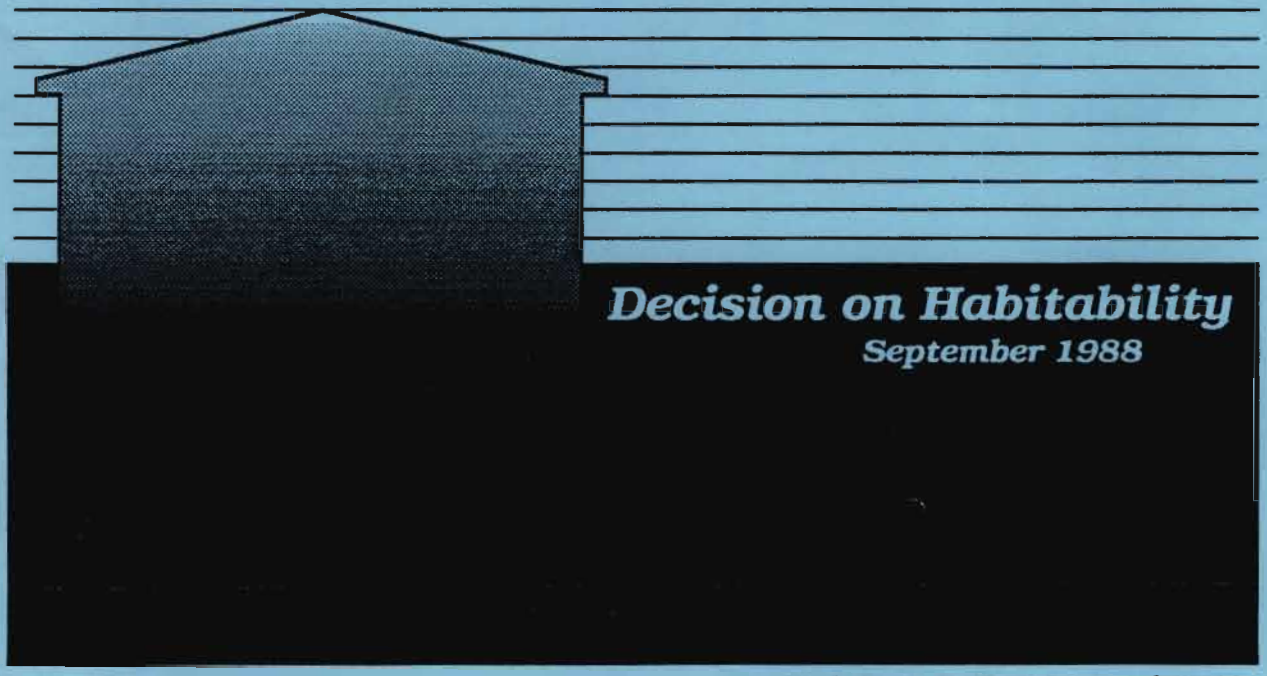
189 — 1988
128 — Today 2/15/75
61

Love Canal

EMERGENCY DECLARATION AREA



Decision on Habitability

September 1988

New York State Commissioner of Health
David Axelrod, M.D.

STATE OF NEW YORK
DEPARTMENT OF HEALTH
ALBANY

DAVID AXELROD, M.D.
COMMISSIONER

HABITABILITY DECISION
LOVE CANAL EMERGENCY DECLARATION AREA

This statement and attached report contain the decision by the New York State Commissioner of Health on the habitability of the Love Canal Emergency Declaration Area. The decision is governed by the criteria recommended by representatives of the scientific community, reviewed by members of the Greater Love Canal community, and adopted by responsible state and federal agencies.

The criteria were published and their rationale detailed in the Love Canal Emergency Declaration Area Proposed Habitability Criteria (December, 1986). The criteria were pilot tested in the winter of 86-87 and further modified on the basis of public review and a critique by the Love Canal Technical Review Committee (TRC). The final habitability criteria which the TRC recommended to the Commissioner of Health focused upon a combination of (a) the application of environmental and health standards, criteria and guidelines and (b) a comparison of environmental data from the EDA with similar data from comparable residential areas.

Both the criteria and the ultimate decision are also bound by the limits of scientific knowledge about the impact of toxic exposures upon the health of our citizens. Although this scientific knowledge is greater than it was in the 1940's and 1950's when the Love Canal was used as a hazardous waste disposal site, this scientific knowledge is not now and never will be complete or absolute, so that any public health judgment necessarily involves the assessment of an inherent level of uncertainty.

Nevertheless, government has a responsibility to exercise public health judgments on behalf of its citizens. In the specific case of Love Canal, this responsibility follows directly from the potential of adverse consequences to human health posed by the pollution of a residential community with toxic chemicals, and government's own decision to limit risks to public health by the evacuation and relocation of local residents.

I hereby find that, based upon the approved criteria and the environmental data available:

-- Subject to limitations and conditions, the areas north of Colvin Boulevard, and the sections west of the Canal itself, are suitable for residential use. These areas are referred to as EDA sampling areas 4, 5, 6 and 7.

-- The areas east of the Canal and south of Colvin Boulevard fail to meet the standards and are not now suitable for residential use. These areas are referred to as EDA sampling areas 1, 2 and 3.

For those areas declared habitable, revitalization programs must await development and approval of an overall land use plan. Any such plan must take into account the continuing remediation activities planned for the EDA, including the upcoming dredging of Black and Bergholtz creeks. People should not be encouraged to move into areas which will be heavily affected by this work.

For those specific sections of the EDA declared uninhabitable, this decision is not a determination of an immediate health threat to the individuals and families still living there. It is, however, a determination that whatever the level of risk associated with the presence of the measured indicator chemicals, that risk exceeds the risk posed in comparison residential areas. In fact, the contamination levels found during the extensive sampling program are relatively low, and many orders of magnitude below the levels found ten years ago in homes immediately adjacent to the Canal. There is no need for the residents of these areas to relocate immediately. But according to the criteria established for comparison with other neighborhoods, these areas cannot now be considered for residential resettlement.

Options for other uses are discussed more fully in the report. They may include commercial or industrial uses where the potential for exposure to environmental toxics can be shown to represent a lesser risk than residential use. Residential redevelopment might also be reconsidered, but not until verifiable remediation removes or isolates the contamination and a careful assessment of exposure and risk has been carried out.

Federal and State statutes will govern the continuing remediation and resettlement process at Love Canal. An overall land use plan, to be developed by the Love Canal Area Revitalization Agency (LCARA), must be submitted to the U.S. Environmental Protection Agency. Such a plan must be approved by the chairman of the state Disaster Preparedness Commission (DPC).

To assure adequate local input, and to continue the partnership between citizens and government which has marked this entire process, I will appoint a group of local citizens to a Land Use Recommendation Committee to provide LCARA and the State with advice on the future of the Love Canal EDA. The Committee will report to LCARA and the chairman of the DPC before the end of the year, and prior to the submission of any proposal to the EPA.

The State Disaster Preparedness Commission has the authority to coordinate and expedite state assistance to localities. Its involvement in the land use planning process will allow such agencies as the state Division of Housing and Community Renewal, the Urban Development Corporation, the Department of Economic Development and the Department of Environmental Conservation to provide continuing assistance to the Love Canal region.

The process of arriving at a scientifically and publicly credible decision on habitability has taken longer and cost more in both human and financial terms, than anyone expected. The reasons for this are complex and involve a number of problems encountered along the way. The primary cause, however, lies in the special nature of this effort and this decision. Never before has government attempted such a complex and sensitive public health judgment involving the futures of our citizens.

Love Canal continues to represent a test of our collective ability to confront unique environmental health issues. Some subtle and other not so subtle threats of toxic exposure from Love Canal environmental pollutants have provided new challenges to better manage human activities. Out of our experiences of the Love Canal has come a more coherent state and federal policy for the exercise of public health responsibilities to protect the human health of current and future generations.

HABITABILITY DECISION
REPORT ON HABITABILITY
LOVE CANAL EMERGENCY DECLARATION AREA

27 September 1988

New York State Department of Health

Empire State Plaza
Albany, New York 12237

ACKNOWLEDGEMENTS

The figures used in this report have been taken from or modified from figures found in the Love Canal Emergency Declaration Area Habitability Study Final Report. They were prepared by CH2M Hill Southeast, consultant to EPA.

TABLE OF CONTENTS

LIST OF ABBREVIATIONS USED

CDC	United States Department of Health and Human Services, Centers for Disease Control
DEC	New York State Department of Environmental Conservation
DHHS	United States Department of Health and Human Services
DOH	New York State Department of Health
EDA	Love Canal Emergency Declaration Area
EPA	United States Environmental Protection Agency
HpCDD	Heptachlorodibenzo-p-dioxin
HpCDF	Heptachlorodibenzofuran
HxCDD	Hexachlorodibenzo-p-dioxin
HxCDF	Hexachlorodibenzofuran
LCIC	Love Canal Indicator Chemicals
NYS	New York State
OCDD	Octachlorodibenzo-p-dioxin
OCDF	Octachlorodibenzofuran
OTA	Congressional Office of Technology Assessment
PeCDD	Pentachlorodibenzo-p-dioxin
PeCDF	Pentachlorodibenzofuran
ppb	parts per billion
QA/QC	quality assurance/quality control
TCDD	Tetrachlorodibenzo-p-dioxin
TCDF	Tetrachlorodibenzofuran
TRC	Love Canal Technical Review Committee

SUMMARY OF HABITABILITY CONCLUSIONS

This decision on the habitability of the Love Canal Emergency Declaration Area (EDA) is made pursuant to the authority granted to the Commissioner of Health by Public Health Law, Section 1388, which provides:

> In case of great and imminent peril to the health of the general public from such hazards as may be identified as resulting from exposure to toxic substances emanating from landfills, the commissioner may declare the existence of an emergency and take such measures and do such acts as he may deem reasonably necessary and proper for the preservation and protection of the public health.

The decision is based upon an application of criteria developed by the State and Federal governments to sampling data obtained from the EDA, other areas of Niagara Falls and two communities in Erie County. The sampling data were measurements of indicator chemicals in air and soil and dioxin in soil. These indicator chemicals were chosen to assess the potential for Love Canal chemicals to be in the EDA and are therefore not suitable for a full assessment of risks posed by the presence of Love Canal chemicals in the EDA.

For the reasons set forth in this report, the following conclusions have been reached regarding habitability within the EDA:

1. Sampling Areas 4 - 7 (EDA 4 - 7) meet all of the habitability criteria and may be used for residential or other purposes.

2. EDA 1 - 3 do not meet the criteria established for habitability. EDA 2 - 3 have lesser indications of hazardous potential than EDA 1, but they do, nevertheless, exceed the comparison criteria for habitability. Remediation may render those areas as habitable as other neighborhoods in Niagara Falls, but they cannot at the present time be deemed appropriate for unrestricted residential use.

   Thus, the areas are not suitable for normal residential use without remediation of the contaminated soil. Prior to remediation, additional studies would be required to determine the extent and magnitude of soil contamination in the area. However, these areas may be used for other purposes (e.g. commercial, industrial) without remediation.

The conclusions regarding the habitability of the EDA assume that safeguards will continue to prevent further leakage from the Love Canal. Thus, the containment and leachate treatment system will be maintained and operated under effective, continuous and clearly accountable management; and the effectiveness of the containment and leachate treatment system will continue to be monitored and reported on an annual basis. The New York State Department of Environmental Conservation (DEC) is committed to implementing these actions.

In addition, areas affected by the creek excavation which is planned for 1989 should not be resettled until the excavation is complete. In the immediate vicinity of the excavation and routes of transport of the creek sediments a spill or other accident, albeit unlikely, could occur. These and other nearby areas will be affected by the noise, traffic, or other nuisances associated with the use of heavy construction equipment. Finally, exposing and excavating the creek sediments could produce noxious odors from the decaying organic matter in the sediments. For these reasons:

1. Until creek excavation is complete, sale or transfer of properties adjacent to the excavation areas in Black and Bergholtz Creeks should not proceed.

2. Similarly, sale or transfer of properties along the routes used by trucks carrying excavated sediments should be postponed until such transportation is completed.

3. Other habitable areas in the EDA may be subject to intermittent odors, noise and other nuisances that should be considered before persons from outside the EDA are encouraged to move into the EDA. At the least, prospective residents should be thoroughly informed of such potential nuisances before purchasing homes and moving in.

Health studies of present and former residents will be continued to assess the effects of exposure to the Love Canal before remediation. The feasibility and usefulness of small-animal surveillance for monitoring the efficacy of containment will also be assessed. These assessments will be reported in a timely manner.

HISTORICAL BACKGROUND

This report on habitability is the culmination of a ten year effort to evaluate the risk posed to human health by hazardous wastes from the Love Canal. This effort began in 1978 when the New York State Department of Health (DOH), New York State Department of Environmental Conservation (DEC) and the United States Environmental Protection Agency (EPA) began intensive studies at the site. On June 20, 1978, the Commissioner of Health issued the first of three Love Canal health orders. The first order found that hazardous chemical wastes deposited at the "Love Canal Chemical Waste Landfill" constituted a "public nuisance and an extremely serious threat and danger to the health, safety and welfare" of residents nearby. The Niagara County Board of Health and County Health Commissioner were directed to remove exposed or visible toxic waste on the site's surface, to limit access to the site, and to take any other corrective action necessary to abate the public nuisance.

Environmental sampling by DOH, DEC and EPA prior and subsequent to the first order established that leachate from the site containing halogenated and non-halogenated organic chemicals had been detected in the basements of homes immediately adjacent to the Love Canal. In addition, air samples in the basements of these homes revealed significant chemical contamination (Special Report to Governor and Legislature).

On August 2, 1978, these data and findings of an epidemiological study by DOH which suggested adverse health effects in some residents prompted the New York State Commissioner of Health to issue a second health order. This second order declared an emergency pursuant to Public Health Law Section 1388, and further directed the County Board of Health and the County Health Commissioner to undertake engineering studies in cooperation with EPA, DEC and DOH to provide a long-range solution for decontamination of the site and to implement a plan for abating pollution in upper groundwater at the site. In addition, the Commissioner ordered a temporary delay in opening the 99th Street School and further studies to: 1) delineate chronic diseases affecting residents adjacent to the site, 2) delineate the full limits or boundaries of the Love Canal with respect to possible toxic effects, 3) determine the extent of leachate migration, and 4) identify which groundwater aquifers had been contaminated by leachate.

The Commissioner of Health also recommended that pregnant women and children under two years of age temporarily move from an area surrounding and to the east of the Love Canal (Figure 1) and that residents in that area avoid the use of their basements and consumption of home-grown produce.

On August 7, 1978, the President of the United States declared an emergency. This declaration permitted federal aid for the remedial work to contain chemical wastes at the site and for the relocation of residents. State aid to the residents was also provided, including funds for the purchase of homes in the vicinity of the Love Canal and a grant to the United Way of Niagara Falls for administering a human services program.

On February 8, 1979, the Commissioner of Health issued the third DOH order. This third order continued the prior order's declaration of an emergency, directed continuation and

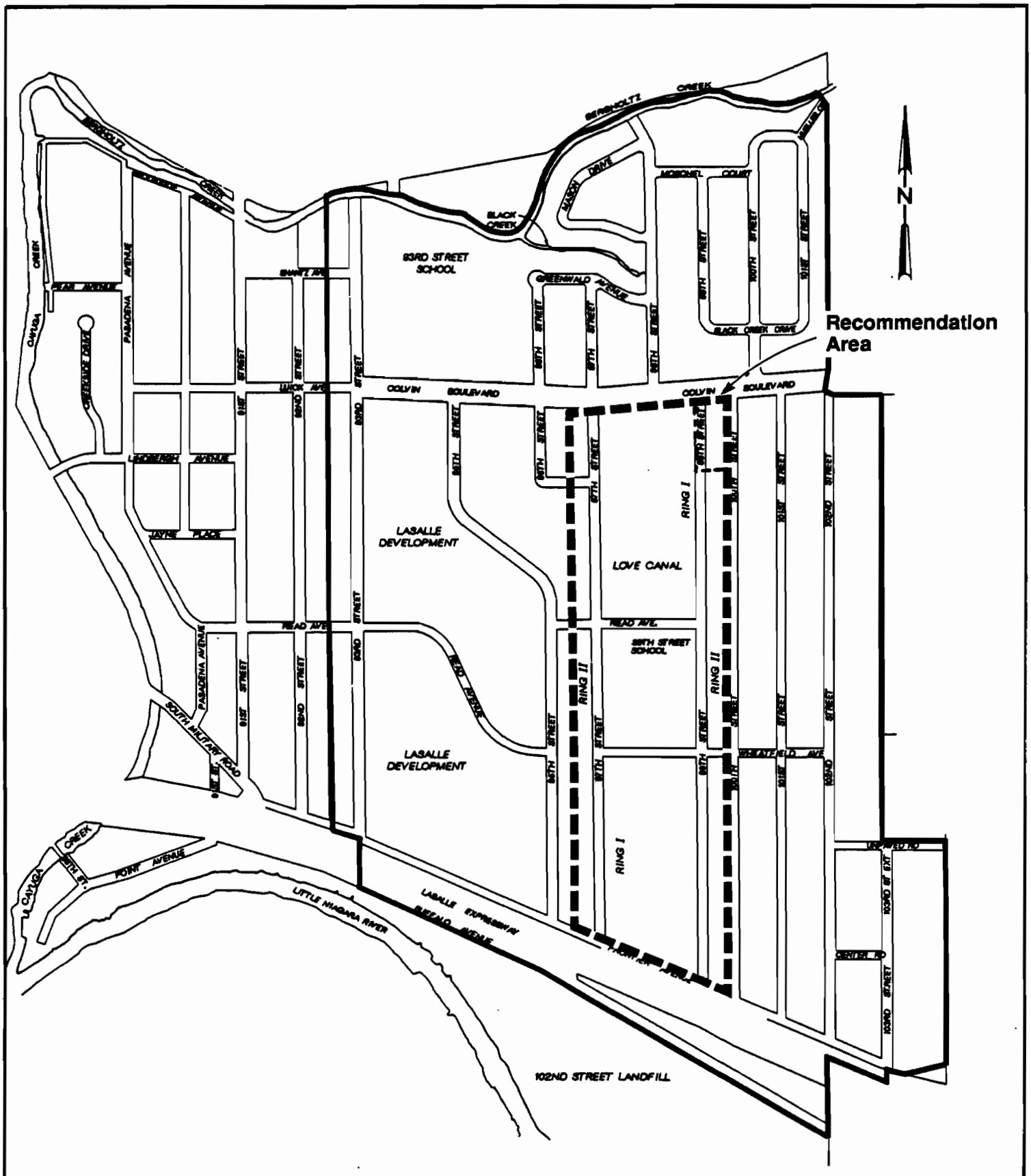


Figure 1

SOURCE:
EDA BOUNDARIES TAKEN FROM NEW YORK STATE
REAL PROPERTY TAX LAW ARTICLE 17, SECTION 1702

RECOMMENDATION TO TEMPORARILY MOVE
SECOND NYS HEALTH ORDER
2 AUGUST 1978

extension of the remedial program addressing groundwater pollution, directed continuation of most of the studies ordered in the second order and delineated a specific area (bounded by 93rd Street on the west, Frontier Avenue on the south, 103rd Street on the east and Black and Bergholtz Creeks on the north) for the identification and study of adverse health effects and the presence of toxic chemicals. In addition, the order extended the area within which evacuation of pregnant women and children under the age of two was recommended (Figure 2).

The third order contained notable new factual findings and conclusions included among which were the following: more extensive adverse health findings for residents of wet areas east of the Love Canal, enumeration of areas subject to flooding from blocked storm sewers, the detection of toxic chemicals in storm sewers, and the possibility that leachate from the Love Canal may have flowed along surface drainage pathways and utility conduits under roads to locations outside the Love Canal, particularly east of the site. The third order also identified various subjects for further study and/or remediation.

On May 22, 1980, President Carter for the second time declared a federal emergency at the Love Canal. This declaration permitted federal funds to be made available to permanently relocate more than 500 families from a 232-acre area surrounding the Love Canal. This area, identified as the Emergency Declaration Area (EDA), was the same as the study area delineated in the third DOH health order. State funds were also provided for the relocation of Love Canal residents.

Following the emergency declaration, the EPA initiated environmental monitoring in the EDA to investigate the magnitude and extent of contamination from the Love Canal. A report of the findings of this study was released in May 1982. In July 1982, the United States Department of Health and Human Services (DHHS) concluded that the EDA was "as habitable as the control areas with which it was compared." This conclusion was predicated on the condition that the Love Canal would be "constantly safeguarded against future leakage from the canal and that cleanup is required for existing contamination of local storm sewers and their drainage tracts."

In June 1983, the Congressional Office of Technology Assessment (OTA) issued a report which questioned the DHHS conclusion that the EDA was as habitable as the control area to which it was compared. OTA's two principal findings were that "with available information it is not possible to conclude either that unsafe levels of toxic contamination exist or that they do not exist in the EDA" and "there are also serious concerns and uncertainties about progress in the remedial program to date and plans for the future." The uncertainties identified were as follows: (1) the known dioxin contamination in storm sewers was not cleaned up and a study of the full extent of contamination associated with the sewers was not completed, (2) reliable methods to detect any leaks in the cap or the concrete barrier wall to be built around the Love Canal were needed, and (3) a long-term monitoring program for groundwater at the site was needed.

In response to the OTA report, the EPA established the Love Canal Technical Review Committee (TRC) consisting of senior-level representatives of EPA, DHHS - Centers for Disease Control (CDC), DOH and DEC. The TRC was charged to provide direction and oversight of actions needed "to address final remediation and habitability of the Love Canal and EDA". Since late 1983, the TRC has met frequently in public to develop and implement a strategy for assessing the habitability of the EDA.

Under the leadership of the CDC and DOH representatives on the TRC, the TRC convened a panel of scientists not employed by government to discuss alternatives and to recommend criteria for determining the habitability of the EDA. These recommendations were further reviewed by the public and another panel of scientists convened by the TRC. In December 1986, proposed habitability criteria were adopted by the TRC.

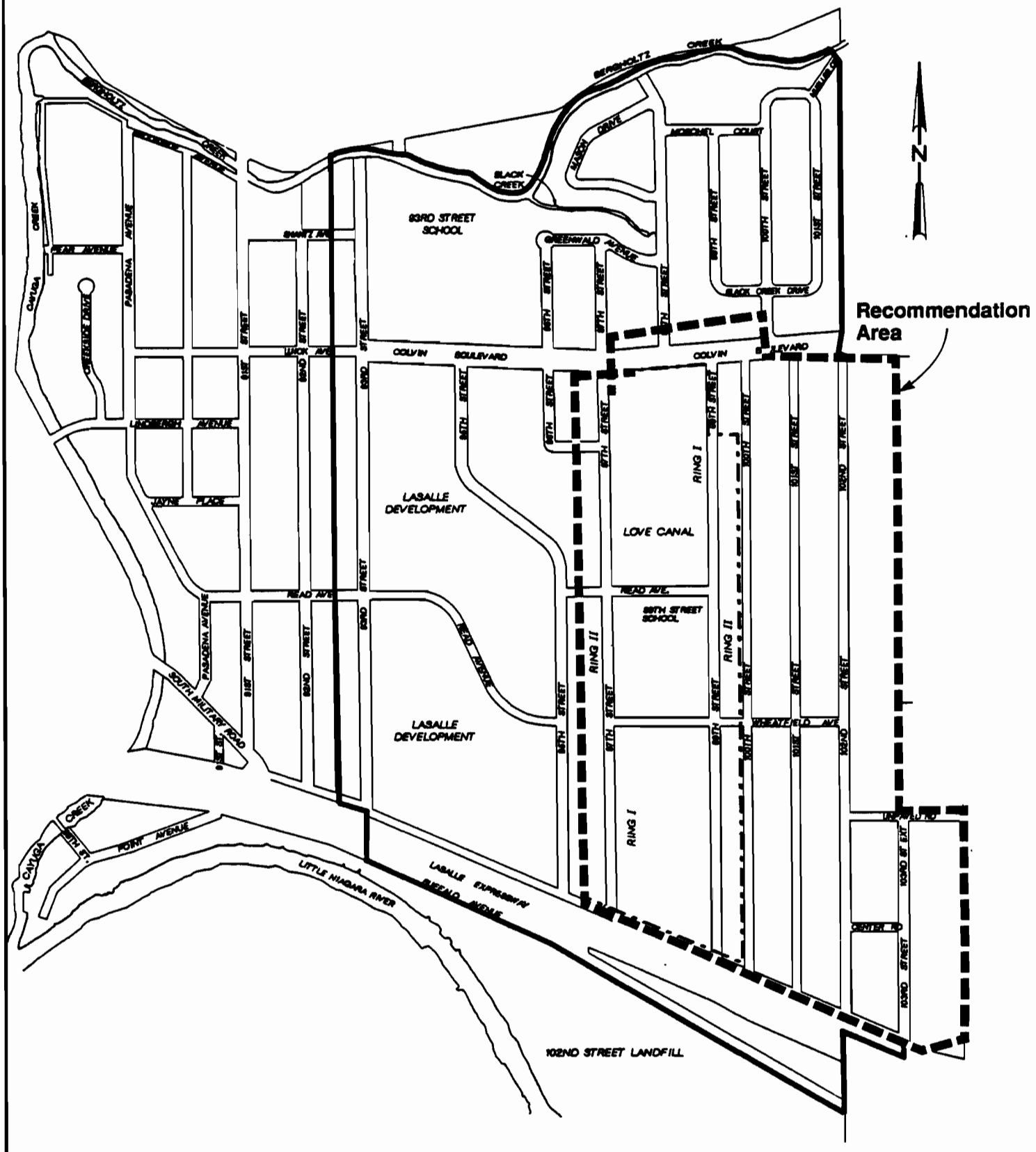


Figure 2

RECOMMENDATION TO TEMPORARILY MOVE
SUPPLEMENTAL HEALTH ORDER
8 FEBRUARY 1979

SOURCE:
EDA BOUNDARIES TAKEN FROM NEW YORK STATE
REAL PROPERTY TAX LAW ARTICLE 17, SECTION 1702

HABITABILITY CRITERIA

This Section summarizes the major elements of the habitability criteria. The habitability criteria and their rationale are detailed in the Love Canal Emergency Declaration Area Proposed Habitability Criteria (December 1986). The criteria and modifications to the criteria which were adopted by the TRC in response to findings of pilot studies are further explained in the Love Canal Emergency Declaration Area Habitability Study Final Report, Volume I (May 1988). Additional explanation of the criteria is documented in transcripts of the meetings of experts, minutes of the TRC meetings and miscellaneous correspondence and reports.

The habitability criteria which were developed were proposed to apply only to the Love Canal EDA. "Habitable" was defined by the criteria as suitable for normal residential use without any restrictions. The criteria recognized that a judgement about the suitability of any area for human habitation rarely involves a simple "yes or no" response. They also acknowledge that such a judgement would require consideration of at least the following factors: "the degree of certainty about the presence or absence of risks; whether these risks are immediate or delayed, serious or negligible, voluntary or involuntary; and whether restricted habitability or alternative land use is intended." To the degree that risks exist at the Love Canal, they were recognized to be imposed involuntarily and to possibly be related to serious health outcomes that may be delayed in their expression. Declaring an area "not habitable" would not preclude all uses, but would suggest that residential use in such an area (e.g. children playing in the yard, planting gardens and eating home-grown produce, wading in puddles, etc.) imposes potential risks not normally found in residential neighborhoods. Such an area could be used for other activities that would entail reduced exposure of the public to the potential source of contamination.

Alternative approaches

Several alternatives were considered and discussed prior to selecting an approach to determining habitability:

1. Assessment of risk based on possible exposure to measured levels of chemicals present in the EDA, epidemiological studies and extrapolation of human and animal toxicity data for those chemicals;

2. Epidemiological assessment of the population which lived at the Love Canal;

3. Comparison of the Love Canal after remediation with a state-of-the-art hazardous waste management facility meeting existing laws and regulations;

4. Identification of time trends in environmental data to evaluate the effectiveness of remediation;

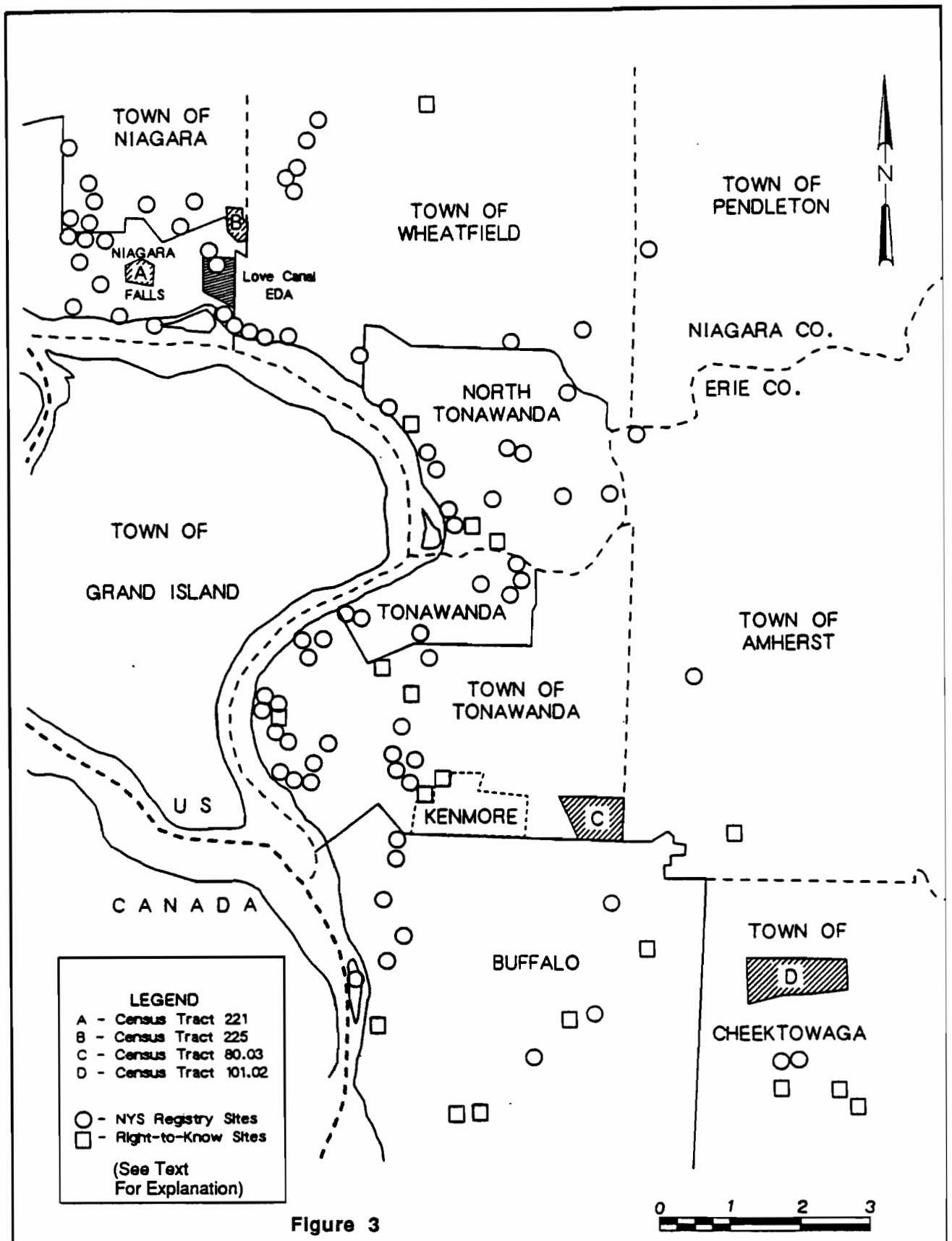


Figure 3

MAP OF WASTE SITES AND COMPARISON AREAS IN NIAGARA AND ERIE COUNTIES

5. Application of environmental and health standards, criteria and guidelines;

6. Comparison of environmental data from the EDA with similar data from comparable inhabited areas; and

7. Combinations of the above.

The approach chosen (a combination of 5. and 6.) was to sample environmental media and compare the results of sampling in the EDA to relevant federal or New York State standards, criteria and guidelines and to the results of similar environmental sampling in similar communities in western New York not close to a waste site. The rationale and procedure used to select comparison areas is described in Volume I of the Habitability Study Final Report. A map (Figure 3) shows the selected comparison areas, the EDA and waste sites in the region. Known waste sites (those listed in the NYS Registry of Inactive Hazardous Waste Sites maintained by DEC) and suspected sites (those reported to DEC under the Community Right-to-Know Law but not yet investigated) were considered in identifying the candidate comparison areas.

Primary elements of the habitability criteria

Environmental sampling was specified to include dioxin in soil and indicator chemicals (referred to as Love Canal Indicator Chemicals or LCICs) in soil and air. Indicator chemicals for air and soil were selected to serve as indicators of migration or movement from the Canal to the EDA. They were selected from lists of chemicals known to have been disposed of in the Love Canal on the basis of their persistence, potential for migration, and ability to be measured at low levels. The specific chemicals chosen are listed below; a more detailed explanation of their choice is presented in Appendix 9 of the criteria document.

LCICs for air:

chlorobenzene
2-chlorotoluene
4-chlorotoluene

LCICs for soil:

Chlorobenzene
1,2-dichlorobenzene
1,2,4-trichlorobenzene
1,2,3,4-tetrachlorobenzene
2-chloronaphthalene
total-BHC
beta-BHC
gamma-BHC

(BHCs are isomers of hexachlorocyclohexane, previously called benzene hexachloride)

The criteria define neighborhoods within the EDA based on geographical and social factors. To facilitate the sampling and statistical analysis, the neighborhoods were combined into sampling areas. Figure 4 depicts the boundaries of neighborhoods and sampling areas. The criteria also provide the option of redefining neighborhood boundaries to limit the impact of finding several neighborhoods not habitable.

The criteria note that a neighborhood in the EDA is considered habitable if three conditions are met:

1. soil sample measurements of 2,3,7,8-TCDD are less than 1 ppb; and

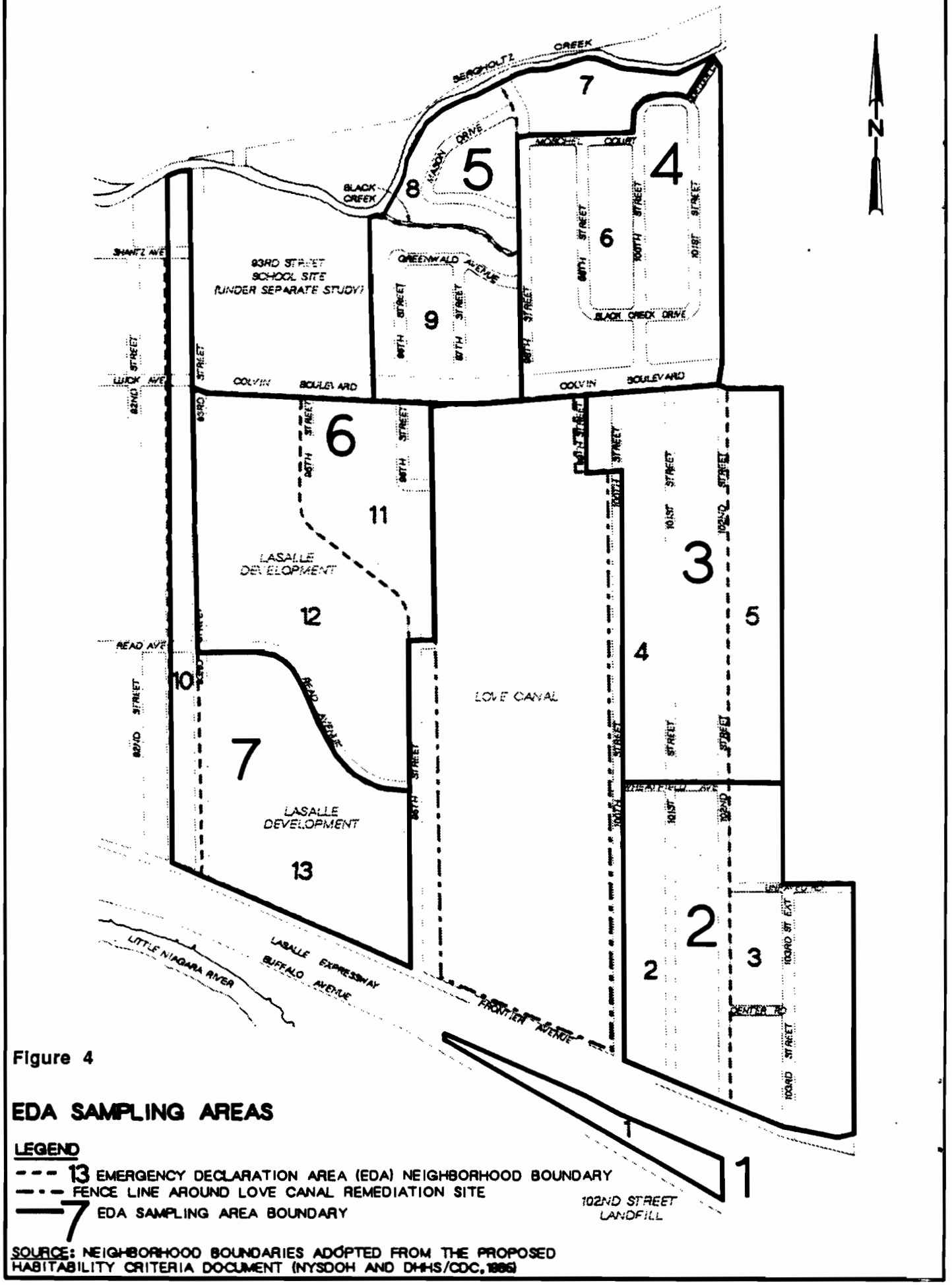


Figure 4

EDA SAMPLING AREAS

LEGEND

- 13 EMERGENCY DECLARATION AREA (EDA) NEIGHBORHOOD BOUNDARY
- FENCE LINE AROUND LOVE CANAL REMEDIATION SITE
- 7 EDA SAMPLING AREA BOUNDARY

SOURCE: NEIGHBORHOOD BOUNDARIES ADOPTED FROM THE PROPOSED HABITABILITY CRITERIA DOCUMENT (NYSDOH AND DHHS/CDC, 1985)

2. the chosen aggregate values (e.g. mean, median, percentiles, etc.) of each LCIC evaluated both individually (univariate) and collectively (multivariate) are not significantly different than the values from the comparison areas; and

3. the integrity of a neighborhood will be preserved.

A residence is considered habitable if three other conditions are met:

1. it is located in a neighborhood judged to be habitable, and

2. results of the air measurements show that re-testing and/or remediation are not necessary, and

3. if remediation is performed and shown to be successful.

Finally, the criteria state that the entire EDA will be judged uninhabitable if no habitable neighborhoods can be defined within it by the criteria.

The criteria recognize that "the determination of habitability or non-habitability of any EDA neighborhood will require a prudent public health judgement based on a review of the data from the comparison studies as well as all other pertinent factors."

The criteria also specify additional procedures to be followed in the gathering and interpretation of additional environmental data:

1. The lowest feasible limits of detection should be obtained without unique or heroic laboratory methods.

2. Sample collection and laboratory analysis should follow stringent quality assurance and quality control (QA/QC) procedures.

3. Comparisons should be based on detailed statistical design and use of univariate (individual LCICs) and multivariate (combined LCICs) statistical procedures.

4. Data should be evaluated for trends and gradients.

5. Property owners should provide written consent before samples are collected.

Special provisions

1. Public and peer review should be provided for:

   - the habitability criteria,
   - the environmental sampling protocols, and
   - all environmental and QA/QC data and statistical analyses.

2. Pilot studies should be conducted to determine the feasibility of implementing the criteria.

3. The habitability decision must await plans for the remediation of creeks in the vicinity of the Love Canal and other areas of TCDD contamination such as 93rd Street School.

4. People should not be encouraged to move into the EDA until the contamination in the creeks, as it affects the EDA, is remediated.

5. The security of Love Canal containment must be re-evaluated to guarantee permanent containment of chemicals in the dump.

6. Safeguards are to be observed to prevent further leakage from the Love Canal. These would include effective, continuous and clearly accountable management of the Love Canal site.

The criteria for determining habitability were based on existing knowledge of toxicology and are expected to protect future residents of the area against detectable harm from any residual levels of Love Canal chemicals that may remain. Nonetheless, to address public health concerns particularly related to exposure of residents prior to remediation, the criteria also note other important considerations which are not directly related to the development of habitability criteria. The scientific experts and public recommended that DOH determine whether present or former Love Canal residents have experienced adverse health effects relative to residents of comparable urban areas and whether small-animal surveillance is feasible and useful.

FINDINGS OF HABITABILITY STUDIES

Design and implementation of the Habitability Study were carried out under the guidance of the TRC and with full public discussion. Results of the Habitability Study and a peer review of the results are contained in a five volume report entitled Love Canal Emergency Declaration Area Habitability Study Final Report (1988).

A summary of the major findings in these reports and a discussion of these findings follows.

Pilot study results and changes to the criteria

Prior to the start of the Habitability Study, pilot studies for the soil and air LCIC assessments were required. The purpose of the pilot studies was to test the feasibility of implementing the habitability criteria and to develop data that could be used to:

- test the sampling and analytical methods proposed for the soil and air LCIC assessments,
- provide preliminary data on the levels and statistical distributions of the LCICs, and
- provide a basis for determining the number of samples that were needed to produce statistically valid results for the comparisons.

The results of the air and soil pilot studies are reported in Pilot Study for Love Canal EDA Habitability Study, Volumes I and II. Based on the findings of the soil pilot study, NYSDOH conducted a small follow-up study that collected soil samples from areas within the EDA, Cheektowaga, Niagara Falls, and the Town of Wheatfield. This study was conducted to evaluate potential non-Love Canal sources for some of the LCICs. The results of this study are also reported in Volume II of the pilot study report.

The pilot study reports underwent peer review from March through May 1987. The major changes in the air LCIC assessment that resulted from the pilot studies and the peer review were:

- the combination of the two isomers of chlorotoluene into a measurement of total chlorotoluene concentration (a shift from three to two air LCICs), and
- the consideration of any detectable air LCIC concentration in EDA residences as significant, which eliminated the need for air measurements in the comparison areas and permitted sampling of each accessible property instead of a sample of properties.

The major changes in the soil LCIC assessment that resulted from the pilot studies and the peer review were:

- The analysis for semivolatile compounds only, thus eliminating chlorobenzene;

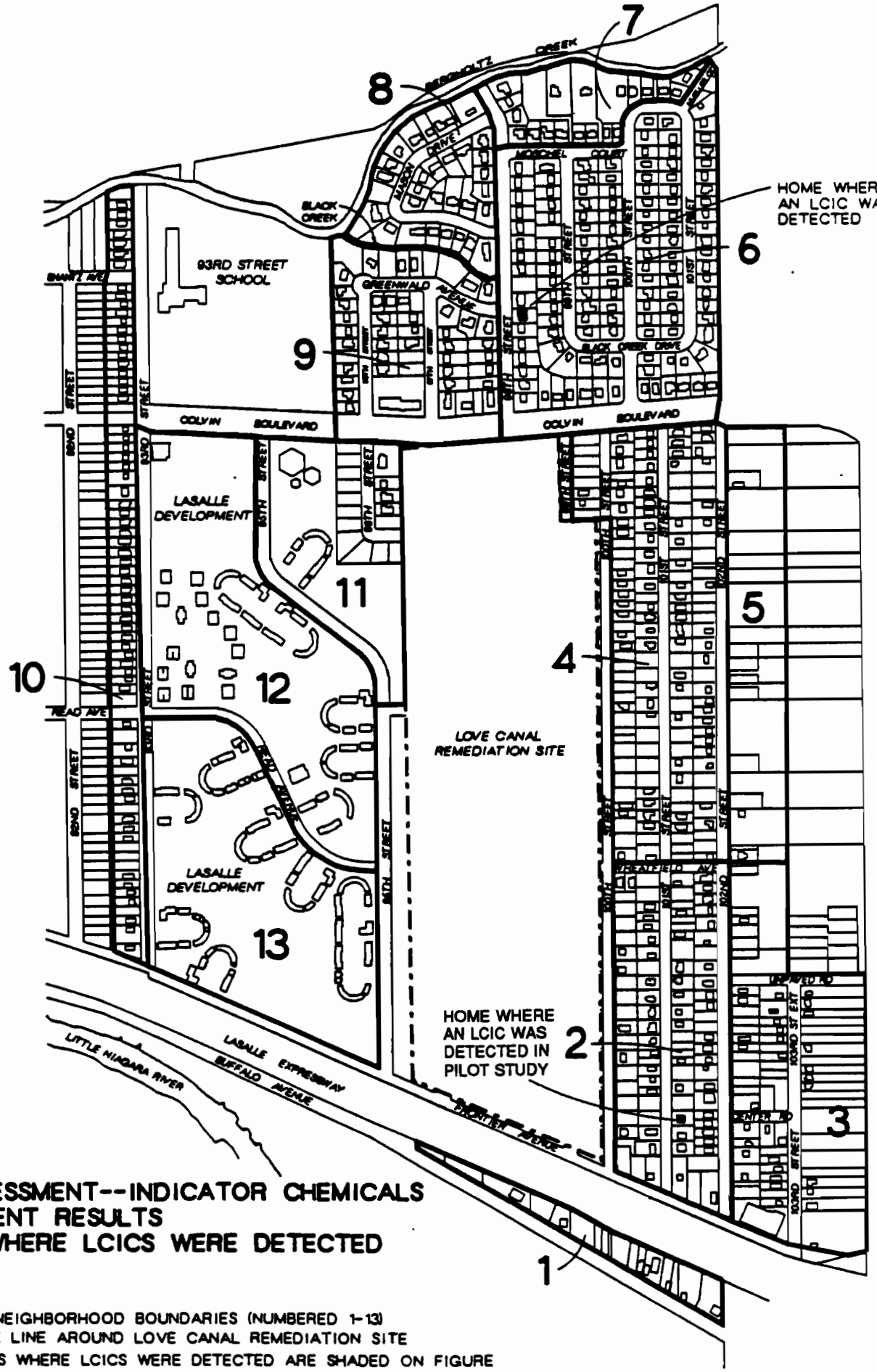


Figure 5

AIR ASSESSMENT--INDICATOR CHEMICALS ASSESSMENT RESULTS HOMES WHERE LCICS WERE DETECTED

LEGEND

——— EDA NEIGHBORHOOD BOUNDARIES (NUMBERED 1-13)

—·— FENCE LINE AROUND LOVE CANAL REMEDIATION SITE

■ HOMES WHERE LCICS WERE DETECTED ARE SHADED ON FIGURE

SOURCE: NEIGHBORHOOD BOUNDARIES ADAPTED FROM THE PROPOSED HABITABILITY CRITERIA DOCUMENT (NYSDOH AND DHHS/CDC, 1986).

- the consideration of two additional comparison areas, both from Niagara Falls; and
- the combination of the 13 EDA neighborhoods into seven sampling areas for purposes of the statistical design and analysis of the soil LCIC data.

Indicator chemicals in air

To assess the potential for air contamination in homes in the EDA, ambient and indoor air was sampled at 562 properties for chlorobenzene and chlorotoluenes. Sampling was conducted in four phases from July-December 1987 and at different times of the day to account for potential seasonal or diurnal (day-night) effects on air levels.

Chlorobenzene was not detected at any of the properties sampled. However, chlorotoluenes were detected in one unoccupied residence during the September sampling. They were initially detected only on the first floor at levels up to 3.4 ppb. One week later in the same house, chlorotoluenes were detected on the main floor and in the basement at levels of 0.5 - 1.6 ppb. In November and December, chlorotoluenes could not be detected anywhere in the dwelling. No obvious source could be identified for the contamination found in September 1987. However, the garage of the dwelling was used by lawn maintenance personnel to store equipment and supplies during September.

In December, chlorotoluenes were detected at a different location in the EDA in one ambient air sample at levels of 0.4 - 1.3 ppb. Wind conditions at the time suggested a source west of the Love Canal EDA.

Figure 5 depicts the distribution of properties sampled during this assessment and the location of the dwelling where chlorotoluenes were detected.

During a pilot study in July 1986 to assess the feasibility of conducting the air assessment, chlorotoluenes were also detected in two occupied residences. In one residence in the EDA levels of 19 ppb were found. The owner's son painted fishing lures as a hobby. Chlorotoluenes could have been a constituent in the paints or solvents being used, but these potential sources were not tested. No chlorotoluenes or chlorobenzene were detected in this home when it was sampled a year later during the Habitability Study. In the other home (located in Cheektowaga) air levels up to 5.6 ppb were measured, and no potential source could be identified. The EDA residence where chlorotoluenes were found is located in EDA 2 (Figure 5).

Thus, tests of air in the habitability studies identified no dwellings where chemicals from the Love Canal are currently adversely affecting ambient or indoor air in dwellings in the EDA.

Dioxin (2,3,7,8-TCDD) in soil

Soil from 2260 locations in the EDA (Figure 6) were analyzed for dioxin (2,3,7,8-TCDD). Samples were taken of the two inches of soil below the sod at locations determined from a grid.

Dioxin was not detected at 2211 locations. Detection limits for the analyses were required to be < 1 ppb, and 95% of the samples from these locations were actually < 0.4 ppb. Figure 7 identifies 49 locations where dioxin was detected. At 45 locations dioxin was reported at levels < 0.5 ppb. In addition, dioxin was found at levels of 0.6-0.9 ppb at three locations and at one location dioxin was 17-21 ppb in five analyses. These locations are circled on Figure 7. Follow-up sampling at the location with 17-21 ppb dioxin found 33 and 35 ppb dioxin in samples at 0-2 inches and 2-7 inches depth, respectively, and 5.9 ppb in

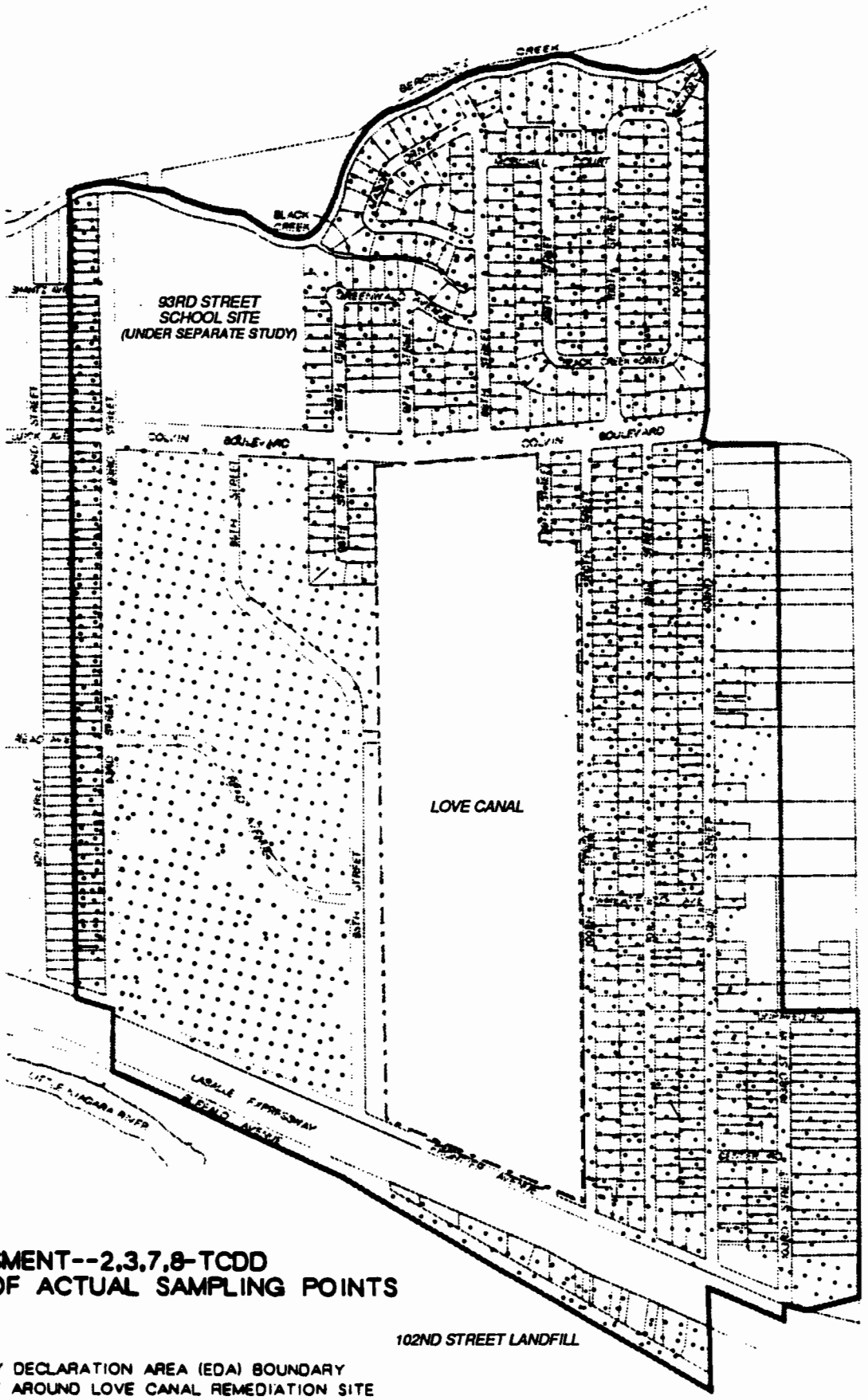


Figure 6

SOIL ASSESSMENT--2,3,7,8-TCDD
LOCATION OF ACTUAL SAMPLING POINTS

SCALE: 1"=650'

LEGEND

- EMERGENCY DECLARATION AREA (EDA) BOUNDARY
- FENCE LINE AROUND LOVE CANAL REMEDIATION SITE
- SAMPLING POINT

SOURCE: EDA BOUNDARIES TAKEN FROM NEW YORK STATE PROPERTY TAX LAW ARTICLE 17, SECTION 1702

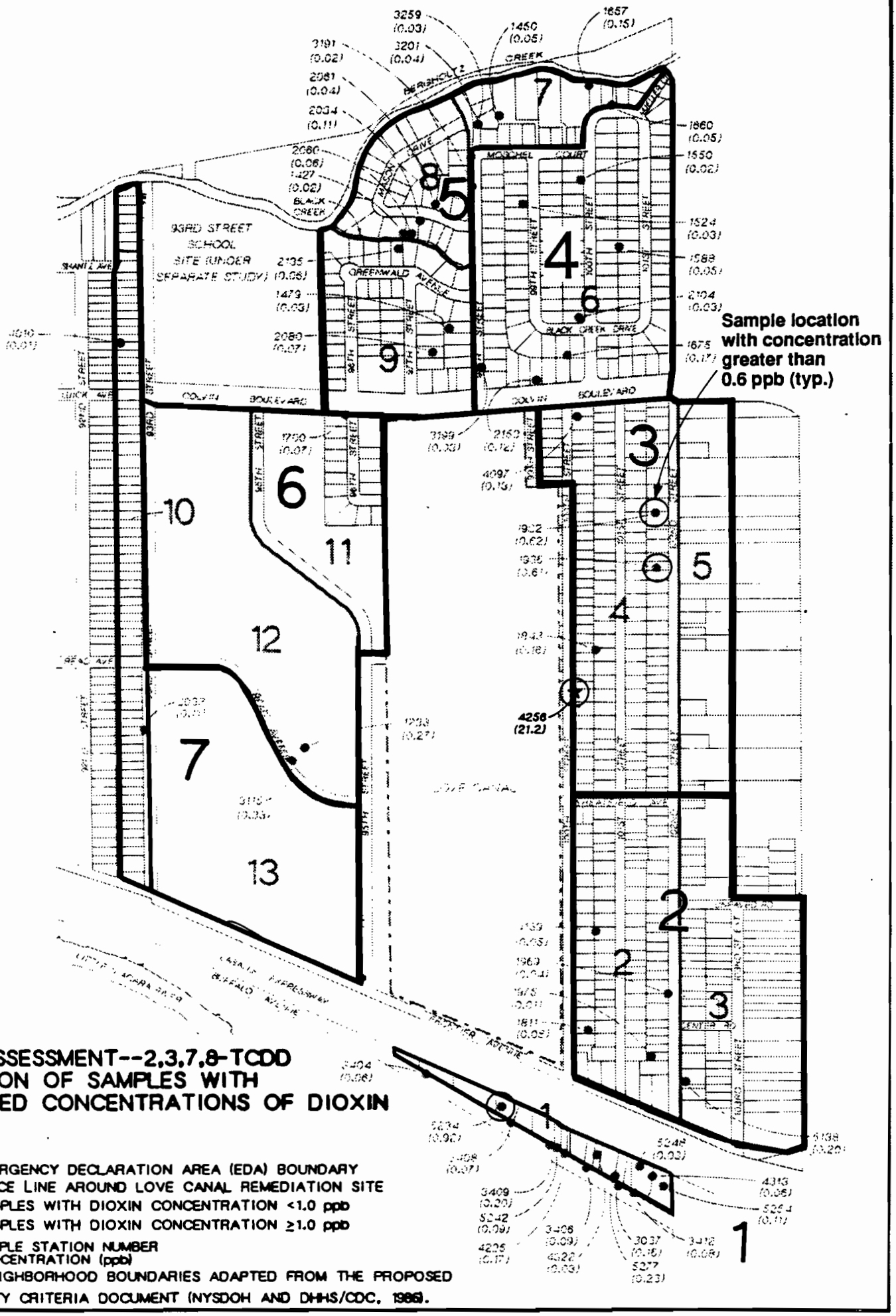


Figure 7

SOIL ASSESSMENT--2,3,7,8-TCDD LOCATION OF SAMPLES WITH DETECTED CONCENTRATIONS OF DIOXIN

LEGEND

- EMERGENCY DECLARATION AREA (EDA) BOUNDARY
- FENCE LINE AROUND LOVE CANAL REMEDIATION SITE
- ● SAMPLES WITH DIOXIN CONCENTRATION <1.0 ppb
- ★ SAMPLES WITH DIOXIN CONCENTRATION ≥1.0 ppb
- 4256 (21.24) SAMPLE STATION NUMBER CONCENTRATION (ppb)

SOURCE: NEIGHBORHOOD BOUNDARIES ADAPTED FROM THE PROPOSED HABITABILITY CRITERIA DOCUMENT (NYSDOH AND DHHS/CDC, 1986).

a sample from 7-12 inches depth. Dioxin was not detected in 46 other samples taken within 65 feet of this location. (Seven sample locations were within 10 feet of this sample.)

In an effort to characterize the source of this contamination, dioxin and dibenzofuran congeners in the surface sample where dioxin was found at high levels were also quantified by the DOH laboratories (Table 1). The relative concentrations of the various dioxin and dibenzofuran congeners (i.e. the dominance of 2,3,7,8-TCDD) suggest that the dioxin at that location was probably a by-product of trichlorophenol manufacture rather than some other source such as solid waste incineration.

The 2,3,7,8-TCCD congener of dibenzodioxin is the most toxic. However, the other congeners are also toxic, and methods have been developed on the basis of toxicological experiments with animals to combine the concentrations of all dibenzodioxin and dibenzofuran congeners in a toxicity-equivalent manner. When combined (Table 1), the 2,3,7,8-TCDD toxicity equivalent concentration is not very different from the 2,3,7,8-TCDD concentration, thus indicating that the contribution of other congeners to the toxicity of the sample is minimal.

Table 1. Dioxins and dibenzofurans in soil sample from EDA 3 (Lot C on 100th Street). Concentrations reported in nanograms per gram dry weight (ppb).

Chemical	Concentration	2378-TCDD Equivalents* NYS Method	EPA Method
DIOXINS			
2378-TCDD	38	38	38
Other TCDDs	1.0	0.00	0.01
12378-PeCDD	0.04	0.04	0.02
Other PeCDDs	0.53	0.00	0.00
2378-HxCDDs	0.07	0.00	0.00
Other HxCDDs	0.24	0.00	0.00
1234678-HpCDD	0.44	0.00	0.00
Other HpCDDs	0.33	0.00	0.00
OCDD	6.3	0.00	0.00
DIBENZOFURANS			
2378-TCDF	1.4	0.47	0.14
Other TCDFs	4.4	0.00	0.00
2378-PeCDFs	0.70	0.23	0.07
Other PeCDFs	1.0	0.00	0.00
2378-HxCDFs	0.51	0.00	0.00
Other HxCDFs	0.25	0 00	0.00
1234678-HpCDF	0.26	0.00	0.00
Other HpCDFs	0.22	0.00	0.00
OCDF	0.64	0.00	0.00
TOTAL		38.75	38.26

The sampling grid for dioxin in soil was designed to have a 95% probability of detecting a locally-contaminated elliptical area approximately 126 feet long and 66 feet wide. This is approximately the size of a median lot in the EDA. The one location where dioxin was

found at 17 - 35 ppb was much more limited in size (less than five feet in radius). If it were assumed that additional small contaminated spots are located randomly throughout the EDA, the statistical likelihood that another such area would be found in the EDA is 0.0004 (4 times in 10,000) if the same sampling protocol were employed.

The 1 ppb level of concern for dioxin in residential soil was derived by the CDC based on an assumption that residents would be exposed to uniform and average contamination of soil. The public health risk associated with exposure to soil is a complex combination of the level of contamination, the size of the contaminated area, the nature of use of the area, the length of time persons are using the area, and the age and behavior of the persons using the area. The risks associated with exposure to a small area of elevated contamination decrease as the area gets smaller. The contaminated area that was found in the EDA had dioxin up to 35 ppb in an area estimated to be less than 5 feet in radius. Such an area (80 square feet) comprises about 1% of the area of a median-size lot in the EDA. Thus, long-term exposure to soil from a lot that might have such an area of contamination poses a lower risk than if the entire lot were contaminated at 1 ppb. If the contaminated area were the focus of a child's play area or a home garden, the dioxin exposure from soil might be higher than if the lot were uniformly contaminated at 1 ppb. However, the chance that such a contaminated area exists and would be the focus of such activities is quite small.

Indicator chemicals in soil

Soil samples were collected to compare levels of LCICs in the EDA with levels in similar inhabited communities in western New York that are not close to a chemical landfill. See Figure 3 for the location of the comparison areas. A more detailed explanation of the process used to select the comparison areas can be found in Volume I of the Habitability Study report.

The EDA was divided into seven sampling areas (EDA 1 - 7) for sampling and comparison purposes (Figure 4), and three comparison areas were chosen (two in Niagara Falls and one in Erie County in the towns of Cheektowaga and Tonawanda). The sampling was designed to determine whether levels of contamination differed between the sampling areas in the EDA and the comparison areas. Levels of LCICs in the comparison areas estimated the "normal" or background levels of these chemicals in comparable inhabited communities. Where levels of LCICs in the EDA areas exceed levels in the comparison areas, the Love Canal is presumed to be the source of these chemicals and other Love Canal chemicals are presumed to be present.

Overall, 887 samples were collected, and 781 samples were successfully analyzed. Figure 8 presents the distribution of the 781 samples. An adequate number of samples was successfully analyzed in each sampling area and comparison area to rely on the statistical comparisons. Each sample included the surface 10 inches of soil below the sod.

Results for each LCIC and combined LCICs in the sampling areas and comparison areas are presented in Appendix A. In general, median LCIC concentrations are uniform except in EDA 1. Median LCIC concentrations in EDA 1 are generally ten or more times higher than elsewhere, and the highest median values for each LCIC are always found in EDA 1. Extreme LCIC levels as measured by the 95th percentile are also in EDA 1; however, the samples with the highest individual level for each LCIC are outside EDA 1.

Chloronaphthalene concentrations were uniformly low throughout all areas and only a few statistically significant differences between EDA areas and comparison areas were found. In addition, laboratory contamination was suspected in several cases. Thus, differences for this compound are probably not significant.

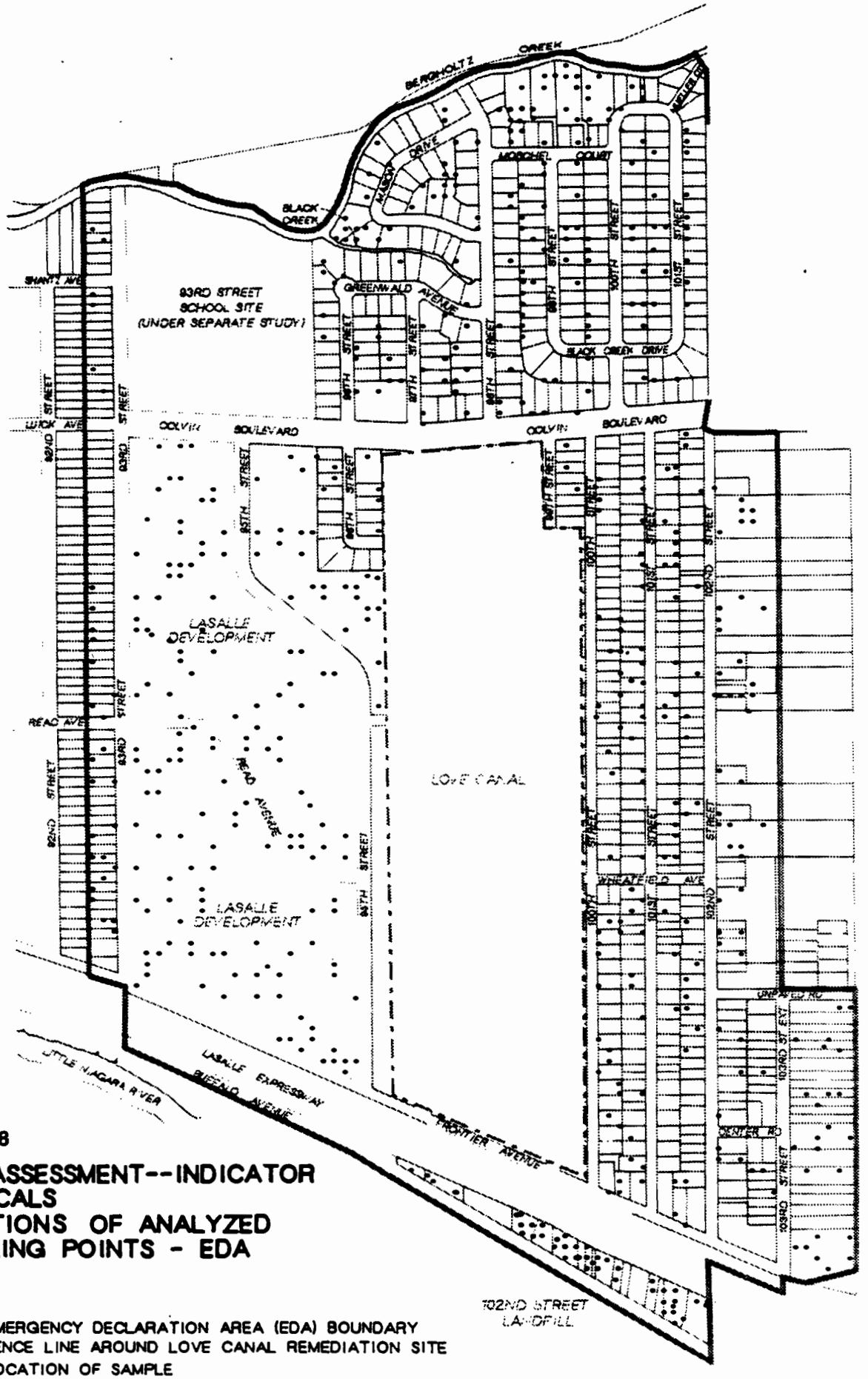


Figure 8

SOIL ASSESSMENT--INDICATOR CHEMICALS LOCATIONS OF ANALYZED SAMPLING POINTS - EDA

LEGEND

- EMERGENCY DECLARATION AREA (EDA) BOUNDARY
- FENCE LINE AROUND LOVE CANAL REMEDIATION SITE
- LOCATION OF SAMPLE

SOURCE: EDA BOUNDARIES TAKEN FROM NEW YORK STATE PROPERTY TAX LAW ARTICLE 17, SECTION 1702

Low-level laboratory contamination of 1,2-dichlorobenzene was observed in most of the laboratories. Thus, differences between areas for dichlorobenzene may actually be somewhat greater than were found.

Statistical comparisons of soil LCIC levels in each of the sampling areas to levels in the comparison areas (Figures 9, 10, and 11) identified the following hierarchy of overall levels of contamination:

- EDA 1 — Highest LCIC levels
- EDA 2 - 3
- EDA 4 - 7 and Niagara Falls comparison areas
- Erie County comparison areas — Lowest LCIC levels

Statistically, soil from EDA 1 had significantly higher levels of all LCICs than soil from all other parts of the EDA and from the comparison areas. Soil from EDA 2 and 3 had higher LCICs than soil from EDA 4 - 7 and the comparison areas. Soil from EDA 4 - 7 did not consistently have elevated LCIC levels compared to soil from the comparison areas in Niagara Falls, but soils from EDA 4 - 7 and from Niagara Falls were significantly more contaminated with LCICs than soil from the Erie County comparison areas.

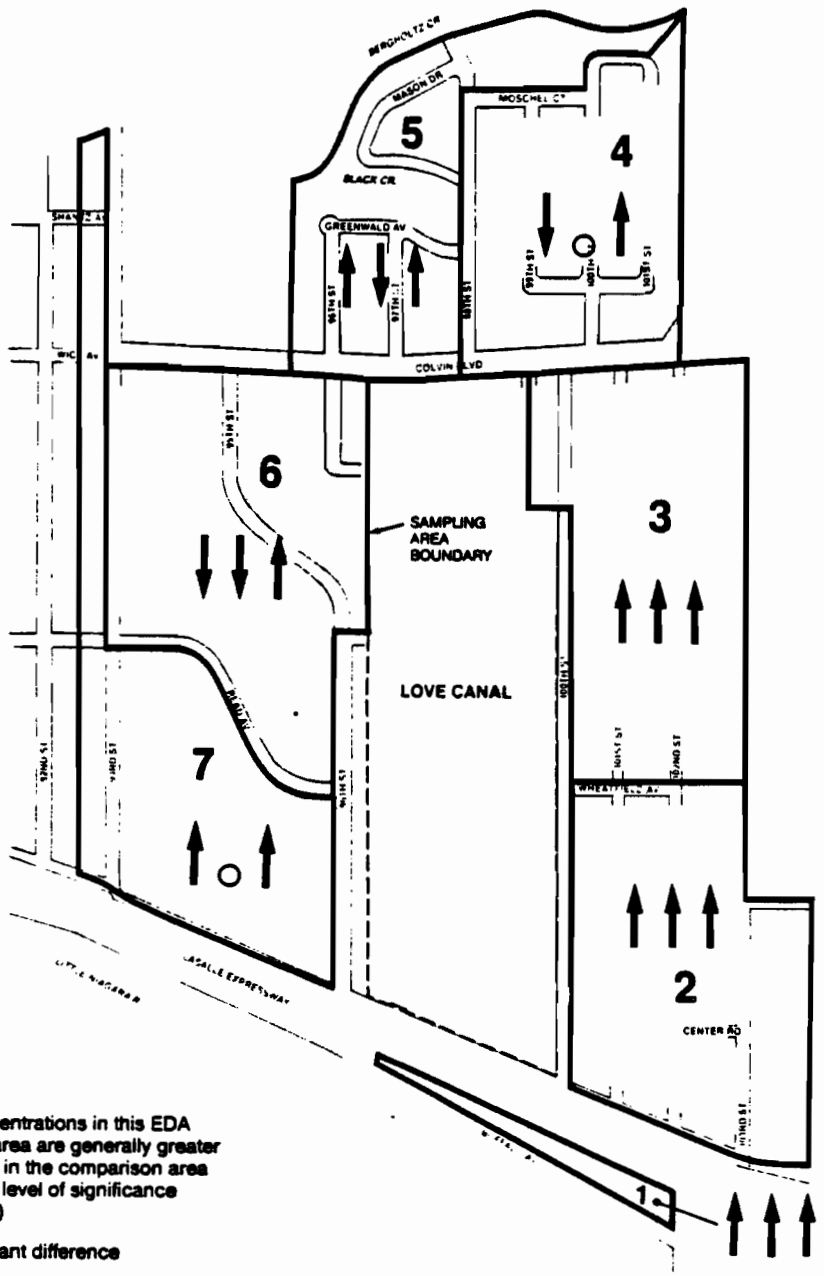
Comparisons carried out for the original 13 neighborhoods separately produce the same results as the comparisons for the sampling areas (i.e., neighborhoods 2 - 5, which comprise EDA 2 - 3, each had significantly higher LCICs in soil than were found in soil from EDA 4 - 7 and the comparison areas). Aggregating neighborhoods in EDA 2 and 3 differently (i.e. combining neighborhood 2 with 4 and 3 with 5 instead of neighborhood 2 with 3 and 4 with 5) also has no effect on the comparisons. Thus, there are no neighborhoods within the sampling areas which are significantly more or less contaminated than the sampling areas themselves.

Three "sensitivity analyses" were conducted to examine whether the results of the comparisons are the consequence of differences in the low levels of contamination or differences in the high levels of contamination between the various areas. The first of these analyses removed the highest 10% of each LCIC reported in each area and repeated the comparisons. The other analyses compared the LCICs in the various areas when values less than 1.0 or 2.0 ppb were considered as not detected.

In EDA 1 the comparisons were not sensitive to (i.e. were not altered by) these changes to the data. However, the differences between EDA 2 - 3 and the comparison areas were sensitive to these changes in a manner which indicates that the statistical differences are the consequence of low levels of contamination rather than high levels. In EDA 2 - 3, if the upper 10% of all data for each LCIC is removed from the data, significant differences are unaffected or increase in significance. If all reported values < 1.0 ppb are considered as not detected, several of the significant differences diminish in significance or vanish. If all reported values < 2.0 ppb are considered as not detected, most of the significant differences vanish. Thus, the significant differences in soil LCIC levels between EDA 2 - 3 and the comparison areas are primarily the consequence of low levels (< 2 ppb) of contamination in EDA 2 - 3.

Discussion of Habitability Study findings

Until the Habitability Study, data on environmental contamination in the EDA and in comparison (control) areas in western New York was largely focused on contamination in the areas immediately adjacent to the Love Canal (Rings I and II) and potential routes of chemical migration from the Love Canal. Samples by DOH, DEC, and EPA included indoor and ambient air, soil, ground and surface water, stream sediments, sump water and sediment, sanitary and storm sewer contamination, and biota.



LEGEND:

↑ LCIC concentrations in this EDA sampling area are generally greater than those in the comparison area at the 0.05 level of significance (two-sided)

○ No significant difference

↓ LCIC concentrations in this EDA sampling area are generally less than those in the comparison area at the 0.05 level of significance (two-sided)

Comparison area symbols are in the following order:

CT221 CT225 CK & TON

NOTE: The direction of the difference between the EDA and Comparison areas is based on the sign of the sum of the elements of the 8 × 1 vector of rank-sums (Appendix B).

SOURCE: Neighborhood boundaries adopted from the Proposed Habitability Criteria document (NYSDOH and DHHS/CDC, 1986)

Figure 9

SOIL ASSESSMENT — INDICATOR CHEMICALS
SUMMARY OF MULTIVARIATE COMPARISONS
(LCICs AS A GROUP)
EDA SAMPLING AREA TO COMPARISON AREA

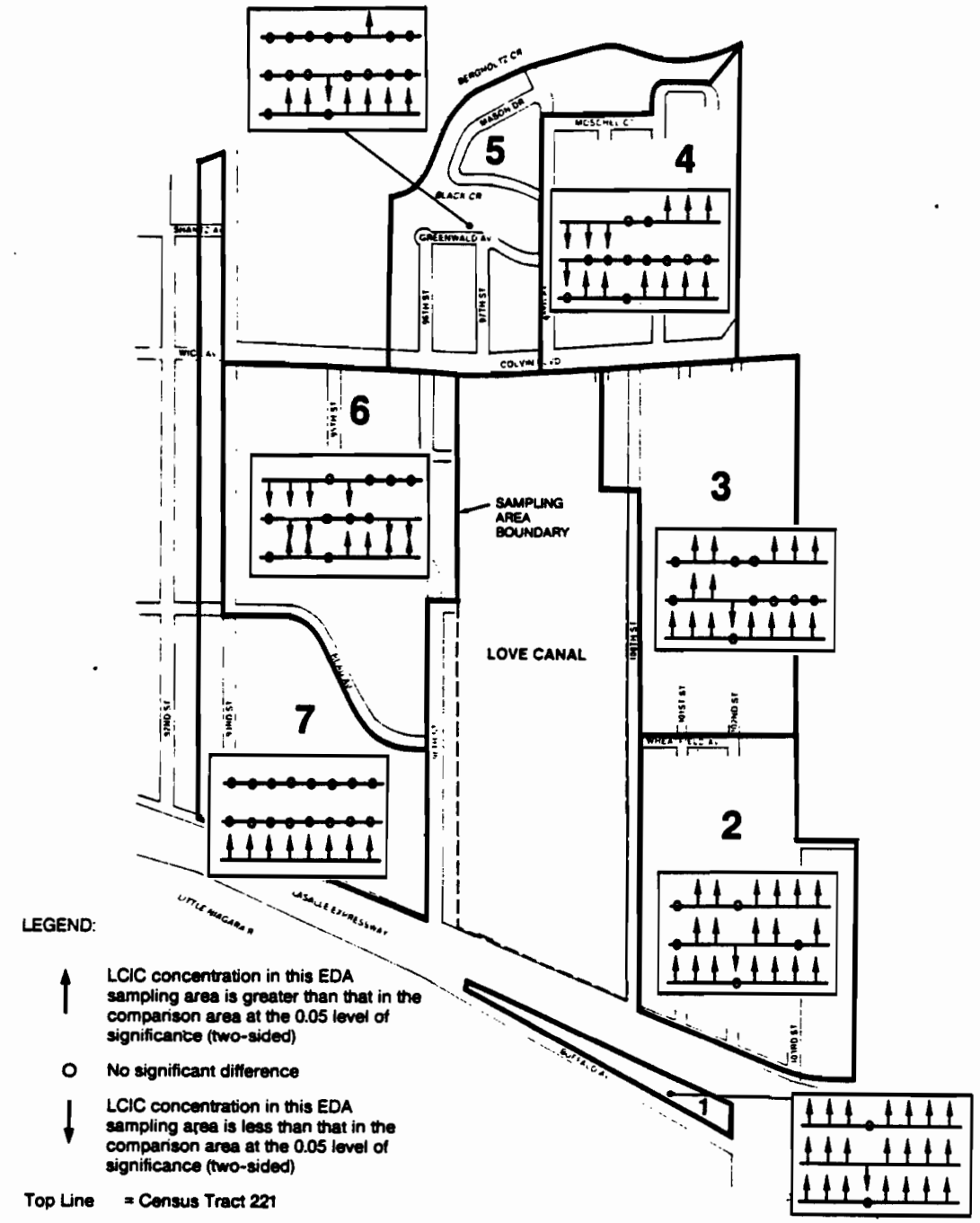
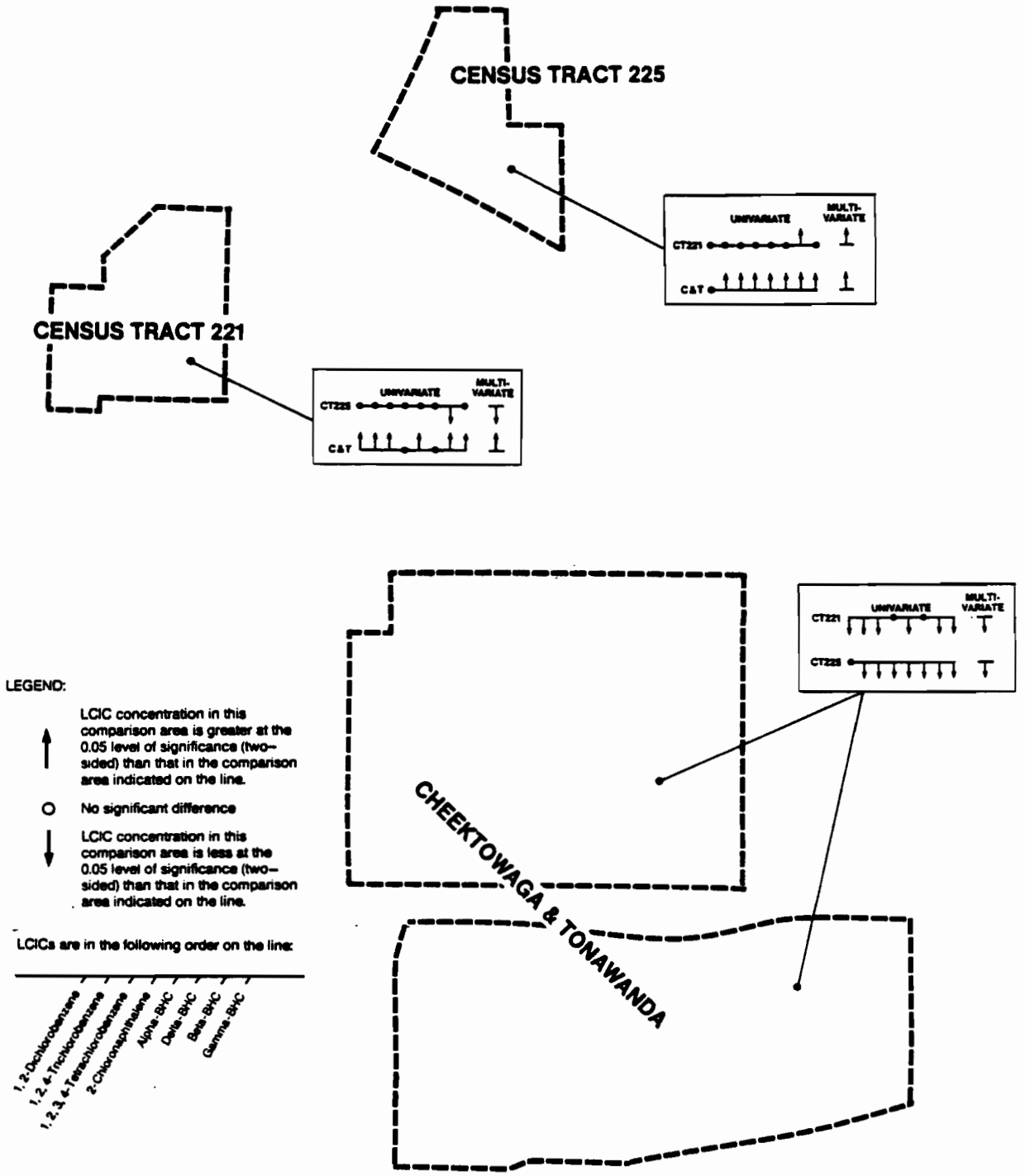


Figure 10

SOIL ASSESSMENT — INDICATOR CHEMICALS
SUMMARY OF UNIVARIATE COMPARISONS:
EDA SAMPLING AREA TO COMPARISON AREA



NOTE: The direction of the difference between the EDA and Comparison areas for the Multivariate comparison is based on the sign of the sum of the elements of the 8 × 1 vector of rank-sums (Appendix B).

SOURCE:
LOVE CANAL EMERGENCY DECLARATION AREA HABITABILITY STUDY FINAL REPORT: VOLUME III, SOIL ASSESSMENT–INDICATOR CHEMICALS

Figure 11

SOIL ASSESSMENT —INDICATOR CHEMICALS SUMMARY OF STATISTICAL COMPARISONS: COMPARISON AREA TO COMPARISON AREA, UNIVARIATE AND MULTIVARIATE

In these earlier studies, sampling of indoor and ambient air found chlorobenzene and chlorotoluene levels as high as 172 ug/m^3 (32.7 ppb) and 7650 ug/m^3 (1683 ppb), respectively, in addition to a large number of other chemicals. The highest levels were found in homes immediately adjacent to the Love Canal (Rings I and II). In soil, dichlorobenzene as high as 240 ug/kg (ppb), trichlorobenzene as high as 64 ppb, and gamma-BHC as high as 20 mg/gm (20,000 ppm) were found along with a number of other chemicals. Dioxin levels were quite elevated in storm sewers adjacent to the Love Canal (up to 312 ppb) and in creek sediments (up to 14 ppb) and less elevated in soils (up to 6.7 ppb). Dioxin was not detected in the few soil samples taken in the EDA.

Thus, in summary, the Habitability Study assessments of air and soil contamination by LCICs and dioxin found considerably lower levels of contamination in the EDA than were found previously in Rings I and II immediately adjacent to the Love Canal and in the storm sewers and creek sediments.

Potential explanations for chemical levels found in the EDA

In general, the levels of chemicals identified by the Habitability Study in the EDA are very low. However, when assessing environmental contamination, negative findings are not as conclusive as positive findings. For example, if small areas of high contamination are suspected and potentially of public health concern, sampling cannot absolutely exclude the possibility that such small areas might exist and not have been found. Therefore, information about the movement of chemicals from the Love Canal to parts of the EDA is of importance to the habitability decision as it provides greater insight into the causes of observed levels of chemicals in the area and potentially greater assurance that the generally negative findings have not overlooked important contamination. In addition, the methods one might choose to remedy contamination would be influenced by an understanding of how the area most likely became contaminated.

Chemicals from the Love Canal may have migrated or been moved to the EDA through various pathways. These include:

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 gases and contaminated fugitive dust, and
4. use of contaminated soil from the Love Canal as fill in the EDA.

No definitive conclusion can be reached regarding the contribution of of one or more of these pathways to the migration or movement of Love Canal chemicals. However, data from this and earlier Love Canal studies suggest that certain pathways are more likely than others to have been routes of migration for Love Canal chemicals into the EDA.

Kim, et al (1980) summarized early studies designed to evaluate the first two potential migration pathways. Contamination of homes in Ring I (abutting the Love Canal) clearly resulted from leaching of Canal chemicals through the soil and on the surface into yards and basements. Significant contamination of the storm sewers was attributed to surface runoff via drains and the pumping of sumps in homes with contaminated basements. Migration through permeable fill around utility lines was not a significant route of transport except along Frontier Avenue. The authors believed that waterborne transport of chemicals before the filling of swales remained a possibility, and they reported random "trace contamination" in fill materials from the major swale, consistent with the use of chemically contaminated soil to fill swales. The authors also acknowledged deposition of dust and gases as a possible mechanisms of migration prior to remedial activities.

The Habitability Study was not designed to evaluate the importance of various mechanisms of transport or migration of chemical contamination from the Canal. However, the data were statistically evaluated to identify significant spatial trends or patterns suggesting the presence of "hot spots" or gradients from the Canal. No such patterns were detected in the EDA by the statistical procedures used.

The patterns of contamination observed in this study have been reviewed in relation to their consistency with the potential mechanisms of transport or migration and previous studies. The one location where dioxin was found at 17-35 ppb in the surface seven inches of soil coincides with the major swale investigated previously and is located at least 500 feet from the Love Canal. Previous studies (Kim, 1980) included core samples into the swale closer to the Love Canal and nearby. The localized nature of the contamination and its association with the soil surface suggests that this contamination is not from remnant or active leachate along the swale. Soil cores taken in 1979 in the vicinity of this sample location found the bottom of the swale at least three feet below the current soil surface. Such contamination could be the result of filling the area with contaminated soil; however, one might expect less discrete and less severe contamination were this the source. Another possible source could be the leakage of contaminated liquids from a truck transporting wastes from the sewer cleaning to the de-watering facility across the street. Residents reported that these trucks were observed on occasion to park on the vacant lot awaiting access to the de-watering facility. However, this source of contamination should not produce such high levels of contamination below the first two inches of soil as were observed, because the dioxin would probably remain associated with particulate material or be adsorbed to soil particles near the surface.

The dioxin and dibenzofuran congeners present at this location suggest that the dioxin is from trichlorophenol wastes, a type of waste known to have been disposed at the Love Canal, rather than some other source such as fly ash. Soil LCICs found in this sample also suggest that the contamination is of Love Canal origin.

The levels of LCICs (chlorobenzenes and BHCs) in soil of EDA 4 - 7 are not significantly different from those found in the Niagara Falls comparison areas. A pilot study evaluating the feasibility of conducting the soil assessment found additional neighborhoods in Niagara Falls with elevated chlorobenzene levels.

Statistically higher levels of contamination by LCICs in EDA 2 - 3 are attributable to low-level soil contamination, primarily concentrations in the <2 ppb range. Such differences are most consistent with contamination from atmospheric transport and deposition/precipitation of contaminated dust and gases from the Canal particularly during the period of active dumping (1942-1953). These data neither refute nor confirm the hypothesis that small quantities of contaminated fill might have been used in EDA 2 - 3 because the sampling was not designed to find small areas of contamination.

Overall, contamination levels for LCICs in EDA 1 are higher than other areas sampled in the habitability study The second highest dioxin result (0.92 ppb) was also found in EDA 1. The extent of dioxin contamination is unknown except that, within 100 feet of this location, two other samples did not detect dioxin and another detected 0.07 ppb. Disposal of wastes at the 102nd Street landfill (across the street) may also have contributed to contamination of EDA 1.

STATUS OF REMEDIAL ACTIONS AND LOVE CANAL CONTAINMENT

Remedial actions at the Love Canal have been directed by the DEC and EPA. A summary of these actions and their effectiveness can be found in the Supplement to the Love Canal Emergency Declaration Area Proposed Habitability Criteria Appendix 6 prepared by DEC in September 1988. Highlights are presented below.

Description of remedial actions

Beginning in October 1978, the City of Niagara Falls, working with DEC and a consultant, began construction of barrier drains to confine migration of chemicals from the Love Canal. By December 1979, a leachate treatment facility was constructed and operating, and in July 1980 DEC completed the placement of a 22-acre, three-foot thick clay cap over the landfill to prevent human contact with the waste, to reduce water infiltration into the waste, and to reduce air emissions. Monitoring of groundwater elevation and chemical quality soon thereafter revealed that considerable recharge was occurring at the toe of the cap and chemical contaminants were present in groundwater beyond the zone of influence of the barrier drain system. As a consequence, in 1981-82 additional work was designed which was completed by late 1984. The work included: 1) the abandonment, plugging and cleaning of storm and sanitary sewers immediately adjacent to the Love Canal (Rings I and II); 2) inspection, cleaning and repair of the barrier drain; and 3) the installation of a new, expanded cap with a synthetic liner and soil over approximately 40 acres.

During 1983, DEC directed sampling of storm and sanitary sewers and Black and Bergholtz Creeks where high levels of dioxin had been found. On May 6, 1985, EPA issued a Record of Decision requiring the clean-up of storm and sanitary sewers and sediments in Black and Bergholtz Creeks. Between December 1985 and November 1987, approximately 63,400 linear feet of storm and sanitary sewers in the vicinity of the Love Canal were cleaned and inspected to ensure that contaminated sediments were removed. Approximately 315 cubic yards of sediments were removed from the sewers, de-watered and stored in drums on the Love Canal site.

On October 26, 1987, EPA signed a Record of Decision which provided for temporary storage of the creek sediments (15,000 cubic yards) and associated construction materials (10,000 cubic yards) in a secure containment facility at the Love Canal site and permanent destruction of all remedial wastes (sewer and creek sediments and treatment plant sludges). The excavation of contaminated sediments from the creeks is scheduled to be carried out in 1989. The wastes will be stored on-site until they can be treated with a transportable thermal destruction unit also to be located at the site. Thermal destruction will not proceed until the technology can be demonstrated at the site. The currently proposed plan calls for the incineration of these wastes during 1993. After treatment the residual materials will be disposed on site.

On September 26, 1988 the EPA issued a Record of Decision (ROD) for the 93rd Street School site. The ROD calls for excavation of approximately 7500 cubic yards of contaminated soil followed by on-site solidification/stabilization and on-site burial of the solidified soil with a low-permeability cover. Before the treatment process is implemented, treatability studies must demonstrate adequate treatment. If implemented, additional groundwater sampling will be performed to monitor the effectiveness of the treatment.

Effectiveness of remedial actions

The effectiveness of each part of the remedial program has been assessed as the work is completed. For example, the sewers were inspected by television camera to ensure that sediments were removed, and all contract work has been extensively supervised by DEC staff. Operation of the treatment plant is regularly monitored and periodically inspected by EPA and DEC. Monitoring records demonstrate that leachate from the barrier drain is heavily contaminated with a variety of Love Canal chemicals, and the treatment process significantly reduces chemical contamination before it is discharged to the sanitary sewer. The creek excavation and operation of the thermal destruction facility will also be monitored extensively.

DEC has assessed the effectiveness of the barrier drain by gathering extensive data from groundwater monitoring wells placed in the vicinity of the Love Canal. DEC reports that measurements of the elevation of groundwater and its chemical quality indicate that:

1. In the overburden soils (upper 20-40 feet) groundwater under the cap flows toward the barrier drain both laterally and upward from beneath the drain.

2. Overburden and bedrock groundwater outside the fenced area has been analyzed for more than 100 chemicals, mostly chlorinated hydrocarbons. Most chemicals are reported as less than the detection limit.

3. Some chemicals have been consistently reported from a number of monitoring wells. However, with one exception (BHCs), no LCICs have been reported. The BHCs were identified in one well in the last round of testing at levels which could not be quantified. This finding will be investigated further as part of the continuing monitoring program.

HABITABILITY CONCLUSIONS

The comparison approach employed for assessing levels of LCICs in soil explicitly assumes that the comparison areas are "habitable" or "normal" for the region and assumes that the presence of higher levels of LCICs in parts of the EDA implies that these and other chemicals associated with the Love Canal have migrated or were displaced from the Love Canal. The absence of a finding of significant differences between certain areas of the EDA and comparison areas does not provide assurance that such areas are "risk free". Finding significant differences in EDA 1 - 3 does imply additional risks from Love Canal chemicals to persons residing in these areas. However, for EDA 2 - 3 these differences are the result of very low-level contamination (< 2 ppb) by indicator chemicals. Median concentrations of these chemicals are, at worst, only slightly higher than median levels of these chemicals in the rest of the EDA and Niagara Falls comparison areas. If one assumes that other Love Canal chemicals not measured as part of the Habitability Study are potentially present, the concentrations should be similarly low and the additional risks associated with Love Canal chemicals in EDA 2-3 are probably very slight. However, the risks cannot be better quantified without additional information about the levels of other Love Canal chemicals which are presumed to be present.

EDA 1

EDA 1 does not meet the criteria established for habitability. Thus, this area is not suitable for normal residential use without remediation of contaminated soil. Prior to remediation, additional studies would be required to determine the extent and magnitude of soil contamination in the area. However, this area may be used for other purposes (e.g. commercial, industrial) without remediation.

Levels of LCICs in soil from EDA Area 1 are significantly higher than LCIC levels in soil from comparison areas in Niagara Falls, Cheektowaga and Tonawanda and from the rest of the EDA. Median LCIC levels in soil from Area 1 are 2-80 times higher than elsewhere in the EDA or comparison areas. In EDA 1, more than five of the LCICs are relatively high (in the top 20% of all values in the EDA for each LCIC) at all but two sample locations. These differences clearly indicate contamination by chemicals from the Love Canal or the 102nd Street Landfill.

EDA 2 - 3

Although data for the soil indicator chemicals suggest that chemicals from the Love Canal may have moved to EDA 2 - 3, median and extreme levels of these chemicals are quite low. Despite the lessened likelihood of adverse consequences to human health when compared to EDA 1, these areas do not meet the criteria for unrestricted residential use. Additional remedial actions could require a re-evaluation of the comparison data and the kinds of risk posed by the residual chemical contamination.

Levels of LCICs in soil from EDA 2 - 3 are statistically higher than LCIC levels in soil from comparison areas in Niagara Falls, Cheektowaga and Tonawanda and from the rest of the EDA. However, the differences between EDA 2 - 3 and the comparison areas are the consequence of differences in low-level soil contamination (primarily concentrations in the <2 ppb range), and the median levels of contamination (2.6 ppb for combined chlorobenzenes and 0.64 ppb for total BHCs) are only slightly higher than those found in Niagara Falls and the rest of the EDA (1.4 ppb for combined chlorobenzenes and 0.18 ppb for total BHCs).

Dioxin was found at one location in Area 3 at levels of 17-35 ppb. The contamination was localized to an area within a radius of a few feet and to a depth of 7 inches with a lower concentration (5.9 ppb) at 7-12 inches. The contaminated soil will be removed and remaining soil resampled to determine actual depth of the contamination. At two additional locations in Areas 2 - 3 dioxin exceeded 0.6 ppb but not 1 ppb.

This contamination of EDA 2 - 3 soil with LCICs may be the consequence of airborne transport and deposition/precipitation of chemicals from the Love Canal prior to remedial actions at the site. This probably occurred during the period of active dumping (1942-1953). Small amounts of contaminated soil from the Love Canal may have been used to fill depressions; however, extensive contamination from this activity can be ruled out. The dioxin contamination may have resulted from the use of contaminated fill material or may be the consequence of a very small leak of contaminated sewer sediments being transported to the de-watering facility at the Canal. The current dioxin sampling indicates that extensive areas of dioxin in excess of 1 ppb in surface soils do not exist in the EDA and that the chance of additional small areas of such dioxin contamination existing elsewhere in the EDA is quite small.

EDA 4 - 7

EDA 4 - 7 can be considered habitable according to the criteria.

Although LCIC levels in soil from EDA 4 - 7 are statistically higher than levels in soil from Cheektowaga and Tonawanda, the levels are not in any consistent way significantly higher than levels in soil from Niagara Falls comparison areas. Potential sources of LCICs other than the Love Canal exist in the Niagara Falls area and could have contributed to soil contamination throughout Niagara Falls to a greater extent than soils in Cheektowaga and Tonawanda. The overall levels of contamination in these areas as measured by the median concentration are not very different, and any additional public health risks are probably very small.

ADDITIONAL AND CONTINUING REQUIREMENTS

The conclusions on habitability of the EDA assume that safeguards will continue to prevent further leakage from the Love Canal. Thus, the containment and leachate treatment system will be maintained and operated under effective, continuous and clearly accountable management; and the effectiveness of the containment and leachate treatment system will continue to be monitored and reported on an annual basis. The DEC is committed to implementing these actions.

In addition to these important future commitments, areas affected by the creek excavation which is planned for 1989 should not be resettled until the excavation is complete. In the immediate vicinity of the excavation and routes of transport of the creek sediments a spill or other accident, albeit unlikely, could occur. These and other nearby areas will be affected by the noise, traffic, and other nuisances associated with the use of heavy construction equipment. Finally, exposing and excavating the creek sediments could produce noxious odors from the decaying organic matter in the sediments. For these reasons:

1. Until creek excavation is complete, sale and transfer of properties adjacent to the area of excavation in Black and Bergholtz Creeks should not proceed.

2. Similarly, sale or transfer of properties along the routes used by trucks carrying excavated sediments should be postponed until such transportation is completed.

3. Other habitable areas in the EDA may be subject to intermittent odors, noise and other nuisances that should be considered before persons from outside the EDA are encouraged to move into the EDA. At the least, prospective residents should be thoroughly informed of such potential nuisances before purchasing homes and moving in.

Health studies of present and former residents will be continued to assess the effects of exposure to the Love Canal before remediation. The feasibility and usefulness of small-animal surveillance for monitoring the efficacy of containment will also be assessed. These assessments will be reported in a timely manner.

REFERENCES

CDC and DOH. December 1986. Love Canal Emergency Declaration Area: Proposed Habitability Criteria

DEC. September 1988. Supplement to the Love Canal Emergency Declaration Area Proposed Habitability Criteria Appendix 6.

DOH. April 1981. Love Canal: A Special Report to the Governor and Legislature.70 pp.

Kim, CS, R Narang, A Richards, K Aldous, P O'Keefe, R Smith, D Hilker, B Bush, J Slack, and D Owens. 1982. from Hazardous Waste Disposal: Assessing the Problem, ed. JH Highland, pp. 77-94, Ann Arbor Publishers.

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

Volume I - Introduction and Decision-Making Documentation, 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.

APPENDIX A. LCICS IN SOIL OF THE LOVE CANAL EDA

Dichlorobenzene (concentrations as parts per billion)

Sampling Area	N	Median	95 percentile	Maximum
1	39	1.01	4.22	5.65
2+3	141	0.40	1.36	19.8
4-7	310	0.37	0.93	3.19
221+225	108	0.40	1.01	1.4
4-7+221+225	418	0.38	0.96	3.19
C&T	57	0.36	1.01	1.38

Trichlorobenzene

Sampling Area	N	Median	95 percentile	Maximum
1	40	8.67	41.2	45.1
2+3	155	0.89	6.34	167
4-7	317	0.47	3.24	35.7
221+225	113	0.64	2.97	33.1
4-7+221+225	430	0.51	3.07	35.7
C&T	60	0.14	0.31	0.92

Tetrachlorobenzene

Sampling Area	N	Median	95 percentile	Maximum
1	37	11.5	52.4	67.2
2+3	154	1.09	8.41	66.7
4-7	313	0.39	2.87	182
221+225	111	0.56	3.31	64.3
4-7+221+225	424	0.44	2.85	182
C&T	61	0.05	0.18	0.84

Chlorobenzenes

Sampling Area	N	Median	95 percentile	Maximum
1	36	21.5	97.6	102
2+3	140	2.61	15.8	232
4-7	304	1.34	6.88	195
221+225	106	1.70	7.77	98.7
4-7+221+225	410	1.44	6.87	195
C&T	56	0.55	1.77	2.14

Alpha-BHC (concentrations as parts per billion)

Sampling Area	N	Median	95 percentile	Maximum
1	39	8.25	35.1	69.7
2 + 3	154	0.29	4.41	100
4-7	318	0.13	2.01	153
221 + 225	113	0.14	2.34	34.0
4-7 + 221 + 225	431	0.13	2.11	153
C&T	61	ND	0.01	0.17

Delta-BHC

Sampling Area	N	Median	95 percentile	Maximum
1	39	1.13	9.83	38.8
2 + 3	151	ND	0.84	80.0
4-7	311	ND	0.30	9.96
221 + 225	111	ND	0.35	5.4
4-7 + 221 + 225	422	ND	0.30	9.96
C&T	61	ND	ND	ND

Beta-BHC

Sampling Area	N	Median	95 percentile	Maximum
1	39	11.6	72.2	102
2 + 3	147	0.17	5.77	51.2
4-7	286	ND	2.06	4108
221 + 225	103	ND	1.61	50.6
4-7 + 221 + 225	389	ND	2.02	4108
C&T	59	ND	ND	5.36

Gamma-BHC

Sampling Area	N	Median	95 percentile	Maximum
1	40	1.73	12.2	21.0
2 + 3	152	0.01	1.78	12.7
4-7	317	ND	0.73	85.6
221 + 225	113	ND	0.87	80.8
4-7 + 221 + 225	430	ND	0.68	85.6
C&T	59	ND	ND	0.04

Total BHCs

Sampling Area	N	Median	95 percentile	Maximum
1	37	22.3	109	164
2 + 3	142	0.64	16.8	137
4-7	284	0.17	6.22	4324
221 + 225	102	0.21	7.42	106
4-7 + 221 + 225	386	0.18	6.26	4324
C&T	58	ND	0.11	5.36