

J-3933-52

February 28, 1997

Mr. William Graney  
U. S. Army Corps of Engineers  
Seattle District  
4735 East Marginal Way South  
Seattle, Washington 98134

Re: Pre-Demolition Survey  
CS Gas Chamber Building  
Camp Bonneville, Vancouver, Washington  
Contract No. DACA67-93-D-1004, Delivery Order No. 52

Dear Mr. Graney:

Hart Crowser is pleased to submit our letter report for the Pre-Demolition Survey at the CS Gas Chamber (Building 1834) located in Camp Bonneville, Vancouver, Washington. Our work was performed in accordance with U.S. Army Corps of Engineers (Corps) Contract No. DACA67-93-D-1004, Delivery Order Number 52. The survey was conducted to provide information concerning the concentrations (if any) of CS gas, lead-based paint (LBP), and asbestos in and around the building, in preparation for demolition of the structure.

## **SUMMARY OF FINDINGS AND RECOMMENDATIONS**

Concentrations of CS and breakdown products were all below detectable limits both in the soil beneath the building, in soil downwind of the building, and in all sampled building materials. Lead-based paint was discovered on some building components (primarily the exterior siding), but below levels which would likely cause designation of the entire building as a lead Dangerous Waste. Lead concentrations in soil were below any levels of concern. No asbestos was discovered in the building. A single unknown compound was detected in the

soil beneath the building. Detailed chemical analysis ruled out concern that the chemical was on any EPA list of hazardous chemicals; however, the specific identity of the compound could not be determined.

**Recommendation.** The building may be demolished without further concern for hazardous materials or Dangerous Waste designation. The Camp Bonneville Fire Department has requested that the building be made available for a training burn. Because of the uncertainty regarding the specific identity of the unknown compound beneath the building, we do not believe burning the building would be prudent at this time. Pending resolution of historical designation status, the building may be demolished by conventional mechanical means and the debris disposed of in a construction debris landfill. Hart Crowser does not recommend additional testing of the soil beneath the building, as it would most likely be an expensive series of tests with little chance of determining the specific identity of the compound.

## **REPORT ORGANIZATION**

Following the **SUMMARY OF FINDINGS AND RECOMMENDATIONS** and this **REPORT ORGANIZATION** section, **BACKGROUND INFORMATION** summarizes the known environmental information about the building, and **SURVEY PROCEDURES** summarizes the sampling procedures Hart Crowser used to conduct the CS, asbestos, and lead-based paint and soil metals surveys at the building. Summaries of the results for each studied contaminant are presented in the **SURVEY RESULTS** section. In addition, this section contains the procedures used to perform a treatability study for the CS residual found on building materials.

Following the **LIMITATIONS** section of the written report, Table 1 presents a summary of the chemical analyses conducted in conjunction with the CS gas survey.

## ***Appendices***

**APPENDIX A** contains the Lead-Based Paint Summary Report for the building, along with the soil lead sample results. A floor plan indicating locations of the lead-based paint and soil lead samples is also included. **APPENDIX B** contains the Asbestos Summary Report, along with a floor plan indicating the asbestos sample locations. **APPENDIX C** contains the laboratory certificates of analyses for the CS gas, asbestos, and lead surveys.

### ***Other Documentation***

The lead-based paint and soil lead survey was conducted in conjunction with a lead and metal survey of the entire Camp Bonneville facility, under Delivery Order No. 49. Photographs, field notes, and other supporting documentation relevant to the survey of Building 1834 will be submitted separately with the final report for that project.

## **BACKGROUND INFORMATION**

The Camp Bonneville "CS Gas Chamber" Building was until recently used to train troops in chemical warfare agents. This 1-story wood frame, post-on-pier converted troop barracks, is approximately 15 feet by 49 feet in plan dimension. This building has painted sheet rock interior walls and ceiling, unpainted cedar shake exterior siding, painted siding beneath the shakes, and an unpainted wood deck floor. It has no internal partitions. The roof is covered with asphalt shingles.

We understand that chemical warfare training in this building was limited to the use of CS gas. CS is the common name for 2-chlorobenzalmalononitrile (CAS: 2698-41-1; synonyms: o-chlorobenzalmalononitrile, and o-chlorobenzylidene malononitrile). CS is used as a military or police riot-control and incapacitating agent. It is a solid particulate that is typically heated to the vapor phase, introduced into the area to be controlled, where it recondenses into a solid particulate (a true fume).

The material reportedly hydrolyses in water into hydrocyanic acid and 2-chlorobenzaldehyde. When mixed with an aqueous oxidizer, the first breakdown products of CS (o-chlorobenzylmalononitrile) are o-chlorobenzaldehyde and hydrocyanic acid. Further reaction results in conversion of the cyanide (in hydrocyanic acid) to a much less toxic cyanate, plus o-chlorobenzoic acid. Depending on the degree of oxidation, the cyanate may be further oxidized to nitrous or nitro groups. Heating CS can result in formation of cyanide gas (HCN).

Chemical warfare training was conducted inside while troops wore chemical warfare protective gear. The CS gas would be generated inside by heating a CS capsule with a candle in a metal container. When the training exercise ended, the doors were flung open and the CS gas dissipated to the ambient air. Over years of such use, a visible residue has adhered to the interior building surfaces.

## **SURVEY PROCEDURES**

### ***CS Sampling Procedures***

On July 3, 1996, Bobby Johnson and Brian Christianson, of Hart Crowser, collected representative samples of building materials from the CS Gas Chamber Building. Approximately 4 ft<sup>2</sup> section was taken from each of the plywood ceiling, gypsum sheet rock interior walls, tarpaper behind the interior walls, and wooden deck floor.

For the ceiling sample (CS-1), a plywood section was removed and cut into nominal 1 ft x 2 ft sections. The same method was attempted for the wall (sheet rock) sample (CS-3), but the framing interfered with removing a 2 ft x 2 ft section; however, sufficient contiguous pieces were obtained that provided approximately 4 ft<sup>2</sup>. The floor sample (CS-4) was taken in the form of four entire contiguous boards 3.25 in. x 63.5 in. that were sawed into shorter lengths to fit inside the sample cooler. An approximately 1.5 ft x 1.5 ft section of tar paper (CS-2) was also taken from behind the wallboard. All building material samples were placed in polyethylene bags, labeled, and placed in a cooler with "blue ice."

Two soil samples were also collected. One sample (1834-SS-1) was obtained from beneath the building by hand auger through the hole in the wooden deck floor. The other sample (1834-SS-2) was obtained from the prevailing downwind direction (10 feet south of the south side). This sample was collected with a stainless steel spoon. Both soil samples were from 0 to 2 inches beneath the surface. The soils samples were placed into glass jars, labeled, and placed in a cooler with "blue ice."

The coolers were sealed according to Corps chain of custody protocols, and transported to the Hart Crowser Chemistry Laboratory in Seattle, Washington. The entire cooler was placed in a freezer for two days, and transferred unopened to a refrigerator, where the samples remained until the treatability study began.

Soil sample preparation for CS analysis consisted of weighing out the samples into borosilicate glass centrifuge tubes, adding the extraction solvent, and shaking the tubes for 15 minutes. The tubes were then centrifuged and refrigerated until shipment to the analytical laboratory.

### ***Asbestos Sampling Procedures***

On July 3, 1996, Brian Christianson collected 32 samples of suspect building materials for asbestos content analysis.

For the asbestos survey, we used the procedures contained in AHERA regulations (40 CFR 763.86) and detailed in our Management Plan. Samples of suspect materials were collected from representative building components and delivered using chain of custody procedures to NVL Laboratories, Inc. for analysis by polarized light microscopy (PLM). Materials which contain 1 percent or greater asbestos content are considered as ACM.

### ***Lead-Based Paint Sampling Procedures***

On June 28, 1996, Brian Christianson and Stacey Callison of Hart Crowser surveyed Building 1834 for lead-based paint with a portable x-ray fluorescence (XRF) device. 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).

We screened for 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  $1.0 \text{ mg/cm}^2$  were considered lead-based paint.

Under certain circumstances, when materials were measured with inconclusive XRF results (i.e., results between  $0.8$  and  $1.2 \text{ mg/cm}^2$ ), 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).

### ***Soil Metals Sampling Procedures***

On July 8, 1996, Brian Christianson and Stacey Callison of Hart Crowser surveyed Building 1834 for lead in near-surface soils adjacent to the building 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 the building for the presence of arsenic, copper, and zinc.

Soil testing locations were generally selected according to the soil-metal sample collection procedures presented in our Management Plan (Hart Crowser, 1996). 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 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.

### **Soil Laboratory Analysis**

We submitted one cup soil sample to NVL for total lead analysis using flame AAS. To aid in directly comparing the AAS result with the LISA measurement, NVL was instructed to analyze soil samples as received (i.e., wet weight).

## **SURVEY RESULTS**

### ***CS Treatability Study***

The goal of the CS treatability study was to design a decontamination procedure that:

- ☐ Effectively and efficiently destroys the CS;
- ☐ Provides minimal hazards to workers;
- ☐ Produces little or no extraordinary waste; and
- ☐ Proves to be cost-effective.

Aqueous solutions of several chemicals were chosen for testing, as follows:

#### **Treatment Solution 1**

Sodium Hydroxide (NaOH, caustic soda). Based on information in NTIS publication AD-A033 469, **Demilitarization of CS, 1. Chemical Disposal of CS by Hydrolysis**, sodium hydroxide was chosen as a proven agent for CS decontamination. Sodium hydroxide is inexpensive, and solutions can be easily neutralized by common inexpensive acids. The resulting solutions can be handled by domestic sewer systems. The biggest drawback lies in potential hazards to workers.

#### **Treatment Solution 2**

Sodium Carbonate (Na<sub>2</sub>CO<sub>3</sub>, soda ash). Sodium carbonate, a component of most laundry detergents, provides a milder caustic solution that is also inexpensive, easily neutralized and disposed of, but is much safer for workers.

#### **Treatment Solution 3**

Sodium Carbonate in household bleach (sodium hypochlorite, NaOCl). The mixture is more aggressive than sodium carbonate alone, and has the added advantage of destroying many cyanide compounds as well as CS. It is also inexpensive, and its safety factor lies between

sodium hydroxide and ordinary sodium carbonate. Disposal could also be handled by domestic sewer systems after neutralization.

#### **Treatment Solution 4**

Trisodium phosphate ( $\text{Na}_3\text{PO}_4 \cdot 10\text{H}_2\text{O}$ , TSP, sodium phosphate, tribasic). TSP was initially selected as a potential chemical for treatment of CS, but was not used, as its limited solubility in water at 25 °C makes it impractical for scale-up.

#### **Treatment Procedures**

For the treatability study, the ceiling, wall, and floor samples were divided into 4 portions of nominally equal surface area. Plans to test the tar paper were abandoned, as interferences from tar dissolved in the solvent would make analysis impossible. Each portion of each sample was assigned a letter designation (A, B, C, or D).

Each "A" portion (the untreated material) was placed on edge in a precleaned stainless steel pan, and the room-side surface was rinsed with solvent (20% v/v methylene chloride in hexane, both HPLC grade), and wiped thoroughly with a solvent-soaked filter paper. The solvent in the pan was transferred into a 40 mL VOA vial, and the pan and filter paper were repeatedly rinsed with solvent that was also transferred to the VOA vial. Since the treatability study was carried out in a fume hood, the air draft rapidly concentrated the solvent, allowing for thorough rinsing.

To determine the degree of penetration of the CS into building material, a chisel was used to split the "A" portion of the flooring sample through its thickness (nominal 1 in.) and the exposed surface was treated in the same manner. The ceiling plywood was too thin to split, and the sheet rock would have absorbed the solvent.

**Treatment Solution 1.** This solution consisted of 6% w/v sodium hydroxide in deionized water that had been allowed to cool to ambient temperature after mixing. Each "B" portion was placed on edge in a precleaned stainless steel pan, and the room-side surface was rinsed thoroughly with about 250 mL of Treatment Solution 1. Solution-soaked filter papers were used to wipe the surface, and the used Solution was transferred to a pre-cleaned 1 L polyethylene bottle. All three "B" wash solutions were transferred to the same bottle, and were refrigerated. Each "B" surface was then allowed to dry overnight under the hood, and the same solvent rinse procedure used on the "A" surfaces was employed in order to sample for residual CS.



**Treatment Solution 2.** Treatment Solution 2 consisted of 10% w/v sodium carbonate in deionized water. Treatment on the "C" portions proceeded in the same manner as with Treatment Solution 1.

**Treatment Solution 3.** Treatment Solution 3 consisted of 10% w/v sodium carbonate in 1:1 deionized water:household bleach (with a final concentration of 2.63% w/v sodium hypochlorite). Treatment on the "D" portions proceeded in the same manner as with Treatment Solution 1.

Using a separatory funnel, each of the three composited treatment solutions was back-extracted with 3 aliquots of methylene chloride/hexane. The solvent extracts were refrigerated for analysis to determine if any CS remained in the wash solutions. The aqueous solutions were preserved for cyanide analysis by raising the pH to greater than or equal to 12 if necessary, and then refrigerating.

### **Results**

The laboratory results (Table 1) indicate no CS or its breakdown product *o*-chlorobenzaldehyde in the extracts at or above the detection limits (0.5 and 7 mg/L, respectively) for both the treated and untreated building material samples. These detection limits convert into <0.02 and <0.28 mg/ft<sup>2</sup>, respectively.

Similarly, no CS or *o*-chlorobenzaldehyde were found in the soils at or above the detection limits of 1.0 and 14 mg/kg, respectively, on an as-received basis. In addition, a soil matrix spike of CS had a 96.3% recovery.

Cyanide analysis was performed on the used treatment solutions to determine waste designation for disposal. Only a trace amount of cyanide was detected in the washwater from Solution 1 (Table 1). Cyanide levels were below the detection limit from Treatment Solutions 2 and 3. The wastewater, after pH neutralization, will be characterized as non-hazardous waste and disposed of into the sanitary sewer system.

**Analysis of Unknown Compound.** During the P&CAM 304 analysis by High Performance Liquid Chromatography (HPLC), a single unknown peak was found in the solvent extract of Sample 1834-SS-1, collected from the soil underneath the building. The compound eluted before the target analytes on a reverse-phase column, indicating a compound probably more polar than the target analytes. Further analysis to determine the identity of the unknown chemical was authorized.

Since potential CS breakdown products include *o*-chlorobenzoic acid and benzoic acid, which are more polar than either CS or *o*-chlorobenzaldehyde, a GC/MS scan was performed on the extract. The GC/MS scan of the unknown peak did not match that of either *o*-chlorobenzoic acid or benzoic acid. According to American Interplex, the analytical laboratory, a library search with its NIST database (comprising over 79,000 compounds, including all chemicals on the EPA hazardous waste lists) did not render a match of greater than 35% confidence with any compound. No further investigation testing to determine the chemical identity of the unknown compound is feasible at this point.

### ***Asbestos Results***

None of the samples analyzed for asbestos content indicated any asbestos present.

### ***Lead-Based Paint Results***

The lead-based paint (defined as paint with lead content greater than 1.0 mg/cm<sup>2</sup>) was located on exterior surfaces, specifically the corner boards, exterior siding, and stairway risers. Lead-based paint in advanced stages of weathering was noted on the cornerboards of the building.

EPA guidelines indicate that painted materials with elevated concentrations of lead (approximately 4 mg/cm<sup>2</sup> or greater) might be a potential dangerous waste if separately removed during demolition or renovation activities. None of the components tested on Building 1834 had over 2.9 mg/cm<sup>2</sup> lead content.

### ***Metals in Soil***

On July 3, 1996, Brian Christianson, of Hart Crowser, measured surface and subsurface soils surrounding Building 1834 for lead content. All measured soil lead values were less than 93 mg/kg (the detection limit of the hand-held XRF). A confirmatory soil sample was submitted for lead AAS analysis, with a result of 17 mg/kg. LISA measurements of arsenic, copper, and zinc were all below applicable regulatory limits. Further discussion of the applicability of the soil metal measurements may be found in the report "Lead-Based Paint and Soil-Metal Survey, Camp Bonneville, Vancouver, Washington," (Hart Crowser, 1997).

## **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 renovation or demolition work for specific application to the referenced building. This survey was limited in that exterior structures could not be damaged during sampling, pending determination of historical preservation status. We do not believe that additional sampling of the structure would likely yield significantly different results than those presented herein. 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 of Hart Crowser.

Sincerely,

**HART CROWSER, INC.**

**DAVID E. CHAWES, C.I.H.**

Delivery Order Manager

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Attachments:

Table 1 - Chemical Analysis Results

Appendix A - Lead-Based Paint and Soil Lead Reports

Appendix B - Asbestos Summary Report

Appendix C - Laboratory Certificates of Analysis

NVL Laboratories, Inc.

American Interplex Laboratories

**APPENDIX B**  
**ASBESTOS SUMMARY REPORT**

**APPENDIX C**  
**LABORATORY CERTIFICATES OF ANALYSIS**  
**NVL LABORATORIES, INC.**  
**AMERICAN INTERPLEX LABORATORIES**

**APPENDIX A**  
**LEAD-BASED PAINT AND SOIL LEAD REPORTS**