Lead-Based Paint and
Soil-Metals Survey
Camp Bonneville
Vancouver, Washington

Prepared for
U.S. Army Corps of Engineers
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CAMP BONNEVILLE
VANCOUVER, WASHINGTON

SUMMARY OF FINDINGS AND RECOMMENDATIONS

Hart Crowser, under contract to the U.S Army Corps of Engineers (Corps), conducted lead-based paint (LBP) and soil metal surveys at Camp Bonneville. The Corps has been charged with overseeing work related to site remediation as part of the Base Realignment and Closure (BRAC) process. Our work was performed in accordance with Corps Contract No. DACA67-93-D-1004, Delivery Order Number 49. The survey was conducted to provide information concerning the location of lead-based paint (LBP) on structures; lead concentrations in soil; and arsenic, copper, and zinc in the soil in and around selected buildings.

Lead-Based Paint

We surveyed fifty-six buildings for LBP at Camp Bonneville with a portable x-ray fluorescence (XRF) device. Forty-three of these buildings contained lead-paint (i.e., at least 1.0 mg/cm^2 of lead) (Table 1). Most of the lead-based paint was located on exterior surfaces. Lead-based paint in advanced stages of weathering was noted on the exterior of twenty-eight buildings (Table 2). Only a few buildings had deteriorated paint on interior components. XRF test results were generally confirmed by laboratory analysis of several paint chip samples (Table D-1).

<u>Recommendations</u>

Hart Crowser recommends abating deteriorated lead-based painted surfaces to reduce the risk of exposure to Camp Bonneville occupants and visitors. Abatement options potentially include paint removal, component removal, encapsulation with a suitable sealant, or demolition.

Workers performing maintenance, abatement, renovation, or demolition of buildings identified as containing LBP should be initially monitored for airborne lead exposure while conducting their work. If lead is measured in their breathing zones in excess of Washington Department of Labor and Industries regulatory standards (WAC 296-62-07521), personal protective measures and blood lead monitoring are necessary.

EPA guidelines indicate that painted wood with elevated concentrations of lead (approximately 4 mg/cm^2 or greater) might be considered a dangerous waste if separately removed during demolition or renovation activities. However, if the lead-impregnated wood is removed in conjunction with other materials that do not contain lead, there is a possibility that the waste stream as a whole would not be considered a dangerous waste. Testing the demolition waste stream for leachable lead is advisable to document and confirm the presumed waste designation of the materials prior to disposal.

If metal components covered with lead-based paint should be removed, they typically can be recycled as scrap metal. Alternatively they can most likely be discarded as non-dangerous waste as it is unlikely that metal materials painted with lead-based paint would be classified as dangerous waste.

Similarly, lead-based paint on masonry would also not likely be classified as a dangerous waste.

Lead in Soil

Many of the soils surrounding the Camp Bonneville buildings were tested for lead content using a hand-held XRF device (NITON Corporation LISA) and confirmatory laboratory analysis. Elevated lead values were detected in the soil around several of the buildings. Soil lead values ranged from less than 93 mg/kg (the detection limit of the hand-held XRF) to more than 6,900 mg/kg (Table 3). Soil with elevated lead values was generally located on the downwind side of the tested buildings.

Building 1963 was the only building in the Bonneville Cantonment with soil with lead concentrations that exceed Washington State's Model Toxics Control Act (MTCA) residential soil cleanup levels for lead. Soil in the Killpack Cantonment that exceeds MTCA residential soil cleanup levels for lead based on XRF measurements was associated with Buildings 4126, 4155, 4314, 4316, 4345, 4366, 4368, 4387, 4389, and 4475. XRF test results were generally confirmed by laboratory analysis of several soil samples (Table D-2).

Recommendations

It appears that future use of the site may include residential-type activities such as overnight camping. The MTCA Method A cleanup level for lead in residential soils in soil is 250 mg/kg. Bringing the soil into compliance with MTCA residential cleanup levels could be accomplished by removing the affected soils, capping the affected area, or providing for institutional controls (e.g., fencing, planting shrubbery, off limits to child care facilities, etc.) over access. Because the soil around most of the buildings screened for lead in the Killpack Cantonment had elevated lead values, it would be advisable to screen the soil surrounding the remaining buildings in this area also. Laboratory analysis of soil samples suggests that the XRF readings of lead in soil are relatively accurate. Therefore, XRF screening by the NITON LISA of unsurveyed locations is recommended as a way to get reliable results at a reasonable cost.

Arsenic, Copper, and Zinc in Soil

None of the soil around the four buildings tested for the presence of arsenic, copper, and lead exceeded the MTCA residential cleanup level for the indicated metal (Table 4). The MTCA Method A cleanup level for arsenic in residential soils is 20 mg/kg (there is no Method A cleanup level for copper and zinc). The MTCA Method B (direct contact) cleanup levels for copper and zinc in soil are 2,960 and 24,000 mg/kg, respectively.
Site personnel indicated that some areas of stressed vegetation, which prompted soil analyses for these metals, may be related to herbicide use.

Recommendations

Because the concentrations of arsenic, copper, and zinc present in the tested soils did not exceed their respective cleanup levels, no remedial action for these three metals is warranted at this time.

It does not appear that the XRF is sensitive enough to accurately predict arsenic or copper concentrations in the soil when relatively low concentrations of these metals are present. The XRF performs marginally better under similar circumstances with respect to zinc.

It may be appropriate to test the soil in non-parking or non-roadway areas devoid of vegetation for the presence of elevated concentrations of pesticides. If elevated concentrations of pesticides are present, then appropriate action should be taken.

REPORT ORGANIZATION

This report is divided into several sections. Following the **SUMMARY OF FINDINGS AND RECOMMENDATIONS** and this **REPORT ORGANIZATION** section, **SURVEY PROCEDURES** summarizes the sampling procedures Hart Crowser used to conduct the lead-based paint and soil metals surveys at Camp Bonneville. Summaries of our survey results, on an area basis, are presented in the **SURVEY RESULTS** section of this report.

Following the **LIMITATIONS** section of the written report, Table 1 presents a summary of the building components testing positive for lead-based paint. Table 2 summarizes the positive components with unsatisfactory paint conditions. A summary of the lead in soil sampling results is presented in Table 3. Table 4 shows the range of concentrations for lead, arsenic, copper, and zinc in the soil relative to appropriate cleanup levels. Figure 1 is a Site Location Plan that shows the location of Camp Bonneville, with an inset Vicinity Map. Figures 2 and 3 are Site Plans for the Bonneville Cantonment and Killpack Cantonment, respectively.

Appendices

Appendix A contains an example Lead-Based Paint and Soil Metal Survey Report and Figure. Building-specific reports and figures have been presented under separate cover. In addition, backup documentation is presented in individual building file folders for each building, submitted under separate cover. Appendix B contains the Soil Metals Raw Data Reports for the buildings surveyed, including all measurements and analytical results. Appendix C contains laboratory certificates of analysis and sample custody documentation for the lead-based paint survey. Quality control results for the survey are also included. Appendix D contains a data quality review and laboratory certificates of analysis and sample custody documentation for the soil metal survey. Quality control results for the LBP soil metal survey are also included as Tables D-1 and D-2. Appendix E contains laboratory certificates of analysis and sample custody documentation for dust wipe samples. Appendix F presents the appropriate training and accreditation certificates for the inspectors and the analytical laboratory. Appendix G contains examples of typical building components.

Other Documentation

Photographs, field notes, and other supporting documentation are located in file folders submitted under separate cover.

SURVEY PROCEDURES

The following discussion is a summary of our lead-based paint and soil metals survey procedures. In general, our field data collection efforts followed the procedures outlined in the Management Plan for Lead-Based Paint and Soil Metals Survey, Camp Bonneville, Washington (Hart Crowser, 1996). At the direction of the Corps, we occasionally modified our field data collection procedures as necessary to accommodate local conditions. Such modifications are discussed below.

Lead-Based Paint Survey

We estimated the lead content in selected painted surfaces with a hand-held Niton XL 309 XRF Spectrum Analyzer. Any component evaluated with the XRF was assumed to be indicative of the lead content of similar painted surfaces in the same building. Painted surfaces with results greater than or equal to 1.0 mg/cm^2 were considered lead-based paint.

Under certain circumstances, when materials were measured with inconclusive XRF results (i.e., results between 0.8 and 1.2 mg/cm^2), or to confirm certain positive or negative XRF measurements, we collected a bulk sample of the paint in question and submitted it to NVL Laboratories, Inc. (NVL) for total lead analysis using flame atomic absorption spectroscopy (AAS).

One dust wipe sample was from inside a building also submitted to NVL for total lead analysis using flame AAS.

Soil Metals Survey

We estimated the content of lead in near-surface soils adjacent to twenty-one buildings with a Lead-In-Soil Analyzer (LISA). The LISA is a Niton XL 309 Spectrum Analyzer modified to detect metals directly in the soil. We also used the LISA to test the soils surrounding four buildings for the presence of arsenic, copper, and zinc. To establish background soil lead conditions, we used the LISA to measure the surface soil at two off-site locations west of the Main Gate. Background tests were conducted in a relatively undisturbed forested area and a nearby lawn.

Soil testing locations were generally selected according to the soil-metal sample collection procedures presented in our Management Plan (Hart Crowser, 1996). They were assumed to be representative of soil conditions in the general vicinity of the unsurveyed buildings, and located within 10 feet of exterior walls. At the Killpack Cantonment, the presence of French drains on the uphill side of buildings caused us to locate soil testing locations further away from exterior walls than specified in the soil sampling procedures.

Up to five measurements were taken with the LISA at each soil testing location. These measurements included:

- Direct surface soil measurements;
- Indirect surface soil measurements of samples contained in plastic bags;
- Indirect surface soil measurements of processed samples contained in cups;
- Indirect near-surface soil measurements of samples contained in plastic bags; and
- Indirect near-surface soil measurements of processed samples contained in cups.

We were not able to conduct direct subsurface soil XRF measurements because they damaged the protective film on the LISA x-ray window.

Direct and indirect measurements were conducted on site and in the Hart Crowser geotechnical laboratory, respectively. Surface soil measurements were taken immediately below the sod layer (typically one to two inches below the surface). Near-surface measurements were taken approximately three to four inches below the surface. We removed rocks, roots, and debris greater than 1/2 inch in size prior to measurement.

We collected indirect soil samples with a stainless steel spoon, which was cleaned between sampling events utilizing a cloth wipe (moistened with soap) and a dry paper towel. The soil was classified using the Unified Soil Classification (USC) system (ASTM D 2487) descriptions.

Direct Soil Measurement

Direct soil measurements were recorded by placing the LISA directly on the soil surface. Sod, rocks, and other large particles were removed from the sampling location prior to measurement (Hart Crowser, 1996; Appendix A).

Indirect (Bag) Soil Measurement

Indirect bag measurements were taken of soil samples stored in plastic ziplock bags. Prior to measurement, we homogenized the soil directly in the bags with a teflon-coated aluminum spoon. The bagged soil samples were measured with the LISA per manufacturer's guidelines.

Indirect (Cup) Soil Measurement

Indirect cup soil samples were processed prior to measurement by passing the sample through a No. 10 stainless steel sieve. Clumped soil was broken down with a mortar and pestle. Gravel, roots, and other non-soil components were discarded prior to measurement. Following soil preparation, the soil was homogenized with a stainless steel spoon and placed in the XRF soil "cups." The soil samples were then measured with the LISA per manufacturer's guidelines.

Laboratory Analysis

We submitted ten cup soil samples to NVL for total lead analysis using flame AAS. An additional four soil samples were submitted to NVL for total lead, arsenic, copper, and zinc analyses using flame AAS. To aid in directly comparing the AAS results with the LISA measurements, NVL was instructed to analyze soil samples as received (i.e., wet weight).

SURVEY RESULTS

Camp Bonneville is generally divided into two areas: the Bonneville Cantonment area, and the Killpack Cantonment area (Figure 1). In addition to these two areas, we also conducted portions of our surveys in non-cantonment areas. A narrative of the results from our lead-based paint and soil metal surveys is presented below for each cantonment. For detailed building-specific information concerning lead-based paint and metals in soil, refer to the individual file folders for each of the buildings surveyed.

Building Construction

Most of the fifty-six buildings we surveyed at Camp Bonneville were constructed in the late 1920s and 1930s. Seventeen buildings were constructed in the 1950s, 1970s, or 1990s. The date of construction for three buildings is apparently not known.

Except for four buildings, the buildings constructed in the 1920s and 1930s had wood walls and floors. The other four buildings had wood walls and concrete floors. Buildings constructed in the 1950s and 1990s were constructed of wood, metal, or concrete. Buildings constructed in the 1970s were constructed of metal or concrete.

Lead-Based Paint Survey Results

We were tasked with conducting a lead-based paint survey of forty-eight buildings. We actually surveyed fifty-six buildings. At the request of the Corps, we also surveyed the Main Gate (Building 4145A-entrance road main gate station), a group of sixteen stockpiled sheds (Building 4125A), and a water reservoir (Building 4532). For consistency, we have also included results for the Training Chamber (Building 1834). For the purpose of this report, the term "lead-based paint" refers to paint that contains at least 1.0 mg/cm^2 of lead.

<u>Buildings with Lead-Based Paint</u>

Forty-three of the buildings surveyed contained painted surfaces which contained at least 1.0 mg/cm^2 of lead. Most of this paint was located on exterior surfaces (Table 1). A smaller percentage of interior surfaces were covered with lead-based paint.

Lead-based paint present on exterior surfaces (i.e., "Exterior," "Porches," and "Stairways") was relatively evenly distributed among building components. Positive measurements were approximately distributed as follows:

- 21 percent associated with wall components (i.e., Siding, Skirting, and Wall);
- 28 percent with trim components (i.e., Corner Board, Upper Trim, and Lower Trim);
- 15 percent with window components (i.e., Window Sill, Window Sash, and Window Header);
- 14 percent with door components (i.e., Door, Door Header, Door Molding, and Door Jamb); and
- 22 percent with other components (i.e., Soffit, Stair Riser, Eave, Column, Ceiling, Sign, Stanchion, Floor, Dripboard, Foundation, Vent, Rail Cap, and Tank)

Lead-based paint on interior surfaces was generally located in bathrooms and storage areas. For interior surfaces, approximately 37 percent of the positive measurements were associated with door components, 26 percent with wall components, 21 percent with window components, and 16 percent with other components.

Building Components with Lead-Based Paint in Unsatisfactory Condition

More than 60 percent of the forty-three buildings which were positive for lead-based paint had components covered with deteriorated paint (Table 2). Most of the deteriorated lead-based paint was located on exterior wooden components. Very little deteriorated lead-based paint was present on interior components. Approximately 32 percent of the deteriorated exterior paint was associated with trim components, 25 percent with other components, 21 percent with wall components, 13 percent with window components, and 9 percent with door components.

Dust Wipe Sample Results

We collected a single dust wipe sample from an interior window sill in Building 1833 (Appendix E). The results indicate that the dust lead content was below the U. S. Department of Housing and Urban Development's (HUD) clearance standard (i.e., 0.5 mg/ft^2) for window sills.

Lead in Soil Survey Results

Using the procedures described in **SURVEY PROCEDURES** section above, we screened the soil surrounding twenty-one buildings for the presence of lead (Figure 2 and 3). For comparison, we screened off-site surface soils at two locations. Lead values in off-site surface soils ranged from 104 to 150 mg/kg

(Appendix B, "Buildings" 9000 and 9001). These background sample locations were from grassy soils adjacent to the roadway leading to the camp. They serve as a representative area of ambient lead from vehicle traffic, unaffected by known lead paint concerns.

Bonneville Cantonment

The only building in the Bonneville Cantonment with elevated lead values in the soil was Building 1963 (Table 3). The near-surface soil in the front of this building had elevated lead values. Based on our limited soil sampling the soil surrounding the remainder of this building, and the soil surrounding the rest of the buildings in the Bonneville Cantonment have lead values below 250 mg/kg.

Killpack Cantonment

Based on our limited soil sampling, with one exception, the buildings screened for lead in the soil in the Killpack Cantonment have elevated lead values. In this area, surface soil lead values as measured by the LISA ranged from 214 to 6,550 mg/kg (Table 3). Laboratory confirmation analysis generally agreed with our screening results. Lead concentrations in surface soils ranged from 250 to 2,500 mg/kg. Lead values (range 284 to 1,262 mg/kg) in deeper soils (3 to 4 inches below the surface) were somewhat less than lead values in surface soils. No near-surface soil was submitted for confirmation analysis.

Arsenic, Copper, and Zinc in Soil Survey Results

We screened the soil around four buildings for the presence of arsenic, copper, and zinc. Building 4475 was the only building with a metal roof and associated distressed vegetation that we surveyed. Although there were indications of distressed vegetation and the presence of a metal roof, we did not test the soils around Building 4125 for arsenic, copper, or zinc because the building lacked exterior painted surfaces. The other three buildings we surveyed (1834, 4126, and 4314) had indications of moderate to low lead values in the soil. No other buildings had older metal roofs and indications of nearby distressed vegetation.

It is possible that the apparent distressed vegetation surrounding some of the site buildings may not be related to metals leaching from metal roofs. Discussions with site personnel revealed that an herbicide was used around Building 4475 to control blackberry growth.

In general, the XRF measurements for these three metals was variable; particularly for arsenic and copper. Our XRF measurements for arsenic were completely different than the actual concentrations of arsenic for identical locations. The four arsenic confirmation analyses were not-detect for arsenic, yet the XRF indicated a range of <147 mg/kg (the detection limit of the machine) to 357 mg/kg. XRF measurements for copper ranged from <201 mg/kg (the detection limit of the machine) to 486 mg/kg. The only confirmation analysis for copper that was within the range specified by the XRF was for Building 4475 (Appendix B). It appears that the XRF is not sensitive enough to accurately predict arsenic or copper in soil when relatively low concentrations of these metals are present. XRF measurements for zinc ranged from <108 mg/kg (the detection limit of the machine) to 1,205 mg/kg. The AAS results for zinc were within the range of values shown by the XRF for two of the four buildings tested.

LIMITATIONS

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of the U.S. Army Corps of Engineers, the U. S. Army, and any contractors bidding on abatement, renovation, or demolition work for specific application to the referenced buildings. This survey report is not necessarily comprehensive because of access limitations and limitations on damaging structures. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

If there are any questions regarding the content of this report, please contact David Chawes or Chad Armour, of Hart Crowser.

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**Table 4. Comparative Analysis of Selected Metals in Soil
Lead, Arsenic, Copper, and Zinc
Camp Bonneville, Washington**

	Concentration in mg/kg				
Metal	MTCA Method A	MTCA Method B	Killpack Cantonment[1]	Bonneville Cantonment[1]	Background Clark County[2]
Lead	250	160[3]	<15 to 2,400	<15 to 150	5 to 30
Arsenic	20	1.67[4]	<5.1	<4.7	2 to 7
Copper	--	2,960	42 to 190	44	10 to 52
Zinc	--	24,000	100 to 190	88	21 to 98

1. Flame AAS analysis
2. Ecology Publication 94-115
3. Non-carcinogen
4. Carcinogen

Figure 1
Vicinity Map

Figure 2
Bonneville Cantonment

Figure 3
Killpack Cantonment

APPENDIX A
EXAMPLE LEAD-BASED PAINT AND
SOIL METAL SURVEY REPORT AND FIGURE

APPENDIX B
SOIL METALS RAW DATA REPORTS

APPENDIX C
BULK PAINT CHIP ANALYSIS
NVL LABORATORIES, INC.

PAINT CHIP QUALITY CONTROL DOCUMENTATION
NVL LABORATORIES, INC.

APPENDIX D
SOIL DATA QUALITY REVIEW AND CERTIFICATES OF ANALYSIS

SOIL TOTAL METALS ANALYSES
NVL LABORATORIES, INC.

APPENDIX D
SOIL DATA QUALITY REVIEW AND CERTIFICATES OF ANALYSIS

Soil Data Quality

Fourteen soil samples were collected on July 2, 3, 8, and 9, 1996. Ten of these samples were submitted to NVL Laboratories, Inc (NVL -Seattle, Washington) for total lead analysis (EPA Method 3550). Four soil samples were analyzed for total lead, copper, zinc, and arsenic using the same procedure. Additionally, two soil samples (4475-1-1S-6 and 1848-5-1S-34) were split and submitted as blind duplicates to Prezant Associates, Inc. (Prezant - Seattle, Washington) for total lead analysis.

Detection limit goals were achieved for all samples analyzed. The Relative Percent Differences (RPD) for the blind duplicate samples were acceptable at 4 and 9.5 percent, respectively. NVL did not submit quality assurance/quality control (QA/QC) data. Prezant's QA/QC data included a Matrix Spike recovery and a Method Blank analysis. The Matrix Spike recovery was acceptable at 108 percent. Lead was not detected above the limit of detection in the Method Blank. The data are deemed acceptable for use in this project.

TOTAL METALS QUALITY CONTROL DOCUMENTATION
PREZANT ASSOCIATES, INC.

APPENDIX E
DUST WIPE SAMPLES ANALYSIS
NVL LABORATORIES, INC.

APPENDIX F
PROJECT CERTIFICATES

APPENDIX G
TYPICAL BUILDING COMPONENTS