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DEPARTMENT OF HEALTH

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Dan

November 9, 1990

Mr. Michael O'Toole
NYS Department of Environmental Conservation
50 Wolf Road
Albany, NY 12205

Dear O'Toole:

Enclosed is a draft report on the Love Canal Emergency Declaration Area (EDA) Areas 2 and 3. This report describes results of the soil sampling study carried out jointly by the Departments of Health and Environmental Conservation to determine remedial options for these areas of the EDA.

Statistical analysis of chemical concentrations in the soil by depth indicates that removal of the top six inches of soil throughout Areas 2 and 3 would remediate these areas to be habitable as defined by the habitability criteria.

Copies of the report are being provided to the public for review and comment. We are prepared to discuss the report at the TRC meeting next week. Dr. Edward Horn will be representing the Department of Health.

Sincerely,

William Stasiuk/pm

William Stasiuk, P.E., Ph.D.
Director
Center for Environmental Health

NOV 13 1980

Love Canal Emergency Declaration Area

Remediation of EDA 2 and 3

DRAFT

Study Report

November 9, 1990

New York State Department of Health

2 University Place
Albany, New York 12203-3313

New York State Department of Environmental Conservation

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Albany, New York 12233-7010

Table of Contents

List of Abbreviations Used

BHC	benzene hexachloride, an older name for HCCH
CDC	United States Department of Health and Human Services, Centers for Disease Control
cy	cubic yard
DCB	dichlorobenzene
EDA	Love Canal Emergency Declaration Area
GC-MS	gas chromatography - mass spectrometry
HCCH	hexachlorocyclohexane
LCIC	Love Canal Indicator Chemical
ND	not detected
NYDEC	New York State Department of Environmental Conservation
NYDOH	New York State Department of Health
PETG	poly(ethylene terephthalate) - a copolyester plastic
ppb	part per billion, microgram per kilogram, nanogram per gram
TCB	trichlorobenzene
TeCB	tetrachlorobenzene
TRC	Love Canal Technical Review Committee

Acknowledgements

This project was jointly carried out by the New York Departments of Health (NYDOH) and Environmental Conservation (NYDEC). The cooperation of the following individuals was essential to the project:

Project design, management, and reporting

Edward Horn	NYDOH	Center for Environmental Health

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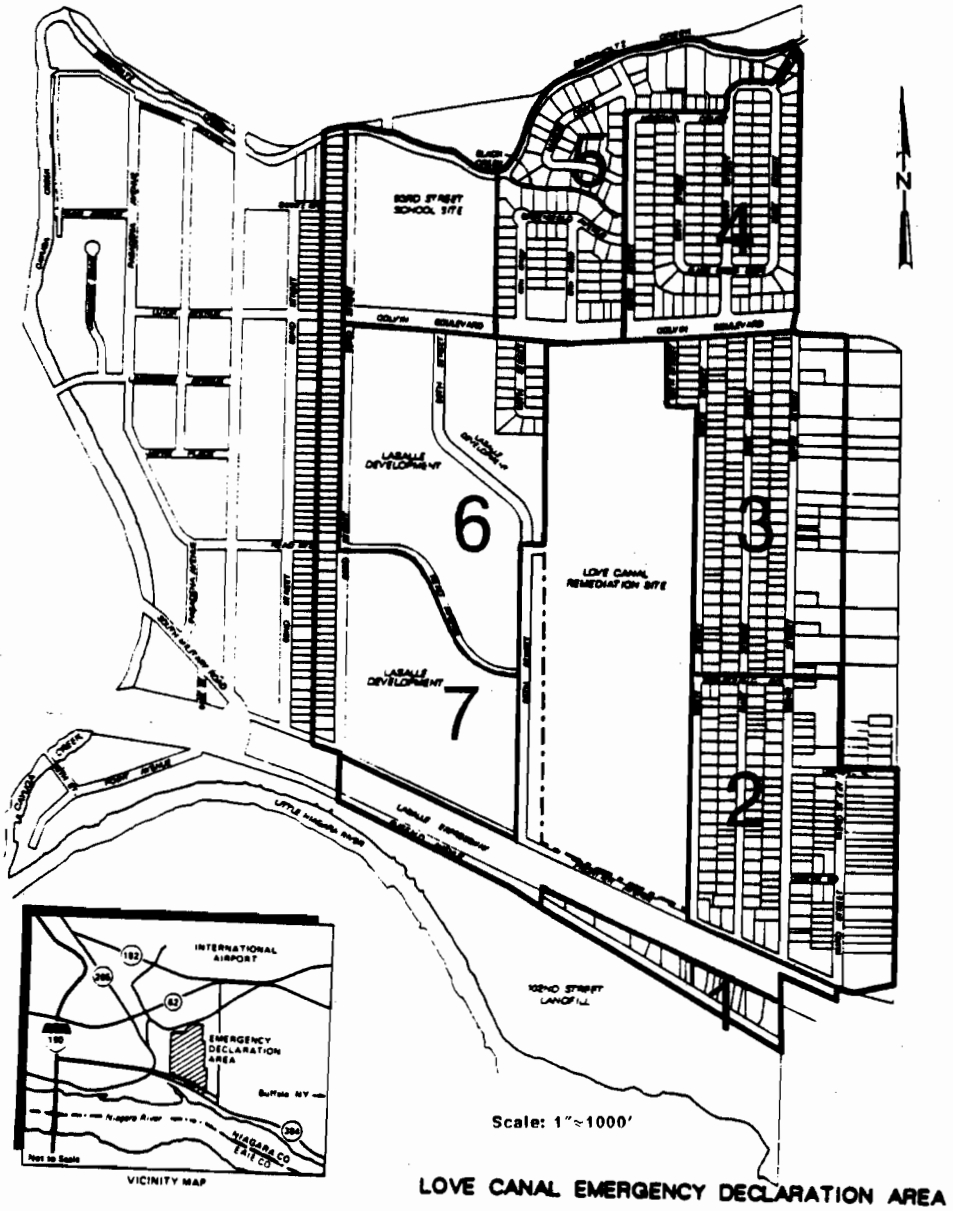
Robert Schick	NYDEC	Western Remedial Action
William Stasiuk	NYDOH	Center for Environmental Health
Charlene Theimann	NYSDOH	Health Liason Program
Allison Wakeman	NYDOH	Environmental Exposure Investigation

Figure 1. Location of Love Canal Emergency Declaration Area and the sampling areas used in the Habitability Study. This map is modified from maps in Volume 3 of the Habitability Study Report (TRC, 1988).



Introduction

On September 27, 1988, Commissioner of Health David Axelrod issued a decision on the habitability of the Love Canal Emergency Declaration Area (EDA) (NYDOH, 1988). The decision was based on the application of criteria developed by the State and Federal governments (CDC and NYDOH, 1986) to sampling data generated and interpreted in the Habitability Study (TRC, 1988). Among other findings, the habitability decision concluded that the neighborhoods east of the Love Canal and south of Colvin Boulevard (EDA 2 and 3) did not meet the habitability criteria and therefore were "not suitable for normal residential use without remediation of the contaminated soil" (see Figure 1 for a location map of the Love Canal, the EDA and the sampling areas). Commissioner of Environmental Conservation Thomas Jorling has stated that the State will remediate the non-habitable area (EDA 2 and 3) if necessary, and the Department of Environmental Conservation (NYDEC) is prepared to evaluate this potential remediation of EDA 2 and 3.

As noted in the habitability decision, EDA 2 and 3 are not habitable because soils there contained levels of seven Love Canal Indicator Chemicals (LCICs) at statistically higher levels than in comparison neighborhoods in Niagara Falls and EDA 4-7. These statistical differences persisted when the comparisons were carried out on the data excluding the the highest 10% of each LCIC reported in the area, and the differences diminished or vanished when reported values less than 1.0 or 2.0 ppb were excluded. Thus, these differences were found to be the consequence of overall low levels of LCICs (median soil concentrations of less than 2.0 ppb) found in EDA 2-3. Given this finding, remediation of soil in EDA 2-3 would be effective only if all surface soils are addressed, and the more traditional approach of identifying "hot spots" for remediation would not be effective.

The Habitability Study assessed levels of LCICs in the soil surface.[1] A primary alternative for remediation is soil removal and disposal. Removal of 12 inches of soil from the 81-acre EDA 2-3 area would produce about 112,000 cubic yards (cy) of soil for disposal, and removal of 3 or 6 inches would generate about 28,000 cy or 56,000 cy of soil, respectively, for disposal. Potential explanations for the LCIC levels found in the EDA (NYDOH, 1988)[2] suggested that contamination could be limited to surface soils less than 12 inches deep. The removal of 3 or 6 inches of soil would be considerably less disruptive to the neighborhood and less difficult and costly to implement than the removal of 12 inches of soil. Therefore, this study was designed to determine whether removal of 3 or 6 inches would be adequate remediation for EDA 2 and 3.

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[1] The depth of soil samples in the habitability study was 12 inches for 75% of samples and at least 7 inches for all samples (TRC, 1988, Vol V, p. 5-7).

[2] NYDOH (1988) considered four possible pathways for movement of chemicals from the Love Canal to the EDA:

1. migration through permeable surface soils including utility lines,
2. surface runoff of leachate along swales and through storm sewers,
3. airborne transport and precipitation of chemical gasses and contaminated fugitive dust, and
4. use of contaminated soil from the Love Canal as fill in the EDA.

The pattern of contamination that was found in EDA 2 and 3 is most consistent with airborne transport and deposition/precipitation from the Love Canal particularly during the period of active dumping (1942-1953).

Study objective

To determine whether elevated levels of Love Canal Indicator Chemicals (LCICs) in EDA 2-3 soils are significantly higher in the top 3 inches or top 6 inches than in the soil beneath these depths, or whether elevated levels extend to 12 inches. Mathmatically, this means that the following inequalities should be statistically evaluated:

$$[LCIC]_{0\text{-}3} > [LCIC]_{3\text{-}12}$$

$$[LCIC]_{0\text{-}6} > [LCIC]_{6\text{-}12}$$

where *[LCIC]* is the individual LCIC concentration in the specified depth of soil in the core.

Study design and methods

An evaluation of the inequalities described in the Study Objectives section required gathering cores of soil to a depth of 12 inches. The locations were selected to maximize the chance of detecting LCICs by identifying sample locations used in EDA 2 and 3 during the Habitability Study (TRC, 1988, Volume 3) that had the highest concentrations of chlorobenzenes and hexachlorocyclohexanes (HCCHs, referred to as BHCs in the Habitability Study) and obtaining new samples from these sample locations. Once collected, the cores were cut into three sections (0-3", 3-6", and 6-12") for analysis of LCICs. This permitted statistical comparison of LCIC concentrations in the top three inches (referred to as $[LCIC]_{0\text{-}3}$) to LCIC concentrations in the remainder of the core ($[LCIC]_{3\text{-}12}$) and of LCIC concentrations in the top six inches ($[LCIC]_{0\text{-}6}$) to LCIC concentrations in the bottom six inches ($[LCIC]_{6\text{-}12}$). Concentrations of LCICs in the top 6 inches ($[LCIC]_{0\text{-}6}$) and in the bottom 9 inches ($[LCIC]_{3\text{-}12}$), were estimated in the following manner:

$$[LCIC]_{0\text{-}6} = \frac{[LCIC]_{0\text{-}3} + [LCIC]_{3\text{-}6}}{2}$$

$$[LCIC]_{3\text{-}12} = \frac{[LCIC]_{3\text{-}6} + 2\,[LCIC]_{6\text{-}12}}{3}$$

where *[LCIC]* is the individual LCIC concentration in the specified depth of soil in the core.

The Wilcoxon signed-rank test (Lehmann and D'Abrera, 1975 and McClave and Dietrich, 1988) was used to compare these concentrations. This statistical test required paired comparisons for each core and thus effectively compared LCIC concentrations at different

depths within each core. The Wilcoxon rank sum test was used in the Habitability Study because it was not possible to identify sample pairs.

From December 4-8, 1989, samples were collected by NYDOH and NYDEC at 84 different locations at which the highest concentrations of LCICs were found in the Habitability Study (Figures 2 and 3). Soil cores were taken to 12 inches using an Environmentalist's Subsoil Probe sampler. The core was 0.9 inches in diameter and was collected into a PETG copolyester liner. The cores were labelled and placed in insulated boxes with "Blue Ice" to keep the cores cold. At the end of each day, all samples were sent by overnight mail to the Wadsworth Center for Laboratories and Research (Department of Health laboratories) in Albany. A detailed description of the sampling protocol and a copy of the sample shipment forms for each sample are in Appendix A.

The cores were cut into three sections in the laboratory. Soil from each of the three sections was analyzed for the soil LCICs (except chloronaphthalene) i.e.

α-HCCH	1,2-dichlorobenzene
β-HCCH	1,2,4-trichlorobenzene
δ-HCCH	1,2,3,4-tetrachlorobenzene
γ-HCCH	

Analysis was also carried out for hexachlorobenzene. Chloronaphthalene was not analyzed, because in the Habitability Study this chemical was found to be uniformly low in all areas tested, i.e. no significant differences were detected in any of the comparisons, median concentrations ranged from not detected to 0.07 ppb for all the areas tested, and the maximum level detected in any sample in the study was 0.32 ppb. Hexachlorobenzene was added because it was disposed at the Love Canal, and analysis for the chemical was simply carried out with the procedure being used. It had been rejected as a soil LCIC for the Habitability Study because of its low potential for migration in groundwater and soil (CDC and NYDOH, 1986, Appendix 9).

The LCICs were extracted by steam distillation and analyzed by gas chromatography-mass spectrometry (GC-MS). See Appendix B for details.

Figure 2. Location of soil core samples collected in EDA 2 on December 4-8, 1989.

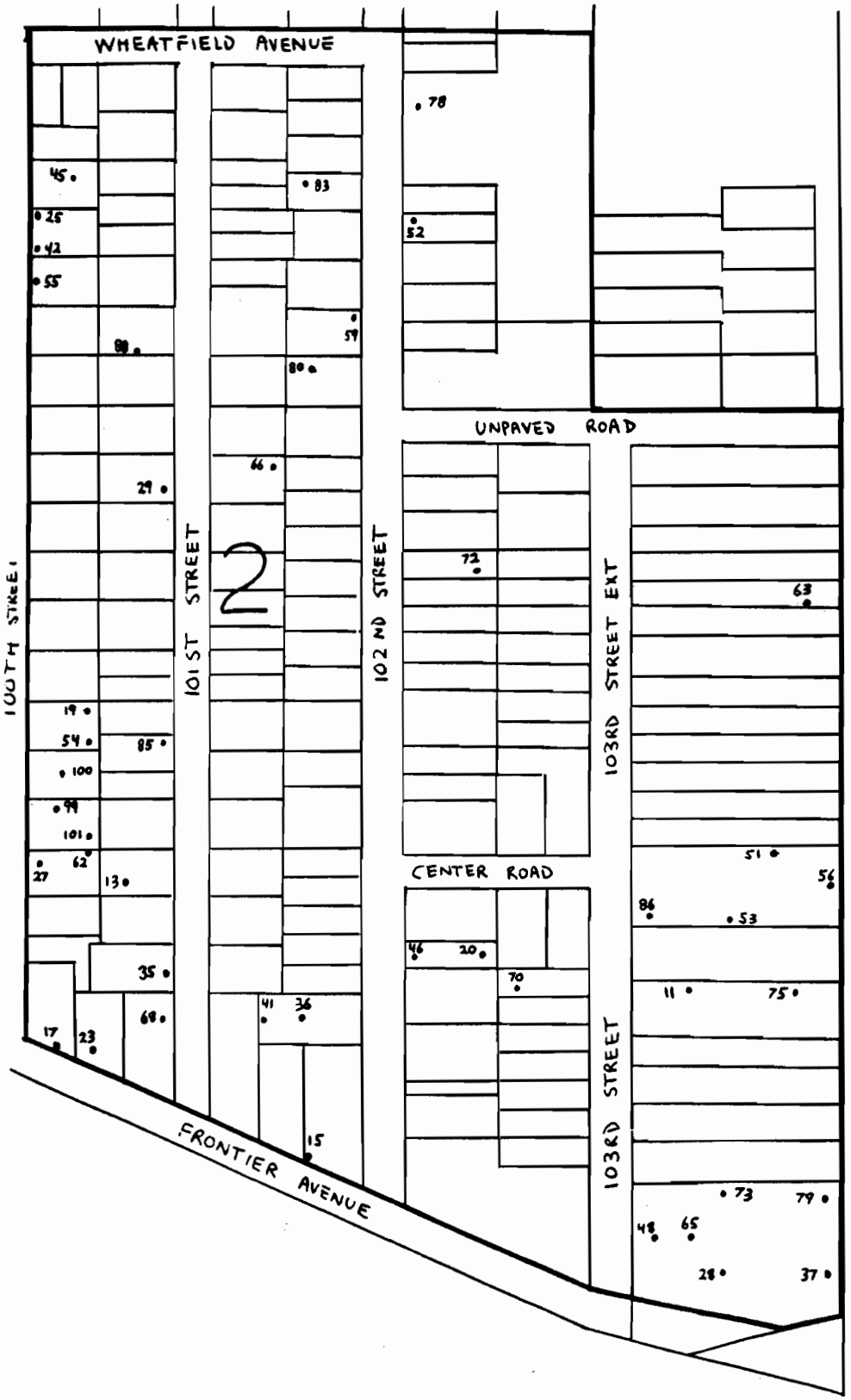

Figure 3. Location of soil core samples collected in EDA 3 on December 4-8, 1989.

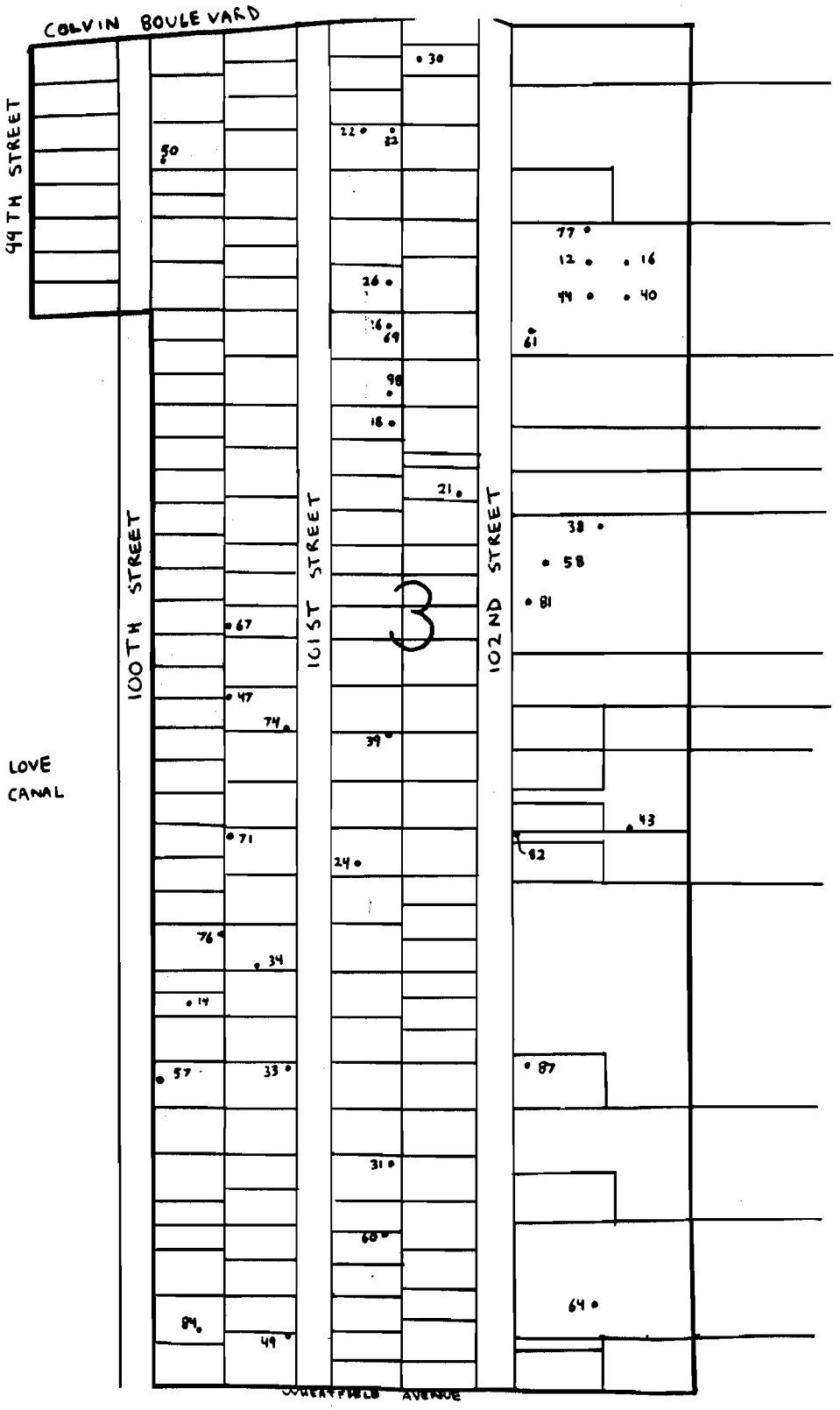

Figure 4. Percent of samples in which LCICs were detected. Total sample size is 243 (three samples each from 81 cores).

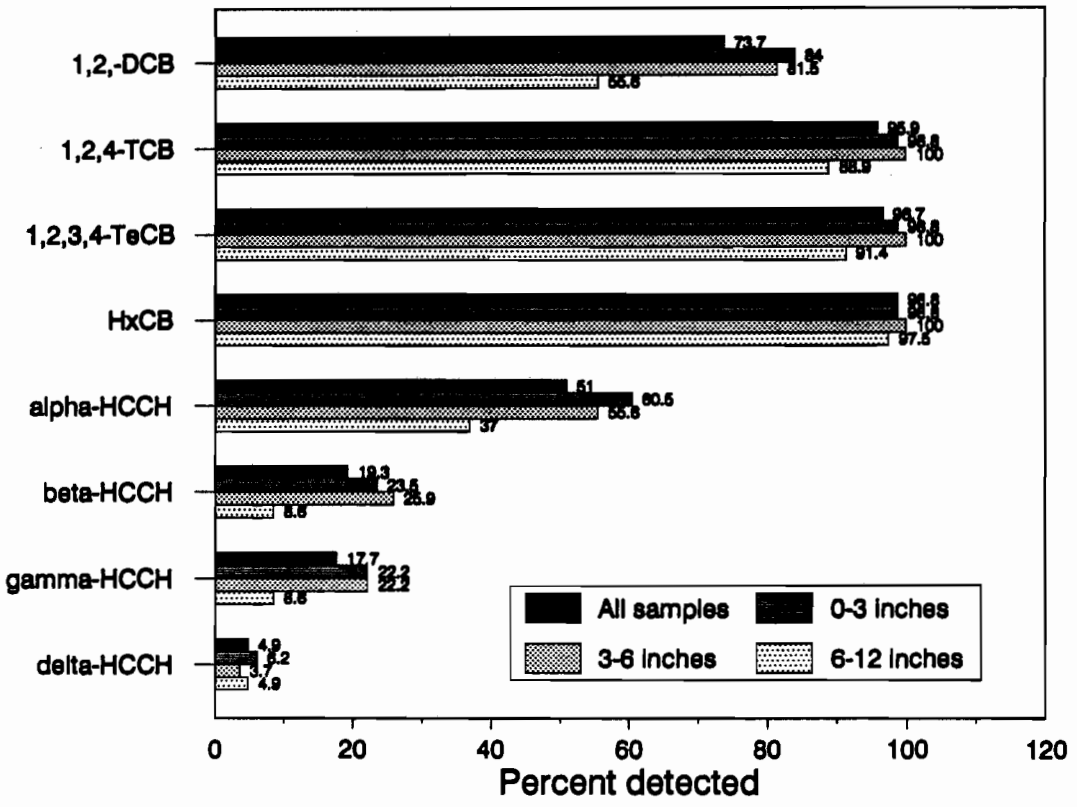

Table 1. Percent of samples with LCICs detected in sections of soil cores from EDA 2-3.

LCIC	0-3 inches	3-6 inches	6-12 inches	All samples
1,2-dichlorobenzene	84.0	81.5	55.6	73.7
1,2,4-trichlorobenzene	98.8	100.0	88.9	95.9
1,2,3,4-tetrachlorobenzene	98.8	100.0	91.4	96.7
hexachlorobenzene	98.8	100.0	97.5	98.8
α-HCCH	60.5	55.6	37.0	51.0
β-HCCH	23.5	25.9	8.6	19.3
γ-HCCH	22.2	22.2	8.6	17.7
δ-HCCH	6.2	3.7	4.9	4.9

Results

Descriptive statistics

Core samples were collected from 84 locations in the sample area. Three cores were not found by the laboratory to be less than the full 12 inches and were therefore not analyzed. Thus, analytical results were obtained for 81 cores (Appendix C).

Figure 4 and Table 1 present the percent of samples in which LCICs were detected. The chlorobenzenes were detected in the majority of samples and more frequently in the top 6 inches of the cores than in the lower 6 inches. The HCCHs were detected less frequently than chlorobenzenes in the samples. However, the pattern of contamination was similar, i.e. HCCHs were detected more frequently in the top 6 inches than the lower 6 inches of the cores.

In samples where LCICs were not detected, the detection limit was reported. The medians of these detection limits are reported in Table 2 and depicted in Figure 5. Detection limits were generally uniform with overall medians for each LCIC between 0.5 and 1.3 ppb except for hexachlorobenzene which was 0.3 ppb. Median detection limits of LCICs in the 0-3″ samples and the 3-6″ samples were not very different from one another. However, median detection limits of LCICs in the lower 6 inches (6-12″) of the cores were somewhat less than in the top 6 inches of the cores, particularly for the chlorobenzenes.

Statistical comparisons

Critical values (*z* values) and one-tailed probabilities were calculated by the Wilcoxon signed-rank test for three pairs of core sections (Table 3). LCIC concentrations in the top 3 inches of the cores are generally greater than in the bottom 9 inches of the core samples. However, for two of the LCICs (β- and δ-HCCH) the differences are not statistically significant at the 5% or 1% level. Except for δ-HCCH, LCIC concentrations are all significantly greater at the 5% level in the top 6 inches than in the bottom 6 inches. It is likely that the statistical comparisons for δ-HCCH are weaker than for the other LCICs because only 7 cores had detectable δ-HCCH.

Although most of the LCIC concentrations in the top 3 inches are greater than in the lower 9 inches of the core, this difference is largely the consequence of much lower concentrations of LCICs in the bottom 6 inches of each core compared to the top 6 inches of each core. Concentrations of LCICs in the 0-3″ section and in the 3-6″ section of each core were also statistically compared by a Wilcoxon signed-rank test (Table 3). Concentrations of LCICs in the 0-3″ samples were not significantly greater than those in the 3-6″ samples at the 1% level of significance, and at the 5% level of significance only trichlorobenzene and α-HCCH were significantly more concentrated at the top of the core (i.e. in the 0-3″ samples).

These results indicate that LCIC concentrations in the surface 3 inches and next 3 inches of soil are not significantly different from one another. However, LCICs in the top 6 inches of soil are significantly more concentrated than in the next 6 inches. This can be seen clearly in Figure 6 and Table 4 and suggests that removal of 6 inches of soil will

Figure 5. Median detection limits for samples where LCIC was not detected. Total sample size is 243 (three samples each from 81 cores).

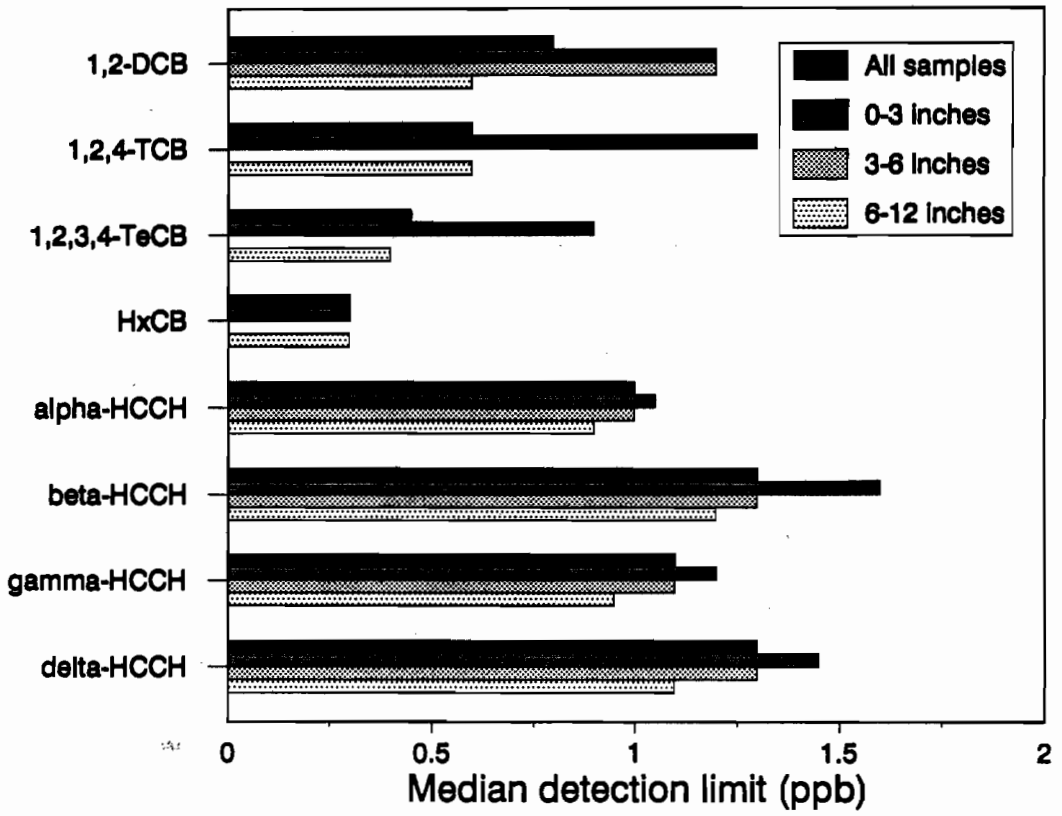

Table 2. Median detection limits for LCIC concentrations (ppb) in sections of soil cores from EDA 2-3.

LCIC	0-3 inches N	0-3 inches Median	3-6 inches N	3-6 inches Median	6-12 inches N	6-12 inches Median	All samples N	All samples Median
1,2-dichlorobenzene	13	1.20	15	1.20	36	0.60	64	0.80
1,2,4-trichlorobenzene	1	1.30	0	-	9	0.60	10	0.60
1,2,3,4-tetrachlorobenzene	1	0.90	0	-	7	0.40	8	0.45
hexachlorobenzene	1	0.30	0	-	2	0.30	3	0.30
α-HCCH	32	1.05	36	1.00	51	0.90	119	1.00
β-HCCH	62	1.60	60	1.30	74	1.20	196	1.30
γ-HCCH	63	1.20	63	1.10	74	0.95	200	1.10
δ-HCCH	76	1.45	78	1.30	77	1.10	231	1.30

Table 3. Comparison of LCIC concentrations in various portions of cores from EDA 2-3. The z value is the calculated normal variate from the Wilcoxon sign-rank test and p is the probability (one-tailed) that the inequality is true. NDs treated as 0 values.

LCIC	0-3" < 3-12"			0-6" < 6-12"			0-3" < 3-6"		
	z	p	N	z	p	N	z	p	N
1,2-dichlorobenzene	3.5690	0.9998	74	5.0371	1.0000	74	1.0762	0.8591	69
1,2,4-trichlorobenzene	4.0656	1.0000	81	5.7747	1.0000	80	1.8962	0.9710	79
1,2,3,4-tetrachlorobenzene	4.0656	1.0000	81	5.7959	1.0000	81	1.5132	0.9349	80
hexachlorobenzene	2.1046	0.9823	81	3.8682	0.9999	80	-2.2327	0.0128	80
α-HCCH	3.6317	0.9999	62	5.0655	1.0000	62	1.7758	0.9621	57
β-HCCH	1.2253	0.8898	27	1.8139	0.9652	27	0.8476	0.8017	25
γ-HCCH	2.1083	0.9825	29	3.1246	0.9991	29	1.5977	0.9449	27
δ-HCCH	1.1832	0.8816	7	0.8452	0.8010	7	1.3628	0.9135	6

reduce the concentration of LCICs at the surface. As explained below, this reduction in soil LCIC concentrations will be sufficient to satisfy the Habitability Criteria.

EDA 2 and 3 were declared not habitable because the Habitability Study found concentrations of LCICs in the surface soils (up to 12") from that area were significantly greater than concentrations of the same chemicals in surface soils from the Niagara Falls comparison areas. To be successful, remediation of surface soil in EDA 2 and 3 should leave LCIC concentrations in surface soil that are less than or equal to LCIC concentrations that would be expected in the Niagara Falls comparison areas. This comparison cannot be directly carried out for at least two reasons. The cores in this study were taken from those locations with the highest LCICs found in EDA 2 and 3 in the Habitability Study. Thus, the median concentrations of LCICs from this study would be expected to be greater than those found in the Habitability Study for this reason alone. In addition, any differences that might be observed could be the result of slight differences in analytical methodology used in the two studies and not actual soil concentrations.

Another approach to determining whether the amount of reduction in concentration of LCICs would be adequate is to first estimate from the Habitability Study how much more contaminated EDA 2 and 3 soils are relative to soils from the comparison areas. If the surface soil after remediation has been reduced by at least that amount, remediation could be considered adequate. For example, assume that the Habitability Study found that the soil concentration of an LCIC was twice as great in EDA 2 and 3 as in the comparison areas. Then, remediation would be effective if the current concentration of that LCIC in the surface soil could be reduced by at least half of the concentration found.

In the Habitability Study, median concentrations of LCICs in EDA 2 and 3 relative to the comparison areas were somewhat variable for each of the LCICs. Where it could be determined (for the chlorobenzenes and α-HCCH), the median LCIC concentration in EDA 2 and 3 was between 1 and 2 times greater than the median LCIC concentration in the Niagara Falls comparison areas (Table 5). This ratio could not be determined for the other HCCHs because the median concentration for these chemicals was below the analytical detection limit in the comparison areas.

In this study, median concentrations of chlorobenzenes in the top 6 inches of the cores were 2 to 4 times greater than in the bottom 6 inches of the cores (Table 6). For

Figure 6. Median LCIC concentrations (ppb) in sections of soil cores from EDA 2-3.

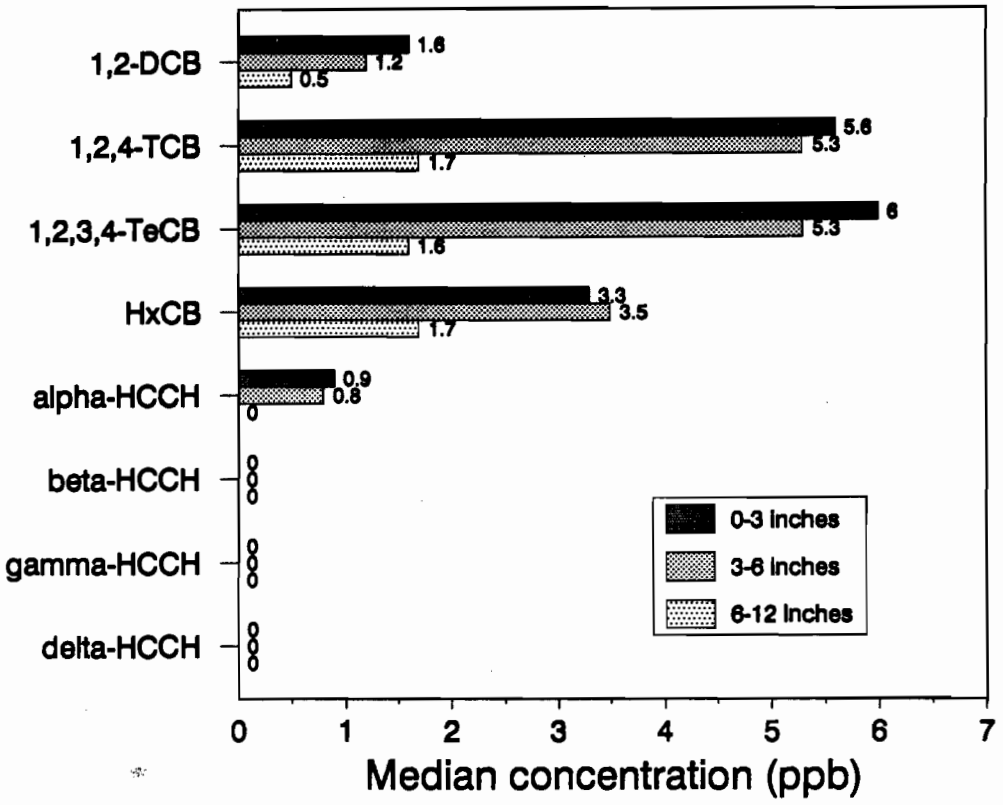

Table 4. Median LCIC concentrations (ppb) in sections of soil cores from EDA 2-3.

LCIC	0-3 inches N	0-3 inches Median	3-6 inches N	3-6 inches Median	6-12 inches N	6-12 inches Median
1,2-dichlorobenzene	81	1.60	81	1.20	81	0.50
1,2,4-trichlorobenzene	81	5.60	81	5.30	81	1.70
1,2,3,4-tetrachlorobenzene	81	6.00	81	5.30	81	1.60
hexachlorobenzene	81	3.30	81	3.50	81	1.70
α-HCCH	81	0.90	81	0.80	81	ND
β-HCCH	81	ND	81	ND	81	ND
γ-HCCH	81	ND	81	ND	81	ND
δ-HCCH	81	ND	81	ND	81	ND

Table 5. Median concentrations in parts per billion (ppb) of LCICs in soil from EDA 2-3 and the Niagara Falls Comparison Areas.

LCIC	EDA 2-3		NF Comparison Areas[1]		Ratio[2]
	N	Median	N	Median	
DCB	141	0.40	108	0.41	1.00
TCB	155	0.89	113	0.64	1.39
TeCB	154	1.09	111	0.56	1.95
α-HCCH[3]	154	0.29	113	0.14	1.43
β-HCCH[3]	147	0.17	103	ND	-
δ-HCCH[3]	151	ND	111	ND	-
γ-HCCH[3]	152	0.01	113	ND	-

[1] The NF Comparison Areas were Census Tracts 221 and 225. Values listed are combined for the two comparison areas.

[2] Ratio is: $\frac{\textit{median concentration in EDA 2\&3}}{\textit{median concentration in NF Comparison Areas}}$

[3] Referred to as BHCs in the Habitability Study Reports (TRC, 1988).

Table 6. Median concentrations in parts per billion (ppb) of LCICs in cores of soil from EDA 2-3.

LCIC	0-6 inches[1]		6-12 inches		Ratio[2]
	N	Median	N	Median	
DCB	81	1.55	81	0.50	3.10
TCB	81	6.20	81	1.70	3.65
TeCB	81	6.70	81	1.60	4.19
HxCB	81	3.65	81	1.70	2.15
α-HCCH	81	0.80	81	ND	-
β-HCCH	81	ND	81	ND	-
δ-HCCH	81	ND	81	ND	-
γ-HCCH	81	ND	81	ND	-

[1] The concentration for the top 6 inches of soil (0-6" section) in each core was estimated from the following:

$$\frac{[LCIC]_{0\text{-}3} + [LCIC]_{3\text{-}6}}{2}$$

[2] Ratio is:

$$\frac{\textit{median concentration in 0-6 inch core section}}{\textit{median concentration in 6-12 inch core section}}$$

most of the HCCHs, the median concentrations were less than the analytical detection limit, and therefore the amount of difference could not be calculated. Therefore, removal of the top 6 inches of soil in EDA 2 and 3 would leave soils that have chlorobenzene concentrations that would be 25% to 50% of the present surface concentrations. It is not possible to say what the consequences of removing 6 inches would be for HCCHs. In this study, the median concentration of α-HCCH in the top 6 inches of soil was 0.8 ppb, and in the bottom 6 inches it was below the detection limit. Therefore, the concentration of α-HCCH will be reduced by the removal of 6 inches of soil, but the extent of the reduction cannot be determined.

Conclusions

In soil core samples from EDA 2 and 3, LCICs were more frequently detected in the top 3 inches and the next 3 inches than in the bottom 6 inches of the 12-inch cores. Median LCIC concentrations in the top 3 inches and next 3 inches were not significantly different; however, median concentrations of LCICs in the top 6 inches of the cores were significantly greater than concentrations in the next 6 inches of soil, being 2 to 4 times higher in the top 6 inches, depending on LCIC. In the Habitability Study, LCIC concentrations in EDA 2 and 3 were less than 2 times higher than LCIC concentrations in the Niagara Falls comparison areas.

Because the LCIC concentrations in the top 3 inches of soil were not significantly different from concentrations in the next 3 inches and, for two of the LCICs, not significantly different from concentrations in the next 9 inches of soil, removal of 3 inches of soil would not be adequate remediation of EDA 2 and 3. However, removal of 6 inches of soil from EDA 2 and 3 will leave LCIC concentrations in the soil that are significantly less than what is there now. Such a removal would reduce the soil LCIC concentrations at the surface to a greater extent than the difference in LCIC concentrations between EDA 2 and 3 and the comparison area soils measured in the Habitability Study. Thus, removal of 6 inches of soil from EDA 2 and 3 would be sufficient to remediate the area, i.e. to satisfy the conditions of habitability established for the Love Canal EDA (CDC and NYDOH, 1986).

References

Centers for Disease Control and New York Department of Health. December 1986. Love Canal Emergency Declaration Area: Proposed Habitability Criteria.

Lehmann, EL and HJM D'Abrera. 1975. *Nonparametrics: Statistical Methods Based on Ranks*. Holden-Day, Inc., Oakland, CA.

McClave, JT and FH Dietrich, II. 1988. *Statistics*, Fourth Edition. Dellen Publishing Company, San Francisco, CA.

Technical Review Committee. 1988. Love Canal Emergency Declaration Area Habitability Study Final Report.

Volume I - Introduction and Decision-Making Documantation, May 1988. 80 pp.
Volume II - Air Assessment - Indicator Chemicals, February 1988. 54 pp.
Volume III - Soil Assessment - Indicator Chemicals, May 1988. 313 pp.
Volume IV - Soil Assessment - 2,3,7,8-TCDD, March 1988. 51 pp.
Volume V - Peer Review Summary - TRC Response, July 1988. 477 pp.

New York Department of Health. September 1988. Love Canal Emergency Declaration Area Decision on Habitability. 36 pp.

Appendix A. Sampling Protocol and Shipment Forms

Soil Sampling Protocol for Love Canal Sampling
Week of 12/4/89

1. After determining locations from previous selected lots, triangulate exact sampling locations using measuring tape and permanent points (i.e. telephone poles, fire hydrants, manhole covers, sewer grates, street curbs). Record in field notes.

2. Prepare soil sampling probe by removing probe cutting shoe by unscrewing, inserting a clean 18" copolyester tube liner into the bottom hollow stem of the probe, inserting an 18" stainless steel tube into the top of the probe (serves as a spacer), and then screwing on the probe cutting shoe (hand tight).

3. Insert the probe into the soil sampler body.

4. Position the soil sampler over the sampling location, perpendicular to the ground surface and affix the hammer assembly.

5. Drive the probe into the surficial soil to a depth of at least 14" using the 12.5 pound drop-hammer (the hammer was marked with tape to denote the sample depth desired).

6. Extract the probe from the soil using the soil sampler jack assembly.

7. Within the sampling van, unscrew the probe cutting shoe (a pipe wrench is sometimes necessary) and remove.

8. Remove the inner tube from the sampling probe by inserting a wooden dowel into the opposite end of the probe and gently pushing on the spacer tube. The sample tube full of soil is then withdrawn from the bottom end.

9. Measure length of sample in tube. If greater than 14", go to step 10. If less than 14", return sample to ground, discard used sample tube and go to step 14.

10. Affix teflon tape to the top end of the tube and cover with a red vinyl cap provided with the tube. Repeat the procedure for the bottom end of the tube using a black vinyl cap.

11. Wipe the outside of the tube with a dry paper towel to remove soil residue.

12. Place the sample tube in a cooler at 4 degrees C., no liquid ice is to be used.

13. Complete request for analysis form.

14. Clean the sampler body assembly (probe bottom end and cutting shoe) with deionized water and Tide liquid laundry soap. A final rinse with deionized water was used to remove the soap residue.

15. Place a new clean tube into the sampling probe and repeat procedure.

16. Ship samples by 5:00 p.m. each day to NYSDOH Wadsworth Laboratory using chain of custody procedures and Emery overnight delivery.

89362PRO0190

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WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
ALBANY, N.Y. 12201

Cooler A-10

CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
BATCH #4026				
895133 895134 895135	771 102nd St	12-4-89 11:22	Core 77	Soil
895136 895137 895138	771 102nd St.	12-4-89 11:33	Core 12	Soil
895139 895140 895141	771 102nd St.	12-4-89 11:44	Core 44	Soil
895142 895143 895144	771 102nd St.	12-4-89 11:55	Core 40	Soil
BATCH #4027				
895145 895146 895147	771 102nd St.	12-4-89 12:05	Core 16	Soil
895148 895149 895150	771 102nd St.	12-4-89 12:15	Core 61	Soil
895151 895152 895153	759 101st St.	12-4-89 12:26	Core 26	Soil
895154 895155 895156	753 101st St.	12-4-89 12:40	Core 69	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

DURING TRANSPORT OF THE SAMPLE FROM SAMPLING SITE TO LABORATORY, THE CHAIN OF CUSTODY MUST BE UNBROKEN. GENERALLY THIS WILL REQUIRE THAT THE SAMPLE BE DELIVERED BY THE SAMPLE COLLECTOR OR HIS DESIGNATED REPRESENTATIVE WHO WILL SIGN FOR THE RECEIPT, INTEGRITY AND TRANSFER OF THE SAMPLE DURING SHIPMENT. IF INTEGRITY OF SAMPLE IS QUESTIONED, DESCRIBE PROBLEM ON REVERSE SIDE OF THIS FORM.

CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. Vanderbilt	NYSDOH	12-4-89	16:55
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by	C. H. Richards	NYS DOH Labs	12-5-89	16:30
11. Sample Accessioned by	C. H. Richards and A. B. Hartman	NYS DOH Labs	12-5-89	11:00

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CHAIN OF CUSTODY RECORD

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BATCH # 4028

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895157 895158 895159	Lot C West of 10016	12-4-89 15:30	Core 23	Soil
895160 895161 895162	10,004 Frontier Ave	12-4-89 15:38	Core 17	Soil
895163 895164 895165	10016 Frontier Ave.	12-4-89 15:47	Core 68	Soil
895166 895167 895168	404 101st St.	12-4-89 15:55	Core 35	Soil
			Total Shipment: 12 cores	

SPECIFY METHOD OF PRESERVATION

- O NaOH
- Ø Cool, 4°C
- O Acidification (specify)
- O Other (specify

TRANSPORTING SAMPLES

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CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12-4-89	16:55
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by	A.H. Richards	NYSDOH/Lab	12-5-89	10:30
11. Sample Accessioned by	A.H. Richards R.J. Hoffman	NYSDOH/Lab	12-5-89	11:00

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
ALBANY, N.Y. 12201

CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
	513 100th St.	12-5-89 9:30	Love Canal EDA 2+3 Core 45	Soil
	Lot B N. of 509	12-5-89 9:36	Love Canal EDA 2+3 Core 25	Soil
	Lot B N. of 509	12-5-89 9:44	Love Canal EDA 2+3 Core 42	Soil
	509 100th St.	12-5-89 9:59	Love Canal EDA 2+3 Core 55	Soil
	431 100th St.	12-5-89 10:11	Love Canal EDA 2+3 Core 100	Soil
427	~~431~~ 100th St.	12-5-89 10:19	Love Canal EDA 2+3 Core 101	Soil
	435 100th St.	12-5-89 10:55	Love Canal EDA 2+3 Core 19	Soil
	435 100th St.	12-5-89 11:05	Love Canal EDA 2+3 Core 54	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

DURING TRANSPORT OF THE SAMPLE FROM SAMPLING SITE TO LABORATORY, THE CHAIN OF CUSTODY MUST BE UNBROKEN. GENERALLY THIS WILL REQUIRE THAT THE SAMPLE BE DELIVERED BY THE SAMPLE COLLECTOR OR HIS DESIGNATED REPRESENTATIVE WHO WILL SIGN FOR THE RECEIPT, INTEGRITY AND TRANSFER OF THE SAMPLE DURING SHIPMENT. IF INTEGRITY OF SAMPLE IS QUESTIONED, DESCRIBE PROBLEM ON REVERSE SIDE OF THIS FORM.

CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12-5-89	~~12:35~~ MEVJ
5. Sample Received by				16:35
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by				

Cooler A-7

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
ALBANY, N.Y. 12201

CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
423	~~427~~ 100th St.	12-5-89 11:13	Love Canal EDA 2+3 Core 27	Soil
	413 103rd St.	12-5-89 13:55	Love Canal EDA 2+3 Core 65	Soil
	413 103rd St.	12-5-89 14:01	Love Canal EDA 2+3 Core 48	Soil
	413 103rd St.	12-5-89 14:08	Love Canal EDA 2+3 Core 73	Soil
	413 103rd St.	12-5-89 14:16	Love Canal EDA 2+3 Core 79	Soil
	413 103rd St.	12-5-89 14:25	Love Canal EDA 2+3 Core 37	Soil
	413 103rd St.	12-5-89 14:36	Love Canal EDA 2+3 Core 28	Soil
	Lot B N. of 423	12-5-89 14:56	Love Canal EDA 2+3 Core 11	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

DURING TRANSPORT OF THE SAMPLE FROM SAMPLING SITE TO LABORATORY, THE CHAIN OF CUSTODY MUST BE UNBROKEN. GENERALLY THIS WILL REQUIRE THAT THE SAMPLE BE DELIVERED BY THE SAMPLE COLLECTOR OR HIS DESIGNATED REPRESENTATIVE WHO WILL SIGN FOR THE RECEIPT, INTEGRITY AND TRANSFER OF THE SAMPLE DURING SHIPMENT. IF INTEGRITY OF SAMPLE IS QUESTIONED, DESCRIBE PROBLEM ON REVERSE SIDE OF THIS FORM.

CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12-5-89	16:35
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by				

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
ALBANY, N.Y. 12201

CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
	Lot B N. of 423	12-5-89 15:07	Love Canal EDA 2+3 Core 75	Soil
			Total Shipments 17 cores	

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

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CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12-5-89	16:35
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by				

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1 cooler

NEW YORK STATE DEPARTMENT OF HEALTH
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CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895257 895258 895259	796 102nd St.	12-6-89 11:37	Love Canal EDA 2+3 Core 30	Soil
895260 895261 895262	736 102nd St.	12-6-89 11:45	Love Canal EDA 2+3 Core 21	Soil
895263 895264 895265	Lot G S. of 775	12-6-89 11:52	Love Canal EDA 2+3 Core 38	Soil
895266 895267 895268	Lot G S. of 775	12-6-89 11:59	Love Canal EDA 2+3 Core 58	Soil
895269 895270 895271	Lot DD 102nd St.	12-6-89 12:23	Love Canal EDA 2+3 Core 43	Soil
895272 895273 895274	619 102nd St.	12-6-89 12:36	Love Canal EDA 2+3 Core 64	Soil
895275 895276 895277	Lot N S. of 593	12-6-89 12:44	Love Canal EDA 2+3 Core 78	Soil
895278 895279 895280	521 102nd St.	12-6-89 12:50	Love Canal EDA 2+3 Core 52	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

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CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. Kirstetter	NYSDOH	12-6-89	17:10
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by	[illegible]	NYS DOH	12/7/89	1340

1 cooler

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NEW YORK STATE DEPARTMENT OF HEALTH
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CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895281 895283 895282	481 102nd St.	12-6-89 12:56	Love Canal EDA 2+3 Core 72	Soil
895284 895286 895285	433 102nd St.	12-6-89 13:04	Love Canal EDA 2+3 Core 46	Soil
895287 895289 895288	433 102nd St.	12-6-89 13:11	Love Canal EDA 2+3 Core 20	Soil
895290 895292 895291	Lot C S. of 432	12-6-89 13:17	Love Canal EDA 2+3 Core 36	Soil
895293 895295 895294	Lot C S. of 432	12-6-89 13:23	Love Canal EDA 2+3 Core 41	Soil
895296 895298 895297	10114 Frontier	12-6-89 13:30	Love Canal EDA 2+3 Core 15	Soil
895299 895301 895300	Lot H N. of 432	12-6-89 13:43	Love Canal EDA 2+3 Core 70	Soil
895302 895304 895303	465 103rd St	12-6-89 13:50	Love Canal EDA 2+3 Core 53	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

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CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12-6-89	17:10
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by	[illegible]	NYSDOH	12/7/89	1340

1 cooler

NEW YORK STATE DEPARTMENT OF HEALTH
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CHAIN OF CUSTODY RECORD

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SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895305 895306 895307	465 103rd St.	12-6-89 13:57	Love Canal EDA 2+3 Core 56	Soil
895308 895309 895310	465 103rd St.	12-6-89 14:07	Love Canal EDA 2+3 Core 51	Soil
895311 895312 895313	483 103rd St.	12-6-89 14:19	Love Canal EDA 2+3 Core 63	Soil
895314 895315 895316	512 102nd St.	12-6-89 14:56	Love Canal EDA 2+3 Core 59	Soil
895317 895318 895319	490 101st St	12-6-89 15:17	Love Canal EDA 2+3 Core 29	Soil
895320 895321 895322	493 101st St.	12-6-89 15:25	Love Canal EDA 2+3 Core 66	Soil
895323 895324 895325	434 101st St.	12-6-89 15:53	Love Canal EDA 2+3 Core 13	Soil
895326 895327 895328	423 100th St.	12-6-89 16:01	Love Canal EDA 2+3 Core 62	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

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CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12-6-89	17:10
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by		NYSDOH	12/7/89	1340

One cooler

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CHAIN OF CUSTODY RECORD

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SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895347 895349 895348	427 100th St.	12-7-89 8:57	Love Canal EDA 2+3 Core 99	Soil
895350 895352 895351	787 100th St.	12-7-89 10:57	Love Canal EDA 2+3 Core 50	Soil
895353 895355 895354	789 101st St.	12-7-89 11:05	Love Canal EDA 2+3 Core 22	Soil
895356 895358 895357	789 101st St.	12-7-89 11:10	Love Canal EDA 2+3 Core 32	Soil
895359 895361 895360	753 101st St.	12-7-89 11:18	Love Canal EDA 2+3 Core 98	Soil
895362 895364 895363	Lot K N. of 735	12-7-89 11:34	Love Canal EDA 2+3 Core 18	Soil
895365 895367 895366	710 101st St.	12-7-89 11:40	Love Canal EDA 2+3 Core 67	Soil
895368 895370 895369	702 101st St.	12-7-89 11:50	Love Canal EDA 2+3 Core 47	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

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CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12-7-89	17:15
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by	[illegible]	NYS DOH	12/8/89	1145

One cooler

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CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895371 895373 895372	702 101st St.	12-7-89 11:56	Love Canal EDA 2+3 Core 74	Soil
895374 895376 895375	697 101st St.	12-7-89 12:01	Love Canal EDA 2+3 Core 39	Soil
895377 895379 895378	685 101st St.	12-7-89 12:07	Love Canal EDA 2+3 Core 24	Soil
895380 895382 895381	Lot E 100th St.	12-7-89 12:13	Love Canal EDA 2+3 Core 71	Soil
895383 895385 895384	668 101st St.	12-7-89 12:20	Love Canal EDA 2+3 Core 34	Soil
895386 895388 895387	669 100th St.	12-7-89 12:27	Love Canal EDA 2+3 Core 76	Soil
895389 895391 895390	657 100th St.	12-7-89 12:42	Love Canal EDA 2+3 Core 14	Soil
895392 895394 895393	646 101st St.	12-7-89 13:12	Love Canal EDA 2+3 Core 33	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

DURING TRANSPORT OF THE SAMPLE FROM SAMPLING SITE TO LABORATORY, THE CHAIN OF CUSTODY MUST BE UNBROKEN. GENERALLY THIS WILL REQUIRE THAT THE SAMPLE BE DELIVERED BY THE SAMPLE COLLECTOR OR HIS DESIGNATED REPRESENTATIVE WHO WILL SIGN FOR THE RECEIPT, INTEGRITY AND TRANSFER OF THE SAMPLE DURING SHIPMENT. IF INTEGRITY OF SAMPLE IS QUESTIONED, DESCRIBE PROBLEM ON REVERSE SIDE OF THIS FORM.

CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12/7/89	17:15
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by	[illegible]	NYS DOH	12/8/89	1145

One cooler

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
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CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895401, 895402, 895403	Lot H S. of 639	12-8-89 9:06	Love Canal EDA 2+3 Core 31	Soil
895404, 895405, 895406	621 101st St.	12-8-89 9:20	Love Canal EDA 2+3 Core 60	Soil
895407, 895408, 895409	512 102nd St.	12-8-89 9:45	Love Canal EDA 2+3 Core 59 - Resample	Soil
895410, 895411, 895412	465 103rd St.	12-8-89 10:00	Love Canal EDA 2+3 Core 56 - Resample	Soil
895413, 895414, 895415	465 103rd St.	12-8-89 10:07	Love Canal EDA 2+3 Core 84	Soil
895416, 895417, 895418	510 102nd St.	12-8-89 10:14	Love Canal EDA 2+3 Core 80	Soil
895419, 895420, 895421	542 102nd St.	12-8-89 10:25	Love Canal EDA 2+3 Core 83	Soil
895422, 895423, 895424	510 101st St.	12-8-89 10:36	Love Canal EDA 2+3 Core 88	Soil

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

DURING TRANSPORT OF THE SAMPLE FROM SAMPLING SITE TO LABORATORY, THE CHAIN OF CUSTODY MUST BE UNBROKEN. GENERALLY THIS WILL REQUIRE THAT THE SAMPLE BE DELIVERED BY THE SAMPLE COLLECTOR OR HIS DESIGNATED REPRESENTATIVE WHO WILL SIGN FOR THE RECEIPT, INTEGRITY AND TRANSFER OF THE SAMPLE DURING SHIPMENT. IF INTEGRITY OF SAMPLE IS QUESTIONED, DESCRIBE PROBLEM ON REVERSE SIDE OF THIS FORM.

CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark S. VanValkenburg	NYSDOH	12-8-89	14:50
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by	[illegible]	NYS DOH	12/9/89	1115

One cooler

page 3.

NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
ALBANY, N.Y. 12201

CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895395 895397 895396	602 101st St.	12-7-89 13:20	Love Canal EDA 2+3 Core 49	Soil
895398 895400 895399	645 100th St.	12-7-89 14:00	Love Canal EDA 2+3 Core 57	Soil
			Total Shipment: 18 cores	

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

DURING TRANSPORT OF THE SAMPLE FROM SAMPLING SITE TO LABORATORY, THE CHAIN OF CUSTODY MUST BE UNBROKEN. GENERALLY THIS WILL REQUIRE THAT THE SAMPLE BE DELIVERED BY THE SAMPLE COLLECTOR OF HIS DESIGNATED REPRESENTATIVE WHO WILL SIGN FOR THE RECEIPT, INTEGRITY AND TRANSFER OF THE SAMPLE DURING SHIPMENT. IF INTEGRITY OF SAMPLE IS QUESTIONED, DESCRIBE PROBLEM ON REVERSE SIDE OF THIS FORM.

CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12/7/89	17:15
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by	[illegible]	NYS DOH	12/8/89	11:45

the cooler

page 2 of 2

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NEW YORK STATE DEPARTMENT OF HEALTH
WADSWORTH CENTER FOR LABORATORIES AND RESEARCH
ALBANY, N.Y. 12201

CHAIN OF CUSTODY RECORD

Must be completed for samples which might be used for enforcement proceedings or litigation.

SAMPLE ID (LAB USE ONLY)	FIELD REFERENCE NO.	DATE/TIME COLLECTED	SAMPLE COLLECTION POINT	TYPE: WATER, AIR SOIL, ETC.
895425 895426 895427	454 101st St.	12-8-89 10:47	Love Canal EDA 2+3 Core 85	Soil
895428 895429 895430	641 100th St.	12-8-89 10:56	Love Canal EDA 2+3 Core 84	Soil
895431 895432 895433	Lot G S. of 715	12-8-89 11:10	Love Canal EDA 2+3 Core 81	Soil
895434 895435 895436	679 102nd St.	12-8-89 11:16	Love Canal EDA 2+3 Core 82	Soil
895437 895438 895439	639 102nd St.	12-8-89 11:31	Love Canal EDA 2+3 Core 83	Soil
			Total Shipment: 13 cores	

SPECIFY METHOD OF PRESERVATION

- ☐ NaOH
- ☒ Cool, 4°C
- ☐ Acidification (specify)
- ☐ Other (specify

TRANSPORTING SAMPLES

DURING TRANSPORT OF THE SAMPLE FROM SAMPLING SITE TO LABORATORY, THE CHAIN OF CUSTODY MUST BE UNBROKEN. GENERALLY THIS WILL REQUIRE THAT THE SAMPLE BE DELIVERED BY THE SAMPLE COLLECTOR OR HIS DESIGNATED REPRESENTATIVE WHO WILL SIGN FOR THE RECEIPT, INTEGRITY AND TRANSFER OF THE SAMPLE DURING SHIPMENT. IF INTEGRITY OF SAMPLE IS QUESTIONED, DESCRIBE PROBLEM ON REVERSE SIDE OF THIS FORM.

CUSTODY OF SAMPLES

	NAME	AFFILIATION	DATE	TIME
1. Sample Container Prepared by				
2. Received by				
3. Received by				
4. Sample Collected by	Mark E. VanValkenburg	NYSDOH	12-8-89	14:50
5. Sample Received by				
6. Sample Received by				
7. Sample Received by				
8. Sample Received by				
9. Sample Received by				
10. Sample Rec'd Lab by				
11. Sample Accessioned by		NYS DOH	12/9/89	1115

Appendix B. Analytical Protocol

New York State Department of Health
Center for Laboratories and Research
Albany, N.Y. 12201

MODIFIED NIELSON-KRYGER STEAM DISTILLATION OF SOILS APPLIED TO LOVE CANAL SOIL CORES

1. Scope and Application

1.1 This method was applied to the determination of semi-volatile compounds in soil cores collected at the Love Canal Site during December 1989.

1.2 The procedure was utilized for analysis of these soil samples for the following compounds using GC/Mass Selective Detector in selected ion monitoring mode:

1,2-dichlorobenzene
1,2,4-trichlorobenzene
1,2,3,4-tetrachlorobenzene
alpha HCCH
beta HCCH
gamma HCCH
delta HCCH
hexachlorobenzene

1.3 Other compounds may be determined by this procedure following documented method development with appropriate recoveries.

2. Summary of Method

2.1 A 50 gram sample of soil is slurred with organic-free water and acidified and "distilled" into hexane using a modified Nielson-Kryger steam distillation apparatus. The extract is treated for sulfur removal and, in most cases, is suitable for gas chromatographic analysis without any further clean-up. The extract is concentrated using Kuderna-Danish apparatus.

3. Interferences

3.1 The modified steam distillation technique used generally provides a significantly "cleaner" extract than some of the more classical techniques such as Soxhlet reflux. The technique is not totally interference-free and the several sample matrices may present a variety of problems of which the analyst must be aware.

4. Apparatus and Materials

4.1 Modified Nielsen-Kryger Condenser with Teflon stopcock and 24/40 glass joint (Ace Glass Co. #6555-13)

4.2 Teflon sleeves for 24/40 joint

4.3 Ring Stand, Clamps and Rubber Tubing
4.4 Round bottom boiling flask with 24/40 glass joint - 2 liter
4.5 Hemispherical heating mantle - 2 liter
4.6 Variable transformer
4.7 Heat resistant magnetic stir plates and magnetic stirring bars
4.8 Pasteur pipets
4.9 Erlenmeyer flasks - 125 ml with 24/40 ground glass joint and ground glass stoppers
4.10 Kuderna-Danish apparatus (K-D)
4.10.1 Evaporative flasks, 125 ml
4.10.2 Snyder columns, six ball or three ball
4.10.3 Distillation receiver, 12 ml graduated
4.10.4 Boiling bumpers
4.10.5 Vigreaux distilling columns
4.11 Gas chromatograph - analytical system complete with gas chromatograph capable of on-column injection, with splitless injection mode, Mass Selective Detector (MSD), and all required accessories including column supplies, gases, etc.
4.11.1 Column: 50 meter Hewlett Packard Ultra-2 capillary, 0.2 mm diameter, 0.25 μm film thickness (or equivalent).

5. Reagents

5.1 Hexane - nanograde or equivalent
5.2 Acetone - nanograde or equivalent
5.3 Organic-free water: free of analytes of interest by gas chromatography/MSD
5.4 Anhydrous Sodium Sulfate - cleaned in a muffle furnace for 2 hrs at 425°C. Store in a clean reagent bottle.
5.5 Elemental Mercury - triple distilled
5.6 Sulfuric Acid, 50%
5.7 Spiking Solution (Method Spike) - Prepare spiking solution(s) of compound(s) of interest such that a convenient spiking volume (i.e. 100 μl) will yield expected concentrations of analytes in actual samples.
5.8 Internal Standard Spiking Solution - Prepare a spiking solution containing ^{13}C-Labelled analogs of the target analytes such that a convenient spiking volume (i.e. 100μl) will yield measurable signals by GC/MSD analysis.

6. Quality Control Procedures

6.1 One organic-free water blank and one method spike of organic-free water is analyzed with each batch of samples. The spike must contain compounds representative

of those being analyzed but need not contain all of the compounds of interest.

6.2 Internal standard spike compounds are added to each sample, method spike and the blank.

6.3 All glassware must be washed with detergent, rinsed with copious amounts of organic-free water and oven dried. To insure that glassware is clean, rinse glassware with nanograde hexane, combine the rinse solvent, concentrate by K-D evaporation and check a portion by gas chromatography. Rinse glassware again with nanograde hexane just prior to use. Magnetic stirring bars should be boiled overnight in concentrated nitric acid for effective cleaning and rinsed with copious amounts of organic-free water.

7. Sample Handling and Preservation

7.1 Samples are submitted as cores in sealed PETG copolymer core liner tubes which had been refrigerated during transit from the site to the laboratory.

8. Procedure

8.1 Distillation and Solvent Extraction

8.1.1 Set up steam distillation apparatus as shown in Figure 1.

8.1.2 Prepare samples as follows:

8.1.2.1 For solid samples, place 50 grams of sample in a 2 liter boiling flask, add 800 ml or organic-free water and a stir bar. Add spiking solution(s). Cautiously add 20 ml 50% H_2SO_4. The pH must be <1. Check with pH paper and record.

8.1.2.2 For liquid samples or slurries, measure 800 ml of sample and add to a 2 liter boiling flask together with a stir bar. Add spiking solution(s). Cautiously add 20 ml 50% H_2SO_4. Check with pH paper and record. The pH must be <1.

8.1.3 Add Internal Spiking solution to all samples including method spike and blank. Add Spiking Solution to Method Spike.

8.1.4 Place boiling flasks in heating mantlers positioned directly below the condensers. Mantlers are placed on top of heat resistant magnetic stir plates. Connect condensers to boiling flasks.

8.1.5 Add 5 ml organic-free water and 15 ml of nanograde hexane to condenser by decanting hexane along inside wall of condenser.

8.1.6 Turn on magnetic stirrers for all samples. Turn on cooling water to condensers. Turn on heating mantles and adjust variable transformer for a rolling boil. If more than one set-up, adjust transformers to that samples begin boiling at same time.

8.1.7 Boil for 1 hour. Allow 15-20 minutes for boil to begin. At the conclusion of the extraction, check pH of the acidified aqueous sample. If the pH is higher than 2, add additional 50% H_2SO_4, redistill and sample to yield a second hexane extract. In this case, both extracts are analyzed and the final concentrations of both extracts are added together.

8.1.8 Drain off water layer and discard.

8.1.9 Collect extracted hexane distillate (from solvent withdrawal tube) in receiving flask (125 ml Erlenmeyer).

8.1.10 Rinse condenser with 50 ml of hexane and add to receiving flask.

8.2 Sample Clean-up

8.2.1 Remove aqueous layer with Pasteur pipet and discard.

8.2.2 Add anhydrous sodium sulfate (previously cleaned) until Na_2SO_4 is free flowing in hexane extract.

8.2.3 Quantitatively transfer sample (rinse 3 times with small amount of hexane) to a K-D apparatus and concentrate to 2.0 ml.

8.2.4 Add a few drops (approximately 0.5 ml) of elemental mercury (triple distilled) to the 10 ml glass stoppered K-D ampul. Shake for 30 minutes using mechanical shaker, medium setting. Let settle.

8.2.5 If precipitate does not settle out, filter the extract through glass wool in a Pasteur pipet which has previously been rinsed with hexane. Concentrate by K-D technique to 1.0 ml.

8.2.6 Transfer the clean extract to a vial and close using a cap with septum. Label the vial and analyze by gas chromatography/mass selective detection in selected ion mode.

9. Recommended Gas Chromatography Conditions

Oven Temperature Profile:
Initial Value = 80°C
Initial Time = 2.00 min
Level 1
PRGM Rate = 5.00°C/min
Final Value = 180°C
Final Time = 5.00 min
Level 2
PRGM Rate = 5.00°C/min
Final Value = 295°C
Final Time = 0.10 min

Transfer Line Temperature = 280°C

Injector Temperature = 250°C

10. References

10.1 Nielson, T.K. and Kryger, S., Dansk Tidsskr. Farm. 43, 39 (1969).

10.2 Veith, G.D. and Kiwus, L.M., An Exhaustive Steam-Distillation and Solvent-Extraction Unit for Pesticides and Industrial Chemicals, Bull. of Environ. Contam. and Toxicol. 17, 6 (1977).

10.3 Narang, A.S., Vernoy, C.A. and Eadon, G.A. Evaluation of Nielsen-Kryger Steam Distillation Technique for Recovery of Phenols from Soil, J. Assoc. Off. Analyt. Chem. 66, 6 (1983).

IMPLEMENTED: September 1982, Revised March 1984, Love Canal Soils 1989.
Revised from HANDBK49 (312-5)

Appendix C. Individual Sample Results

The location of each core is depicted in Figures 2 and 3 (pp. 6-7).

Love Canal EDA 2-3 Soil Remediation Study

Core #	Depth (inches)	Chlorobenzenes				Hexachlorocyclohexanes			
		DCB	TCB	TeCB	HxCB	α-HCCH	β-HCCH	γ-HCCH	δ-HCCH
11	0-3″	2	9.5	6.8	4.4	6.3	1.2	0.5	<0.6
	3-6″	1.7	9.5	6.6	6.8	14	2.2	0.9	<0.6
	6-12″	0.6	5	3.3	3.6	4.8	1.1	0.4	<0.5
12	0-3″	2.1	4.8	3.9	19	<1.3	<2	<1.8	<2.7
	3-6″	0.7	1.2	1.1	27	<1.4	<2.1	<1.9	<2.9
	6-12″	<0.7	<0.6	<0.6	4.8	<1.2	<1.8	<1.6	<2.5
13	0-3″	<0.7	0.9	0.7	0.4	<0.4	<0.8	<0.6	<0.7
	3-6″	3.1	13	13	8.1	1.7	0.7	0.6	<0.7
	6-12″	1.4	4.3	4.5	4.5	0.6	<0.7	<0.5	<0.7
14	0-3″	<2.4	<1.3	<0.9	<0.3	<0.9	<1.6	<1.3	<1.7
	3-6″	1.2	4.5	3.7	2.2	1.5	<1.3	<1.1	<1.4
	6-12″	2.6	9.2	6.9	5.3	2.3	1.7	0.5	<1.1
15	0-3″	2.7	13	13	8.8	3.7	1.6	0.8	<0.9
	3-6″	2	7.5	7.9	15	3.6	1.6	1.1	<1
	6-12″	0.7	3.2	3.1	4.6	0.8	<0.9	<0.7	<0.9
16	0-3″	<2.4	5.5	7.9	4.1	1.9	<3.5	<3	<3.5
	3-6″	3.3	8.8	26	4.9	1.7	<3.2	<2.7	<3.2
	6-12″	3.4	11	9.9	4.2	1.5	<2.6	<2.2	<2.6
17	0-3″	2.4	9	11	5.7	3.1	1.5	<0.8	<0.9
	3-6″	2.2	8.5	13	5.8	3.4	1.6	<0.8	<1
	6-12″	2.8	8.7	9.6	12	1.5	<0.8	<0.5	<0.6
18	0-3″	2.6	9.1	9.6	2.7	3.4	<1.6	2.1	<1.7
	3-6″	0.9	4.7	9.7	1.3	2	<1.1	<1	<1.2
	6-12″	<0.8	0.7	3.5	0.3	<0.8	<1	<0.9	<1.1
19	0-3″	1.7	9.2	11	7.4	<1.1	<1.8	<1.5	<1.9
	3-6″	3.8	12	13	6.8	<1.5	<2.4	<2	<2.5
	6-12″	<1.1	0.6	0.6	0.8	<1.2	<1.9	<1.6	<2
20	0-3″	1.5	8.2	7.6	4.5	1.5	<1.3	<1.1	<1.3
	3-6″	1.7	7.3	6.4	6.3	1	<0.8	<0.7	<0.9
	6-12″	1.3	1.5	1.5	6.1	0.4	<0.8	<0.7	<0.8
21	0-3″	13	34	22	31	42	160	20	11
	3-6″	13	120	79	42	150	38	9.1	3.6
	6-12″	1.3	4.3	2.8	3	9.1	480	5.7	1.1
22	0-3″	1.2	6.5	4.3	2.9	2.8	2.9	2.2	<1.7
	3-6″	1.1	5.4	3.4	3.5	1.5	1.4	<1.1	<1.3
	6-12″	1.7	6.7	3.5	5.3	3.8	4.1	1.5	<1.2

Values are concentrations in nanograms chemical per gram of soil or parts per billion (ppb).

Legend

DCB	1,2,dichlorobenzene	α-HCCH	alpha hexachlorocyclohexane
TCB	1,2,4-trichlorobenzene	β-HCCH	beta hexachlorocyclohexane
TeCB	1,2,3,4-tetrachlorobenzene	γ-HCCH	gamma hexachlorocyclohexane
HxCB	hexachlorobenzene	δ-HCCH	delta hexachlorocyclohexane

Core #	Depth (inches)	Chlorobenzenes				Hexachlorocyclohexanes			
		DCB	TCB	TeCB	HxCB	α-HCCH	β-HCCH	γ-HCCH	δ-HCCH
23	0-3″	5.2	16	17	9.2	3.6	<3.6	<2.6	<3
	3-6″	2.7	8.2	8.9	11	<2.1	<3.9	<2.8	<3.2
	6-12″	<0.6	0.5	0.3	1.2	<0.7	<1.2	<0.9	<1
24	0-3″	3.9	12	9.6	1.9	3	1.5	<1.4	<1.6
	3-6″	5.9	23	11	1.8	3.6	2.4	1.1	<1.4
	6-12″	1.5	6.2	3.5	1	1.9	<1.2	<0.9	<1.1
25	0-3″	2.5	16	20	3.4	2.7	<2.7	<2.2	<2.8
	3-6″	<1.3	13	19	3.3	1.3	<1.9	<1.6	<2
	6-12″	<0.6	0.6	0.9	0.6	<1	<1.7	<1.4	<1.7
26	0-3″	<2.2	1.7	2.2	1.1	<1.9	<3	<2.5	<2.9
	3-6″	<0.6	0.4	0.8	0.7	<1.6	<2.5	<2.1	<2.4
	6-12″	<2	<1.1	0.5	0.5	<1.2	<2	<1.7	<2
27	0-3″	2	7.8	7.3	3.3	<0.5	<0.7	<0.6	<0.8
	3-6″	2	8.9	9	6.5	1.9	0.6	0.5	<0.6
	6-12″	2.7	11	11	8.6	1.2	<0.6	<0.5	<0.6
28	0-3″	2	7.1	8.3	5.6	2.8	1.5	0.8	<1
	3-6″	1.7	6.5	7.2	7.7	2.2	<1	<0.9	<1.2
	6-12″	<0.5	0.6	0.5	0.9	<0.5	<0.6	<0.6	<0.7
29	0-3″	1	3.3	2.8	1.9	<0.9	<1.3	<1.1	<1.3
	3-6″	1.2	2.9	2.5	3	0.8	<1	1.1	<1.1
	6-12″	1.2	2.2	1.8	2.8	<0.6	<0.8	<0.7	<0.9
30	0-3″	44	510	140	380	2900	670	150	53
	3-6″	2.7	7.6	5.1	7	0.8	<0.7	<0.5	<0.6
	6-12″	0.3	1.1	0.9	1.3	<0.5	<0.7	<0.6	<0.7
31	0-3″	3.8	17	13	8.3	10	15	<1.8	<2
	3-6″	0.9	3.8	5.2	2.7	<1.3	<1.7	<1.5	<1.7
	6-12″	<0.9	0.5	0.6	0.6	<1.1	<1.5	<1.3	<1.4
32	0-3″	0.8	3	2.1	1.8	<1.3	<1.5	<1.5	<1.8
	3-6″	1	3.1	2.1	2.8	<0.9	<1.1	<1.1	<1.3
	6-12″	0.5	1.6	1.1	3.1	<0.7	<0.8	<0.8	<1
33	0-3″	1.1	5	5.8	1.7	0.9	<1.4	<1.1	<1.5
	3-6″	1.1	4.8	6.2	2.1	1.1	<1.1	0.4	<1.2
	6-12″	0.8	3.8	4.6	2	0.8	<1	<0.8	<1.1
34	0-3″	0.3	2.1	3	1.1	<1	<1.6	<1.2	<1.5
	3-6″	1	4.1	4.5	1.9	1	<1.2	<0.9	<1.1
	6-12″	<1.6	1.5	2	1.6	<1.4	<2.2	<1.7	<2

Values are concentrations in nanograms chemical per gram of soil or parts per billion (ppb).

Legend

DCB	1,2,dichlorobenzene	α-HCCH	alpha hexachlorocyclohexane
TCB	1,2,4-trichlorobenzene	β-HCCH	beta hexachlorocyclohexane
TeCB	1,2,3,4-tetrachlorobenzene	γ-HCCH	gamma hexachlorocyclohexane
HxCB	hexachlorobenzene	δ-HCCH	delta hexachlorocyclohexane

Core #	Depth (inches)	Chlorobenzenes				Hexachlorocyclohexanes			
		DCB	TCB	TeCB	HxCB	α-HCCH	β-HCCH	γ-HCCH	δ-HCCH
35	0-3″	7.4	45	13	6.2	5.1	4	<1	<1.2
	3-6″	4.3	20	8.7	5.2	3.8	4.1	<0.9	<1
	6-12″	56	530	110	65	310	810	35	3.2
36	0-3″	4.3	21	17	19	4.4	1.3	1	<1.3
	3-6″	2.8	11	11	28	2.6	0.7	<0.8	<1
	6-12″	<0.3	1.7	1.1	3.2	<0.6	<0.9	<0.7	<0.9
37	0-3″	1.6	5.2	6.9	3.1	1.8	<0.8	<0.8	<1
	3-6″	1.1	5.3	5.3	3.8	1.8	<0.6	<0.6	<0.8
	6-12″	<0.8	1.4	1.6	1.5	0.6	<0.8	<0.7	<0.9
38	0-3″	<0.3	2.4	2.9	2	0.6	<0.8	<0.6	<0.8
	3-6″	<1.2	1.4	2.3	1.7	<0.7	<1	<0.8	<0.9
	6-12″	<0.3	<0.3	<0.2	0.2	<0.5	<0.7	<0.6	<0.7
39	0-3″	0.5	4.4	3.7	2.8	<1.1	<1.8	<1.3	<1.6
	3-6″	<1.3	1.5	0.8	1.2	<1	<1.6	<1.2	<1.5
	6-12″	<1.2	2.7	1.5	1.3	<1.2	<1.8	<1.4	<1.7
40	0-3″	<2	2.5	2.4	1.3	<1.8	<2.7	<2.4	<3.8
	3-6″	<0.9	1.1	0.6	0.6	<1	<1.5	<1.3	<2.1
	6-12″	0.8	2.5	2.8	2.5	<1.4	<2.1	<1.9	<2.9
41	0-3″	2.4	12	14	6.5	2.6	1	1	<1
	3-6″	2.6	13	15	8.1	2.2	<1	0.7	<1
	6-12″	0.4	1.6	1.6	2	<0.6	<0.9	<0.8	<1
42	0-3″	2	14	19	3.3	1.6	<1.7	<1.2	<1.8
	3-6″	1.1	6.6	8.4	2.6	<0.7	<1.2	<0.9	<1.3
	6-12″	<0.3	0.3	0.4	0.3	<0.7	<1.2	<0.9	<1.3
43	0-3″	0.6	2.6	1.7	1.3	<0.6	<0.9	<0.8	<1
	3-6″	3.3	12	5.4	2.3	1	0.5	<0.6	<0.8
	6-12″	1.1	5.3	3.5	2.4	0.8	<0.8	<0.7	<0.9
44	0-3″	1	5.5	5.9	4.1	<1.5	<2.3	<2	<3.1
	3-6″	1.2	6.9	7.5	5.2	1.2	<2.1	<1.8	<2.9
	6-12″	0.5	3.2	26	4	<1	<1.5	<1.4	<2.2
45	0-3″	<0.7	1.2	1.6	0.4	<0.7	<1.1	<0.9	<1.2
	3-6″	<2.6	4	2.9	1	<1	<1.6	<1.4	<1.7
	6-12″	<1.6	0.7	1.3	0.4	<1.1	<1.8	<1.5	<1.9
46	0-3″	4.2	7.4	7.1	9.1	2.8	<0.9	<0.8	<0.9
	3-6″	3.5	6.8	6.9	11	2.7	1.1	1.2	<0.9
	6-12″	1.1	2.2	4.5	5.2	0.6	<0.8	<0.7	<0.9

Values are concentrations in nanograms chemical per gram of soil or parts per billion (ppb).

Legend

DCB	1,2,dichlorobenzene	α-HCCH	alpha hexachlorocyclohexane
TCB	1,2,4-trichlorobenzene	β-HCCH	beta hexachlorocyclohexane
TeCB	1,2,3,4-tetrachlorobenzene	γ-HCCH	gamma hexachlorocyclohexane
HxCB	hexachlorobenzene	δ-HCCH	delta hexachlorocyclohexane

Core #	Depth (inches)	Chlorobenzenes				Hexachlorocyclohexanes			
		DCB	TCB	TeCB	HxCB	α-HCCH	β-HCCH	γ-HCCH	δ-HCCH
47	0-3"	0.6	2.9	3	1.6	<1.4	<1.8	<1.6	<1.9
	3-6"	1.1	3.4	3.2	2	<0.8	<1	<0.9	<1
	6-12"	1.6	6.5	6.1	5.7	1.2	<1.1	<1.1	<1.2
48	0-3"	2.7	14	12	49	12	11	3.4	3.7
	3-6"	1.9	6.8	5	28	2.7	2.3	1.2	<1.3
	6-12"	0.5	1.7	0.8	2.4	0.3	<0.7	<0.6	<0.8
49	0-3"	1	6.2	9	0.8	<1.1	<1.8	<1.5	<2
	3-6"	0.7	3.8	6.5	1.3	0.6	<1.5	<1.2	<1.6
	6-12"	<0.5	1.2	1.5	0.5	<0.6	<1.1	<0.9	<1.1
50	0-3"	2.5	27	54	10	13	3.6	3.4	3.4
	3-6"	5.3	57	100	14	16	5.2	4.2	2.2
	6-12"	0.6	5.8	11	4.7	3.6	1.3	1	0.6
52	0-3"	1	4.9	5	2.7	0.9	<0.9	<0.8	<1
	3-6"	0.5	3.1	3.3	2.9	0.6	<1	<0.9	<1.1
	6-12"	<0.6	0.2	0.2	0.6	<0.8	<1.1	<1	<1.2
53	0-3"	0.6	3.5	3.3	2.4	1.4	<1.4	<1.1	<1.4
	3-6"	<6.7	4.8	6.2	3.4	1.3	<1.8	<1.5	<1.9
	6-12"	0.7	3.3	3.2	5.7	1.1	<1.2	<1	<1.2
54	0-3"	3.9	17	15	8.8	1.6	<1.7	<1.2	<1.8
	3-6"	2.9	9.9	11	9.3	0.8	<1.2	<0.9	<1.3
	6-12"	<0.4	0.7	0.4	1.2	<0.7	<1.2	<0.9	<1.3
55	0-3"	<1.9	2.6	2.8	3	<1	<1.6	<1.3	<1.6
	3-6"	<0.4	0.8	0.4	0.4	<0.9	<1.5	<1.3	<1.6
	6-12"	<0.4	0.8	0.4	<0.4	<1.3	<2.1	<1.7	<2.2
56	0-3"	<0.7	2.4	1.9	0.6	1.4	<2.1	<1.3	<1.7
	3-6"	<0.6	0.4	0.2	0.3	<1	<1.9	<1.2	<1.5
	6-12"	<0.7	<0.7	<0.5	<0.2	<0.9	<1.7	<1.1	<1.4
57	0-3"	1.1	7.7	15	2.3	<1.1	<1.5	<1.3	<1.5
	3-6"	3.7	35	32	2.5	<1.3	<1.7	<1.5	<1.6
	6-12"	4.2	49	80	4	<1.4	<1.8	<1.6	<1.8
58	0-3"	0.9	5.2	5.2	2.6	1	<1.2	<1	<1.3
	3-6"	1.7	6.6	6.9	4.8	<1.1	<1.6	<1.4	<1.8
	6-12"	<0.6	<0.4	<0.3	0.2	<0.7	<1	<0.9	<1.1
59	0-3"	1	5.6	3.9	1.5	4.2	1.5	1	<0.7
	3-6"	2.4	8.9	6.5	3	3.1	1.4	<1.1	<1.2
	6-12"	2.5	6	3.6	2.4	2.4	<1.2	<1	<1.1

Values are concentrations in nanograms chemical per gram of soil or parts per billion (ppb).

Legend

DCB	1,2,dichlorobenzene	α-HCCH	alpha hexachlorocyclohexane
TCB	1,2,4-trichlorobenzene	β-HCCH	beta hexachlorocyclohexane
TeCB	1,2,3,4-tetrachlorobenzene	γ-HCCH	gamma hexachlorocyclohexane
HxCB	hexachlorobenzene	δ-HCCH	delta hexachlorocyclohexane

Love Canal EDA 2-3 Soil Remediation Study

Core #	Depth (inches)	Chlorobenzenes				Hexachlorocyclohexanes			
		DCB	TCB	TeCB	HxCB	α-HCCH	β-HCCH	γ-HCCH	δ-HCCH
60	0-3"	0.9	4.1	3.3	4.9	0.6	<1.7	<1.5	<1.7
	3-6"	<1.2	2.1	2.1	1.6	<1.1	<1.5	<1.3	<1.5
	6-12"	<0.6	1.1	1.5	0.4	<0.9	<1.1	<1	<1.1
61	0-3"	2.8	9.5	10	4.1	4	<3.6	2.1	<3.5
	3-6"	4.9	10	11	5.5	2.4	<2.8	1.1	<2.7
	6-12"	1	4.4	2.8	4.9	<1.7	<2.6	<2.2	<2.6
62	0-3"	0.9	3.9	3.6	2.4	0.5	<0.9	<0.7	<0.9
	3-6"	0.6	3	2.7	2.3	<0.4	<0.7	<0.6	<0.7
	6-12"	0.3	1	0.7	1.1	<0.5	<0.8	<0.6	<0.8
63	0-3"	0.8	4.2	3.8	1.6	<0.8	<1.2	<1	<1.3
	3-6"	1	7.6	2.7	1.4	<0.9	<1.3	<1.1	<1.3
	6-12"	<0.7	1.2	0.7	0.7	<1	<1.5	<1.2	<1.6
64	0-3"	1.2	4.6	4.7	1.8	<0.7	<1	<0.9	<1.1
	3-6"	0.8	3.3	3.6	1.8	0.5	<0.8	<0.7	<0.9
	6-12"	<0.4	2.8	3.3	1.6	0.3	<0.7	<0.6	<0.8
65	0-3"	2.4	13	11	41	11	14	<1.1	1.8
	3-6"	2.6	9.4	8.5	31	4.8	5.1	<1.1	<1.3
	6-12"	1.4	3.2	2.1	6.1	<0.4	<0.6	<0.5	<0.7
66	0-3"	3.5	4.7	4.7	8.3	<0.4	<0.7	<0.5	<0.6
	3-6"	10	5.2	5.1	11	<0.4	<0.7	<0.5	<0.6
	6-12"	3.8	3.3	3.4	13	0.4	<0.6	<0.5	<0.6
67	0-3"	<1	0.5	0.7	0.4	<0.8	<0.9	<0.9	<1
	3-6"	2.4	12	13	5	<1	<1.2	<1.1	<1.3
	6-12"	0.7	2.3	2.2	1.7	<1.2	<1.4	<1.3	<1.5
68	0-3"	4	14	13	6.8	2.6	<1.6	2	<1.3
	3-6"	2.4	7.5	8	7.5	1.4	<0.9	1	<1
	6-12"	0.6	2.7	2.5	2.3	<0.5	<0.9	<0.7	<0.8
69	0-3"	3.8	15	10	4.8	2.3	<2.7	<2.3	<2.7
	3-6"	8.5	39	18	8.1	5.6	2	1.4	<2.1
	6-12"	2	9.6	4.9	3.4	1.6	<1.9	<1.6	<1.9
70	0-3"	1.7	7	8	4.5	1.4	<0.7	<0.6	<0.8
	3-6"	1.4	6.8	6.6	5.4	1.7	<0.7	0.6	<0.7
	6-12"	0.9	5.5	6.2	4.7	1	<1	<0.8	<1
71	0-3"	1.4	5.5	5.9	23	<1.3	<2.1	<1.6	<1.9
	3-6"	0.9	4.5	4.9	47	<0.9	<1.5	<1.1	<1.3
	6-12"	1	2.4	2.3	42	<0.9	<1.4	<1.1	<1.3

Values are concentrations in nanograms chemical per gram of soil or parts per billion (ppb).

Legend

DCB	1,2,dichlorobenzene	α-HCCH	alpha hexachlorocyclohexane
TCB	1,2,4-trichlorobenzene	β-HCCH	beta hexachlorocyclohexane
TeCB	1,2,3,4-tetrachlorobenzene	γ-HCCH	gamma hexachlorocyclohexane
HxCB	hexachlorobenzene	δ-HCCH	delta hexachlorocyclohexane

Core #	Depth (inches)	Chlorobenzenes				Hexachlorocyclohexanes			
		DCB	TCB	TeCB	HxCB	α-HCCH	β-HCCH	γ-HCCH	δ-HCCH
72	0-3″	1.5	3.9	3.8	2.4	<0.9	<1.3	<1.1	<1.3
	3-6″	1.4	2.4	1.9	1.7	<1	<1.5	<1.3	<1.5
	6-12″	1.3	15	6.3	3	<1.3	<1.9	<1.7	<2
73	0-3″	2.4	11	9.9	22	5.1	2.6	1	<0.8
	3-6″	0.8	2	1.7	2.6	<0.5	<0.7	<0.6	<0.8
	6-12″	<0.9	<0.6	<0.5	0.2	<1	<1.4	<1.2	<1.4
74	0-3″	1.1	5	4.5	1.3	0.9	<1	<0.9	<1.1
	3-6″	0.3	1	1	0.9	<1	<1.2	<1.1	<1.2
	6-12″	<0.5	1	0.6	1.3	<0.9	<1.2	<1.1	<1.2
75	0-3″	29	180	40	70	300	32	22	<1.8
	3-6″	32	180	42	69	270	34	21	5.9
	6-12″	11	38	20	28	56	560	26	5.8
76	0-3″	1.7	8.1	10	1.7	0.7	<1.7	<1.4	<1.9
	3-6″	0.5	3.4	3.5	1.3	<0.8	<1.3	<1.1	<1.4
	6-12″	<0.8	0.6	0.9	0.4	<0.9	<1.4	<1.2	<1.6
77	0-3″	2.4	3.5	2.8	7.3	<1.3	<2	<1.8	<2.8
	3-6″	1.3	4.1	29	16	<1	<1.6	<1.4	<2.2
	6-12″	0.6	1.3	1.1	5	<1.3	<2	<1.7	<2.7
78	0-3″	2.3	8.6	8.7	3.7	1.4	<1	1.4	<1.1
	3-6″	1.6	5.2	5.1	3.6	1.1	<0.9	<0.8	<1
	6-12″	<0.4	0.9	0.9	1.2	<0.6	<0.9	<0.8	<1
79	0-3″	1	4.1	4.6	4.1	1.7	<0.8	<0.7	<0.9
	3-6″	0.6	3.4	3.8	5	1.5	<0.4	<0.6	<0.8
	6-12″	<0.6	<0.5	0.5	0.5	<0.5	<0.7	<0.6	<0.8
80	0-3″	2.4	6	6	5.5	<1	<1.8	<1.1	<1.4
	3-6″	1.9	2.2	2.3	10	<1.1	<2.2	<1.3	<1.7
	6-12″	<0.8	0.3	0.4	1	<1	<2	<1.2	<1.6
81	0-3″	1	4.2	4.7	1.5	<1.8	<2.7	<2.2	<2.8
	3-6″	<1.2	2.3	2.4	0.9	<1.1	<1.7	<1.4	<1.7
	6-12″	1.1	3.2	3.1	1.2	<1	<1.6	<1.3	<1.7
82	0-3″	<0.7	1.5	1	0.5	<1.3	<1.8	<1.5	<1.6
	3-6″	<0.7	1	0.7	0.4	<0.9	<1.3	<1.1	<1.2
	6-12″	<0.8	0.4	0.3	0.3	<0.8	<1.1	<1	<1
83	0-3″	1.6	4	2.8	1.1	<1.2	<2.2	<1.4	<1.7
	3-6″	<1.3	1	1.3	0.8	<1.2	<2.3	<1.4	<1.8
	6-12″	0.8	2.5	1.6	1.4	1	<2	<1.3	<1.6

Values are concentrations in nanograms chemical per gram of soil or parts per billion (ppb).

Legend

DCB	1,2,dichlorobenzene	α-HCCH	alpha hexachlorocyclohexane
TCB	1,2,4-trichlorobenzene	β-HCCH	beta hexachlorocyclohexane
TeCB	1,2,3,4-tetrachlorobenzene	γ-HCCH	gamma hexachlorocyclohexane
HxCB	hexachlorobenzene	δ-HCCH	delta hexachlorocyclohexane

Love Canal EDA 2-3 Soil Remediation Study

Core #	Depth (Inches)	----------Chlorobenzenes---------- DCB	TCB	TeCB	HxCB	-------Hexachlorocyclohexanes------- α-HCCH	β-HCCH	γ-HCCH	δ-HCCH
84	0-3″	<2.3	2.9	3.1	0.6	<1.3	<2	<1.6	<2
	3-6″	<1.7	3.4	3.2	0.7	<0.9	<1.4	<1.2	<1.5
	6-12″	0.5	4.1	5.3	1.7	0.7	<1.4	<1.2	<1.5
85	0-3″	1.9	5.8	6.5	3.6	1.5	<1.6	<1.3	<1.6
	3-6″	2	8.3	9.6	9.6	3.2	2.3	<2.4	<3
	6-12″	1.8	5.8	7	7.3	1.1	<1.4	<1.2	<1.5
86	0-3″	2	7.2	7.9	2.7	1.2	<1.6	<1	<1.2
	3-6″	2.3	6.8	8.3	3.5	1.4	1.4	0.7	<1.6
	6-12″	2.8	4.5	2.2	3	<0.9	<1.7	<1	<1.3
87	0-3″	1.3	5.3	4.4	7.8	<0.8	<1.2	<1	<1
	3-6″	1.1	3.6	3.4	2.6	<0.9	<1.2	<1.1	<1.1
	6-12″	<0.6	0.4	0.3	0.5	<0.7	<1	<0.9	<0.9
88	0-3″	1.7	7	8.1	2.4	1	<1.8	<1.5	<1.8
	3-6″	0.6	2.9	2.3	1.3	<1.1	<1.6	<1.3	<1.7
	6-12″	<0.8	<0.6	<0.4	0.2	<1	<1.5	<1.3	<1.6
98	0-3″	<1.2	2.8	3	1.5	<1	<1.2	<1.1	<1.4
	3-6″	<0.9	1.3	1.4	1	<0.8	<0.9	<0.9	<1
	6-12″	<0.9	0.5	0.5	0.3	<0.8	<0.9	<0.9	<1.1
99	0-3″	0.4	2.1	3	1.9	0.6	2.2	<0.7	<0.9
	3-6″	5.2	16	19	8.2	1.8	0.8	<0.7	<0.9
	6-12″	2.9	8.9	9.8	9	0.9	<0.6	<0.5	<0.6
100	0-3″	1.6	6.7	8.6	5.3	0.7	<1.4	<1	<1.5
	3-6″	0.7	3.4	4.4	3.1	<0.8	<1.4	<1	<1.5
	6-12″	<0.2	0.1	0.2	0.2	<0.5	<1	<0.7	<1
101	0-3″	3.3	15	16	11	1.8	<1.2	1	<1.3
	3-6″	1.4	8.5	4.6	5.2	1	<1.1	<0.8	<1.2
	6-12″	<0.3	<0.3	<0.2	0.3	<0.7	<1.3	<0.9	<1.4

Values are concentrations in nanograms chemical per gram of soil or parts per billion (ppb).

Legend

DCB	1,2,dichlorobenzene	α-HCCH	alpha hexachlorocyclohexane
TCB	1,2,4-trichlorobenzene	β-HCCH	beta hexachlorocyclohexane
TeCB	1,2,3,4-tetrachlorobenzene	γ-HCCH	gamma hexachlorocyclohexane
HxCB	hexachlorobenzene	δ-HCCH	delta hexachlorocyclohexane