childhood habits such as mouthing behavior and pica; and the type of playing surface at the residence, i.e. grass, dirt, sandbox, etc.

Residential Sampling

Exide, in collaboration with EPA, collected residential samples from a variety of media including soil, interior dust and paint, and tap water to calculate site-specific values for the IEUBK Child Blood Lead Model. The residential sampling was used to calculate site-specific input values for the IEUBK model. PADOH and ATSDR reviewed the residential sampling data, as it relates to the inputs used in the IEUBK model, and summarized the data below.

Residential Soil Sampling

In 2001 and 2002, Exide sampled approximately 650 properties, which equate to approximately 12,500 soil samples taken in Laureldale Borough and Muhlenberg Township. Shortly thereafter, the property owners received a copy of the soil results. Based on the soil results, the properties were grouped, by EPA, into three categories:

1. Residential properties with average soil lead concentrations less than 650 ppm - no cleanup required

2. Residential properties with an average soil lead concentration greater than 650 ppm - cleanup required based on the site-specific risk assessment.

3. Residential properties with average soil lead level greater than 1200 ppm - immediate cleanup required

Additional Residential Sampling

In conjunction with the Blood Lead study, interior dust and tap water samples were collected at the residences. Properties located within the Exide study area and occupied with children under the age of 84 months (i.e. 7 years) or pregnant/nursing women who provided a blood sample (as discussed above), were the subject of the environmental sampling.

To assess children's exposure to lead in interior dust, one composite dust sample was collected from each resident that also provided a blood sample. For Quality Assurance purposes, one duplicate dust sample was collected at every tenth residence. Dust samples were obtained with a vacuum-assisted dry sampler using a personal monitor pump. Composite sub samples were gathered from within a 625-cm^2 grid area. The area inside a template grid was sampled by passing a vacuum over the area three times. The sampling cartridge was placed in a sealed plastic bag, labeled and sent to Martel Laboratories for analysis.

Although it is not related to the Exide site, lead based paint is a very important potential source of lead exposure for many children seven years and younger. Non-destructive lead-based paint screening was performed for residences with children aged 6 to 84 months (i.e., 6 months to 7 years) or pregnant or nursing women, in accordance with HUD's "Guidelines for the Evaluation and Control for Lead-Based Paint Hazards in Housing". Screening locations included at least one wall and one trim that were painted in each of the primary living areas. Three readings were obtained and averaged. Three exterior surfaces were also screened. As a QA procedure, duplicate readings were collected at every tenth house. In addition to the XRF readings, the condition of the painted surfaces was rated as tight, loose, or peeling.

A tap water sample was obtained from the primary water faucet in each residence, where paint and dust sampling was also performed. Duplicate samples were collected at every tenth house.

Quality Assurance and Quality Control

In preparing this health consultation, ATSDR and PADOH relied on the information provided in the referenced documents. ATSDR and PADOH reviewed the quality assurance and quality control measures that were followed regarding data gathering, chain-of-custody, laboratory procedures, and data reporting. ATSDR and PADOH expected and presumed that to ensure the accuracy of the data, extreme care was taken during all aspects of sample collection. ATSDR and PADOH also assumed that the laboratory only used certified, clean-sample collection devices. Once samples were collected, ATSDR and PADOH expected they were stored according to the method protocol and were delivered to the analytical laboratory as soon as possible. Finally, ATSDR and PADOH presumed that laboratory Standard Operating Procedures and other procedures and guidance for sample analysis, reporting, and chains of custody were followed. The analyses, conclusions, and recommendations in this health consultation are valid only if the referenced documents are complete and reliable.

Sample Results

Sample Results (prior to 2001)

Exide, in agreement with PADEP, conducted extensive sampling of residential properties adjacent to the site. In 1991, random soil sampling for lead southwest of Exide (west of the Park), showed concentrations ranging from 779 to 5082 ppm of soil lead. In 1992 to 1995, Exide performed soil sampling of residential properties and within the Park boundary (figure 2 and 3). Sampling conducted at residential properties showed lead levels in the 0 to 3 inch soil horizon, up to 14,259 ppm. The areas most heavily contaminated with lead are located south and west of the site, following the presumed overall pattern of air deposition from the smelter location. Exide, in conjunction with EPA, has cleaned-up and continues to clean-up residential properties in the area with soil lead levels greater than 650 ppm.

In the 1995 Park soil-sampling event, conducted by PADEP, lead levels ranged from 199 ppm (eastern side of the Park) to 4401 ppm (northwest portion of the Park). The 1995 park soil sampling data display the same overall trend in lead levels as the more recent Park soil sampling event (2001), as discussed further below. The areas with the greatest soil lead levels are located in the northwest corner of the Park, closest to the Exide facility. Elevated lead levels in the Park warranted closing of the Park in 1996 by the City of Reading and subsequent additional Park sampling, as discussed below.

Park Sample Results

Soil Samples

ATSDR and PADOH reviewed the soil sampling results collected by Exide, and their contractors. Composite soil samples were collected from the Park, with the Park subdivided into Exposure Areas (EA) sampling. In each EA, 3 samples were collected and averaged (Table 1 and Figure 4). The results of the soil sampling can be divided into 3 categories:

1). EA with soil lead levels less than 650 ppm - no clean-up action currently proposed by EPA

2). Open areas and frequently used EAs with soil lead levels greater than 650 ppm - clean-up action proposed by the EPA.

3). Heavily wooded and steeply sloped EAs with soil lead levels greater than 650 ppm - no clean-up action currently being considered by the EPA, due to the limited likelihood of exposure frequency.

The soil lead concentrations range from an average of 126.8 ppm in EA Sediment Pond, located on the eastern portion of the Park, to 4845.3 ppm in EA NN, located on the northwestern portion of the site. Overall, the highest levels of lead were detected on the northwest portion of the Park, in very steep terrain, which is closest to the Exide site. The highest soil lead concentrations in northwestern portion of the park were in EA MM, NN, OO, and PP at levels of 2029.5, 4845.3, 3654.6 and 1154.5 ppm, respectively. Elevated soil lead levels were also detected on the islands, within the reservoir. Lead levels on the reservoir islands were 2712.5 ppm (EA UU), 1973.2 ppm (EA TT) and 1022.1 ppm (EA

ZZ). The northwestern portion of the site and the islands are not currently proposed in EPA's remedial activities.

The eastern portion of the Park, which is relatively flat, and the southern portion of the Park generally, had lower levels of soil lead compared to the northwest portion of the Park. However, there were several EA's in the eastern and southern portions of the Park with average lead concentrations exceeding 650 ppm. The highest soil lead values in these areas were 1147.2 ppm in EA F, located on the eastern portion of the Park, and 1921.4 ppm in EA T, located on the southern portion of the Park. These areas, with lead concentration exceeding 650 ppm, are currently included in EPA's remediation plans.

Reservoir Samples

Water samples were collected from the Park's reservoir (Table 2). One out of the thirty water samples slightly exceeded the Maximum Contaminant Level (MCL) for drinking water of 15 ppb. The one sample detected a lead concentration of 15.9 ppb. The rest of the samples detected lead concentrations from <1.5 ppb to 6.7 ppb. The average water lead concentration in the reservoir is 2.9 ppb. Although the Park is currently closed, the reservoir water *poses no apparent public health concern* to area Park visitors, based on the data evaluated.

Sediment Samples

Sediment sampling was performed in the Park's reservoir (Table 3). The average reservoir sediment concentration was 298 ppm of lead. The concentrations of lead in the sediment were below the site-specific risk assessment level of 650 ppm. In addition, the sediment levels in the Park were also below ATSDR's comparison value for soil of 400 ppm. Since the levels of lead are below cleanup levels and comparison values, the reservoir sediment *poses no apparent public health concern* to area residents that might visit the Park.

Residential Sample Results

Soil Samples

Out of the 650 properties sampled, approximately 450 properties contain an average soil lead concentration of 650 ppm or less. A total of 115 properties have been cleaned up or will be cleaned up by 2010 by Exide. In 2000-2002, Exide cleaned up 83 properties that contain soil lead levels greater than 1200 ppm, with approximately 120 residential properties still requiring soil cleanup. In 2008, Exide will cleanup an additional 40 properties with children 7 years old and younger. In 2009-2010 Exide will cleanup the remaining 80 developed residential properties. There are approximately 10-12 undeveloped residential properties/vacant lots that currently do not pose a public health risk. If these properties are proposed for development, it is understood that Exide will resample the properties, prior to construction. If the soil levels on the graded lots are greater than 650 ppm, it is understood that Exide will cleanup the properties prior to construction. After residential soil removal and cleanup activities, it is understood that Exide has or will conduct confirmatory sampling to verify that each property achieved the cleanup level. The EPA and Exide have remediated or currently are in the process of remediating the residential properties.

Blood Lead Samples

In addition to the soil lead data, blood lead sampling data was also obtained from neighborhood children, in Muhlenburg Township and the Borough of Lauderdale, by Exide at Quest Diagnostics in Reading (Table 4). Voluntary blood lead screening was conducted in the community to aid in calculating site-specific risk assessments. A total of 48 children from age 6 to 84 months (i.e. 6 months to 7 years) participated in the blood lead study, with 36 of those children being residents and 12 visitors. With the exception of two children, the BLL's of the study participants were below 10 ug/dL. The first elevated level was present in a 2 year old visitor, at 14 ug/dL. The permanent resident on the property did not exhibit elevated BLL. EPA concluded that the visitor's elevated BLL was most likely a result of lead exposure outside the Exide study area. The child's parents were advised to follow up with their family physician. The other observed elevated case was an 8-year old resident (17ug/dL). The child's parents indicated that the child has had a history of elevated BLL associated with lead paint exposures at their former home. The child's BLL has decreased since the family moved into the area. The two younger siblings in the same dwelling did not have elevated BLL.

The average BLL for the resident children was 2.8 ug/dL, vs. 4.0 ug/dL for the visitors. A total of 21 individuals aged 7 to 17 years also took part in the study, with 15 residents and 6 visitors. The average BLLs were 2.9 and 2.4 ug/dL for the residents and visitors, respectively, which closely resembles national averages for blood lead levels. Finally, 11 adults over the age of 18 years provided samples for the study, including 9 residents and 2 visitors. The average BLL for the adult participants were 1.5 and 2.0 ug/dL for the residents and visitors, respectively.

Additional Residential Samples

Residential sampling was performed, in conjunction with the above mentioned blood lead sampling, to assist in calculating site-specific values for the IEUBK Child Blood Lead Model. Interior dust, interior and exterior paint samples, tap water and soil samples were collected from houses where blood lead was also analyzed.

A composite dust sample was collected from 37 residences. Residential dust lead levels ranged from 120 mg/kg to 8100 mg/kg, with an average of 1423 mg/kg (Table 5). In addition, interior and exterior paint surfaces were also screened for lead-based paint at 37 residences (Table 6). Lead was detected in both interior and exterior samples in several residences, due to the age of the houses. A total of 11 houses had XRF readings for interior paint greater that 10 mg/cm^3. A maximum level of 23.9 mg/cm^3 and 30.8 mg/cm^3 was detected in the interior and exterior paints, respectively. These values for lead-based paint assisted in calculating site-specific risk levels for childhood lead exposure. Tap water samples were also obtained at above-mentioned residences to assess children's potential exposure to lead in tap water (Table 7). One residence had a lead concentration (25 ug/L) greater than the Maximum Contaminant Level (MCL) of 15 ug/L. Residential soil samples were collected from the 37 residences (Table 8), with between 3 to 8 samples collected per properties. A total of 229 soil samples were collected, of which 171 samples were from the 0 to 3 inch soil horizon. The soil lead levels ranged from 60 to 1671 mg/kg.

Risk Assessment Models

ATSDR and PADOH reviewed two risk assessment models, conducted by Exide's contractors and analyzed by EPA, to estimate the risk from exposure to lead contaminated soil at the Park. The first model is the EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model, used to estimate Blood Lead Levels (BLL's) in children from multiple sources. The second risk assessment model applied to the site uses the EPA's Adult Blood Lead Model, and estimates exposures due to recreational use by adolescents and adults at the Park.

Child Blood Lead Model (IEUBK)

EPA's Integrated Exposure Uptake Biokinetic (IEUBK) model is a computer model that utilizes a variety of exposure sources to calculate a theoretical blood lead level (BLL) in children, aged 6 to 84 months (i.e. 6 months to 7 years). Site-specific values are utilized in the IEUBK model, taking into account lead exposure from multiple sources including water, soil, household dust, food and air (Table 9). The model then calculates a lead level in soil and the resulting theoretical BLL that is protective of children that reside in the area and may frequent the Park.

The IEUBK Model, which is multi-compartmental pharmacokinetics model, was developed to predict the probability of elevated blood lead concentrations in children under the age of 7. The model addresses three components of human health risk assessment: (1) The multimedia nature of exposures to lead; (2) lead pharmacokinetics; and (3) significant variability in exposure and risk. The IEUBK Model can be used to predict the probability that children (7 years or less), who are exposed to lead from multiple environmental media, of having BLL's exceeding a given health-based level of concern (e.g., CDC level of 10 µg/dL).

These risk estimates can be useful in assessing the possible consequences of alternative lead exposure scenarios following intervention, abatement, or other remedial actions. The IEUBK Model was not developed to assess lead risks for age groups older than 7 years. The model operates with an exposure time step on 1 year (the smallest time interval for a single exposure event) and, therefore, is more suited to applications in which long-term (i.e., >1 year) average exposures and blood lead concentrations are to be simulated. The following criteria are factored into the IEUBK Model:

1. *Intake of lead in soil, house dust, air, water, and food.* Sampling data on lead in these various media are used to identify site-specific intake rates. Media specific default intake rates are used in this model if the sampling data was not available.
2. *Uptake of lead from the contaminated media into the blood stream.* Only a fraction of the lead that an individual is exposed to is taken in and makes it to the bloodstream. Typically, default uptakes rates are used in the IEUBK model.
3. *Biokinetics of lead within the body.* The biokinetics of lead, or where lead goes within the body and how fast it is eliminated.
4. *Distributions of blood lead concentrations within the population of concern.* The mean identified in the biokinetic component is then used to calculate the most probable distribution of blood lead levels within a population using default assumptions on the distribution. These

assumptions include variability in physiology, behavior, sampling, and analysis. These results are used to determine the probability that a child will have a blood lead concentration above a specific level (default value of 10µg/dL).

As discussed above, a blood lead study was initiated in 2002, by Exide, to measure the current BLL's among children living in the communities surrounding the Exide facility. The average BLL's in the Exide area were close to the national average of 2.0 ug/dL. The blood lead study indicated that 34 of the 36 children tested exhibited BLL between 0.5 ug/dL and 7 ug/dL, which are below the CDC BLL action level of 10 ug/dL. The EPA study determined that one of these children has had a history of elevated BLL from lead paint exposure in his previous home. The child's BLL has since decreased when the family moved into their new home in the area. The second child with elevated BLL was an occasional visitor. Permanent residents at the same property did not exhibit elevated blood lead levels, indicating the lead exposure in all probability occurred elsewhere and was most likely unrelated to exposures from either the Site or the Park.

Children whose blood levels range from 10-to-20 µg/dL are at a risk of having decreases in IQ of up to 11 points, and slightly impaired hearing and growth. Those children with blood lead levels of 20-to-40 µg/dL could experience problems in metabolizing vitamin D, which is crucial in bone development. Children with blood lead levels greater than 40 µg/dL could experience anemia and other blood related problems. Colic, kidney disease, and diseases of the brain have been observed in children with blood lead levels greater than 60 µg/dL.

A soil cleanup value of 650 ppm was derived by applying site-specific inputs from blood levels, residential tap water and soil/dust samples (see above results of residential and park sampling), and the likely exposure frequency. Table 10 outlines the input parameters utilized in the IEUBK model, based on age (0 to 7 years), to calculate soil lead cleanup levels. The IEUBK model found that a soil cleanup level of 650 ppm, for children ages 84 months (i.e. 7 years) or younger would have a 5% chance or less of having a BLL exceeding the CDC standard of 10 ug/dL. PADOH and ATSDR conclude that the soil cleanup level of 650 ppm generated by the IEUBK model appears to be, and is supported by PADOH and ATSDR, protective of public health specifically to children who might visit and play in the Park.

Adult Blood Lead Model

Based on the 2001 Park soil sampling results, a second risk assessment was performed, using the EPA's Adult Blood Lead Model for an adolescent recreational user with a threshold vale of 10 ug/dL. Sample results from the northwest portion of the Park, three islands, and the small area of land on the south side of the spillway (western end of the lake) were included in the analysis. The model applies incremental effects attributable to environmental media, over and above an assumed steady state baseline blood lead level, based on environmental concentrations, ingestion rates, and estimates of lead absorption fractions. The only pathway of exposure evaluated in this model is incidental soil ingestion.

The estimated exposure frequency varies for different Exposure Areas because certain grids are assumed more accessible than others. (Table 11). Exposure frequencies applied in the assessment represent EPA's estimate of worst-case scenario for each Exposure Area. Exposure Area PP, QQ, RR, SS and DD have an estimated exposure frequency of 80 days/year (or 6-7 visits per month). For

Exposure Areas NN and OO, due to the steep terrain, it is reasonably anticipated the use of these areas would be less frequent, and therefore have an exposure frequency of 20 days/year. In the island/peninsula/spillway (Exposure Areas TT, UU, and ZZ), access to these areas are limited and the estimated exposure frequency is 40 days/year (3 – 4 visits per month).

The exposure frequencies utilized the worst-case scenario, based on a particular EA. For this model, the potential receptor population is an adolescent recreational visitor to the Park, with a threshold BLL of 10 ug/dL. BLL's are estimated using environmental concentrations, ingestions rates, and estimates of lead absorption rates. The EPA's default values for the baseline and exposure parameters were applied from EPA's analysis of the NHANES III database, using the values for the Northeast region of the US, for all ethnicities combined (US EPA, 2002).

The total incremental uptake is an increase over the baseline BLL's, through the Biokinetic Slope Factor (BSK), as detailed further in the March 2008 Risk Assessment for Lead Exposure document (Gradient Corporation). The baseline GM blood lead was 1.98 µg/dL, with a GSD of 2.0 µg /dL. The soil ingestion rate was 0.05 g/day. The absorption fraction for lead from soil/dust was 12%. The Biokinetic Slope Factor value was 0.4 µg/dL per µg/day. The probability of exceeding a target blood lead of 10 µg/dL for the adolescent was calculated by treating the model's central estimate as a geometric mean (GM) and applying a specified geometric standard deviation (GSD) to calculate the fraction of individuals predicted exceed the blood lead concentration of 10 µg/dL.

The results show that recreational use of these portions of Park, if left unremediated, would result in a slight increase in blood lead level over the baseline (table 12). However, the predicted BLLs are still below the CDC intervention guideline of 10 ug/dL. All predicted geomeans and the 95th percentile BLL's are below 10 µg/dL with a less than a 5% probability of exceeding this level. The highest predicted blood lead level estimated by the model is 7.3 ug/dL and occurred at EA U, which is well below the CDC intervention guideline of 10 ug/dL. The model is a conservative estimate. In general, adults ingest much less soil than children do and they absorb much less of the lead that they do ingest. PADOH and ATSDR would not expect blood lead levels of adults in this neighborhood to be elevated.

Contaminant Evaluation

Lead

Lead occurs naturally in soils, typically at concentrations ranging from 10 to 50 mg/kg (milligrams of lead per kilogram of soil, equivalent to ppm). Because of the widespread historical use of lead, urban soils often have lead concentrations much greater than normal background levels. These concentrations frequently range from 150 mg/kg to greater than 10,000 mg/kg near the base of a home painted with lead-based paint.

Lead has been used in the production of batteries, ammunition, metal piping, and devices to shield X-rays. Lead is released into the air during burning coal, oil, waste, mining activities, smelting activities and factories. Because of health concerns, lead from paints has been dramatically reduced in recent years. The use of lead as an additive to gasoline was banned in 1996 in the United States. Lead is commonly found in soil especially near roadways, older houses, old orchards, mining areas, industrial sites, near power plants, incinerators, landfills, and hazardous waste sites. People living near hazardous waste sites may be exposed to lead by breathing air, drinking water, eating foods, or swallowing dust or dirt that contain lead. When lead is released to the air, it may travel long distances before settling to the ground. Once lead falls onto soil, it sticks strongly to soil particles and remains in the upper layer of soil. Movement of lead from soil into groundwater will depend on the type of lead compound and the characteristics of the soil.

Studies conducted in Maryland and Minnesota have indicated that within urban settings, the highest soil lead levels occur near inner city areas, especially where high traffic flows have occurred and that the concentration of lead in the soil is correlated with the size of the city. In 1981, soil levels in the Minneapolis/St. Paul inner city area were 60 times greater (423 ppm) than levels found in rural Minnesota (6.7 ppm), with 95% of all the contamination being contributed to leaded gasoline. Soil samples collected near foundations of homes with painted exteriors had the highest lead levels on average with 522 ppm lead. Levels of lead in surface soil were identified as high as 20,136 ppm near homes that had exteriors painted with lead-based paint.

Soil lead is held tightly on the surfaces of very fine clay and organic matter particles. Therefore, when lead is added to the soil surface, it tends to accumulate in the upper 1 to 2 inches of soil unless the soil has been disturbed by activities such as excavation for building or tillage for landscaping and gardening. During smelting operations at the Exide facility, lead was released from the stack into the air and settled onto the ground in the neighboring community. Lead particles from emissions deposit on the soil, become tightly bound to soil particles, and are retained in the upper portions of the surface soil after deposition. Since lead does not dissipate, biodegrade, or decay, the risk of exposure is long-term.

People are exposed to soil lead from direct contact with contaminated soil or from contact with very fine soil particles carried into houses as airborne dust or either on shoes, clothing, or pets. Lead is taken into the body by either ingestion (eating) or inhalation (breathing). Children are at higher risk for ingesting lead because they are apt to mouth dirty items such as toys and pacifiers and to suck dirty fingers and hands. Some young children exhibit *pica,* the desire to eat soil, and consume much larger quantities. Exposure also may result from eating garden produce grown in or near contaminated soil. Lead can be taken up from the soil into plant tissues, or contaminated dust may settle on edible leaves and fruits.

The biological fate of lead is well known. When ingested, 10%-to-80% (depending on various factors) is absorbed directly, distributed throughout the body through the bloodstream, and what remains is excreted. Your body does not change lead into any other form. Lead is primarily distributed through the kidneys, bone marrow, liver, brain, bones, and teeth. Bone and tissue have been found to contain 95% of the total amount of lead stored in the body. Therefore, collecting and analyzing blood samples for lead measures recent and ongoing exposures, but not the lead that is being stored. However, if blood is mobilized from bones (during pregnancy, menopause, etc.) then you can also measure it in blood samples from preexisting exposures

The main target for lead toxicity is the nervous system, both in adults and children. Exposure to high lead levels can severely damage the brain and kidneys in adults or children and ultimately cause death. In pregnant women, high levels of exposure to lead may cause miscarriage. Preschool-age children and fetuses are usually the most vulnerable segments of the population for exposure to this contaminant. Infants and children are exposed to lead mainly through diet and ingestion of non-food materials associated with normal early hand-to-mouth behavior. Chronic exposure to low lead levels has been shown to cause subtle effects on the central nervous system, which can result in deficits in intelligence, behavior, and school performance.

The Department of Health and Human Services (DHHS) has determined that lead and lead compounds are reasonably anticipated to be human carcinogens and based on animal data the EPA has determined that lead is a probable human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic lead is probably carcinogenic to humans and that there is insufficient information to determine whether organic lead compounds will cause cancer in humans. There is evidence that it is a carcinogen in animals at high doses; however, there is insufficient evidence that lead causes cancer in humans. Kidney tumors have developed in rats and mice that had been given large doses of some kind of lead compounds.

Many factors will determine the severity of the health effects from lead exposure. These factors include: Dose; age at exposure; duration of exposure; occupational exposures; life stages of women (childbirth, lactating, and menopause); health and lifestyle of person exposed; and nutrional status of the person. The developing nervous system is the most sensitive system to the effects of lead. The efficiency of lead absorption from the gastrointestinal tract is greater in children than in adults. In addition, a diet containing more calcium and iron may reduce lead absorption.

Although no threshold level for adverse health effects has been established, evidence suggests that adverse effects occur at blood lead levels at least as low as 10 µg/dL. The Centers for Disease Control and Prevention (CDC) has determined that a blood lead level greater than or equal to 10 µg/dL in children indicates excessive lead absorption and constitutes the grounds for intervention. The 10 µg/dL level is based on observations of enzymatic abnormalities in the red blood cells at blood levels below 25 µg/dL and observations of neurological and cognitive dysfunction in children with blood lead levels between 10 and 15 µg/dL. Some persons with lead poisoning may not be overtly symptomatic because of the differences in individual susceptibility, symptoms of lead intoxication and their onset may vary. With increasing exposure, the severity of symptoms can be expected to increase. In the early stages of symptomatic lead intoxication or mild toxicity, blood lead levels generally range from 35 to 50 µg/dL in children and 40 to 60 µg/dL in adults. Mild toxicity may result in muscle pain and irritability. Moderate toxicity may result in bone pain, general fatigue, difficulty concentrating, headache, diffuse abdominal pain, and weight loss. Severe lead toxicity may result in encephalopathy, which may lead to seizures. Based on sufficient animal studies, EPA classifies lead as a probable human carcinogen. No cancer slope factor has been developed for lead to evaluate possible cancer risks to people exposed to lead in the study area.

A blood lead test is the most useful screening and diagnostic test for evaluating a possible exposure to lead. Therefore, as a prudent public health practice, blood lead tests are recommended for children (five years of age and younger). In addition, the possibility of exposure to lead-based paint in homes constructed prior to 1978 and/or other sources of lead could also contribute to the overall dose of lead that is taken into the body. For this reason, PADOH recommends that all children under the age of six should have their blood tested for lead, if they have not recently been tested, regardless of their exposure to the surface soil on the vacant lot. The screening recommendations for Pennsylvania recommend a blood lead test for all children at ages one and two years for all children and for all children age's three to six without a confirmed prior lead blood test.

Soil Lead Concentrations/ Blood Lead Levels

There is a great deal of variability in the scientific literature regarding the relationship of soil lead concentrations and blood lead levels (BLL) in children. In general, children's BLL raise 3-7 µg/dL for every 1,000 ppm increase in soil or dust lead concentration. A blood lead level of 10 µg/dL would result from soil lead levels ranging from 485 ppm to 1,133 ppm. The results of several studies, however, have indicated that the increase in blood lead as a function of soil lead concentration is not linear. The rate of increase in BLL at low concentrations of lead in soil is greater than at high concentrations of lead in soil. To deal with this non-linear relationship, EPA developed the IEUBK Model for lead exposure in children. The IEUBK Model is used to predict the risk of elevated blood lead levels in children less than seven years old that are exposed to lead from various sources. The model also predicts the risk that typical child, exposed to specify media lead concentrations, will have a blood lead level greater than or equal to the level associated with adverse health effects (10µg/dL). The IEUBK Model is EPA's primary tool for identifying clean-up levels for lead-contaminated soil and was utilized at Bernhart Park

Discussion

PADOH and ATSDR evaluated the environmental sampling data to determine if the potential Park visitors might be exposed to lead-contaminating soil at levels that would pose a public health threat. One of the mandates of ATSDR, under the Comprehensive Environmental Response, Compensation, and Liability Act (CRCLA), or Superfund, is to address the potential for adverse effects on public health resulting from exposures to contaminants. ATSDR has assessed the public health implications from lead exposure on numerous hazardous waste sites. Lead has been identified as a contaminant in at least 1,026 of the National Priorities List (NPL) sites and is ranked first on the Priority List of Hazardous Substances. ATSDR's specific responsibility at lead-contaminated hazardous waste sites include:

1). Evaluation of site-specific environmental lead exposure information

2). Identification of populations potentially exposed to lead

3). Decisions about whether or not to conduct blood lead screening

4). Evaluate blood lead screening results

5). Determine whether EPA's proposed site remediation plans are sufficient to protect public health.

PADOH and ATSDR consider ingestion of on-site soil to be the main pathway of concern, and the most relevant to this Health Consultation. The soil exposure pathway is an especially important pathway for children, who often exhibit hand-to-mouth behavior and have consequently higher ingestion rates of soil. PADOH and ATSDR consider exposure to lead contaminated soil on-site, in the northwest portion of the Park, to be a completed exposure pathway. For an exposure pathway to be completed, all the following elements must be present:

1) A source of contamination

2) Transport through an environmental medium (i.e. soil, water, air)

3) A point of exposure

4) A route of human exposure

5) A receptor population

Upon viewing the topographic map for the Park (Figure 6), PADOH calculated the percent gradient, or slope, for the areas of the park with the highest lead levels, NN and OO (Figure 4), located in the northwest portion of the Park. For comparison purposes, the slope was also computed for areas of the park that are considered relatively 'flat' encompassing E, G, H, and I. The OO (77%) and NN (58%) sampling areas are considerably steeper than E, G, H, and I sampling areas (1%). Since these areas in the northwest portion of the Park have a considerably steeper gradient, this affirms the assumption that the frequency of visitation, and thus exposure, by young children would be far less for the steeper areas of the park than the 'flatter' portions of the Park.

Exposure Area	Lead Level (ppm)	Vertical (ft)	Horizontal (ft)	Slope* (%)
OO	3654.6	85	110	77%
NN	4845.3	35	60	58%
E, G, H, I	419-1147	7.8	720	1%

* Slope = (Change in Vertical elevation across an Exposure Area) ÷ (Change in Horizontal (ft) across an Exposure Area) * 100

The IEUBK model, developed by EPA, is one of the most extensive efforts to date to make population-based predictions in BLL based on environmental data. The model is comprehensive and incorporates both exposure/uptake parameter and a biokinetic component to estimate the BLL's in the exposed population. EPA's IEUBK model has been utilized extensively in ATSDR's public health assessment process. PADOH and ATSDR evaluated the results of IEUBK model analysis for childhood lead exposure, especially children 7 years or younger, completed for Bernhart Park. Based on this review, PADOH and ATSDR, conclude EPA's soil lead clean-up level of 650 ppm in the southern and eastern portions of the site are protective of public health.

For the northwestern portions of the park, the Adult Blood Lead Model was used. PADOH and ATSD, upon visiting the site, considered the likely visitors (i.e. adults or adolescents) and the potential exposure frequency. It is unlikely that an infant or young child (under the age of 7) would have access to these areas and would not be under adult supervision. For these reasons, PADOH and ATSDR believe the Adult Blood Lead Model was appropriate in assessing potential risk in these areas of the park. The highest predicted blood lead level estimated by the model was 7.2 ug/dL at EA NN, which is well below the CDC intervention guideline of 10 ug/dL. Recreational use of these portions of Park, by adolescent visitors, if left unremediated, would result in a slight increase in blood lead level over the baseline. Based on the sampling data, the Adult Blood Lead Model, and likely exposure scenarios, soil lead levels in the northwest portions of the Park pose *no apparent public health hazards,* with the following deviation:

> PADOH and ATSDR identified access points located in the northwestern section of park that include a heavily wooded area and the reservoir spillway (Exposure Areas QQ, RR, SS, DDD, and MM) that are not currently proposed by EPA for remediation. These areas exceed 650 ppm and provide ***unrestricted access*** from the neighboring housing development. Due to the close proximity to the adjacent residential areas, the lack of access restrictions, and the environmental sampling data, there is a potential for the public, especially children, to be exposed to lead contaminated soil in these areas. Based on this information, the exposure

scenarios in this area of the park are more similar to the exposure assumptions currently being considered by the EPA in the southern and eastern portions of the park (IEUBK model), particularly for children, and pose a ***public health hazard,*** **however;**

1. Since these Exposure Areas (QQ, RR, SS, DDD, and MM) are located in a portion of the park that is heavily wooded and very steep it is unlikely, but possible, that children would recreate in these areas for an extended period.
2. PADOH and ATSDR do not have any direct evidence, only anecdotal accounts, that children are currently frequenting these areas of the park, since the park is currently closed.

PADOH and ATSDR recommend that ***EPA consider remedial, mitigation-type, or other-type appropriate activities or solutions*** in this area of the Park. Such activities could include but are not limited to any or all of the following possibilities: (1) erecting a fence, barrier, and/or signage; (2) addition of clean topsoil or other appropriate cover to the area: (3) diverting the public towards a “clean” alternative footpath, concourse, causeway, trail, or the like; and/or (4) other feasible measures that would minimize the likelihood of exposure and/or ingress and egress to these areas. If appropriate remedial, mitigation-type, or other activities or solutions are employed in the above-mentioned Exposure Areas of the Park (QQ, RR, SS, DDD, and MM) that minimize the likelihood of exposure and/or ingress and egress to these areas**,** PADOH and ATSDR believe that the exposure scenarios in this area of the Park would be similar to the exposure scenarios in the remainder of the Park and thus would pose ***no apparent public health hazard*** to potential Park visitors.

In addition, PADOH and ATSDR evaluated the sampling and risk assessments conducted for the islands, which are located within the reservoir. The lead levels on the reservoir island were 1022, 1973 and 2713 ppm for EA ZZ, TT, and UU, respectively. The highest predicted blood lead level estimated by the model is 7.3 ug/dL and occurred at EA UU, which is well below the CDC intervention guideline of 10 ug/dL. It is reasonably expected that since the islands are surrounded by water, access and recreational use would be infrequent. Recreational use in these areas of the Park by adolescent visitors, if left unremediated, would result in a risk of a slight increase in blood lead level over the baseline. Based on the sampling data, the Adult Blood Lead Model, and likely exposure scenarios, soil lead levels in the northwest portions of the Park pose *no apparent public health hazards.* Any change in future use of the islands (e.g. if the reservoir were to be permanently drained) could alter these conclusions.

Overall, PADOH and ATSDR agree with EPA’s conclusion that active remediation of the entire park is not warranted at this time, with the exception of the above-mentioned sections. EPA’s proposed remediation and remedial action plans appear to be protective of public health, especially park visitors. Any future use of the site that significantly alters the usage of the northwest portion of the park could affect these public health conclusions.

Child Health Considerations

PADOH and ATSDR recognize that infants and children are more vulnerable to chemical exposure than adults. As part of their child health considerations, PADOH and ATSDR are committed to evaluating exposure scenarios that potentially involve children. Considering exposure to surface soil in the Park, children may have an increased vulnerability due to many factors including:

1) Children weigh less than adults, resulting in higher doses of chemical exposure relative to body weight

2) Children have higher rates of ingestion

3) Metabolism and detoxification mechanisms differ in both the very young and very old and may increase or decrease susceptibility, and;

4) The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.

Studies show that adverse reproductive and developmental effects are possible after exposures to significant doses of lead. Therefore, fetuses, infants, and children are more susceptible to the effects of lead. Residents that have young children at home should take precautions to avoid tracking in potentially contaminated soil into their home. PADOH's suggestions are summarized in the *Recommendations* section.

Small children can be exposed by eating lead-based paint chips, chewing on objects painted with lead-based paint, or swallowing soil that contains lead. Children are more vulnerable to lead poisoning than adults. A child who swallows large amounts of lead may develop blood anemia, severe stomach ache, muscle weakness, and brain damage. Lead affects children in different ways depending on how much lead a child ingests. Even at much lower levels of exposure, lead can affect a child's mental and physical growth. Exposure to lead is more dangerous for young and unborn children.

Unborn children can be exposed to lead through their mothers. Harmful effects include premature births, smaller babies, and decreased mental ability in the infant, learning difficulties, and reduced growth in young children. Fetuses are at even a greater risk from lead exposure than children. Since lead crosses the placenta, a women exposed to lead during her pregnancy can pass on lead to her developing fetus, with some health effects persisting beyond childhood. In addition, lead in bones of women who were exposed before pregnancy may be mobilized because of the physiological stresses of pregnancy resulting in exposure to fetus.

Children under the age of six are considered to be at a greater risk for health effects from exposure to lead compared to older children and adults. The reasons for children's increased vulnerability to lead poisoning are due to the following factors:

1. children's developing central nervous system;
2. hand-to-mouth behavior exhibited by children increases the ingestion rate for either contaminated soil or the ingestion of lead containing dust or paint chips;

3. children’s efficiency of lead absorption from the gastrointestinal tract is greater than adults; and
4. Iron and calcium deficiencies that are prevalent in children may enhance the absorption and increase the toxic effects of lead.

Most children with lead poisoning have no obvious symptoms; therefore, the condition often remains undiagnosed and untreated Health effects from lead exposure in children and unborn fetuses include both physical and mental impairments, hearing difficulties, impaired neurological development, and reduced birth weights and gestational age. Neurobehavioral toxicity, effects such as impulsivity, aggression, and short attention span when exposure levels are high and distractibility, poor organization, a lack of persistence, and daydreaming occur when exposure levels are low. Some health effects from lead exposure, such as impaired academic performance and motor skills, may become irreversible and persist, even when blood lead concentration return to below 10 µg/dL.

Regulations and Standards

EPA regulates lead under the Clean Air Act and has designated lead as a hazardous air pollutant. Prior to the Clean Air Act in 1977, the amount of lead discharged by stack emissions from industrial sources, and eventually settling and accumulating in nearby soil, such as the Exide facility, was not restricted. In addition to the Clean Air Act, in the early 1970’s EPA began to phase-out the use of leaded gasoline because of its effects on the environment from automobile emissions. By 1988, less than 1% of gasoline contained lead as compared to the gasoline used in 1970. In 1988, the Lead-Based Paint Poisoning Prevention Act was passed through legislation and became law. It prohibits the use of lead-based paint in residential structures built or renovated by any federal agency. The Act also gives the Department of Housing and Urban Development (HUD) authority to develop regulations on the removal of lead-based paint from housing constructed prior to 1978. In addition to HUD, EPA, the U.S. Department of Health and Human Services (DHHS), and the Department of Labor’s Occupational Safety and Health Administration (OSHA) are the primary federal agencies for promulgating regulations aimed at minimizing lead exposure.

In 2001, in compliance with the Toxic Substance Control Act (TSCA) §403, EPA published a final rule for dangerous levels of lead. That rule establishes a soil-lead hazard of 400 ppm for bare soil in play areas and 1,200 ppm for bare soil in non-play areas for the rest of the yard, based on an average of all other samples collected. As recognized in the TSCA, lead contamination at levels equal to or exceeding the 400 ppm and 1,200 ppm standards may pose serious health risks. The potential risks are site-specific and may warrant timely response actions. Property owners and other decision makers should implement effective measures to reduce or prevent children’s' exposure to lead in soil that exceeds these levels. These measures may incorporate, but are not limited to, interim controls that include covering bare soil and placement of washable doormats in entryways.

Community Health Concerns

Community members have expressed concern regarding the environmental sampling and possible adverse health effects associated with exposure to lead in the Park. The following is a summary of the community’s health concerns:

What are the potential effects of lead on health?

The nervous system is the most sensitive target of lead exposure. While the immediate health effect of concern in children is typically neurological, it is important to remember that childhood lead poisoning can lead to health effects later in life including renal effects, hypertension, reproductive problems, and developmental problems with their offspring. Lead serves no useful purpose in the human body, but its presence in the body can lead to toxic effects, regardless of exposure pathway.

USEPA presently classifies lead as a B2 carcinogen for both inhalation and ingestion. There is evidence that it is a carcinogen in animals at high doses; however, there is insufficient evidence that lead causes cancer in humans. Most of the health effects associated with lead is the result of chronic, low level exposures. Acute effects of lead intoxication are similar to chronic effects, but occur rarely. Acute effects can be severe and include encephalopathy, which may result in death. Chronic effects of lead intoxication vary depending on exposure levels. Some health effects attributed to lead exposure are interference with Vitamin D production, neurobehavioral toxicity, renal dysfunction, and, at higher exposures, dysfunction of cardiovascular, hepatic, gastrointestinal, and endocrine systems.

Why are children more sensitive to lead's effects?

Children are prone to incur lead exposures higher than adults. The developing nervous system of a child is much more susceptible to the effects of lead. Children also display adverse health effects at much lower lead exposure than adults. The differences that increase a child's exposure versus an adult's exposure to lead include:

- The development of the brain and nervous system begins in the early stages of embryonic life and continues beyond birth into adolescence. The developing brain is extremely vulnerable to toxic effects from exposures to lead.
- An increase in lead intake into the lungs and digestive system on a body weight basis.
- Greater absorption of lead into the body by the digestive system and more difficulty eliminating lead from the body.
- Increased mobility of lead in a child's body.
- A more frequent occurrence of nutrient deficiencies that lead to increased absorption from the digestive system into the body.
- Differences in behavior that increase lead exposure include:
    - Crawling and playing on the floor or ground
    - Placing non-food items into the mouth
    - More hand to mouth activities
    - Lack of hand washing before eating

How are the EPA clean-up level of 650 ppm, and not the EPA clean-up level of 400ppm, in the eastern and southern areas of the Park protective of human health?

Under the EPA’s Residential Lead Hazard Standards (Toxic Substance Control Act, Section 403), lead is considered a hazard when equal to or exceeding 400 ppm of lead in bare soil in children's play areas or 1200 ppm average for bare soil in the rest of the yard. PADOH and ATSDR reviewed the EPA’s comprehensive risk assessment conducted to evaluate the potential lead exposure risks to the community. Since each site in unique, the assessment looked at site-specific risks, such as exposure duration and residential samples. EPA's risk assessment in this area of the Park utilized the IEUBK model to predict acceptable soil lead levels, which would be protective of public health, specifically children playing in those area. The model takes into account lead in water, soil, household dust, food and air. The model determined that a soil lead level of 650 ppm is protective of children's health. PADOH and ATSDR support the use of this model and that 650 ppm is an acceptable clean-up level for these portions of the Park.

Why is the northwest portion of the Park evaluated under the Adult Blood Lead model, and not the Child Blood Lead Model? Why is this area not being cleaned up to 650 ppm as well?

The northwest portion of the site contains terrain that is heavily wooded and very steep. This area of the park also contains three islands. PADOH and ATSDR, upon visiting the Park, believe access to these portions of the Park is likely to be infrequent, and not occur on an on-going basis, especially without adult supervision to children under the age of 7. Thus, the IEUBK Child Lead Model would not be appropriate in these areas. EPA, in their risk assessment, evaluated this area of the Park under the Adult Lead Model, for adolescent visitors. PADOH and ATSDR conclude that active remediation to 650 ppm in the northwestern portion of the park, with the exception of the breached fence area, is not warranted in this area, due to the Lead Model results, terrain, and exposure frequency.

Is it safe on the islands if the reservoir is drained?

PADOH and ATSDR feel that the island areas are similar to the other wooded areas in the northwestern portion of the park. Therefore, PADOH and ATSDR conclude that potential exposures on the islands if the reservoir is drained pose no apparent public health hazard, due to the infrequent likelihood of exposure and highly wooded/swampy terrain.

Is it safe to eat fish from the reservoir?

Fish can take up contaminants from water and sediment. Fish that eat along the bottom of the reservoir in the sediment especially could ingest any lead present in the sediment. Lead levels in the reservoir sediment and reservoir surface water are below ATSDR's comparison values for soil of 400 ppm. Out of the thirty water samples collected, only one slightly exceeded the Maximum Contaminant Level (MCL) for drinking water of 15 ppb. The one sample detected a lead concentration of 15.9 ppb. The remainder of the samples detected lead concentrations from <1.5 ppb to 6.7 ppb. The average water lead concentration in the reservoir was 2.9 ppb.

However, the most accurate and reliable way to determine contaminant levels in fish is via sampling, and at this time fish tissue sampling data for the reservoir are not available. Therefore, not enough data exist on the actual lead levels in reservoir fish tissue to fully and accurately determine whether adverse health effects are possible from consuming fish from the Park's reservoir.

Individuals should follow the general Commonwealth-wide one-meal-per-week fish consumption advisory for all species recreationally caught in Pennsylvania. In addition, residents should follow any fish advisories set by the Commonwealth of Pennsylvania for a specific body of water. To determine if recommendations that are more protective apply to the fish that you might consume, refer to the Pennsylvania Fish and Boat Commission's website at www.fish.state.pa.us.

Conclusions

1. PADOH and ATSDR reviewed the IEUBK model analysis conducted for childhood lead exposure at Bernhart Park. Based on this review, PADOH and ATSDR conclude that EPA's soil lead clean-up level of 650 ppm in the southern and eastern portions of the park are protective of public health and poses ***no apparent public health hazard*** to area residents that may visit the park, particularly to young children that may play in those area.

2. PADOH and ATSDR also reviewed modeled results from the Adult Blood Lead model, which includes adolescent recreational use of the park, completed for the northwestern portions of the park. Based on the model, environmental sampling data, terrain, and the likely exposure frequency, exposures to the current soil lead levels in the western portion of the site pose ***no apparent public health hazard*** to area residents that may visit the park, with the following exception:

   PADOH and ATSDR identified access points located in the northwestern section of park that include a heavily wooded area and the reservoir spillway (Exposure Areas QQ, RR, SS, DDD, and MM) that are not currently proposed by EPA for remediation. These areas exceed 650 ppm and provide ***unrestricted access*** from the neighboring housing development. Due to the close proximity to the adjacent residential areas, the lack of access restrictions, and the environmental sampling data, there is a potential for the public, especially children, to be exposed to lead contaminated soil in these areas. Based on this information, the exposure scenarios in this area of the park are more similar to the exposure assumptions currently being considered by the EPA in the southern and eastern portions of the park (IEUBK model), particularly for children, and pose a ***public health hazard.*** However, since these Exposure Areas are located in a portion of the park that is heavily wooded and steep it is unlikely, but possible, children would recreate in these areas for an extended period. In addition, PADOH and ATSDR do not have any direct evidence, only anecdotal accounts, that children are currently frequenting these areas of the park, since the park is currently closed.

   PADOH and ATSDR recommend that ***EPA consider remedial, mitigation-type, or other-type appropriate activities or solutions*** in this area of the Park. Such activities could include but are not limited to any or all of the following possibilities: (1) erecting a fence, barrier, and/or signage; (2) addition of clean topsoil or other appropriate cover to the area: (3) diverting the public towards a "clean" alternative footpath, concourse, causeway, trail, or the like; and/or (4) other feasible measures that would minimize the likelihood of exposure and/or ingress and egress to these areas. ***If appropriate remedial, mitigation-type, or other activities or solutions are employed in the above-mentioned Exposure Areas of the Park (QQ, RR, SS, DDD, and MM) that minimize the likelihood of exposure and/or ingress and egress to these areas***, PADOH and ATSDR believe that the exposure scenarios in this area of the Park would be similar to the exposure scenarios in the remainder of the Park and thus would pose ***no apparent public health hazard*** to potential Park visitors.

3. PADOH and ATSDR conclude, based on the terrain, site visit observations, likely exposure frequency, and the Blood Lead Models results, that overall ***active remediation of the entire park is not warranted*** at this time, with the exception of the above mentioned conditions and

areas of the park. EPA's proposed remediation plans are protective of public health, particularly park visitors, with the exception of the above-mentioned areas. However, any future use of the park that significantly disturbs or alters the northwestern portion of the Park could effect PADOH and ATSDR's public health conclusions.

Recommendations

1. PADOH and ATSDR recommend, as discussed further in the Conclusions Section, that EPA consider remedial, mitigation-type, or other appropriate solutions, in portions of the northwest section of the Park (Exposure Areas QQ, RR, SS, DDD, and MM) to minimize the likelihood of exposure.
2. PADOH and ATSDR, as a general recommendation and prudent public health measure, recommend that all children under the age of seven years be tested for lead if they have not been tested within the past year, regardless of their exposure history. The possibility for exposure to lead-based paint and other sources of lead in the home (i.e., old plumbing) or an urban environment (i.e., surface soil contaminated from leaded gasoline), although not site related, make this public health recommendation appropriate in this situation. The screening recommendations for Pennsylvania encourage:
    a. A blood lead test for all children at ages one and two years
    b. For all children and for all children ages three to six without a confirmed prior lead blood test
    c. Women who are pregnant or who may become pregnant should also discuss their possible lead exposures with their personal physician.
3. PADOH and ATSDR will continue to collaborate with EPA in reviewing and implementing, as appropriate, any future sampling, remediation and removal activities associated with the Park.
4. PADOH and ATSDR recommend that residents take the following steps to reduce their potential exposure to lead in surface soil, as much as possible, both in the Park and adjacent residential areas:
    - Establish a clean hands policy – children should wash their hands when coming in from playing outside and before eating.
    - Provide children with a covered sand box and discourage them from playing in the soil.
    - Maintain a healthy grass or sod on play areas. Bare play areas, such as those under a swing set, can also be covered with woodchips, mulch, or clean sand.
    - Do not eat or smoke in areas with contaminated soil.
    - Avoid tracking soil into the house on your shoes and clothing and by household pets. Ask family members to remove their shoes by the door, and frequently bathe your pets as they could also track contaminated soil into your home.

- Regularly conduct damp mopping and damp dusting of surfaces. Dry sweeping and dusting could increase the amount of lead-contaminated dust in the air.
- If you have carpets, use a vacuum with a High Efficiency Particulate Air (HEPA) filter. Vacuuming without this type of filter can increase the amount of lead-contaminated dust in the air.

Public Health Actions Planned

1. PADOH and ATSDR will make this Health Consultation available to area residents. PADOH and ATSDR will continue to be available to answer residents' health questions as they pertain to Bernhart Park.

2. PADOH and ATSDR will review and evaluate potential future environmental sampling data, as warranted and requested, at the Park.

3. PADOH and ATSDR recommend that access to the site continue to be restricted, until the completion of EPA's on-site clean-up activities. In addition, access along the northwestern portion of the park, where the fence is breached should also be restricted.

4. PADOH and ATSDR will develop and distribute a site-specific fact sheet to area residents that outlines the findings and recommendations of this health consultation.

5. PADOH and ATSDR plan to continue working with EPA, and the community, on increasing the knowledge in the community on the lead hazards

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Certification

This health consultation for Bernhart Park was prepared by the PADOH under a cooperative agreement with the ATSDR. It is in accordance with approved methodology and procedures existing at the time the health consultation were initiated. Editorial review was completed by the cooperative agreement partner.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

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Tables

Table 1 – Park soil sampling results

Sample ID	Pb (XRF) (mg\kg)	Corrected Value (mg\kg)	Mean Corrected Value (mg/kg)	Standard Deviation	Coefficient of Variation
AA-BP-01A	309.2	351.1			
AA-BP-02A	427.2	492.5	443.9	92.9	0.42
AA-BP-02A (Dup)	474.8	549.5			
AA-BP-03A	335.4	382.5			
A-BP-01A	336.2	383.5			
A-BP-02A	398.6	458.2	374.8	88.0	0.47
A-BP-03A	252.2	282.8			
BB-BP-01A	462.4	534.7			
BB-BP-02A	517.6	600.8	1062.8	858.2	1.61
BB-BP-03A	1729.6	2053.0			
B-BP-01A	252.6	283.3			
B-BP-02A	294.6	333.6	328.6	43.0	0.26
B-BP-03A	324.0	368.8			
C-BP-01A	662.4	774.3			
C-BP-02A	432.0	498.2	790.9	301.3	0.76
C-BP-03A	934.4	1100.2			
CC-BP-01A	532.0	618.1			
CC-BP-02A	481.6	557.7	526.4	110.7	0.42
CC-BP-03A	352.8	403.3			
D-BP-01A	586.4	683.2			
D-BP-02A	559.2	650.7	667.0	16.3	0.05
D-BP-03A	572.8	667.0			
DD-BP-01A	1100.0	1298.6			
DD-BP-02A	594.0	692.4	955.3	311.0	0.65
DD-BP-03A	746.4	875.0			
E-BERN-01A	730.0	855.3			
E-BERN-02A	555.6	646.3	619.7	249.9	0.81
E-BERN-03A	314.6	357.6			
EE-BERN-01A	336.2	383.5			
EE-BERN-02A	491.2	569.2	525.6	126.2	0.48
EE-BERN-03A	537.2	624.3			
F-BERN-01A	1080.0	1274.7			
F-BERN-02A	930.4	1095.4	1147.2	111.1	0.19
F-BERN-03A	910.4	1071.5			
FF-BP-01A	511.2	593.1			
FF-BP-02A	233.8	260.8	437.5	167.2	0.76
FF-BP-03A	399.0	458.7			

G-BP-01A	1309.6	1549.8			
G-BP-02A	692.8	810.7	1140.8	375.8	0.66
G-BP-03A	902.4	1061.9			
GG-BP-01A	141.7	150.4			
GG-BP-02A	184.9	202.2	204.9	55.9	0.55
GG-BP-03A	235.0	262.2			
H-BP-01A	779.2	914.3			
H-BP-02A	282.8	319.5	564.5	310.9	1.10
H-BP-03A	399.8	459.7			
HH-BERN-01A	372.8	427.3			
HH-BERN-02A	417.6	481.0	462.1	30.2	0.13
HH-BERN-03A	415.2	478.1			
I-BP-01A	333.6	380.3			
I-BP-02A	397.6	457.0	419.8	38.4	0.18
I-BP-03A	368.4	422.0			
II-BP-01A	272.6	307.3			
II-BP-02A	585.6	682.3	471.6	191.7	0.81
II-BP-03A	371.2	425.4			
JJ-BP-01A	347.6	397.1			
JJ-BP-02A	253.6	284.5	337.9	56.5	0.33
JJ-BP-03A	293.4	332.2			
K-BP-01A	466.4	539.5			
K-BP-02A	738.8	865.9	639.8	196.2	0.61
K-BP-03A	445.2	514.1			
KK-BERN-01A	632.4	738.4			
KK-BERN-02A	571.6	665.5	692.7	39.8	0.11
KK-BERN-03A	578.8	674.1			
L-BP-01A	325.8	371.0			
L-BP-02A	167.1	180.8	323.7	126.1	0.78
L-BP-03A	366.2	419.4			
M-BP-01A	849.6	998.6			
M-BP-02A	686.0	802.6	860.3	120.4	0.28
M-BP-03A	666.8	779.6			
O-BP-01A	895.2	1053.3			
O-BP-02A	470.4	544.3	750.3	268.0	0.71
O-BP-03A	561.6	653.5			
P-BP-01A	723.6	847.6			
P-BP-02A	382.6	439.1	607.1	213.7	0.70
P-BP-03A	462.4	534.7			
Q-BP-01A	328.8	374.6			
Q-BP-02A	383.2	439.8	462.1	100.6	0.44
Q-BP-03A	493.6	572.1			
R-BP-01A	649.0	758.3			
R-BP-02A	577.6	672.7	618.3	173.7	0.56

R-BP-03A	370.0	424.0			
S-BERN-01A	634.4	740.8			
S-BERN-02A	1500.0	1777.9	1128.7	565.8	1.00
S-BERN-03A	740.0	867.3			
T-BERN-01A	2160.0	2568.7			
T-BERN-02A	1429.6	1693.6	1921.4	568.8	0.59
T-BERN-03A	1269.6	1501.9			
U-BERN-01A	952.0	1121.3			
U-BERN-02A	653.2	763.3	1176.7	443.8	0.75
U-BERN-03A	1389.6	1645.6			
V-BERN-01A	726.0	850.5			
V-BERN-02A	702.8	822.7	875.6	68.9	0.16
V-BERN-03A	812.0	953.6			
Sed Pond-01A	126	131.6			
Sed Pond-02A	113	116.0			
Sed Pond-03A	152	162.8	126.4	46.6	0.74
Sed Pond-04A	60	52.6			
Sed Pond-05A	157	168.7			
X-BERNHART PARK-01A	1249.6	1477.9			
X-BERNHART PARK-02A	1220.0	1442.4	1526.1	115.6	0.15
X-BERNHART PARK-03A	1400.0	1658.1			
XX-BERN-01A	893.6	1051.3			
XX-BERN-02A	448.0	517.4	852.9	292.2	0.69
XX-BERN-03A	842.4	990.0			
Y-BERNHART PARK-01A	1120.0	1322.6			
Y-BERNHART PARK-02A	1150.0	1358.6	1522.1	315.0	0.41
Y-BERNHART PARK-03A	1589.6	1885.3			
YY-BERN-01A	519.2	602.7			
YY-BERN-02A	840.0	987.1	829.0	201.0	0.49
YY-BERN-03A	764.8	897.0			
Z-BERN-01A	1160.0	1370.5			
Z-BERN-02A	1069.6	1262.2	1108.5	364.1	0.66
Z-BERN-03A	594.4	692.8			
ZZ-Bern-01A	921.6	1084.9			
ZZ-Bern-02A	763.6	895.6	1022.1	109.6	0.21
ZZ-Bern-03A	922.4	1085.8			
AAA-BERN-01A	676.0	790.6			
AAA-BERN-02A	543.6	632.0	631.6	159.1	0.50
AAA-BERN-03A	410.4	472.4			
BBB-BP-01A	252.0	282.6			
BBB-BP-02A	353.0	403.6	360.9	67.9	0.38
BBB-BP-03A	347.0	396.4			
CCC-BP-01A	459.6	531.3			
CCC-BP-02A	565.6	658.3	590.6	63.9	0.22

CCC-BP-03A	502.0	582.1			
DDD-BP-01A	1009.6	1190.3			
DDD-BP-02A	948.0	1116.5	963.3	331.3	0.69
DDD-BP-03A	502.8	583.1			
LL-BERNHART-01A	1269.6	1501.9			
LL-BERNHART-02A	1160.0	1370.5	1294.5	254.1	0.39
LL-BERNHART-03A	860.0	1011.1			
MM-BERNHART-01A	1710.0	2029.5	2029.5		
Comp. of 5 Discrete Samples					
NN-BERNHART-01A	3730.0	4449.9			
NN-BERNHART-02A	4770.0	5696.0	4845.3	737.4	0.30
NN-BERNHART-03A	3680.0	4390.0			
OO-BERNHART PARK-01A	2499.2	2975.2			
OO-BERNHART PARK-02A	2889.6	3442.9	3654.6	806.4	0.44
OO-BERNHART PARK-03A	3810.0	4545.8			
PP-BERNHART PARK-01A	600.0	699.5			
PP-BERNHART PARK-02A	1420.0	1682.1	1154.5	495.3	0.86
PP-BERNHART PARK-03A	919.2	1082.0			
QQ-BERN-01A	1200.0	1418.5			
QQ-BERN-02A	674.8	789.2	1006.4	357.0	0.71
QQ-BERN-03A	693.6	811.7			
RR-BERNHART PARK-01A	573.2	667.4			
RR-BERNHART PARK-02A	560.0	651.6	743.0	144.8	0.39
RR-BERNHART PARK-03A	775.6	909.9			
SS-BERN-01A	903.2	1062.8			
SS-BERN-02A	931.2	1096.4	1016.3	110.9	0.22
SS-BERN-03A	758.8	889.8			
TT-BERN P-01A	1629.6	1933.2			
TT-BERN P-02A	1420.0	1682.1	1973.2	313.0	0.32
TT-BP-03A	1939.2	2304.2			
VV-BERN-01A	660.8	772.4			
VV-BERN-02A	490.4	568.2	628.0	125.7	0.40
VV-BERN-03A	469.6	543.3			
W-BERNHART PARK-01A	1000.0	1178.8			
W-BERNHART PARK-02A	891.2	1048.5	1069.9	100.0	0.19
W-BERNHART PARK-03A	836.0	982.3			
WW-BERN-01A	426.0	491.1			
WW-BERN-02A	441.2	509.3	577.0	133.4	0.46
WW-BERN-03A	626.0	730.7			
UU-BERN-01A	2280	2712.5	2712.5		
Comp. of 5 Discrete Samples					

Exposure Areas exceeding 650 ppm
Exposure Areas used for Child Lead model, proposed for clean-up by EPA
Exposure Areas used for Adult Lead model, not proposed for clean-up by EPA

Table 2 – Results for park reservoir water samples

Sample ID	Pb (ug/L)	QA
Bernhart 1 WA Total	<3	
Bernhart 1 WA Total Duplicate	<3	
Bernhart 1 WA Dissolved	1.8	
Bernhart 1 WA Dissolved Duplicate	<1.5	UL
Bernhart 1 WB Total	<3	
Bernhart 1 WB Dissolved	<1.5	
Bernhart 2 WA Total	<3	
Bernhart 2 WA Dissolved	2.6	L
Bernhart 2 WB Total	<3	
Bernhart 2 WB Dissolved	2.3	L
Bernhart 3 WA Total	<3	
Bernhart 3 WA Dissolved	2	
Bernhart 3 WB Total	15.9	
Bernhart 3 WB Dissolved	<1.5	
Bernhart 4 WA Total	<3	
Bernhart 4 WA Dissolved	2.5	
Bernhart 4 WB Total	<3	
Bernhart 4 WB Dissolved	<1.5	
Bernhart 5 WA Total	3.2	L
Bernhart 5 WA Dissolved	<1.5	
Bernhart 5 WB Total	13	L
Bernhart 5 WB Dissolved	<1.5	
Bernhart 6 WA Total	<3	
Bernhart 6 WA Total Duplicate	<3	
Bernhart 6 WA Dissolved	2.5	L
Bernhart 6 WA Dissolved Duplicate	2.5	L
Bernhart 6 WB Total	<3	
Bernhart 6 WB Dissolved	2.4	L
Bernhart 7 WA Total	<3	
Bernhart 7 WA Dissolved	<1.5	
Bernhart 7 WB Total	<3	
Bernhart 7 WB Dissolved	<1.5	
Bernhart 8 WA Total	<3	
Bernhart 8 WA Dissolved	2.5	
Bernhart 8 WB Total	<3	
Bernhart 8 WB Dissolved	2	
Bernhart 9 WA Total	<3	UL
Bernhart 9 WA Dissolved	1.5	
Bernhart 9 WB Total	<3	UL
Bernhart 9 WB Dissolved	<1.5	
Bernhart 10 WA Total	<3	UL
Bernhart 10 WA Dissolved	<1.5	
Bernhart 10 WB Total	<3	UL
Bernhart 10 WB Dissolved	<1.5	

Bernhart 11 WA Total	<3	
Bernhart 11 WA Dissolved	<1.5	UL
Bernhart 11 WB Total	<3	
Bernhart 11 WB Dissolved	2.6	L
Bernhart 12 WA Total	<3	
Bernhart 12 WA Dissolved	<1.5	
Bernhart 12 WB Total	<3	
Bernhart 12 WB Dissolved	2.1	
Bernhart 13 WA Total	<3	
Bernhart 13 WA Dissolved	1.6	
Bernhart 13 WB Total	4.2	
Bernhart 13 WB Dissolved	2.8	
Bernhart 14 WA Total	3.9	
Bernhart 14 WA Dissolved	2.6	
Bernhart 14 WB Total	3.8	J
Bernhart 14 WB Dissolved	6.7	J
Bernhart 15 WA Total	<3	UL
Bernhart 15 WA Dissolved	<1.5	
Bernhart 15 WB Total	<3	UL
Bernhart 15 WB Dissolved	<1.5	
Bernhart Inlet Total	<3	
Bernhart Inlet Dissolved	<1.5	UL
Bernhart Outlet Total	<3	
Bernhart Outlet Dissolved	1.7	
Bernhart SED Pond Total	<3	
Bernhart SED Pond Dissolved	<1.5	

J = Analyte identified, value is an estimated quantity
L = Analyte present. Reported valued may be biased low, actual value is expected to be higher
UL = Analyte not detected above reported sample quantitation limit. However, the reported quantitation limit may be biased low

Table 3 – Results for reservoir sediment samples in the park

Sample ID	Pb (mg/kg)	Mean Pb (mg/kg)
Bernhart 1 W Sed	246	298.3
Bernhart 2 W Sed	308	
Bernhart 3 W Sed	212	
Bernhart 4 W Sed	286	
Bernhart 5 W Sed	417	
Bernhart 6 W Sed	279	
Bernhart 7 W Sed	326	
Bernhart 8 W Sed	246	
Bernhart 9 W Sed	221	
Bernhart 10 W Sed	197	
Bernhart 11 W Sed	267	
Bernhart 12 W Sed	278	
Bernhart 13 W Sed	203	
Bernhart 14 W Sed	470	
Bernhart 15 W Sed	345	
Bernhart 16 W Sed (Duplicate of 14 W Sed)	471	

Table 4 – Results from the community blood lead level study

Age group	# Participants	Minimum (ug/dL)	Maximum (ug/dL)	Average (ug/dL)
6 – 84 months				
Residents	36	0.5	7	2.8
Visitors	12	0.75	14	4
Total	48			
7 - <18 years				
Residents	15	0.5	17	2.9
Visitors	6	0.75	4	2.4
Total	21			
≤ 18 years				
Residents	9	0.75	3	1.5
Visitors	2	1	3	2
Total	11			

Table 5 - Residential dust lead sampling results used to calculate site-specific for risk assessment levels

Soil remediation status	# of Properties	Minimum (mg/kg)	Maximum (mg/kg)	Average (mg/kg)
Cleaned up	4	370	1800	1243
Retained for future	18	250	5000	1493
No further action	15	120	8100	1533
Total	37			1423

Table 6 - Residential paint sampling results used to calculate site-specific for risk assessment levels

Paint group (mg/cm^3)	# Samples	Minimum XRF	Maximum XRF
Interior			
< 1	16	0.017	0.7
1-10	10	0.04	7.9
>10	11	0.04	23.9
Exterior			
< 1	11	0.1	0.6
1-10	14	0.1	9
>10	11	0.3	30.8

Table 7 - Tap water sampling results for risk assessment calculations

# Residences	Minimum (ug/L)	Maximum (ug/L)	Mean	Standard Deviation
37	0.5	25	0.0017	0.004

Table 8 – Residential soil sampling results used to calculate site-specific for risk assessment levels

Soil remediation status	#of Properties	Minimum (mg/kg)	Maximum (mg/kg)	Average (mg/kg)
Cleaned up	4	1058	1671	1358
Retained for future	19	124	1023	649
No further action	14	60	498	245
Total	37			

Table 9 – Input parameters for IEUBK model, by age

Input parameter	0-1 yrs	1-2 yrs	2-3 yrs	3-4 yrs	4-5 yrs	5-6 yrs	6-7 yrs
Air (ug/m^3)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Dietary uptake (ug/day)	2.26	1.96	2.13	2.04	1.95	2.05	2.22
Soil/dust transfer coefficient	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Soil ingestion (mg/day)	85	135	135	135	100	90	85
Bioavailability	30%	30%	30%	30%	30%	30%	30%
Tap water (ug/L)	1	1	1	1	1	1	1
All -Geometric Standard Deviation	**1.32**	**1.32**	**1.32**	**1.32**	**1.32**	**1.32**	**1.32**

Table 10 – Summary of IEUBK model results

	Residents		**Visitors**		**Combined**	
	Observed PbB (ug/dL)	**Predicted PbB (ug/dL)**	**Observed PbB (ug/dL)**	**Predicted PbB (ug/dL)**	**Observed PbB (ug/dL)**	**Predicted PbB (ug/dL)**
N	31	31	9	9	40	40
Mean	2.7	7.7	2.5	12.7	2.7	8.8
GM	2.3	6.9	2.3	11.1	2.3	7.7
Min	0.5	2.1	0.8	3	0.5	2.1
Max	7	17	4	23.8	7	23.8
% PbB > 10 ug/dL	0%	29%	0%	60%	0%	36%

Table 11 – Park exposure frequency assumptions

Exposure Area	Lead concentration (ppm)	Visitation frequency (days/yr)	Rationale for exposure frequency
TT	1973	40	Islands/peninsula/spillway - less accessible
UU	2713	40	Islands/peninsula/spillway - less accessible
ZZ	1022	40	Islands/peninsula/spillway - less accessible
PP	1155	20	Very steep hillside
QQ	1006	20	Very steep hillside
RR	743	20	Very steep hillside
SS	1016	20	Very steep hillside
DDD	963	20	Very steep hillside
MM	2028	80	Less steep area - access somewhat limited
NN	4845	80	Less steep area - access somewhat limited
OO	3655	80	Less steep area - access somewhat limited

Table 12 – Results of Adult Blood lead model

Exposure Variable	Hillside							Islands/Peninsula			
	PP	QQ	RR	SS	DDD	NN	OO	MM	TT	UU	ZZ
PbS (ug/g)	1155	1006	743	1016	963	4845	3655	2028	1973	2713	1022
Fs	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
BKSF (ug/dL per ug/day)	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
GSDi	2	2	2	2	2	2	2	2	2	2	2
BLL0 (ug/dL)	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98	1.98
IRS (g/day)	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
AFS, D	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
EFS, D (days/yr)	80	80	80	80	80	20	20	40	40	40	40
ATS, D (days/yr)	365	365	365	365	365	365	365	365	365	365	365
BLLadult (µg/dL) *	2.3	2.2	2.2	2.2	2.2	2.3	2.2	2.2	2.2	2.3	2.1
BLLAdult, 0.95 (µg/dL) **	7.1	7	6.8	7	7	7.2	6.9	7	7	7.3	6.6
P(Pbadult > BLLt) (%) ***	1.7%	1.6%	1.4%	1.6%	1.5%	1.7%	1.5%	1.6%	1.5%	1.8%	1.2%

*   BLL of adult, geometric mean
** Estimated BLL
** Probability that Adult BLL > 10 ug/dL, assuming lognormal distribution

Figures

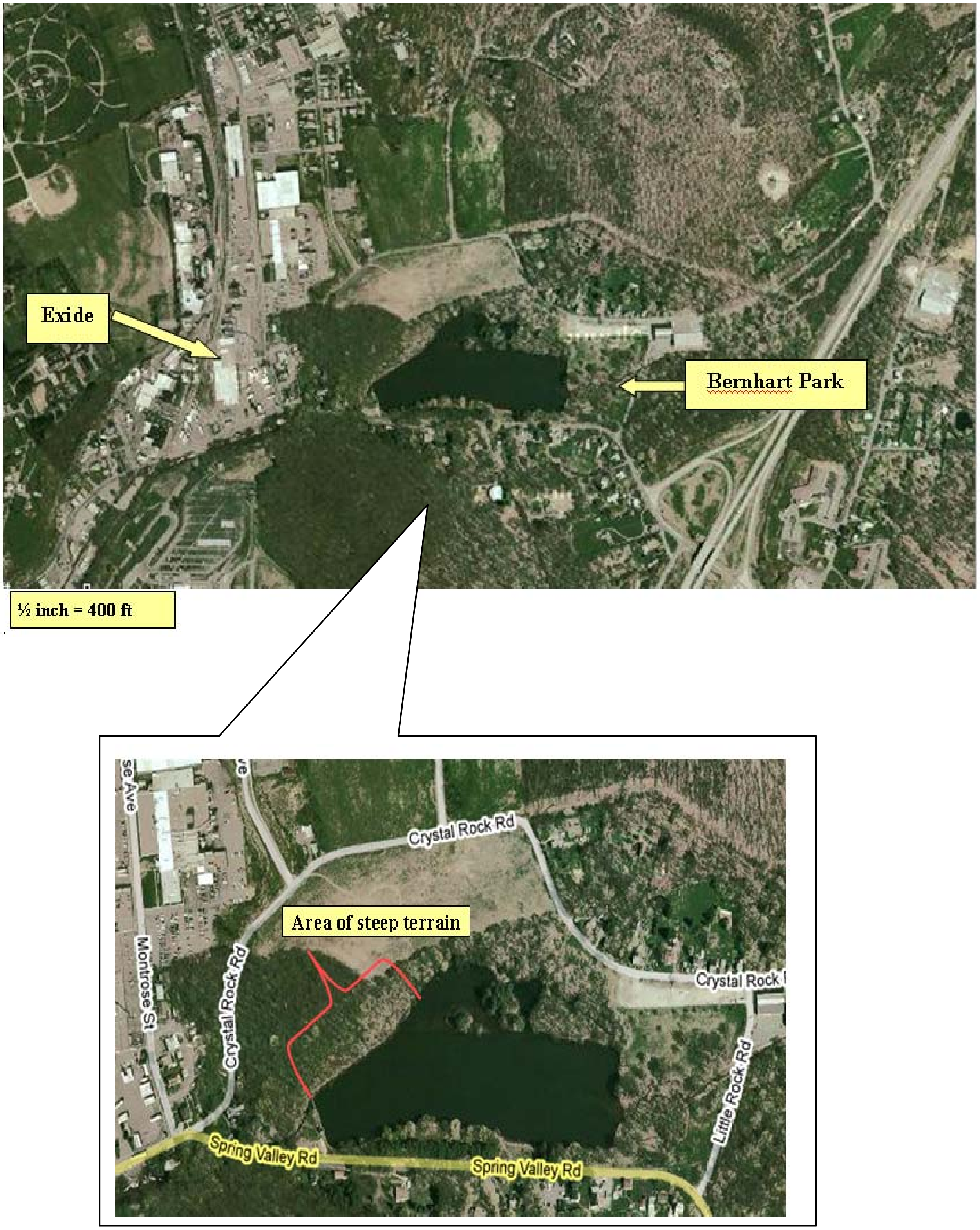


Figure 1 – Aerial photo of Park, in relation to Exide site

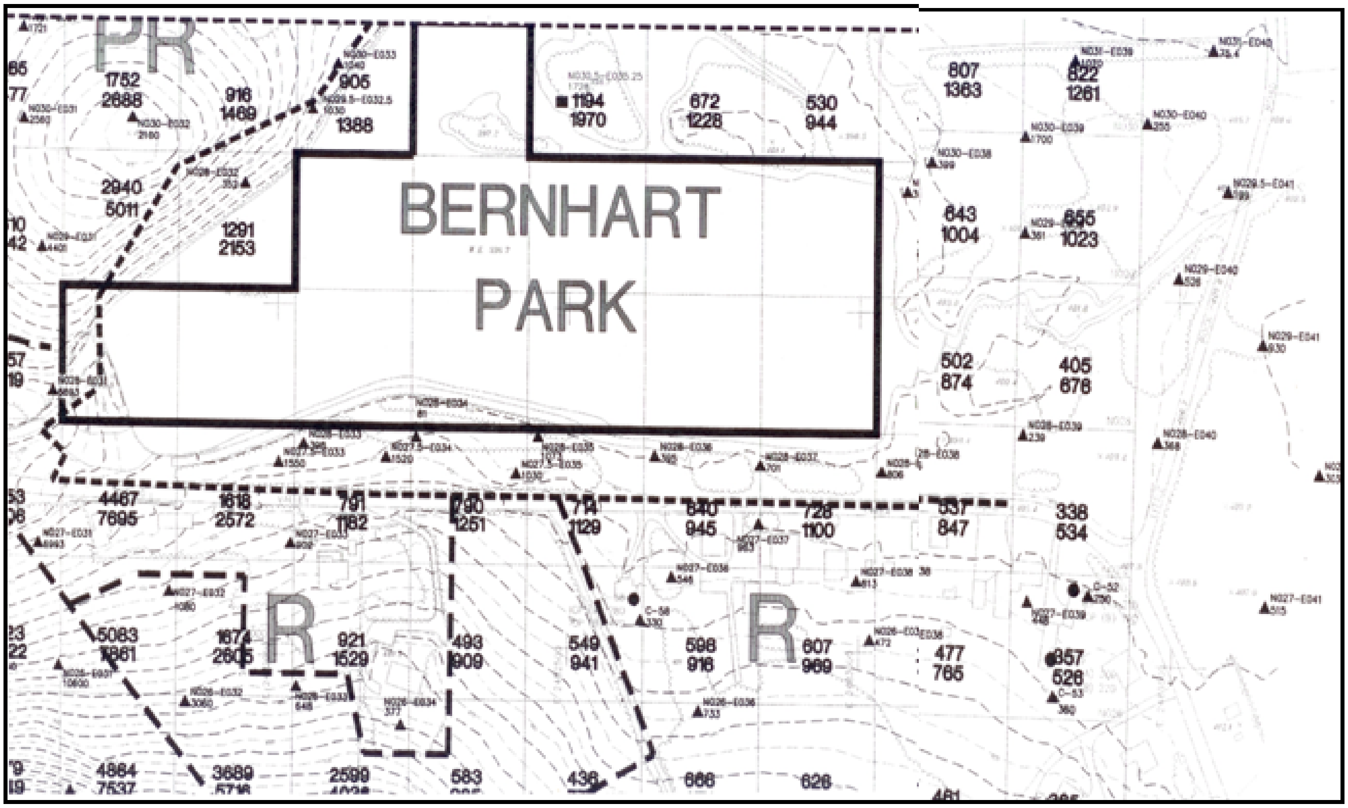
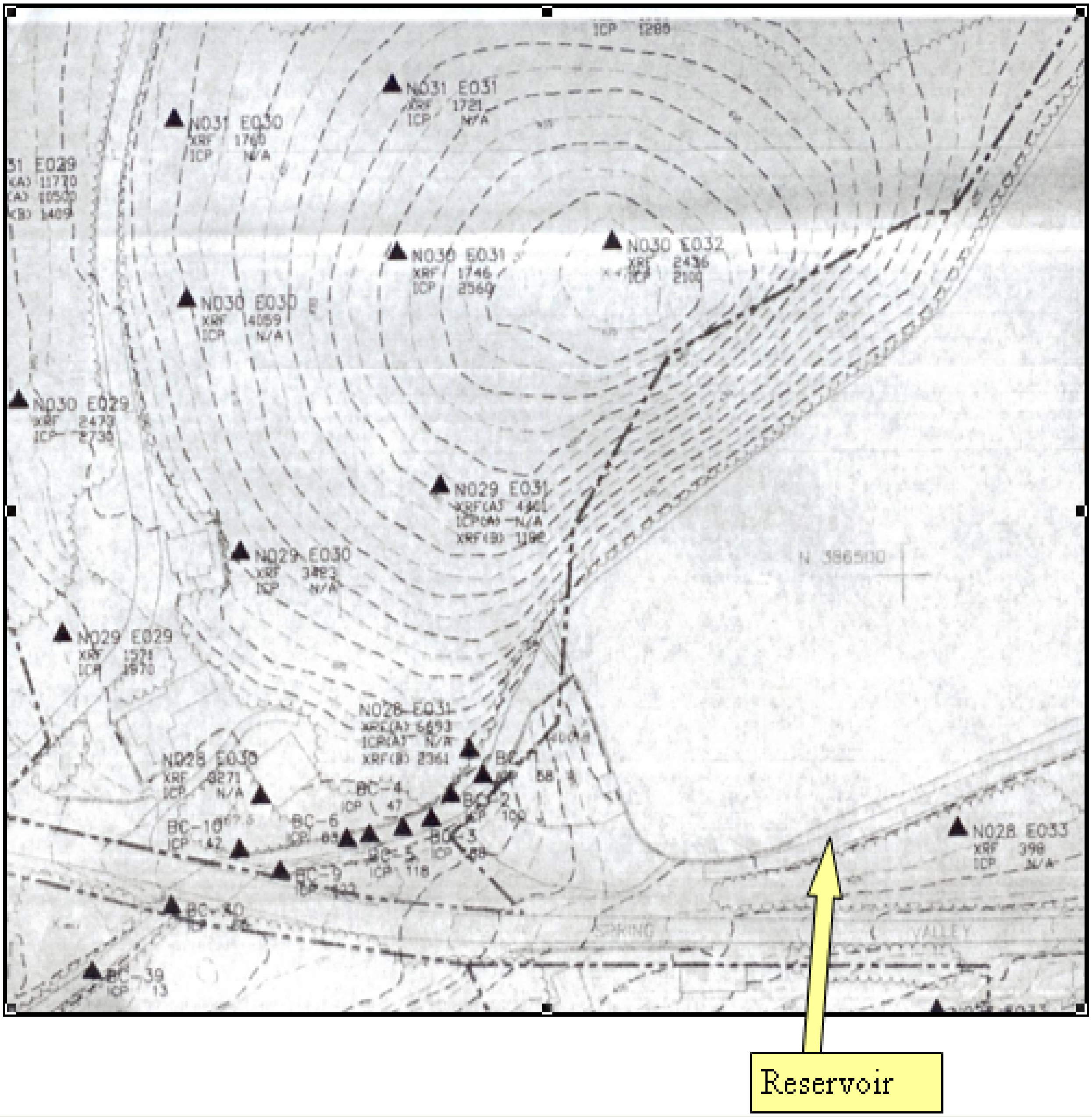


Figure 2 – Soil sampling results conducted by PADEP in Bernhart Park (1995)



——— - - ——— - - ——— = Park boundary

Figure 3 – Soil sampling results, in and outside the Park boundary, conducted by PADEP in 1995.

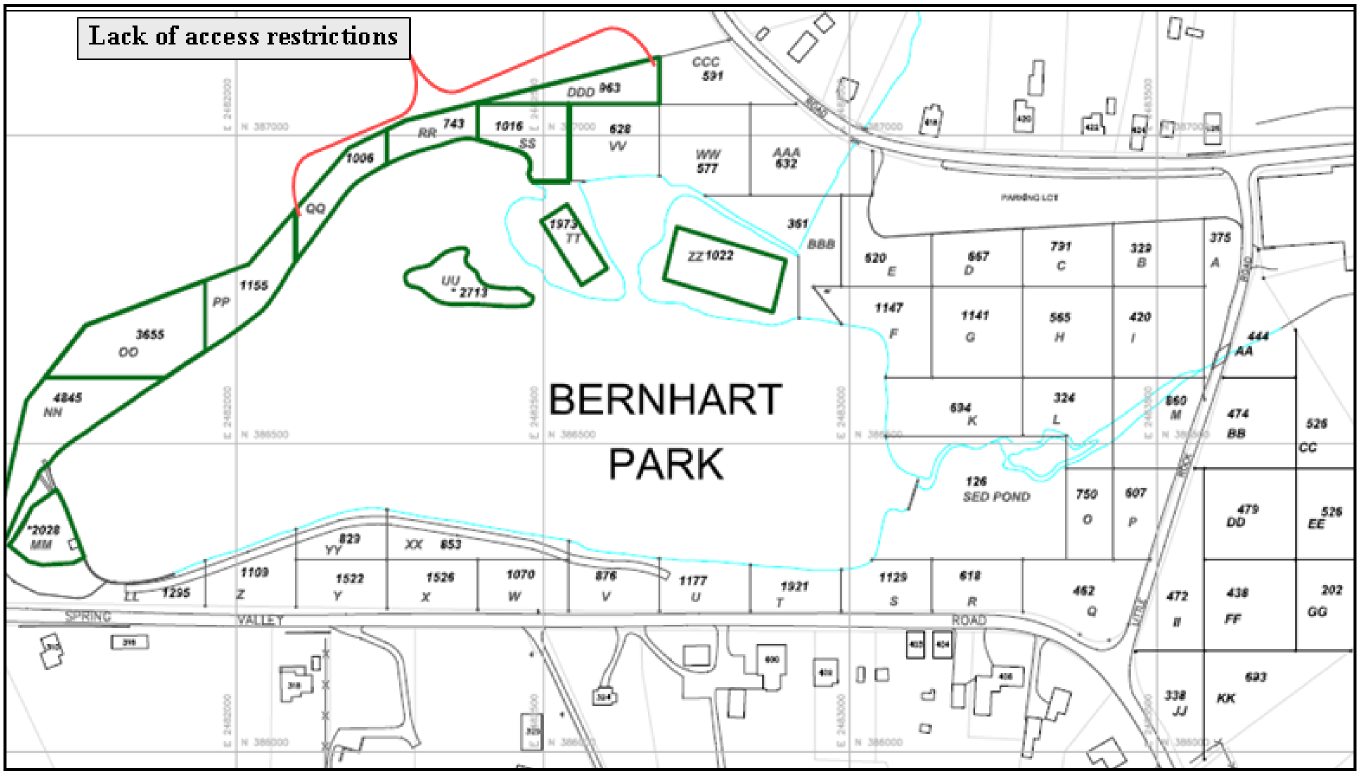
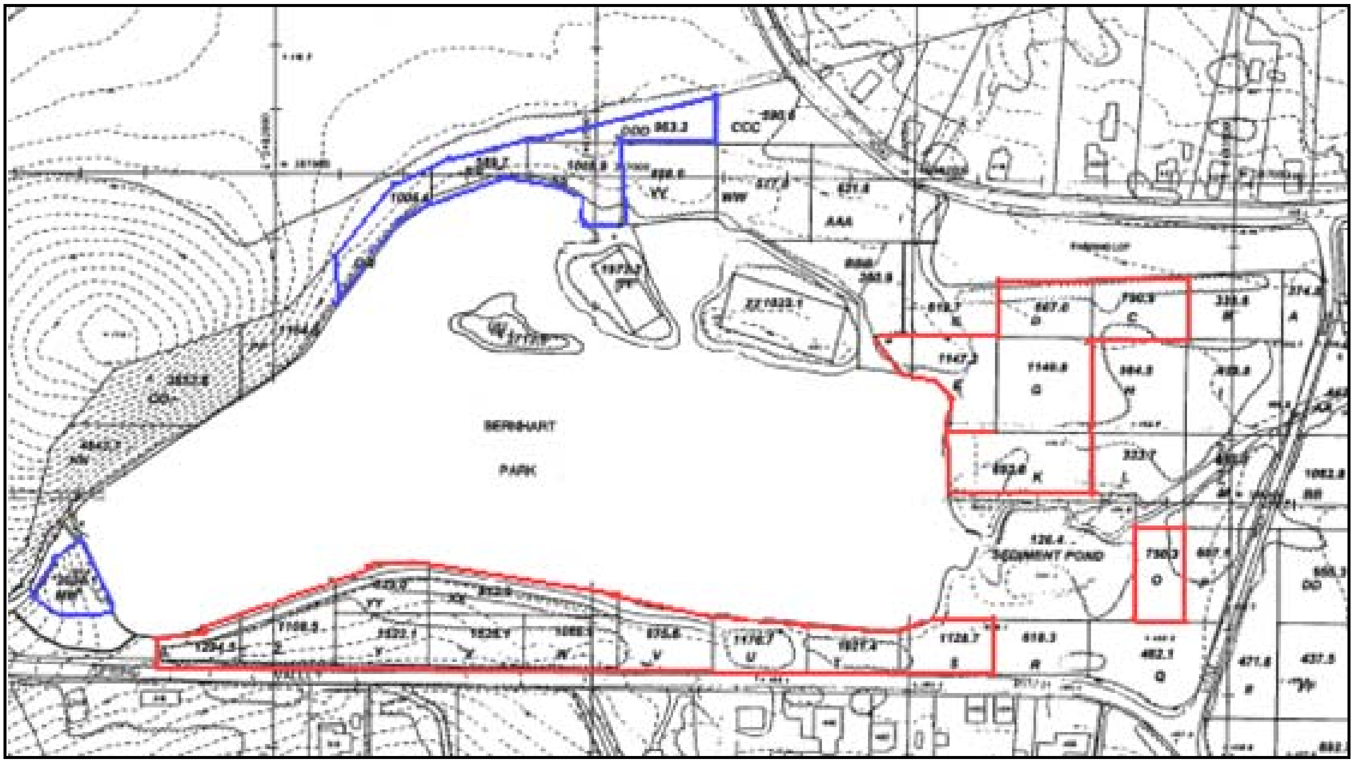


Figure 4 – EPA 2001 soil sampling results in Bernhart Park



- Exposure Areas currently proposed by EPA for remedial activities

- Exposure Areas proposed by PADOH/ATSDR for EPA to consider possible remedial activities (areas not currently proposed by EPA for remediation).

Figure 5 – Topographic map for Bernhart Park, containing 2001 soil sampling results and proposed Exposure Areas for remedial activity.