2021 Hazardous Waste Scanning Project

File Form Naming Convention.

(*File_Type*).(*Program*).(*Site_Number*).(*YYYY-MM-DD*).(*File_Name*).pdf

Note 1: Each category is separated by a period "."
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Specific File Naming Convention Label:

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LOVE CANAL

A Special Report
to the Governor
and Legislature

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April 1981

LOVE CANAL Epidemiologic Studies

All of the State Health Department's previous, on-going and planned epidemiological studies at Love Canal are motivated by a single concern: to determine the nature, degree and source of excessive health risks, if any, faced by persons who presently or ever lived near the landfill.

This concern stems from the knowledge that many of the more than 100 chemicals identified in soil, sump and air samples at the Love Canal are capable of causing acute and chronic toxic reactions in man (see Table I). For example, long-term exposure to benzene has been shown to cause leukemia and suppress bone marrow function; when ingested in sufficient quantity, lindane can cause convulsions; chloroform and carbon tetrachloride can cause liver damage; and dioxin -- one of the most toxic chemicals known to man -- has been linked to cancer and birth malformations in laboratory animals.

Thus, varied health studies carried out by Health Department researchers since 1978 have focused on the most likely indicators of acute and chronic chemical toxicity, including: reproductive outcome, liver function, respiratory ailments, convulsive disorders, skin problems and cancer incidence.

In the spring, summer and fall of 1978, staff of the department's Bureau of Environmental Epidemiology and Occupational Health conducted more than 11,100 field interviews in the Niagara County area, most involving residents of the Love Canal neighborhood, their physicians and control populations. A standard, 22-page questionnaire was administered, covering the subjects' health and medical histories and a diligent effort was made to corroborate all reports of illnesses through followup interviews with physicians and by consulting hospital and medical records.

With the aid of local health personnel and technicians from Roswell Park Memorial Institute, 4,386 blood samples were obtained from 3,919 persons, involving 114,036 separate blood tests. Those tested were notified of results via their private physicians.

Blood Test Findings: Liver function, as determined through blood analysis, was selected as a factor for immediate investigation since the liver serves as a highly sensitive indicator of toxic exposure and recent experimental studies have linked some of the chemicals found in the landfill with liver disease or cancer.

Preliminary evaluation of liver function tests suggested that persons residing on 97th and 99th streets bordering the landfill may face a greater than expected risk of developing liver disease. None of the individuals with abnormal test results, who were examined by their family physicians, however, presented clinical evidence of liver disease.

The Health Department presented this data on November 10, 1978 to an outside "blue ribbon" panel of experts in various fields of epidemiology, toxicology, hepatology, clinical and environmental medicine who concluded that the biochemical abnormalities detected did not represent a manifestation of liver disease. Repeat liver function tests for residents relocated from the canal showed a return to normal in most cases.

...test data reviewed by scientific panel

Examination of the results of complete blood counts performed as part of the preliminary health survey indicated that the incidence of blood cell disorders including anemia was within expected limits for the population under study.

Survey Results: Particular emphasis was placed on detection of various skin disorders among Love Canal residents, since the skin is the most obvious point of chemical exposure. Researchers found no documented evidence of chloracne, an eruptive skin disorder that has been associated with acute exposure to dioxin, polychlorinated biphenyls (PCBs) and related chemical compounds. Currently in progress is an investigation of other less serious skin disorders among residents living immediately adjacent to the landfill.

TABLE I

POTENTIAL HEALTH EFFECTS OF CHEMICAL COMPOUNDS IDENTIFIED AT LOVE CANAL

COMPOUND	ACUTE EFFECTS	CHRONIC EFFECTS
benzaldehydes	allergen	
benzene	narcosis skin irritant	acute leukemia aplastic anemia pancytopenia chronic lymphatic leukemia lymphomas (probable)
benzoic acid	skin irritant	
carbon tetrachloride	narcosis hepatitis renal damage	liver tumors (possible)
chloroform	central nervous narcosis skin irritant respiratory irritant gastrointestinal symptoms	
dibromoethane	skin irritant	
dioxin	chloracne	nervous system disorders psychologic abnormalities cancer, spontaneous abortions, liver dysfunction (indicated in animal studies)
lindane	convulsions high white cell counts	
methylene chloride	anesthesia (increased carboxy hemoglobin)	respiratory distress death
trichloroethylene	central nervous depression skin irritant liver damage	paralysis of fingers respiratory and cardiac arrest visual defects deafness
toluene	narcosis (more powerful than benzene)	anemia (possible) leukopenia (possible)

Since air-borne contamination is another likely route of exposure to Love Canal chemicals, the prevalence of various asthmatic and other respiratory conditions was weighed. Studies to date have failed to indicate any excessive incidence of respiratory diseases or disorders among Love Canal residents.

...chronic disease incidence surveyed

Using the Health Department's statewide cancer registry to examine all malignancies reported from the Love Canal census tract between 1955 and 1977, researchers found no apparent excess of any form of cancer among Love Canal residents. Health Department epidemiologists also failed to find an excessive incidence of convulsive disorders within the Love Canal population.

While such retrospective epidemiological surveys represent an important source of health data, it is important to point out several inherent shortcomings of such studies in determining potential adverse health effects attributable to chemical exposure: only the prevalence of disease, not the overall incidence of disease can be assessed; the effects of previous chemical exposure within the

study population may not yet be observable since there is a latency period in many diseases, which can be 20 to 30 years in the case of cancer.

The Department will continue to attempt to identify previous residents of the Love Canal area to determine the true incidence of cancer and other chronic diseases.

Adverse Pregnancy Outcomes: The sensitivity of the human reproductive process to toxic chemical exposure is well established, especially in the case of some pharmaceutical agents. It is also known that many chemicals are hazardous to the conceptus of lower animals, depending on dosage, route of administration and stage of gestation. Because of the wide variety of chemicals encountered at Love Canal, and the likelihood that various manifestations of toxicity were likely to be found, it was decided to examine three fetal endpoints of possible toxic chemical exposure: congenital defects, spontaneous abortions (miscarriages) and low birth weight.

...three fetotoxic endpoints examined

For comparison purposes, expected numbers of spontaneous abortions were derived from a report of Warburton and Fraser[1], which illustrated the frequency of miscarriages among 6,000 pregnancies experienced by women living in Canada, tabulated by both birth order and maternal age at conception. It should be noted that the Warburton/Fraser model is considered by many researchers to represent a conservative estimate of the incidence of miscarriages within the general population.

[1]D. Warburton, F.C. Fraser, Am. J. Human Genetics 16, 1 (1963)

...two control groups selected

Because of possible social and other demographic differences between the Canadian population and Love Canal women, a second control population was selected in a neighborhood just outside the Love Canal area (north of Colvin Boulevard). While this second control group had many demographic, social and other similarities to its Love Canal counterpart, it also had certain limitations, including the possibility that chemical contamination from the canal may have reached out to this neighborhood as well. Were this true, it might lessen the extent to which the rate of abnormal reproductive events among Love Canal women appeared to deviate from the expected.

The pregnancy outcomes of these two control groups were compared with those of women living immediately adjacent to the Love Canal (99th and 97th streets) and women living on historically dry lots or sections that had previously been under water or in the pathway of creeks that flowed through the area.

TABLE II

PREGNANCY HISTORIES AND AGE DISTRIBUTION
FEMALE RESIDENTS OF SPECIFIED SECTIONS OF THE LOVE CANAL
AND NORTH OF COLVIN AREA

Pregnancy History at Present Address	99th*	97th*	Water	Non-Water	North of Colvin
Women Ever Pregnant	22	20	49	98	66
Number of Pregnancies**	50	29	108	164	125
(Sets of Twins)	(1)		(2)	(2)	
Women with Live Births	21	19	44	92	64
Number of Live Births	39	26	83	144	110
Women with Miscarriages	7	3	16	16	11
Number of Miscarriages	12	3	25	21	11
Women with Birth Defect Child	4	0	7	7	7
Number of Birth Defect Children	4	0	10	7	8
Women with Low Birth Weight Child	1	0	10	6	3
Number of Low Birth Weight Children	1	0	13	11	3
Women with Stillbirths	0	0	2	1	3
Number of Stillbirths	0	0	2	1	4
Women with No Unfavorable+ Event	14	17	22	70	45
Women with an Unfavorable+ Event	8	3	27	28	21
Age (years) of Females					
Total++	89	90	208	474	343
0–14	26	29	49	138	62
15–29	14	27	65	121	90
30–44	20	17	35	96	62
45–59	21	15	44	73	86
60 and older	8	2	14	45	34

** Houses on the Canal*

*** Number of Pregnancies = (Live Births + Miscarriages + Stillbirths) Minus Twins*

+ Unfavorable Event: Miscarriage, Birth Defect Child, Stillbirth or Low Birth Weight Child

++ Total Includes Age Unknown

The pregnancy histories and outcomes of all women living in the general Love Canal vicinity as of June 1978 were examined, both prior to and following residence near the landfill. Table II summarizes the pertinent information concerning the age distribution and pregnancy histories of females in four sections of the Love Canal (97th and 99th streets and the water and non water sections) and the north of Colvin Boulevard control group. Over 98 percent of the population in each section was white, and no single ethnic group predominated.

...pregnancy histories compared prior to and after residence on canal

The same questionnaire was used throughout the investigation. Questions relating to the past health, therapeutic, social, occupational and pregnancy histories were obtained from all adult (and, where pertinent, child) residents in the course of a seven-month door-to-door survey. The field personnel administering the questionnaires remained constant throughout the study and had no prior knowledge of the specific hypotheses under investigation. Completed questionnaires were reviewed for completeness and possible inconsistencies by two groups of experienced supervisors, and subsequently by members of the department's statistical unit. An effort was made to confirm all reports of untoward reproductive outcomes through physician interviews and by checking vital and medical records.

Birth certificate information for all infants born to women from the Love Canal area was obtained from the department's Office of Vital Records. Birth weights were verified, and any infant weighing less than five pounds, eight ounces was considered a low birth weight infant. The proportion of low birth weight infants at Love Canal was compared with that for all of upstate New York during the period 1950-1977.

Table III describes the medically confirmed birth defects that occurred among children born to all women in the study group. When the ratio of congenital defects to live births was calculated and compared with control data, no significant excess of congenital defects was discerned in any of the Love Canal sections under study, with the possible exception of wetland homes, and then only when compared with historically dry properties (see Table IV). The import of this observation is questionable, however, due to the small number of birth defects involved.

...no significant excess of congenital defects identified

Similarly, historically wet properties were the only study areas in which there was a statistically significant excess of low birth weight babies. Compared with the other study populations, the relative risk of bearing a low birth weight infant was about 2.2 times greater for women living in homes on former wetlands. As shown in Table IV, there was only one low birth weight infant among the 65 births occurring among residents living directly adjacent to the Love Canal.

Statistical methods were employed to calculate the observed-vs.-expected ratios of spontaneous abortions to pregnancies to determine whether any significant excess of miscarriages may have occurred among any of the study populations. As shown in Table V, these analyses indicate that there may have been a slight excess of miscarriages among women living on 99th Street and those residing in historically wet sections of the Love Canal neighborhood.

No single month or season of the year predominated for the occurrence of spontaneous abortions or births of children with congenital defects. Analysis of the mean age at which pregnant women had moved into each of the four study areas also showed no significant difference. Evaluations indicated, however, that women living on 99th Street and in the traditional wet areas had, on the average, resided near the canal for a longer period during their childbearing years. The mean years of residence (during ages 15-44) for each study group was:

...slight increase of miscarriages and low birth weight infants on 99th St. and former wet areas

99th Street - 13.0; 97th Street - 9.4 years; water areas - 13.6 years; non water areas -10.4 years; and north of Colvin Boulevard - 12.6 years.

Collectively, these findings point to a slight to moderate excess of spontaneous abortions and low birth weight infants occuring in households on 99th Street bordering the landfill and in homes built on former wetlands in the canal area.

TABLE III

DOCUMENTED CONGENITAL DEFECTS AMONG CHILDREN BORN IN SPECIFIED AREAS OF LOVE CANAL AND NORTH OF COLVIN AREA

LOCATION TYPE OF MALFORMATION	SEX
97th & 99th STREETS*	
Congenital deafness	M
Reflux of ureters	F
Cleft palate, deformed ears and teeth, hearing defect, mental retardation, heart defect	F
Club foot	M
WATER AREA	
Prolapsed mitral valve	M
Non-functioning Rt. hydronephrosis	F
Born with 3 ears	M
Ears turned down	F
One kidney	F
Hydrocephalus	M
Club foot	F
Web toes	F
Web toes	M
Web toes	F

LOCATION TYPE OF MALFORMATION	SEX
NON-WATER AREA	
Inverted testicle	M
Absence of deciduous teeth	M
Extra toe	M
Obstruction of ureter	M
Disaccharide deficiency	M
No diaphragm	M
Severely retarded, eye defect, teeth defect	F
NORTH OF COLVIN	
Hypospadias penis	M
Deformed kidney	F
Incomplete left lip	F
Hydrocephalic-slepian eye, deafness	M
Mongolism	F
Diaphramic hernia	M
Immature lungs, pulmonary insufficiency	M
Congenital dysplasia of left hip	F

* Houses on the Love Canal

TABLE IV

PERCENT OF CHILDREN WITH LOW BIRTH WEIGHT OR CONGENITAL DEFECTS, BORN IN SPECIFIED AREAS OF THE LOVE CANAL

Location	Live Births	Children with Low Birth Weight+			Children with Congenital Defects		
		Number	Percent	p**	Number	Percent	p***
99th Street*	39	1	2.56	++	4	10.26	>.05
97th Street*	26	0	0.00	++	0	0.00	++
Rest of Love Canal Area	227	24	10.57	.017	17	7.49	>.05
Water	83	13	15.66	.001	10	12.05	>.05
Non Water	144	11	7.64	>.05	7	4.86	++

* Houses on the Canal
** Normal approximation, one-sided; sample proportion compared with population proportion 6.97 (Average for period 1950–1977, white births recorded in New York State, excluding New York City)
*** Normal approximation, one-sided; north of Colvin control (7.27)
\+ Defined as ⩽2500 grams ++ Observed was less than Population or Control

TABLE V

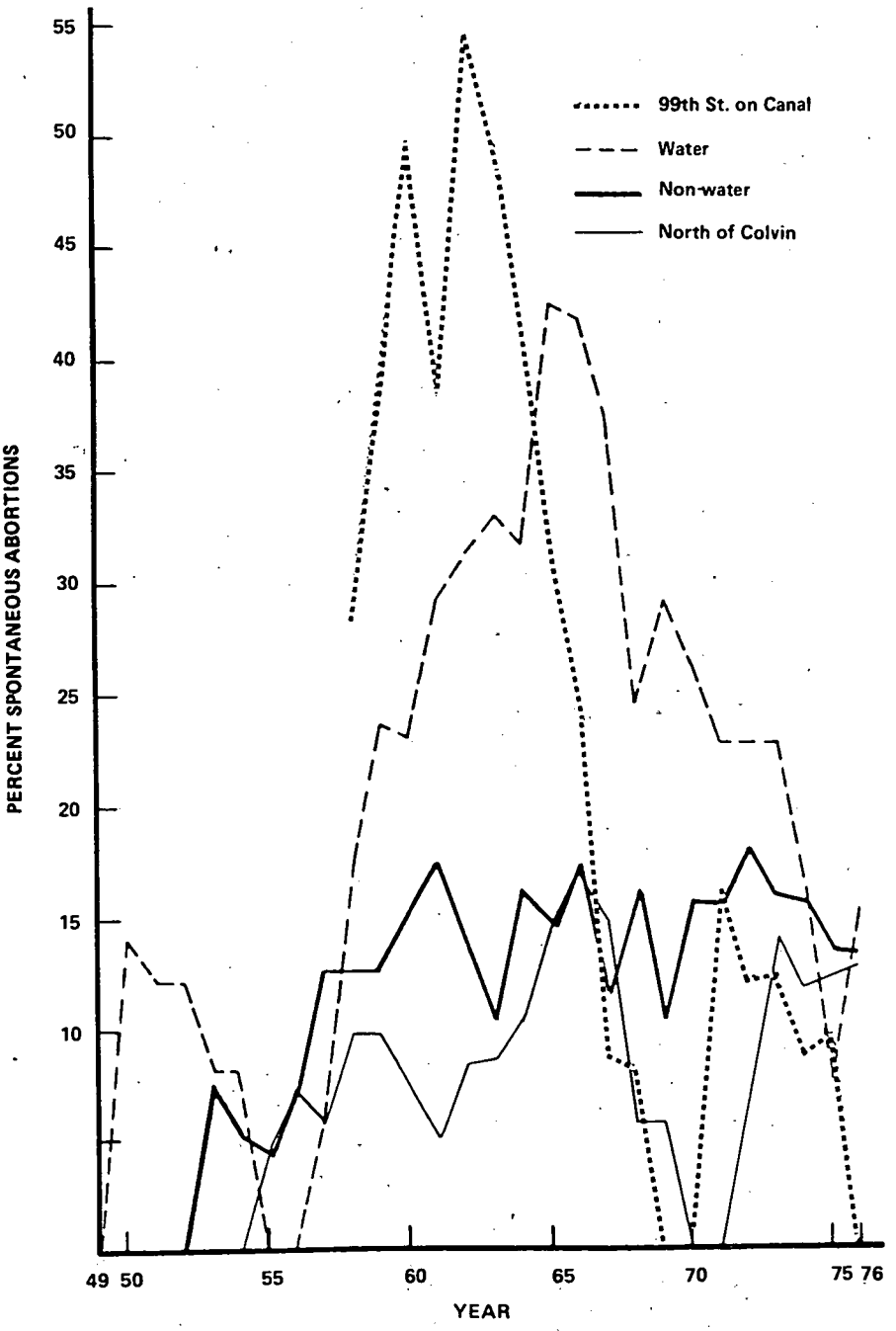
SPONTANEOUS ABORTION RATIOS OF OBSERVED TO EXPECTED NUMBERS* FOR SPECIFIED AREAS OF THE LOVE CANAL BASED ON TWO COMPARISON GROUPS

Area	Warburton & Fraser Comparison Group		North of Colvin Comparison Group	
	P	O/E	P+	O/E
99th Street**	.110	1.5	.007	6.0
97th Street**	***	0.7	>.05	1.2
Rest of Love Canal Area	>.05	1.1	.050	2.6
Water	.031	1.5	.007	3.4
Non Water	***	0.8	>.05	2.0

** Standardized for age and parity*
*** Houses on the canal*
**** Observed was less than expected*
\+ Mantel-Haensel chi square (one-sided test)

FIGURE I

PERCENT OF PREGNANCIES
TERMINATING IN SPONTANEOUS ABORTION
(Five-Year Moving Average)



An interesting phenomenon surfaced when researchers examined the percentage of pregnancies that resulted in spontaneous abortions during each of the past three decades among the various Love Canal study populations. As shown in Figure 1, the higher than expected number of miscarriages among 99th Street residents occurred between 1958 and 1964. A similar pattern is evident in the historic water areas; the highest percent of spontaneous abortions took place between 1959 and 1970.

...highest percent of spontaneous abortions occurred in 1960s

The apparent absence of an excessive number of miscarriages on 97th Street, adjacent to the canal, might be partially explained by the fact that many of the houses on this street were not built until the late 1960s and early 1970s. In contrast, the vast majority of homes on 99th Street were occupied by the early 1960s. Interestingly, the rise in spontaneous abortions occurring in the historic water areas began less than one year after landfilling was largely completed in the general area, which may serve to support the theory that contaminated fill dirt from the canal was used to level low-lying swale areas.

It has not yet been possible to correlate the geographic distribution of adverse pregnancy outcomes since 1950 with direct evidence of chemical exposure as measured in 1978 and 1979. The department's Division of Laboratories and Research is currently analyzing more than 3,600 soil samples taken from each of the 600 homes included in the pregnancy outcome study in an effort to identify a chemical or group of chemicals that may have been responsible for documented fetotoxic events in the canal area.

On-going Health Department Investigations: The studies described above were limited to persons who resided in the Love Canal area in the summer of 1978. But what of those individuals who once lived in the Love Canal area, especially during periods of active dumping, and subsequently moved away; have they experienced any adverse health effects?

To address this question, the Health Department's Bureau of Environmental Edpidemiology and Occupation Health is searching out an estimated 2,500 people who once lived in the Love Canal neighborhood and moved away. This search is national in scope; it will probably take at least another two years to complete. Thus far, about one-third of the target population has been located. Each former resident is being asked to complete a comprehensive questionnaire dealing with current and past health and medical history.

...search for previous canal residents continues

Our investigations dealing with the Love Canal also raised many important public health issues concerning the health implications of residence in communities that are highly industrialized and have large numbers of chemical dump sites. The department's Bureau of Environmental Epidemiology and Occupational Health is, therefore, conducting a series of investigations in Niagara and Erie counties to determine whether there are any unusual patterns of cancer or an excessive rate of miscarriages and other adverse pregnancy outcomes in these areas. Information from these studies will provide an essential data base for use in interpreting future environmental disasters of this type and for designing surveillance programs to monitor potential environmentally-related health hazards throughout the State.

The lesson of the Love Canal with respect to health impact assessment is clear: existing data banks do not yield sufficient scientific information in the time frame needed for policy decision making. Data needed to evaluate health impacts of chemical exposure must be collected through time-consuming interviews with the exposed population, and by consultation with physicians and verification of hospital records. The end result is that such studies take years to complete.

Two bills which were enacted during the 1980 legislative session, the "Environmental Disease Registry" law and the "Right to Know" law provide

...proposed registry of environmental and occupational exposures

the statutory basis for the development and implementation of a comprehensive epidemiological surveillance and research program to monitor the health impact of environmental and occupational exposure to toxic agents.

The Health Department is working with the State Public Health Council to develop and put in place the regulations needed to require the reporting of pertinent data. Computerized analyses of these data will facilitate the accurate and timely evaluation of suspected health hazards in communities and areas throughout the State, thus providing government with the information necessary for making decisions about environmental problems.

The surveillance program, as proposed, will create a new data base of environmental and occupational exposures to toxic substances. The three principal elements of the program are:

1. A disease registry of health endpoints which may signal toxic exposure, to include:
   a. adverse pregnancy outcomes, i.e., spontaneous fetal deaths, low birth weights and those congenital malformations clearly not genetic in origin;
   b. occupational lung diseases, such as lung cancer and pneumoconiosis;
   c. abnormal levels of heavy metals in blood and/or urine.
2. An occupational registry of employees exposed at their worksite to known or highly suspected human carcinogens.
3. Utilization of environmental data provided by the State Department of Environmental Conservation in order to broadly categorize various geographic regions of the State relative to the nature and quantity of environmental pollutants present there.

Long-term surveillance of exposed populations will also enable us to develop much needed information concerning the dosage and induction period for known human carcinogens. At present, we are totally dependent on animal models for these determinations, and these observations may not be transferable to humans. The ability to provide scientifically sound information regarding acceptable dose levels could have a positive impact on both government and industry, which now must proceed on the basis of stringent requirements extrapolated almost entirely from animal experimentation.

The surveillance program also proposes creation of an exposure registry which will allow epidemiologists to identify and follow exposed populations at risk from various diseases. Currently, such studies of disease associated with chemical exposure are very difficult to conduct because of the general inadequacies and inconsistencies of industrial exposure records.

The adoption of this surveillance program will permit the department to respond swiftly and expertly to requests for health impact assessments following exposure to toxic substances, and provide government policymakers with timely and sound scientific analyses of the evidence gathered.

Federal and Private Health Studies: Aside from the State's epidemiologic investigations, three additional studies bearing on chronic disease incidence at the Love Canal have been undertaken and reported to date.

In January 1980, the Biogenics Corporation of Houston, under contract with the federal Environmental Protection Agency, carried out a cytogenetic study involving analysis of blood specimens from 36 Love Canal residents. The chromosomes in 11 of the 36 individuals tested were regarded somewhat abnormal by the researchers. This study is considered controversial by many medical experts due to the small number of subjects tested and the absence of a contemporary control population.

A neurologist at the State University of New York at Buffalo undertook a nerve conduction study of a small number of Love Canal residents in the spring of 1980. The results of this study were essentially negative, with no statistically

significant differences detected between nerve conduction velocity in the 35 Love Canal residents tested and a matched control group of 20 persons living elsewhere.

An informal survey of pregnancy outcomes and chronic disease incidence was conducted by a medical consultant to the Love Canal Homeowners Association and reported in testimony on March 21, 1979, before the House Subcommittee on Oversight Investigations. The excessive rates of fetotoxic events and disease incidence directly attributed to chemical pollution in this study have been questioned by epidemiologists due to the lack of adequate control groups, and failure to medically validate anecdotal information reported on questionnaires.

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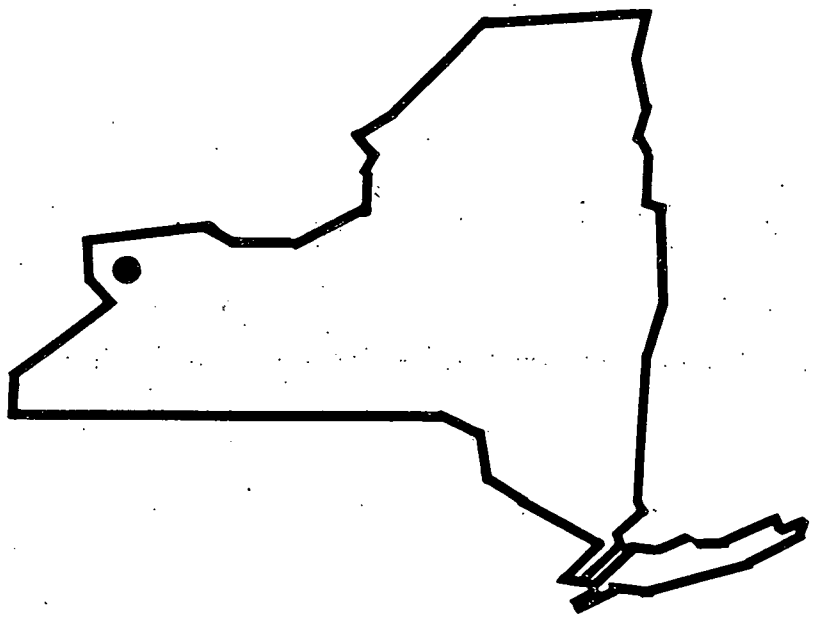
A Special Report to the
Governor & Legislature

LOVE CANAL



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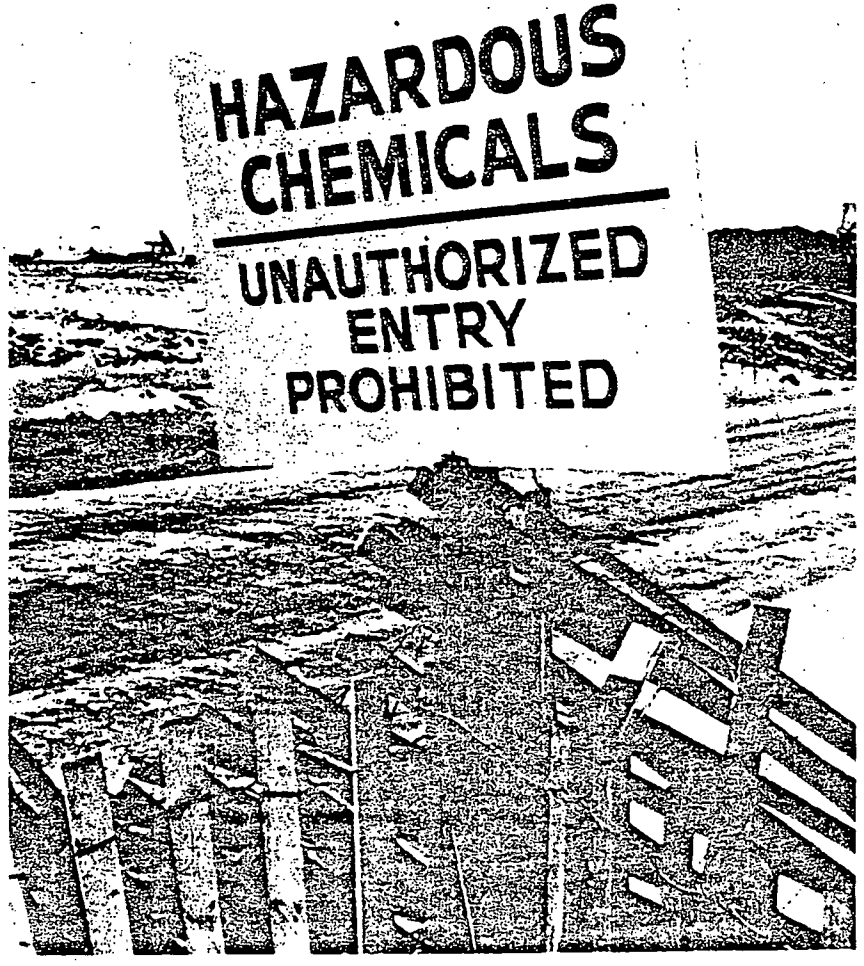
April 1981


HAZARDOUS
CHEMICALS
UNAUTHORIZED
ENTRY
PROHIBITED

LOVE CANAL Table of Contents

LOVE CANAL History & Demographics

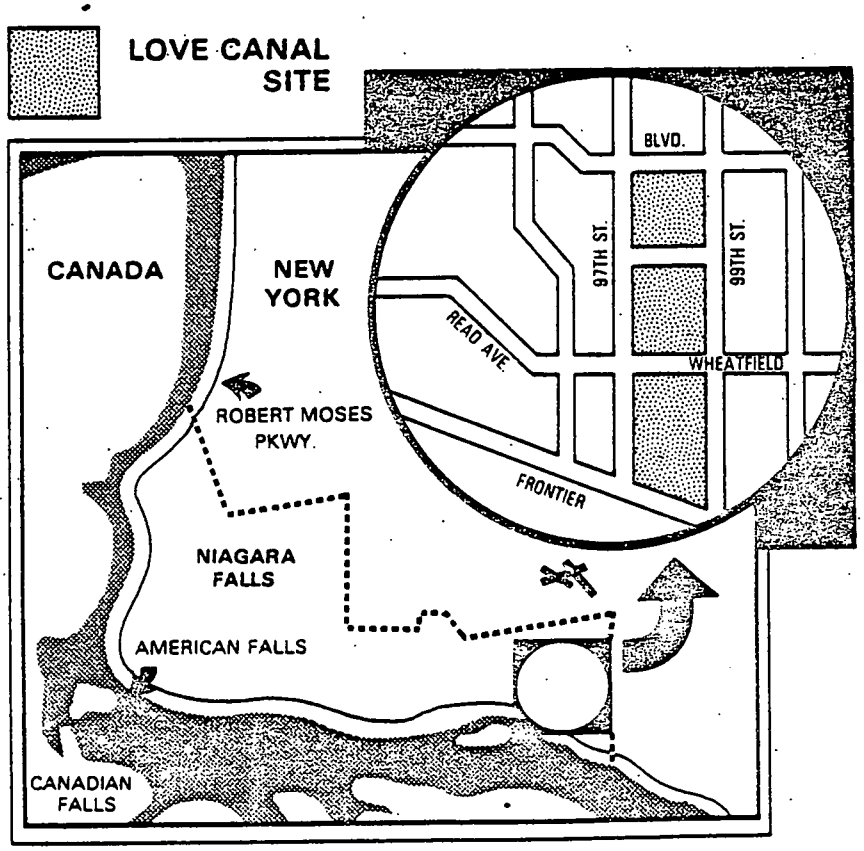
The former Love Canal landfill is a rectangular, 16-acre tract of land located in the southeast end of the City of Niagara Falls (est. pop. 77,050) in Niagara County (est. pop. 242,200) on the western frontier of New York State.

The landfill takes its name from William T. Love, whose plan it was in the 1890s to dig a power canal between the upper and lower Niagara Rivers to provide cheap hydroelectric power for a proposed model industrial city. The model city project and the partially dug canal were abandoned before the turn of the century when alternating current was invented, obviating the need for industry to locate near the source of power.

Aerial photography from 1938 depicts the canal as being about 3,000 feet long and almost 100 feet wide, extending in a north-south axis, with the southern end approximately 1,500 feet from the Niagara River. Much of the canal bed contained impounded water and there was no visible evidence of waste disposal in 1938. The excavation was reportedly used as a swimming hole for local residents for several decades into the twentieth century.

Manufacturing of chemical and allied products was and is a major industrial enterprise of Niagara County. According to 1970 data from the New York State Department of Commerce, there were in the county nine major chemical-producing companies employing a total of 5,267 people. Recent surveys by the State Department of Environmental Conservation point to the presence of approximately 100 chemical dump sites in the county.

One of these is the Love Canal landfill, in which the Hooker Electrochemical Company, now the Hooker Chemical and Plastics Corporation, admits to the deposition, between 1942 and 1953, of 21,800 tons of chemical wastes from its plants in Niagara Falls. These wastes – some drummed, some not – included chlorinated hydrocarbon residues, processed sludges, fly ash and other



Infrared aerial photo of Love Canal area (taken in spring 1978) showing 99th Street elementary school in center, two rings of homes bordering the landfill and LaSalle Housing Development in upper right. White patchy areas indicate barren sections where vegetation will not grow, presumably due to leaching chemical contamination.

materials. The City of Niagara Falls also used the site for disposal of municipal wastes for a number of years, concluding in 1953.

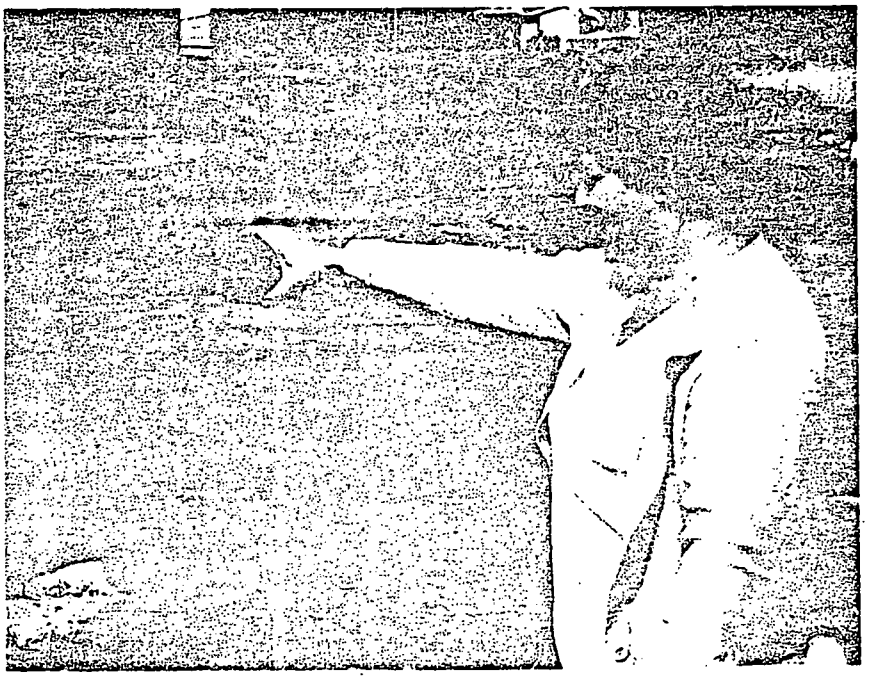
In April 1953, Hooker sold the Love Canal property, to which it then held title, to the City of Niagara Falls Board of Education. Homebuilding directly adjacent to the landfill was accelerated in the mid-1950s and in 1954 a public elementary school was built on the middle third of the Love Canal property.

Aerial photography from 1956 shows continuing residential development and soil banks, some of them as high as 15 feet, surrounding parts of the canal bed. By 1966 these hills were no longer apparent, and two streets crossed the landfill north and south of the public elementary school. By 1972, virtually all houses with backyards directly abutting the landfill were completed.

In the mid-1970s chemical odors from the landfill were cited by residents as a source of discomfort in complaints made to local officials. Above normal precipitation during the period preceded the surfacing of chemically contaminated wastes in residents' backyards. In some houses directly adjoining the landfill an oily coating was discovered in basement sump pits; there also was evidence of underground chemical infiltration through cinderblock foundations in some first-ring homes.

The southern section of the landfill in 1978 presented a scarred, blighted appearance, further aggravated by subsidence of the fill, resulting in surfacing of barrels and exposure of chemical wastes. Despite these conditions, there is evidence that much of the landfill surface continued in use as a children's playground until April 1978, when the New York State Health Commissioner declared the area a threat to human health and welfare and ordered local health officials to restrict access to the landfill site by erecting a fence.

In spring 1978, when the State of New York first intervened at Love Canal, there were 99 homes with backyards directly abutting the canal in which 230 adults and 134 children resided. A total of 410 students were enrolled in the elementary school that had been built in 1954. In the surrounding residential neighborhood, at its outermost limits four blocks from the landfill, 2,618 people resided; the majority lived in one-family homes.



Black chemical sludge collected from ground surface near 99th Street School in 1978

LOVE CANAL Task Force

Recognizing the complexity of the Love Canal situation and the necessity for close coordination of all State activities and assistance, the Governor, on August 3, 1978, directed the formation of an interagency Love Canal Task Force. The task force, headed by the State Commissioner of Transportation, included representatives of the departments of Health, Transportation, Environmental Conservation, Social Services, Banking, Insurance, Equalization & Assessment, Division of Housing & Community Renewal and Office of Disaster Preparedness. An on-site task force group, composed of representatives of the State agencies most directly involved, was immediately established and headquartered at the 99th Street School.

Of significance was the early involvement of area residents in task force decision-making. Representatives of homeowners and tenants associations and of local governments served as ex-officio members of the task force.

The task force was faced with three fundamental responsibilities: the relocation of affected families (to be coordinated by the Department of Transportation); the construction of a drainage system to prevent further migration of toxic chemical waste from the landfill (to be carried out by the City of Niagara Falls and the Department of Environmental Conservation); and the continuation of environmental testing and toxicologic and epidemiologic health studies (to be conducted by the Department of Health).

LOVE CANAL Toxicologic Investigation

Since March 1978, the State Health Department's Division of Laboratories and Research has carried out more than 6,000 analyses of environmental and biological samples associated with the Love Canal.

The U.S. Environmental Protection Agency also conducted extensive air, water and soil sampling in homes and yards throughout the Love Canal neighborhood, following a federal emergency declaration in May 1980.

The primary goals motivating all of the environmental and toxicological studies are: to identify the chemical compounds present in the Love Canal environment; to establish whether the kind or degree of chemical exposure bears a relationship to observed health effects; to determine the extent and means of chemical migration outward from the landfill; to validate the efficacy of remedial construction work undertaken at the site; and to develop improved methodologies for analyzing toxics in environmental samples and biological specimens.

Extensive environmental testing also has been carried out in support of State and federal litigation and State petitions for federal financial aid.

While the Love Canal toxicological study is far from complete and the answers to many of our questions remain elusive, the on-going investigation represents the most intensive effort ever undertaken to document the environmental and public health implications of previous inadequate methods of chemical waste disposal.

Chemicals Identified: At the request of the State Interagency Task Force on Hazardous Wastes, the Hooker Chemical Corp. submitted a declaration estimating that 21,800 tons of chemical wastes had been buried in the Love Canal over a 10-year period (1942 - 52), including significant quantitites of trichlorophenols or TCP (see Table I). Municipal wastes, as well as some fly ash fill, were deposited in the canal. Reports that the federal government buried radioactive material at the Love Canal have not been substantiated.

. . .more than 200 chemical compounds present in landfill

Laboratory analyses of soil and sediment samples from the Love Canal indicate the presence of more than 200 distinct organic chemical compounds; approximately 100 of these have been identified to date.

Dioxin (2,3,7,8 tetrachlorodibenzoparadioxin), considered one of the most toxic man-made compounds based on animal experimental studies, is one of the chemicals found in the landfill. Since dioxin (TCDD) is a contaminant by-product formed during the manufacture of trichlorophenols (TCPs), its presence in the Love Canal was suspected when 200 tons of TCPs appeared on the list of chemicals buried at the site; its presence was confirmed in April 1979 using sophisticated analytical equipment at the University of Nebraska's Midwest Center for Mass Spectrometry. The Department of Health has since acquired the same type of mass spectrometer and formed its own dioxin analysis capability.

The highest level of dioxin quantified to date at the Love Canal is approximately 300 parts per billion (ppb) in a storm sewer adjoining the canal. Lesser concentrations also have been found in leachate collected from remedial holding tanks, soil samples from the canal and backyards of nearby homes and sediment and marine life of two creeks bordering the Love Canal neighborhood (see Figure I).

Although dioxin is of concern, it is impossible to determine whether it represents the major toxic hazard at the Love Canal until the absolute risks for each of the major chemical species found at the Love Canal are estimated. Given the complex milieu of chemical wastes deposited in the canal, there is also the possibility of antagonistic, additive or synergistic effects.

TABLE I

CHEMICALS DISPOSED OF IN LOVE CANAL
BY HOOKER CHEMICAL CORP. (1942–1953)*

Type of Waste	Physical State	Total Estimated Quantity-Tons	Container
Misc. acid chlorides other than benzyol - includes acetyl, caprylyl, butyryl, nitro benzoyls	liquid and solid	400	drum
Thionyl chloride and misc. sulfur/chlorine compounds	liquid and solid	500	drum
Misc. chlorination - includes waxes, oils, naphthenes, aniline	liquid and solid	1,000	drum
Dodecyl (Lauryl, Lorol) mercaptans (DDM), chlorides and misc. organic sulfur compounds	liquid and solid	2,400	drum
Trichlorophenol (TCP)	liquid and solid	200	drum
Benzoyl chlorides and benzo-trichlorides	liquid and solid	800	drum
Metal chlorides	solid	400	drum
Liquid disulfides (LDS/LDSN/BDS) and chlorotoluenes	liquid	700	drum
Hexachlorocyclohexane (Lindane/BHC)	solid	6,900	drum and nonmetallic containers
Chlorobenzenes	liquid and solid	2,000	drum and nonmetallic containers
Benzylchlorides - includes benzyl chloride, benzyl alcohol, benzyl thiocyanate	solid	2,400	drum
Sodium sulfide/sulfhydrates	solid	2.000	drum
Misc. 10% of above		2,000	
	TOTAL	21,800	

* *Interagency Task Force on Hazardous Wastes, Draft Report on Hazardous Waste Disposal in Erie and Niagara Counties, New York, March 1979*

TABLE II

CHEMICALS FOUND AT THE LOVE CANAL*

CHEMICAL	WATER & LEACHATE	AIR	SOIL & SEDIMENT
Benzene	ID **	522.7 $\mu g/m^3$	< 0.1-0.8 ug/kg
α-Benzene Hexachloride	3.2 ug/l	0.002-0.1 $\mu g/m^3$	ID
β-Benzene Hexachloride	38 ug/l	3 $\mu g/m^3$	ID
δ-Benzene Hexachloride	6.9 ug/l	0.4 $\mu g/m^3$	ID
γ-Benzene Hexachloride (Lindane)	50 ug/l	ID	20 mg/gm
Carbon Tetrachloride	ID	5.0 $\mu g/m^3$	
Chlorobenzene	10 mg/l	0.1-172 $\mu g/m^3$	0.4-2.9 ug/kg
Chloroform	0.2-3.9 ug/l	0.5-24.0 $\mu g/m^3$	0.2-2.3 ug/kg
Chlorotoluene	75 mg/l	0.008-7650 $\mu g/m^3$	ID
Dichlorobenzene	3 mg/l	< 0.3-100.5 $\mu g/m^3$	240 ug/kg
Dichloroethane	0.2-4.8 ug/l		< 0.4-2 ug/kg
Dichlorotoluene	95 ug/l	< 18-74 $\mu g/m^3$	
1,3-Hexachlorobutadiene (C-46)		22-114 $\mu g/m^3$	
Pentachlorobenzene	2.5 mg/l	0.5 mg/m^3	58 ug/kg
Tetrachlorobenzene	5 mg/l	0.01-74 $\mu g/m^3$	11-100 ug/kg
Tetrachloroethylene	< 0.3-0.8 ug/l	< 0.2-52 $\mu g/m^3$	< 0.3 ug/kg
Tetrachlorotoluene	1 mg/l	< 0.01-0.97 $\mu g/m^3$	ID
Trichlorobenzene	52 $\mu g/m^3$	0.03-84 $\mu g/m^3$	34-64 ug/kg
Trichloroethylene	52 mg/l	73 $\mu g/m^3$	ID
Trichlorophenol	0.1-11.3 ug/l	ID	0.5-90 ug/kg
Trichlorotoluene	34 mg/l	0.05-43.7 $\mu g/m^3$	ID
Toluene	250 mg/l	0.1-6.2 mg/m^3	< 0.1-104 ug/kg
Dioxin (TCDD)	1.4-5.1 ppt		< 2 ppt-312 ppt
1,2-Dichloroethylene	0.1-0.1 ug/l	334 $\mu g/m^3$	
PCB	0.64 mg/l		2-6 ppm
Methylene Chloride	< 0.3-0.3 ug/l	< 0.7-11.6 $\mu g/m^3$	
Bis (2-ethylhexyl) Phthalate	9.1-24 ug/l		

* These analyses are a summation of work carried out by the Toxicology Institute, Division of Laboratories and Research, New York State Department of Health and various laboratories of the U.S. Environmental Protection Agency and their subcontractors.

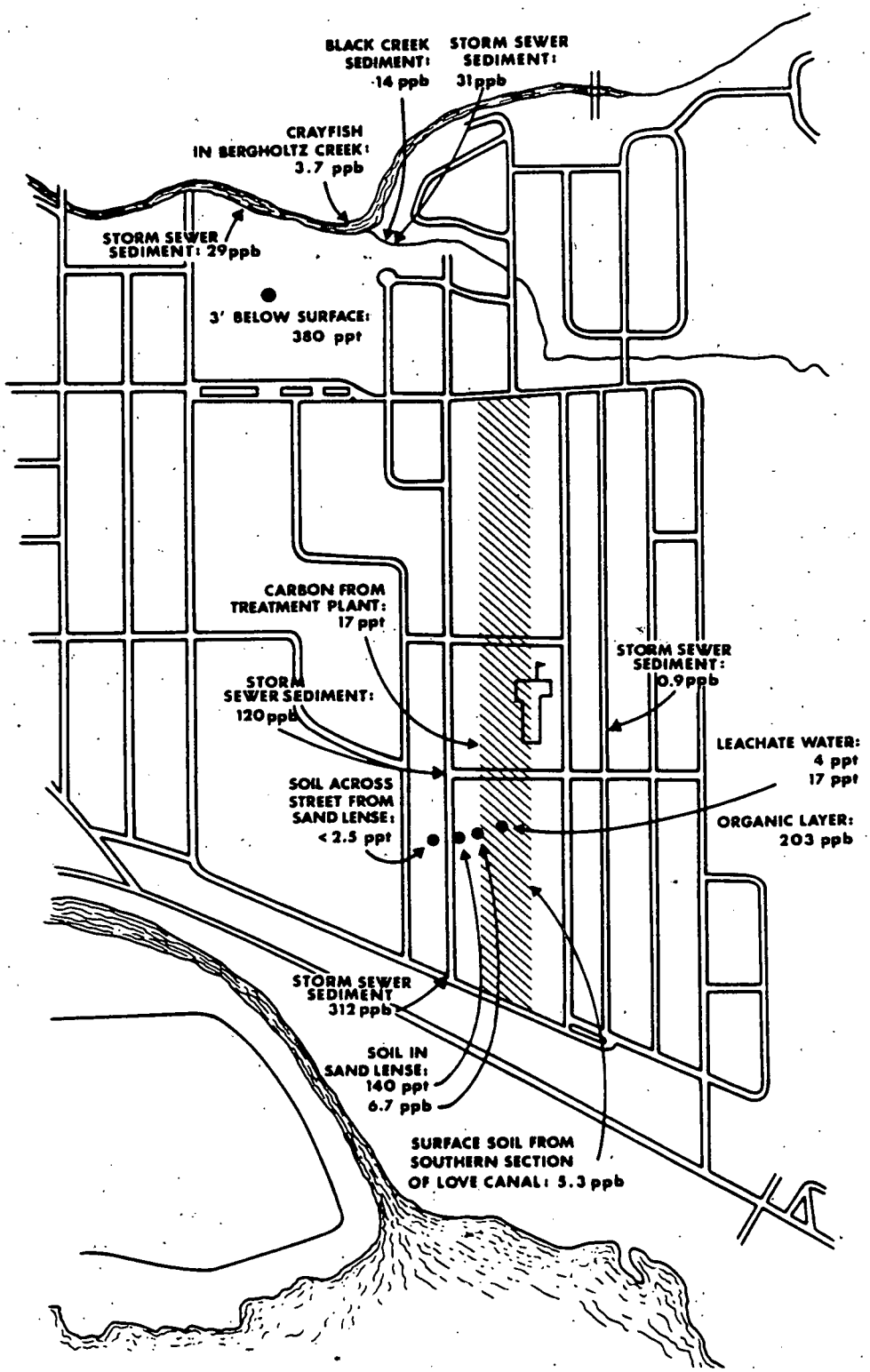
** ID - Identified but not quantitated

ug/l - microgram per liter

ug/m^3 - microgram per cubic meter

FIGURE I

DIOXIN: LOVE CANAL SAMPLES



Preliminary Air Sampling: The departments of Health and Environmental Conservation launched an intensive air, soil and goundwater sampling program in spring 1978, following qualitative identification of a number of organic compounds in the basements of 11 homes adjacent to the Love Canal. Prompted by public health concerns, initial priority was given to evaluation of basement air samples from homes contiguous to the canal.

To determine the extent of chemical migration into private residences, 800 basement air samples from 400 homes within a four block radius of the landfill were analyzed for seven chemical compounds: chloroform, benzene, trichloroethene, toluene, tetrachloroethene, chlorobenzene and chlorotoluene. The mapping of benzene air concentrations revealed no clear patterns of contamination. On the other hand, compounds not present in common household products, such as chlorobenzene and chlorotoluene showed definite clusters of contamination in homes immediately adjacent to the canal, with significantly less evidence of contamination further out.

. . .800 air samples from home basements analyzed

Special analytical equipment was employed to conduct continuous air monitoring of total toxic vapors over a period of several days in the basements of five homes near the canal. Results of these tests indicated that a sharp increase in toxic vapor levels occurs following a rainfall and may persist for two or three days.

Soil Sampling Program: In an effort to identify the outward boundaries of chemical contamination and means of chemical migration, the Department of Health embarked on a number of varied, but related, soil sampling programs during 1979. Many of these projects are still on-going and all data have not yet been fully evaluated.

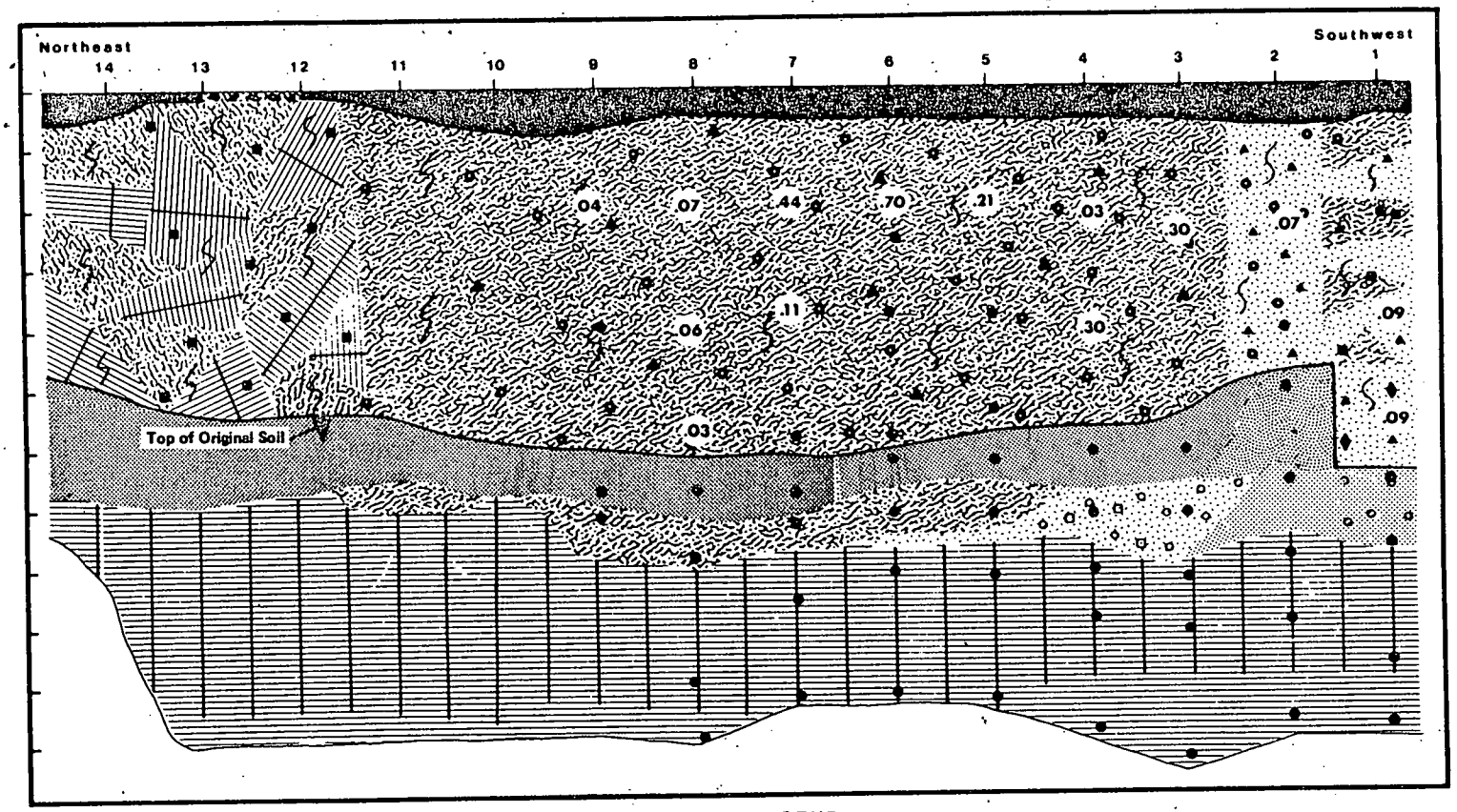
During excavation for the tile drainage system in the southern section of the canal, a geologic sand lense (thin sand strata) was discovered four feet below the surface, apparently intersecting the landfill from east to west. Since such highly permeable soil would be a likely path for chemical migration, samples were taken along the lense verifying the presence of more than 200 chemical compounds in the immediate canal area.

Borings into the sand lense near a vacant residence that abuts the canal on 97th Street revealed that qualitatively obvious chemical contamination -- including trace amounts of dioxin -- had reached the eastern edge of 97th Street. The backyard sample nearest to the landfill registered 6.7 ppb of dioxin; the front sample showed 0.14 ppb. A sample taken directly across 97th Street in a line with the others failed to show detectable levels of dioxin or significant chemical contamination. Investigation of this phenomenon revealed that utility pipes underlying 97th Street were backfilled with clay rather than the usual gravel fill, apparently impeding further outward migration.

To determine if chemicals were leaching from the landfill along former stream beds (swales) or underground utility pipe pathways (sewer and water lines, gas mains, etc.), more than 500 samples from seven soil horizons were taken from six major transects cut through former swales and roadways. Evaluation of these samples fails to show significant chemical migration.

. . .transects cut through stream beds and roadways

Chemical analysis of transects cut through the major swale gives evidence of trace contamination in the fill dirt above the old stream bed surface, and no contamination at or below the swale surface (see Figure II). Since any water conducted along the swale presumably would be perched above the previous swale surface -- and indeed perched waters were observed -- the department is investigating the theory that contamination in the upper layers of the stream beds may be due to use of contaminated fill dirt brought in to level low-lying swale areas prior to home building.



CONTAMINANT MOVEMENT - LOVE CANAL
East of 99th Street & Read Avenue
Transect 3

0 3 6 9
Horiz. Scale - Feet

Fragment Placing is Randomly Distributed

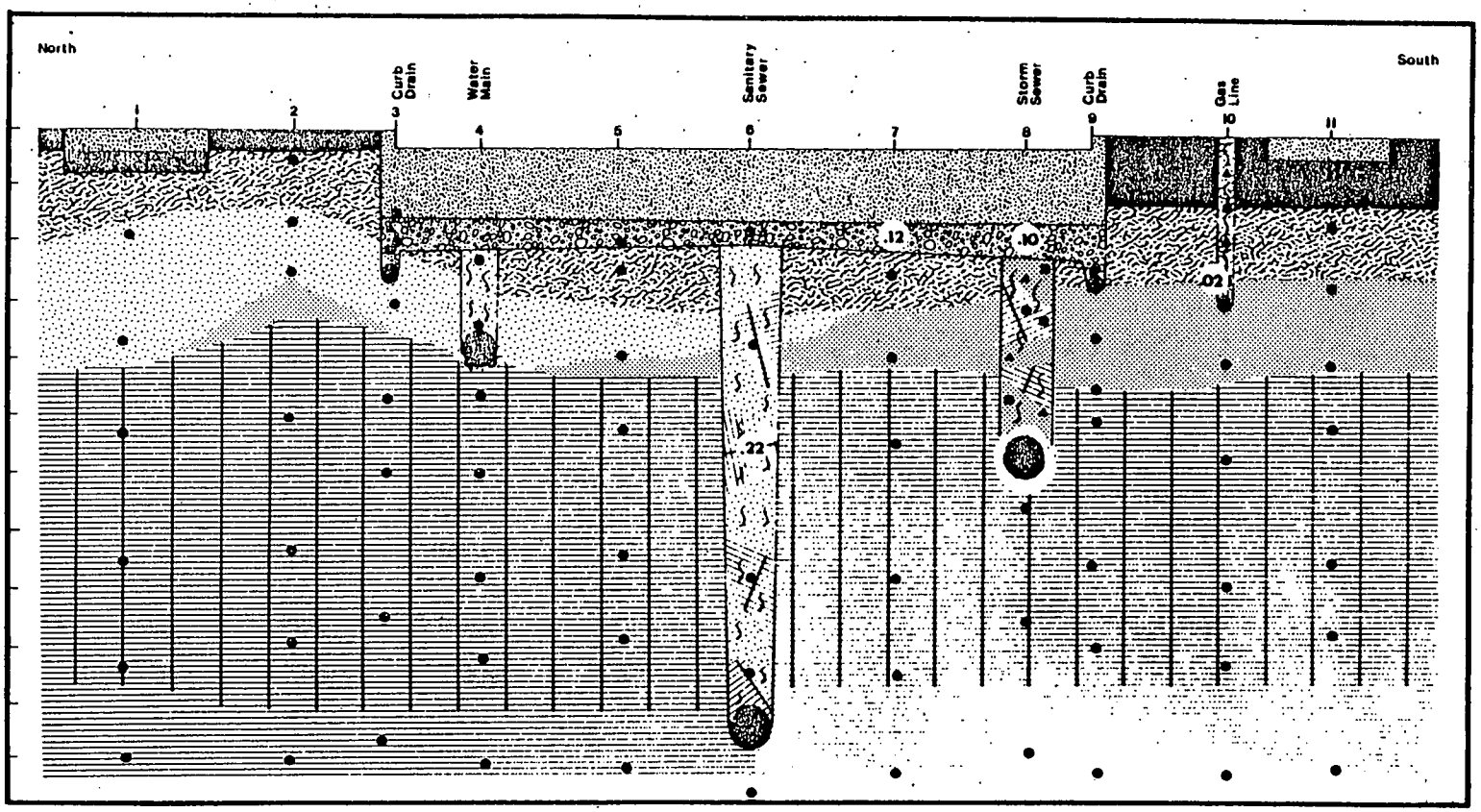
µg/g (Dry) as Chlorine; Lindane standard

● Insignificant

LEGEND

- CLAYEY - SILT (Disturbed) Topsoil
- ASPHALT & CONCRETE
- CLAYEY - SILT (Buried Surface)
- SILTY - CLAY (Firm)
- SILTY - CLAY (Soft)
- SANDY - SILT
- SILTY - SAND
- CLAYEY - SILT
- Carbonate Concretions
- Shell Fragments
- Rock Fragments
- Cinder Fragments
- Brick Fragments
- Slag Fragments
- Disturbed
- SANDY-SILT (Buried Surface)

FIGURE II



CONTAMINANT MOVEMENT – LOVE CANAL
Wheatfield Avenue - East of 99th Street
Transect 1

0 2 4 6
Horizontal Scale - Feet

µg/g (Dry) as Chlorine;
Lindane standard

Fragment Placing
Is Random

● Insignificant

LEGEND

- CLAYEY-SILT (Disturbed Topsoil)
- ASPHALT & CONCRETE
- SAND & GRAVEL
- CLAYEY-SILT
- SILTY-CLAY (Firm)
- SILTY-CLAY (Soft)
- CINDERY-SLAG
- Cinder Fragments
- Slag Fragments
- Disturbed
- SAND
- SANDY-SILT
- SILTY-SAND
- Pipes

FIGURE III

Soil classification reveals that utility lines are buried in high clay content soils from trench excavation as opposed to sand or gravel fill, thus making the roadways walls of clay and potential barriers to chemical migration (See Figure III). The only exception to this observation is Frontier Avenue where utility lines were infilled with gravel and chemical migration along this permeable bedding was evident. The Love Canal leachate collection system has been extended across Frontier Avenue to cut off further migration of chemical wastes from this source.

. . .3,600 soil samples from 594 homes now under analysis

The Health Department Toxicology Institute is currently engaged in chemical analyses of more than 3,600 soil samples collected from 594 homes whose residents were included in the Department's case-control epidemiological health studies. The objective of this large-scale sampling program is to attempt to identify a chemical or group of chemicals that may have some correlation with fetotoxic events documented by health investigators. Included in the study are homes directly adjacent to the Love Canal landfill, residences in outlying areas (including the area north of Colvin Boulevard) and homes built on historically "wet" and "dry" properties.

Six to seven samples from each residence, characteristic of distinct soil horizons in the area, are being screened for chemical contamination using two methods –thin layer chromatography and gas chromatography with electron capture detection. Samples with high contamination readings will be subjected to more exacting analysis using mass spectrometry.

Of the 594 surface soil samples collected, 553 or 93 percent have been analyzed by gas chromatography to date and integrated into the Love Canal computer data base. Eight percent (247 out of 3,046) of the subsurface samples have been completed. The data base includes the concentrations in parts per million (ppm) of 13 specific compounds as well as a measure of total organic halogens in each sample. The distributions of total chemical concentrations are given in Table III.

None of the residential soil samples analyzed thus far has shown anywhere near the total contamination found in some samples taken directly from the sand lense which transects the Love Canal landfill. The compounds comprising the

TABLE III

DISTRIBUTIONS OF TOTAL CONCENTRATIONS OF ELECTRON CAPTURE ACTIVE COMPOUNDS IN RESIDENTIAL SOIL SAMPLES

RANGE OF TOTAL CONCENTRATION*	PERCENT OF SURFACE SAMPLES IN THE GIVEN RANGE	PERCENT OF SUBSURFACE SAMPLES IN THE GIVEN RANGE
0.0 to 0.5	15.2%	85.8%
0.5 to 1.0	20.8%	6.9%
1.0 to 5.0	46.7%	5.7%
5.0 to 10.0	5.6%	1.2%
10.0 to 50.0	10.1%	0.4%
50.0 and above	1.6%	0.0%

* *The total concentration is the area of the gas chromotographic tracing multiplied by the lindane response factor which converts lindane response in area to parts per million. Certain regions of the tracing corresponding to extraneous factors such as solvents are not included.*

total chemical concentration also vary greatly from sample to sample and include many unidentified compounds which may or may not be related to Love Canal dumping. The identification and sources of soil contaminants must be accurately determined before the soil test data can be related to the epidemiological findings.

In association with this study, Health Department scientists are also undertaking several basic research projects aimed at enhancing the understanding of organic chemical interaction with, and movement through, different soil types.

. . .tests for radioactivity and beryllium negative

93rd Street School Study: Initial radiation scans of the 93rd Street schoolyard in 1978 picked up slightly higher than normal background readings. Evaluation of detailed follow-up sampling on school property, however, failed to show significant chemical or radioactive contamination. The results also confirmed other evidence that contaminated fill dirt, rather than underground leaching of chemicals, may be responsible for isolated low-level contamination identified in some outlying areas.

Some hexachlorocyclohexane contamination was found in the homeplate area of the school baseball diamond. Further investigation demonstrated the presence of a fly ash fill layer under the topsoil with some sporadic, low-level lindane contamination registered. The fly ash was found to contain 380 parts per trillion (ppt) of dioxin, consistent with levels found in fly ash from municipal incinerators.

At the request of concerned homeowners, soil samples collected near the 93rd Street School and south of Colvin Boulevard were tested for beryllium, a usually nonradioactive light metal used in the production of rocket fuel. Beryllium levels in such samples ranged from 0 to 7 ppm, consistent with normal concentrations associated with the earth's crust.

Storm Sewer Investigation: Discovery of significant storm sewer contamination was one of the first indications of the severity of problems at the Love Canal. To determine the location of chemical contamination entry points, the departments of Health and Environmental Conservation conducted an extensive sampling program in spring and summer 1979, involving collection and analysis of approximately 80 sewer water and sediment samples. Two major contamination entry points were identified, one near a home on 97th Street and the other at the 99th Street School (see Figure IV).

. . .two storm sewer contamination entry points identified

These two contamination sources, along with the majority of contaminated sumps in vacant homes bordering the canal, have now been cut off from the storm sewer system and the barrier drain constructed around the canal should prevent further storm sewer contamination.

In conjunction with the storm sewer study, holes were bored in a low spot at the site of a former pond near 100th and 101st streets to determine if underground pools of chemicals could be leaching into storm sewers; no excess chemical contamination was found.

Monitoring of Remedial Work: Continual air monitoring was carried out during all phases of remedial construction work at the Love Canal, not only as a safety precaution for workmen and residents but also to obtain air quality data to serve as a baseline for future comparisons.

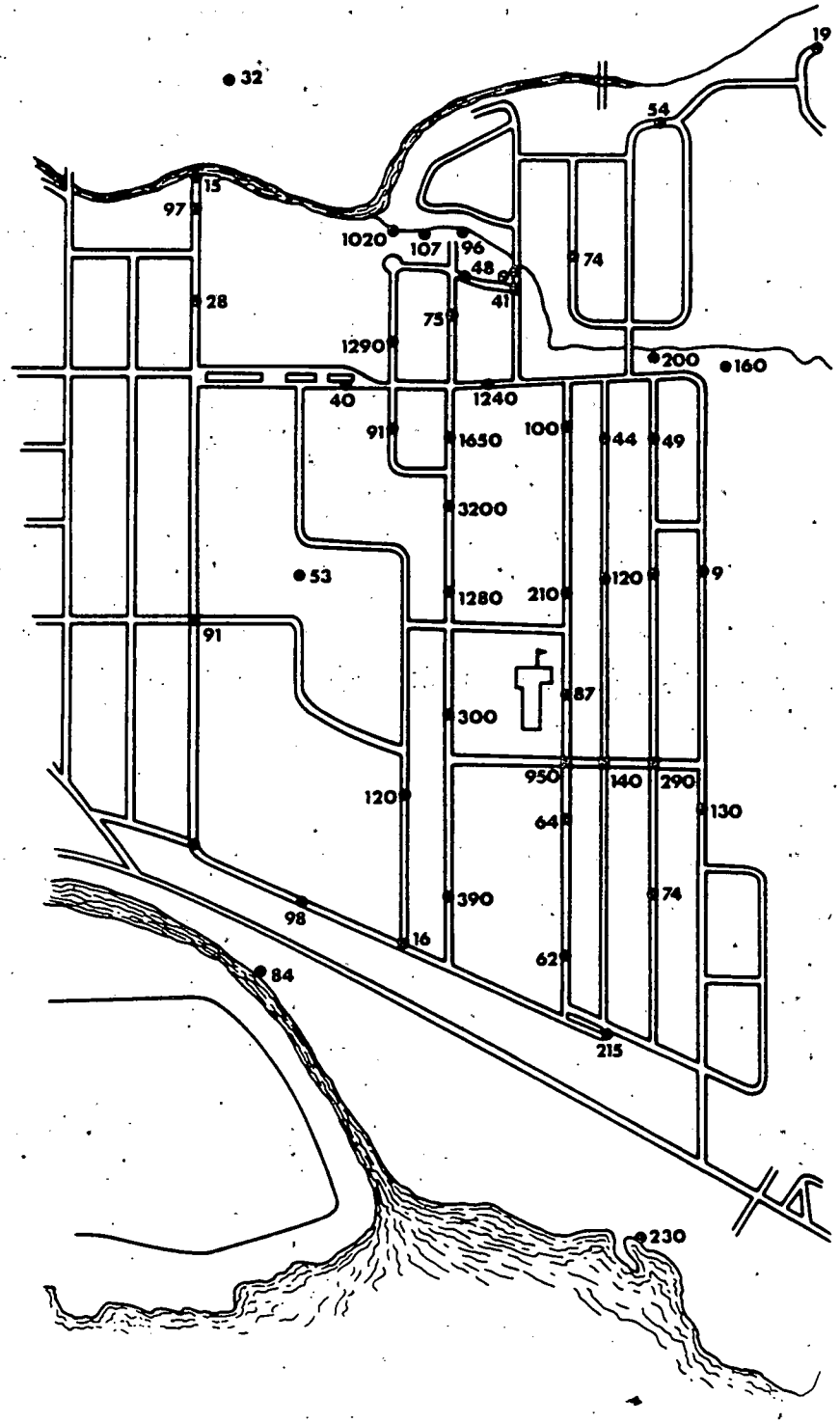
Monitoring of the leachate treatment plant also represents a major on-going State responsibility. Samples of plant influent and effluent must regularly be tested for pollutants, specific Love Canal chemicals and other physical parameters to assure that the system is functioning properly. Evaluation of organic sludge and spent carbon beds also must be carried out on a routine basis.

Animal Toxicological Studies: Several animal studies have been undertaken by Health Department scientists in an effort to identify possible pathways of

FIGURE IV

LOVE CANAL STORM SEWERS

EQUIVALENT LINDANE (MICROGRAMS/LITER)
APRIL 1979



chemical exposure at Love Canal and to aid in assessing potential human health risks.

In one such experiment, 30 pregnant rats were placed in the basement of a home directly abutting the landfill for the 21-day gestation period. Fifteen of the rats were exposed to contaminated basement air; the other 15 which served as a control group, received air that was filtered through activated carbon to remove organic chemicals. Examination of fetuses in both groups one day prior to term failed to show any statistically significant differences in such teratologic indicators as: numbers of fetuses, body weight, number of resorption sites, skeletal and soft tissue status. Blood chemistries, organ weights and tissue pathology of pregnant dams in both groups also showed no significant variation. It should be noted that this experiment was carried out in April 1979, after installation of the leachate collection system in the southern canal section and that pollutant concentrations in the basement air were in some cases as much as 100 times lower than air samples taken in 1978.

. . .pregnant mice and rats exposed to Love Canal samples

In another study, 32 experimental mice were exposed to volatile chemicals from Love Canal surface soil for 90 days. Highly contaminated soil from the southern portion of the landfill was placed in mouse cages in such a way that mice would be constantly exposed to the soil vapors but could not touch or eat the material. Another 30 mice, used as a control group, were treated identically but had no Love Canal soil placed in their cages. At the end of each 30 day period, 10 experiment and 10 control mice were killed and extensively examined using histopathology and clinical chemistry techniques.

These studies indicated that constant inhalation of soil vapors did not produce any severe toxic symptoms in mice, apart from transient behavioral effects and an increase in liver, thymus and spleen weights. The exposed mice developed ruffled fur coats and exhibited a two-to-three day period of hyperactivity each time fresh Love Canal soil was placed in the cages. There were, however, no consistent alterations in body weight, food consumption, blood cell counts, histopathology and kidney or adrenal weights.

In a third study, Love Canal soil extract was administered to pregnant rats at three dose levels during the 6th to 15th day of gestation. Rats were killed one day prior to term and the fetuses examined for teratological effects.

At the highest dose used, 150 mg/kg, a large number (70 percent) of the dams died. However, examination of 1,200 rat fetuses from this study revealed no severe soil-extract-related teratological effects, with the exception of a dose-related decrease in body weight.

In summary, Health Department animal studies related to the Love Canal landfill have not documented any consistent pattern of toxic effects from volatile and nonvolatile components of contaminated surface soils. Animal studies are continuing with other Love Canal samples, including leachate, to gain a more complete assessment of the toxic potential of the Love Canal environment.

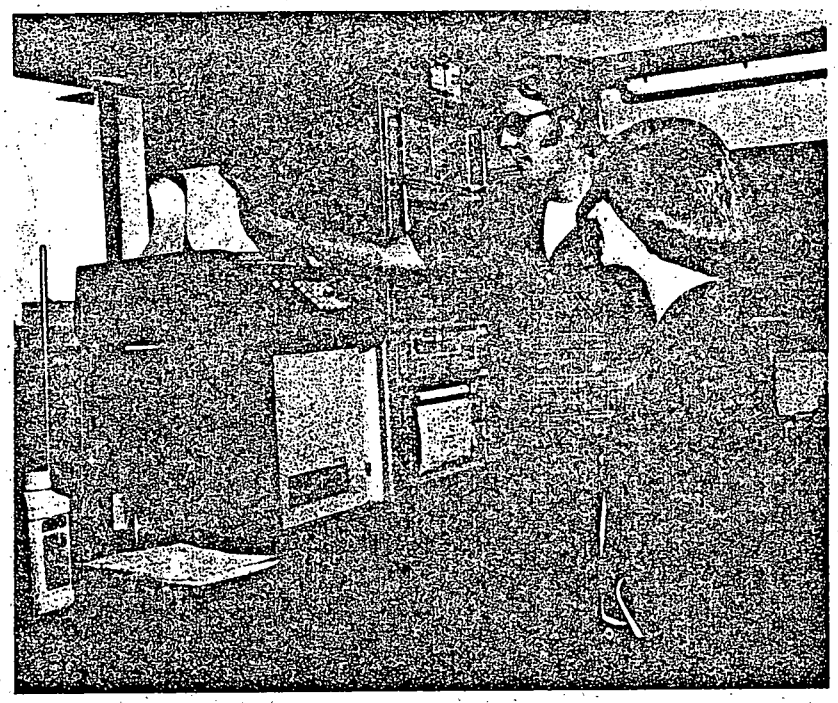
Organic Laboratory Expansion: The comprehensive laboratory analytical program undertaken by the Department of Health in association with the Love Canal investigation has frequently extended into scientific areas that have never or only recently been explored. Consequently, considerable effort has been expended in laboratory development activities, including:

--acquisition of an MS-50 mass spectrometer and preparation of the new equipment for dioxin analysis;

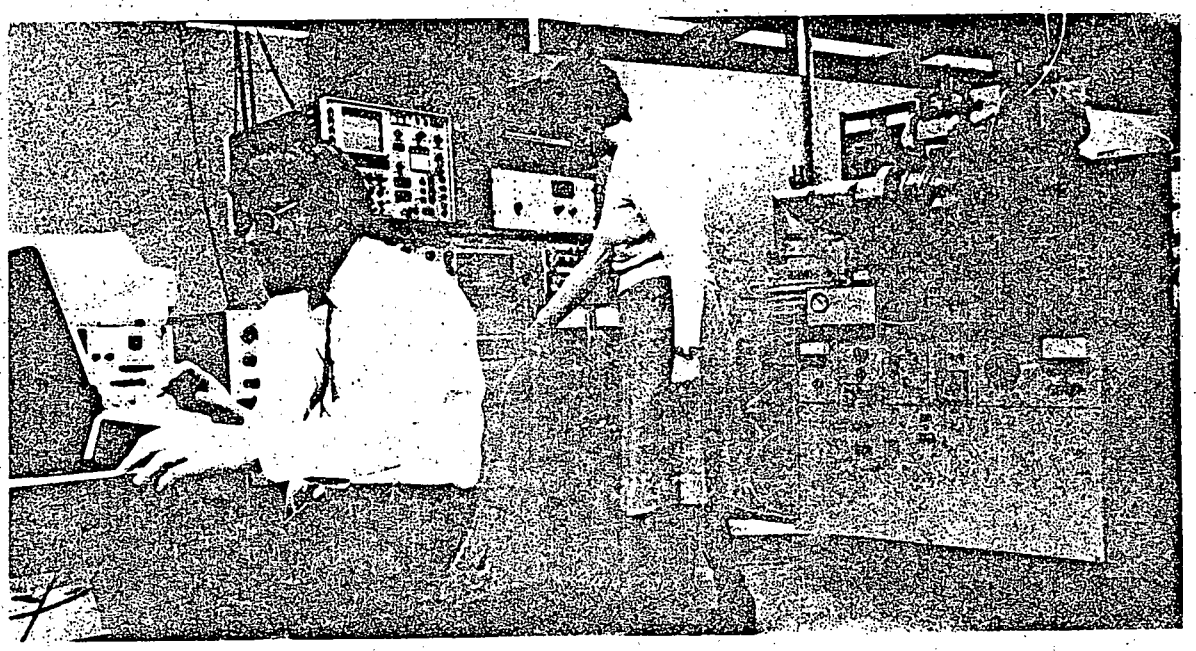
--development of needed specialized laboratory equipment, including high resolution glass capillary columns;

--improvement of biological sample clean-up methods for more accurate detection of dioxins and dibenzofurans;

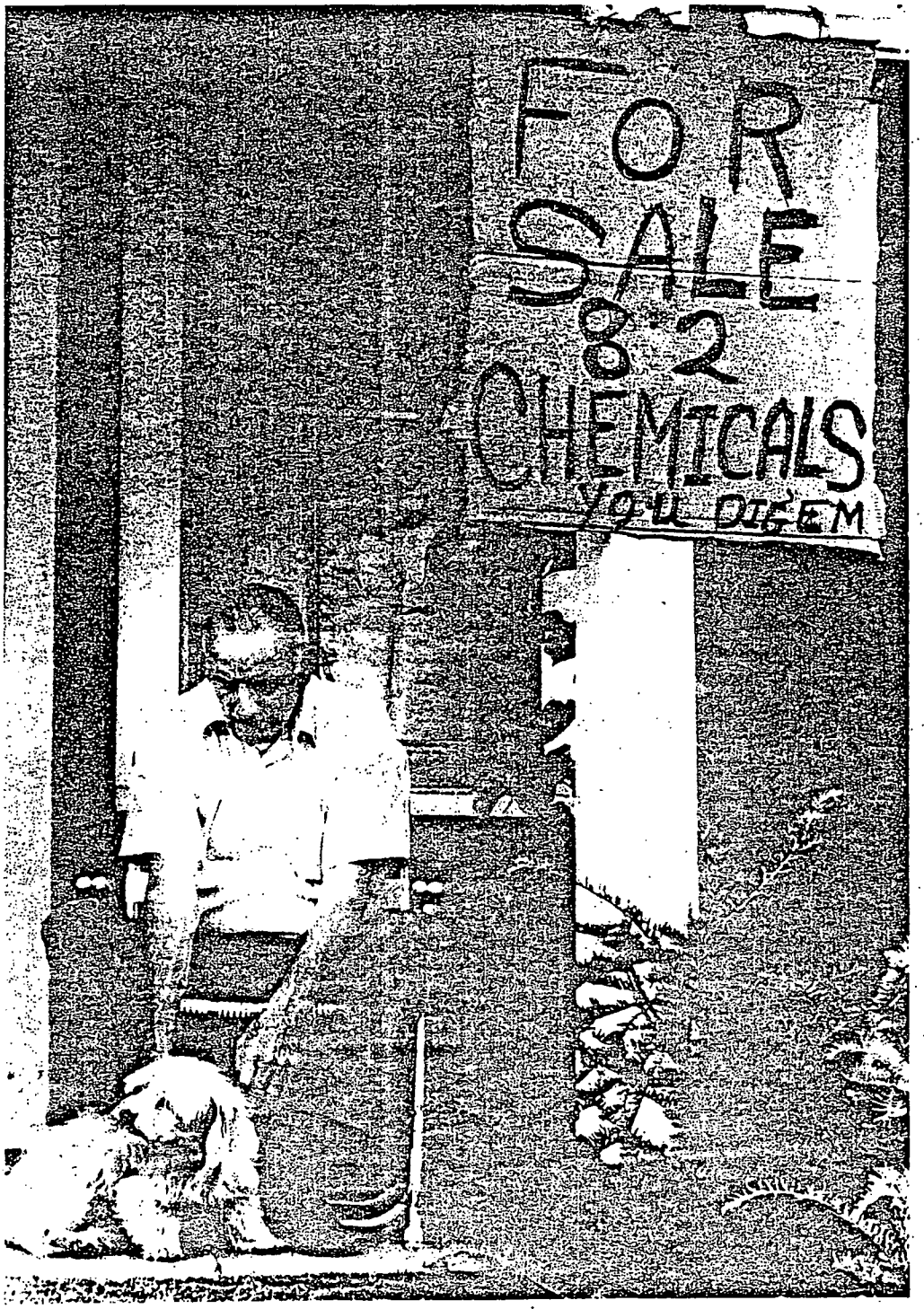
--use of high pressure liquid chromatography to more accurately separate and differentiate chlorinated dioxin and chlorinated dibenzofuran isomers.



Love Canal air monitoring field laboratory established by Health Department at Wheatfield sewage treatment plant.



The Kratos MS-50 ultra high resolution mass spectrometer acquired by the Health Department to analyze environmental samples for TCDD (dioxin) and other related toxic substances.


FOR
SALE
SO2
CHEMICALS
YOU'LL DIE 'EM

LOVE CANAL Epidemiologic Studies

All of the State Health Department's previous, on-going and planned epidemiological studies at Love Canal are motivated by a single concern: to determine the nature, degree and source of excessive health risks, if any, faced by persons who presently or ever lived near the landfill.

This concern stems from the knowledge that many of the more than 100 chemicals identified in soil, sump and air samples at the Love Canal are capable of causing acute and chronic toxic reactions in man (see Table I). For example, long-term exposure to benzene has been shown to cause leukemia and suppress bone marrow function; when ingested in sufficient quantity, lindane can cause convulsions; chloroform and carbon tetrachloride can cause liver damage; and dioxin -- one of the most toxic chemicals known to man -- has been linked to cancer and birth malformations in laboratory animals.

Thus, varied health studies carried out by Health Department researchers since 1978 have focused on the most likely indicators of acute and chronic chemical toxicity, including: reproductive outcome, liver function, respiratory ailments, convulsive disorders, skin problems and cancer incidence.

In the spring, summer and fall of 1978, staff of the department's Bureau of Environmental Epidemiology and Occupational Health conducted more than 11,100 field interviews in the Niagara County area, most involving residents of the Love Canal neighborhood, their physicians and control populations. A standard, 22-page questionnaire was administered, covering the subjects' health and medical histories and a diligent effort was made to corroborate all reports of illnesses through followup interviews with physicians and by consulting hospital and medical records.

With the aid of local health personnel and technicians from Roswell Park Memorial Institute, 4,386 blood samples were obtained from 3,919 persons, involving 114,036 separate blood tests. Those tested were notified of results via their private physicians.

Blood Test Findings: Liver function, as determined through blood analysis, was selected as a factor for immediate investigation since the liver serves as a highly sensitive indicator of toxic exposure and recent experimental studies have linked some of the chemicals found in the landfill with liver disease or cancer.

Preliminary evaluation of liver function tests suggested that persons residing on 97th and 99th streets bordering the landfill may face a greater than expected risk of developing liver disease. None of the individuals with abnormal test results, who were examined by their family physicians, however, presented clinical evidence of liver disease.

The Health Department presented this data on November 10, 1978 to an outside "blue ribbon" panel of experts in various fields of epidemiology, toxicology, hepatology, clinical and environmental medicine who concluded that the biochemical abnormalities detected did not represent a manifestation of liver disease. Repeat liver function tests for residents relocated from the canal showed a return to normal in most cases.

...test data reviewed by scientific panel

Examination of the results of complete blood counts performed as part of the preliminary health survey indicated that the incidence of blood cell disorders including anemia was within expected limits for the population under study.

Survey Results: Particular emphasis was placed on detection of various skin disorders among Love Canal residents, since the skin is the most obvious point of chemical exposure. Researchers found no documented evidence of chloracne, an eruptive skin disorder that has been associated with acute exposure to dioxin, polychlorinated biphenyls (PCBs) and related chemical compounds. Currently in progress is an investigation of other less serious skin disorders among residents living immediately adjacent to the landfill.

TABLE I

POTENTIAL HEALTH EFFECTS OF CHEMICAL COMPOUNDS IDENTIFIED AT LOVE CANAL

COMPOUND	ACUTE EFFECTS	CHRONIC EFFECTS
benzaldehydes	allergen	
benzene	narcosis skin irritant	acute leukemia aplastic anemia pancytopenia chronic lymphatic leukemia lymphomas (probable)
benzoic acid	skin irritant	
carbon tetrachloride	narcosis hepatitis renal damage	liver tumors (possible)
chloroform	central nervous narcosis skin irritant respiratory irritant gastrointestinal symptoms	
dibromoethane	skin irritant	
dioxin	chloracne	nervous system disorders psychologic abnormalities cancer, spontaneous abortions, liver dysfunction (indicated in animal studies)
lindane	convulsions high white cell counts	
methylene chloride	anesthesia (increased carboxy hemoglobin)	respiratory distress death
trichloroethylene	central nervous depression skin irritant liver damage	paralysis of fingers respiratory and cardiac arrest visual defects deafness
toluene	narcosis (more powerful than benzene)	anemia (possible) leukopenia (possible)

Since air-borne contamination is another likely route of exposure to Love Canal chemicals, the prevalence of various asthmatic and other respiratory conditions was weighed. Studies to date have failed to indicate any excessive incidence of respiratory diseases or disorders among Love Canal residents.

...chronic disease incidence surveyed

Using the Health Department's statewide cancer registry to examine all malignancies reported from the Love Canal census tract between 1955 and 1977, researchers found no apparent excess of any form of cancer among Love Canal residents. Health Department epidemiologists also failed to find an excessive incidence of convulsive disorders within the Love Canal population.

While such retrospective epidemiological surveys represent an important source of health data, it is important to point out several inherent shortcomings of such studies in determining potential adverse health effects attributable to chemical exposure: only the prevalence of disease, not the overall incidence of disease can be assessed; the effects of previous chemical exposure within the

study population may not yet be observable since there is a latency period in many diseases, which can be 20 to 30 years in the case of cancer.

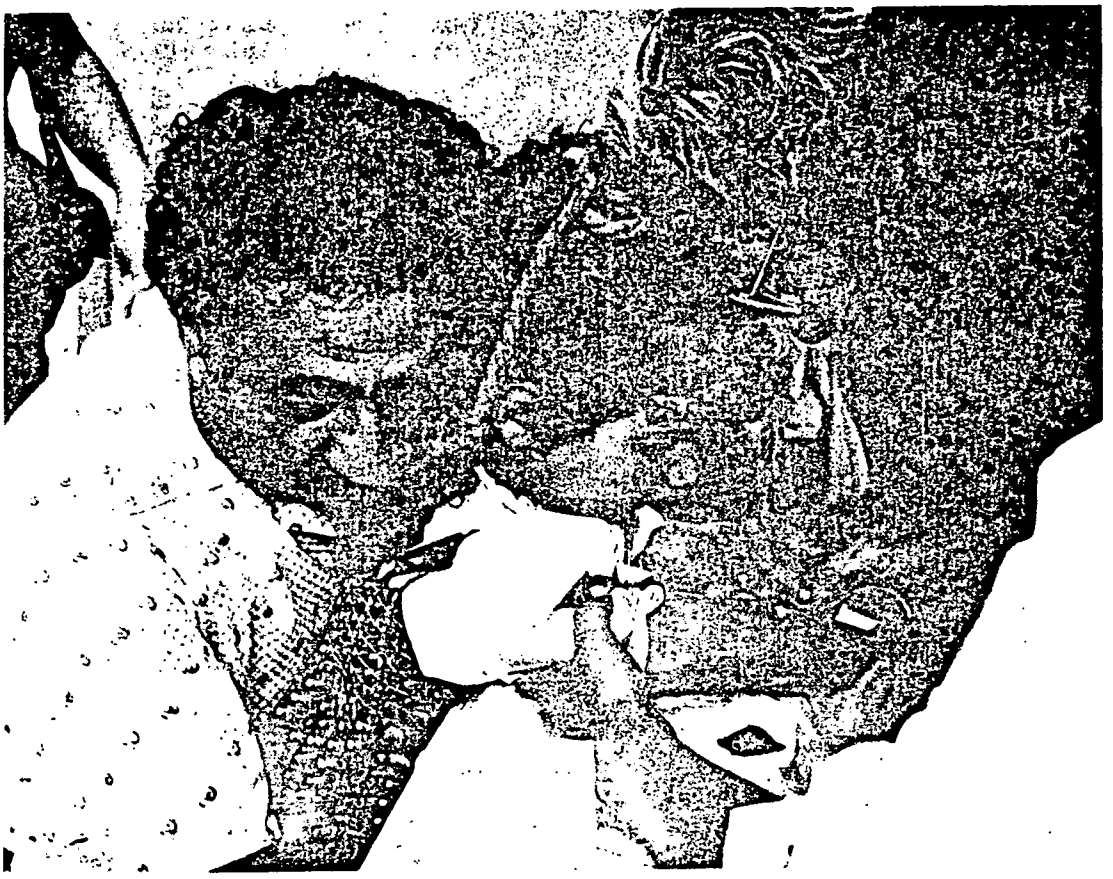
The Department will continue to attempt to identify previous residents of the Love Canal area to determine the true incidence of cancer and other chronic diseases.

Adverse Pregnancy Outcomes: The sensitivity of the human reproductive process to toxic chemical exposure is well established, especially in the case of some pharmaceutical agents. It is also known that many chemicals are hazardous to the conceptus of lower animals, depending on dosage, route of administration and stage of gestation. Because of the wide variety of chemicals encountered at Love Canal, and the likelihood that various manifestations of toxicity were likely to be found, it was decided to examine three fetal endpoints of possible toxic chemical exposure: congenital defects, spontaneous abortions (miscarriages) and low birth weight.

...three fetotoxic endpoints examined

For comparison purposes, expected numbers of spontaneous abortions were derived from a report of Warburton and Fraser[1], which illustrated the frequency of miscarriages among 6,000 pregnancies experienced by women living in Canada, tabulated by both birth order and maternal age at conception. It should be noted that the Warburton/Fraser model is considered by many researchers to represent a conservative estimate of the incidence of miscarriages within the general population.

[1]D. Warburton, F.C. Fraser, Am. J. Human Genetics 16, 1 (1963)



...two control groups selected

Because of possible social and other demographic differences between the Canadian population and Love Canal women, a second control population was selected in a neighborhood just outside the Love Canal area (north of Colvin Boulevard). While this second control group had many demographic, social and other similarities to its Love Canal counterpart, it also had certain limitations, including the possibility that chemical contamination from the canal may have reached out to this neighborhood as well. Were this true, it might lessen the extent to which the rate of abnormal reproductive events among Love Canal women appeared to deviate from the expected.

The pregnancy outcomes of these two control groups were compared with those of women living immediately adjacent to the Love Canal (99th and 97th streets) and women living on historically dry lots or sections that had previously been under water or in the pathway of creeks that flowed through the area.

TABLE II

PREGNANCY HISTORIES AND AGE DISTRIBUTION
FEMALE RESIDENTS OF SPECIFIED SECTIONS OF THE LOVE CANAL AND NORTH OF COLVIN AREA

Pregnancy History at Present Address	99th*	97th*	Water	Non-Water	North of Colvin
Women Ever Pregnant	22	20	49	98	66
Number of Pregnancies**	50	29	108	164	125
(Sets of Twins)	(1)		(2)	(2)	
Women with Live Births	21	19	44	92	64
Number of Live Births	39	26	83	144	110
Women with Miscarriages	7	3	16	16	11
Number of Miscarriages	12	3	25	21	11
Women with Birth Defect Child	4	0	7	7	7
Number of Birth Defect Children	4	0	10	7	8
Women with Low Birth Weight Child	1	0	10	6	3
Number of Low Birth Weight Children	1	0	13	11	3
Women with Stillbirths	0	0	2	1	3
Number of Stillbirths	0	0	2	1	4
Women with No Unfavorable+ Event	14	17	22	70	45
Women with an Unfavorable+ Event	8	3	27	28	21
Age (years) of Females					
Total++	89	90	208	474	343
0–14	28	29	49	138	62
15–29	14	27	65	121	90
30–44	20	17	35	96	62
45–59	21	15	44	73	86
60 and older	8	2	14	45	34

** Houses on the Canal*

*** Number of Pregnancies = (Live Births + Miscarriages + Stillbirths) Minus Twins*

+ Unfavorable Event: Miscarriage, Birth Defect Child, Stillbirth or Low Birth Weight Child

++ Total Includes Age Unknown

The pregnancy histories and outcomes of all women living in the general Love Canal vicinity as of June 1978 were examined, both prior to and following residence near the landfill. Table II summarizes the pertinent information concerning the age distribution and pregnancy histories of females in four sections of the Love Canal (97th and 99th streets and the water and non water sections) and the north of Colvin Boulevard control group. Over 98 percent of the population in each section was white, and no single ethnic group predominated.

...pregnancy histories compared prior to and after residence on canal

The same questionnaire was used throughout the investigation. Questions relating to the past health, therapeutic, social, occupational and pregnancy histories were obtained from all adult (and, where pertinent, child) residents in the course of a seven-month door-to-door survey. The field personnel administering the questionnaires remained constant throughout the study and had no prior knowledge of the specific hypotheses under investigation. Completed questionnaires were reviewed for completeness and possible inconsistencies by two groups of experienced supervisors, and subsequently by members of the department's statistical unit. An effort was made to confirm all reports of untoward reproductive outcomes through physician interviews and by checking vital and medical records.

Birth certificate information for all infants born to women from the Love Canal area was obtained from the department's Office of Vital Records. Birth weights were verified, and any infant weighing less than five pounds, eight ounces was considered a low birth weight infant. The proportion of low birth weight infants at Love Canal was compared with that for all of upstate New York during the period 1950-1977.

Table III describes the medically confirmed birth defects that occurred among children born to all women in the study group. When the ratio of congenital defects to live births was calculated and compared with control data, no significant excess of congenital defects was discerned in any of the Love Canal sections under study, with the possible exception of wetland homes, and then only when compared with historically dry properties (see Table IV). The import of this observation is questionable, however, due to the small number of birth defects involved.

...no significant excess of congenital defects identified

Similarly, historically wet properties were the only study areas in which there was a statistically significant excess of low birth weight babies. Compared with the other study populations, the relative risk of bearing a low birth weight infant was about 2.2 times greater for women living in homes on former wetlands. As shown in Table IV, there was only one low birth weight infant among the 65 births occurring among residents living directly adjacent to the Love Canal.

Statistical methods were employed to calculate the observed-vs.-expected ratios of spontaneous abortions to pregnancies to determine whether any significant excess of miscarriages may have occurred among any of the study populations. As shown in Table V, these analyses indicate that there may have been a slight excess of miscarriages among women living on 99th Street and those residing in historically wet sections of the Love Canal neighborhood.

No single month or season of the year predominated for the occurrence of spontaneous abortions or births of children with congenital defects. Analysis of the mean age at which pregnant women had moved into each of the four study areas also showed no significant difference. Evaluations indicated, however, that women living on 99th Street and in the traditional wet areas had, on the average, resided near the canal for a longer period during their childbearing years. The mean years of residence (during ages 15-44) for each study group was:

...slight increase of miscarriages and low birth weight infants on 99th St. and former wet areas

99th Street - 13.0; 97th Street - 9.4 years; water areas - 13.6 years; non water areas -10.4 years; and north of Colvin Boulevard - 12.6 years.

Collectively, these findings point to a slight to moderate excess of spontaneous abortions and low birth weight infants occuring in households on 99th Street bordering the landfill and in homes built on former wetlands in the canal area.

TABLE III

DOCUMENTED CONGENITAL DEFECTS AMONG CHILDREN BORN IN SPECIFIED AREAS OF LOVE CANAL AND NORTH OF COLVIN AREA

LOCATION TYPE OF MALFORMATION	SEX
97th & 99th STREETS*	
Congenital deafness	M
Reflux of ureters	F
Cleft palate, deformed ears and teeth, hearing defect, mental retardation, heart defect	F
Club foot	M
WATER AREA	
Prolapsed mitral valve	M
Non-functioning Rt. hydronephrosis	F
Born with 3 ears	M
Ears turned down	F
One kidney	F
Hydrocephalus	M
Club foot	F
Web toes	F
Web toes	M
Web toes	F

LOCATION TYPE OF MALFORMATION	SEX
NON-WATER AREA	
Inverted testicle	M
Absence of deciduous teeth	M
Extra toe	M
Obstruction of ureter	M
Disaccharide deficiency	M
No diaphragm	M
Severely retarded, eye defect, teeth defect	F
NORTH OF COLVIN	
Hypospadias penis	M
Deformed kidney	F
Incomplete left lip	F
Hydrocephalic-slepian eye, deafness	M
Mongolism	F
Diaphramic hernia	M
Immature lungs, pulmonary insufficiency	M
Congenital dysplasia of left hip	F

* Houses on the Love Canal

TABLE IV

PERCENT OF CHILDREN WITH LOW BIRTH WEIGHT OR CONGENITAL DEFECTS, BORN IN SPECIFIED AREAS OF THE LOVE CANAL

Location	Live Births	Children with Low Birth Weight+			Children with Congenital Defects		
		Number	Percent	p**	Number	Percent	p***
99th Street*	39	1	2.56	++	4	10.26	>.05
97th Street*	26	0	0.00	++	0	0.00	++
Rest of Love Canal Area	227	24	10.57	.017	17	7.49	>.05
Water	83	13	15.66	.001	10	12.05	>.05
Non Water	144	11	7.64	>.05	7	4.86	++

* Houses on the Canal

** Normal approximation, one-sided; sample proportion compared with population proportion 6.97 (Average for period 1950—1977, white births recorded in New York State, excluding New York City)

*** Normal approximation, one-sided; north of Colvin control (7.27)

\+ Defined as ≤2500 grams ++ Observed was less than Population or Control

TABLE V

SPONTANEOUS ABORTION RATIOS OF OBSERVED TO EXPECTED NUMBERS* FOR SPECIFIED AREAS OF THE LOVE CANAL BASED ON TWO COMPARISON GROUPS

Area	Warburton & Fraser Comparison Group		North of Colvin Comparison Group	
	P	O/E	P+	O/E
99th Street**	.110	1.5	.007	6.0
97th Street**	***	0.7	>.05	1.2
Rest of Love Canal Area	>.05	1.1	.050	2.6
Water	.031	1.5	.007	3.4
Non Water	***	0.8	>.05	2.0

** Standardized for age and parity*

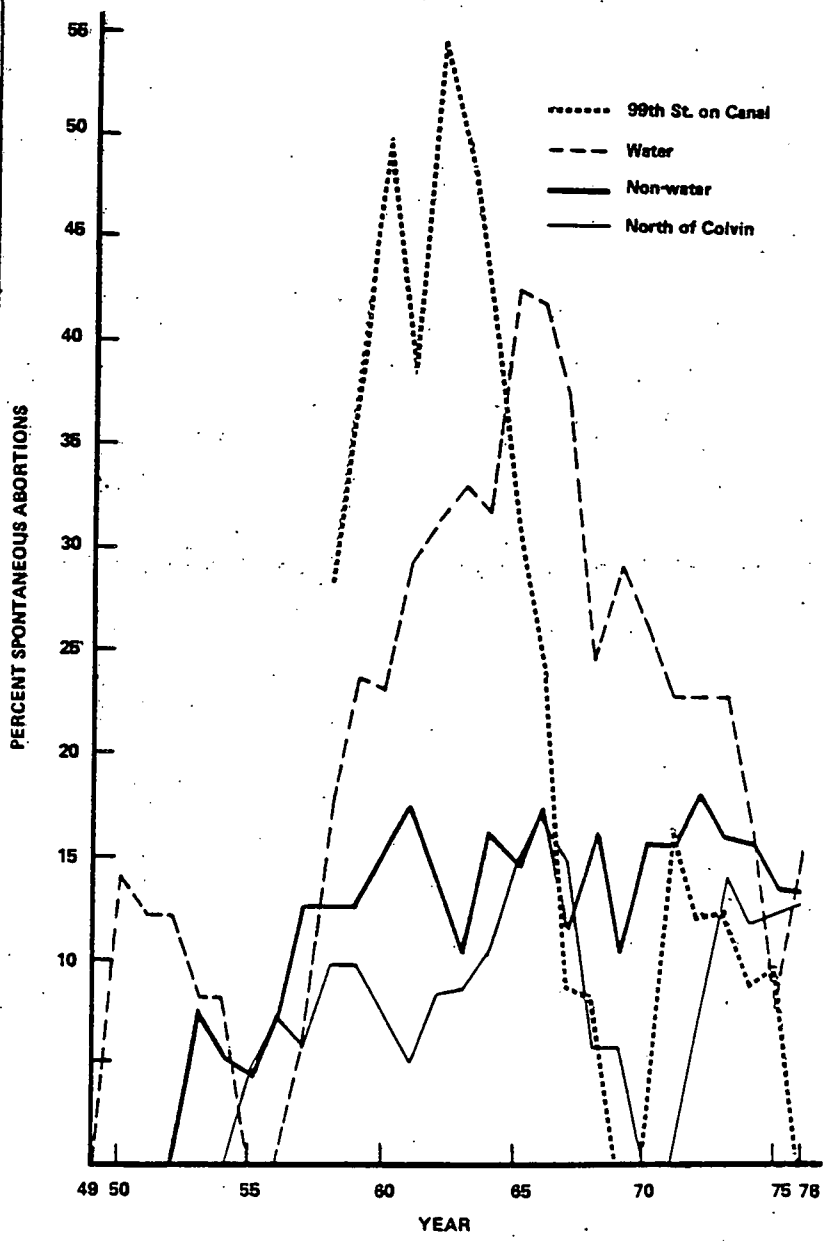
*** Houses on the canal*

**** Observed was less than expected*

\+ Mantel-Haensel chi square (one-sided test)

FIGURE I

PERCENT OF PREGNANCIES
TERMINATING IN SPONTANEOUS ABORTION
(Five-Year Moving Average)



An interesting phenomenon surfaced when researchers examined the percentage of pregnancies that resulted in spontaneous abortions during each of the past three decades among the various Love Canal study populations. As shown in Figure 1, the higher than expected number of miscarriages among 99th Street residents occurred between 1958 and 1964. A similar pattern is evident in the historic water areas; the highest percent of spontaneous abortions took place between 1959 and 1970.

...highest percent of spontaneous abortions occurred in 1960s

The apparent absence of an excessive number of miscarriages on 97th Street, adjacent to the canal, might be partially explained by the fact that many of the houses on this street were not built until the late 1960s and early 1970s. In contrast, the vast majority of homes on 99th Street were occupied by the early 1960s. Interestingly, the rise in spontaneous abortions occurring in the historic water areas began less than one year after landfilling was largely completed in the general area, which may serve to support the theory that contaminated fill dirt from the canal was used to level low-lying swale areas.

It has not yet been possible to correlate the geographic distribution of adverse pregnancy outcomes since 1950 with direct evidence of chemical exposure as measured in 1978 and 1979. The department's Division of Laboratories and Research is currently analyzing more than 3,600 soil samples taken from each of the 600 homes included in the pregnancy outcome study in an effort to identify a chemical or group of chemicals that may have been responsible for documented fetotoxic events in the canal area.

On-going Health Department Investigations: The studies described above were limited to persons who resided in the Love Canal area in the summer of 1978. But what of those individuals who once lived in the Love Canal area, especially during periods of active dumping, and subsequently moved away; have they experienced any adverse health effects?

To address this question, the Health Department's Bureau of Environmental Edpidemiology and Occupation Health is searching out an estimated 2,500 people who once lived in the Love Canal neighborhood and moved away. This search is national in scope; it will probably take at least another two years to complete. Thus far, about one-third of the target population has been located. Each former resident is being asked to complete a comprehensive questionnaire dealing with current and past health and medical history.

...search for previous canal residents continues

Our investigations dealing with the Love Canal also raised many important public health issues concerning the health implications of residence in communities that are highly industrialized and have large numbers of chemical dump sites. The department's Bureau of Environmental Epidemiology and Occupational Health is, therefore, conducting a series of investigations in Niagara and Erie counties to determine whether there are any unusual patterns of cancer or an excessive rate of miscarriages and other adverse pregnancy outcomes in these areas. Information from these studies will provide an essential data base for use in interpreting future environmental disasters of this type and for designing surveillance programs to monitor potential environmentally-related health hazards throughout the State.

The lesson of the Love Canal with respect to health impact assessment is clear: existing data banks do not yield sufficient scientific information in the time frame needed for policy decision making. Data needed to evaluate health impacts of chemical exposure must be collected through time-consuming interviews with the exposed population, and by consultation with physicians and verification of hospital records. The end result is that such studies take years to complete.

Two bills which were enacted during the 1980 legislative session, the "Environmental Disease Registry" law and the "Right to Know" law provide

...proposed registry of environmental and occupational exposures

the statutory basis for the development and implementation of a comprehensive epidemiological surveillance and research program to monitor the health impact of environmental and occupational exposure to toxic agents.

The Health Department is working with the State Public Health Council to develop and put in place the regulations needed to require the reporting of pertinent data. Computerized analyses of these data will facilitate the accurate and timely evaluation of suspected health hazards in communities and areas throughout the State, thus providing government with the information necessary for making decisions about environmental problems.

The surveillance program, as proposed, will create a new data base of environmental and occupational exposures to toxic substances. The three principal elements of the program are:

1. A disease registry of health endpoints which may signal toxic exposure, to include:
   a. adverse pregnancy outcomes, i.e., spontaneous fetal deaths, low birth weights and those congenital malformations clearly not genetic in origin;
   b. occupational lung diseases, such as lung cancer and pneumoconiosis;
   c. abnormal levels of heavy metals in blood and/or urine.
2. An occupational registry of employees exposed at their worksite to known or highly suspected human carcinogens.
3. Utilization of environmental data provided by the State Department of Environmental Conservation in order to broadly categorize various geographic regions of the State relative to the nature and quantity of environmental pollutants present there.

Long-term surveillance of exposed populations will also enable us to develop much needed information concerning the dosage and induction period for known human carcinogens. At present, we are totally dependent on animal models for these determinations, and these observations may not be transferable to humans. The ability to provide scientifically sound information regarding acceptable dose levels could have a positive impact on both government and industry, which now must proceed on the basis of stringent requirements extrapolated almost entirely from animal experimentation.

The surveillance program also proposes creation of an exposure registry which will allow epidemiologists to identify and follow exposed populations at risk from various diseases. Currently, such studies of disease associated with chemical exposure are very difficult to conduct because of the general inadequacies and inconsistencies of industrial exposure records.

The adoption of this surveillance program will permit the department to respond swiftly and expertly to requests for health impact assessments following exposure to toxic substances, and provide government policymakers with timely and sound scientific analyses of the evidence gathered.

Federal and Private Health Studies: Aside from the State's epidemiologic investigations, three additional studies bearing on chronic disease incidence at the Love Canal have been undertaken and reported to date.

In January 1980, the Biogenics Corporation of Houston, under contract with the federal Environmental Protection Agency, carried out a cytogenetic study involving analysis of blood specimens from 36 Love Canal residents. The chromosomes in 11 of the 36 individuals tested were regarded somewhat abnormal by the researchers. This study is considered controversial by many medical experts due to the small number of subjects tested and the absence of a contemporary control population.

A neurologist at the State University of New York at Buffalo undertook a nerve conduction study of a small number of Love Canal residents in the spring of 1980. The results of this study were essentially negative, with no statistically

significant differences detected between nerve conduction velocity in the 35 Love Canal residents tested and a matched control group of 20 persons living elsewhere.

An informal survey of pregnancy outcomes and chronic disease incidence was conducted by a medical consultant to the Love Canal Homeowners Association and reported in testimony on March 21, 1979, before the House Subcommittee on Oversight Investigations. The excessive rates of fetotoxic events and disease incidence directly attributed to chemical pollution in this study have been questioned by epidemiologists due to the lack of adequate control groups, and failure to medically validate anecdotal information reported on questionnaires.

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LOVE CANAL Remedial Construction

Following issuance of the Commissioner of Health's August 2, 1978 emergency health Order, the Department of Environmental Conservation assumed overall responsibility for remedial construction work at the Love Canal landfill. The Department's specific responsibilities included: review and approval of detailed plans for remedial construction efforts undertaken by the City of Niagara Falls; on-site environmental monitors for the construction activity at the Love Canal site; and consultation with federal, State and local agencies on the development of long-range engineering needs and solutions.

The Department of Environmental Conservation's concern over the Love Canal situation dates back to September 1976, when DEC engineers first visited the site to investigate the suspected discharge of Mirex by Hooker Chemical and Plastics Corporation. Based on preliminary test data from sewer water samples, the Department strongly urged the City of Niagara Falls to hire a consultant to conduct a hydrogeological investigation of the site and to develop a conceptual pollution abatement system; this report was completed by Calspan Corporation of Buffalo in August 1977 and reviewed by DEC staff. Preliminary work indicated the need for more intensive investigations, and in October 1977, the Department of Environmental Conservation sought the assistance of the U.S. Environmental Protection Agency in conducting an expanded study of groundwater pollution in the vicinity.

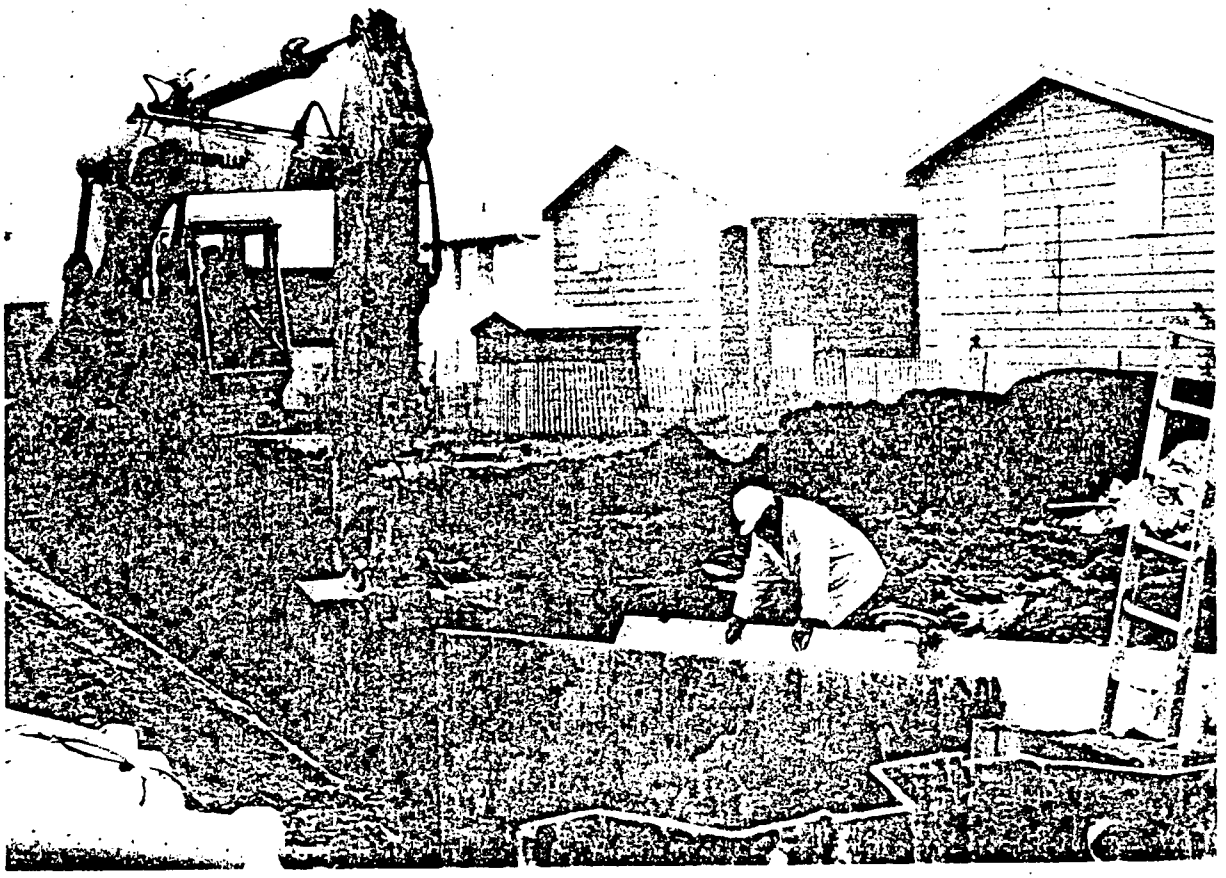
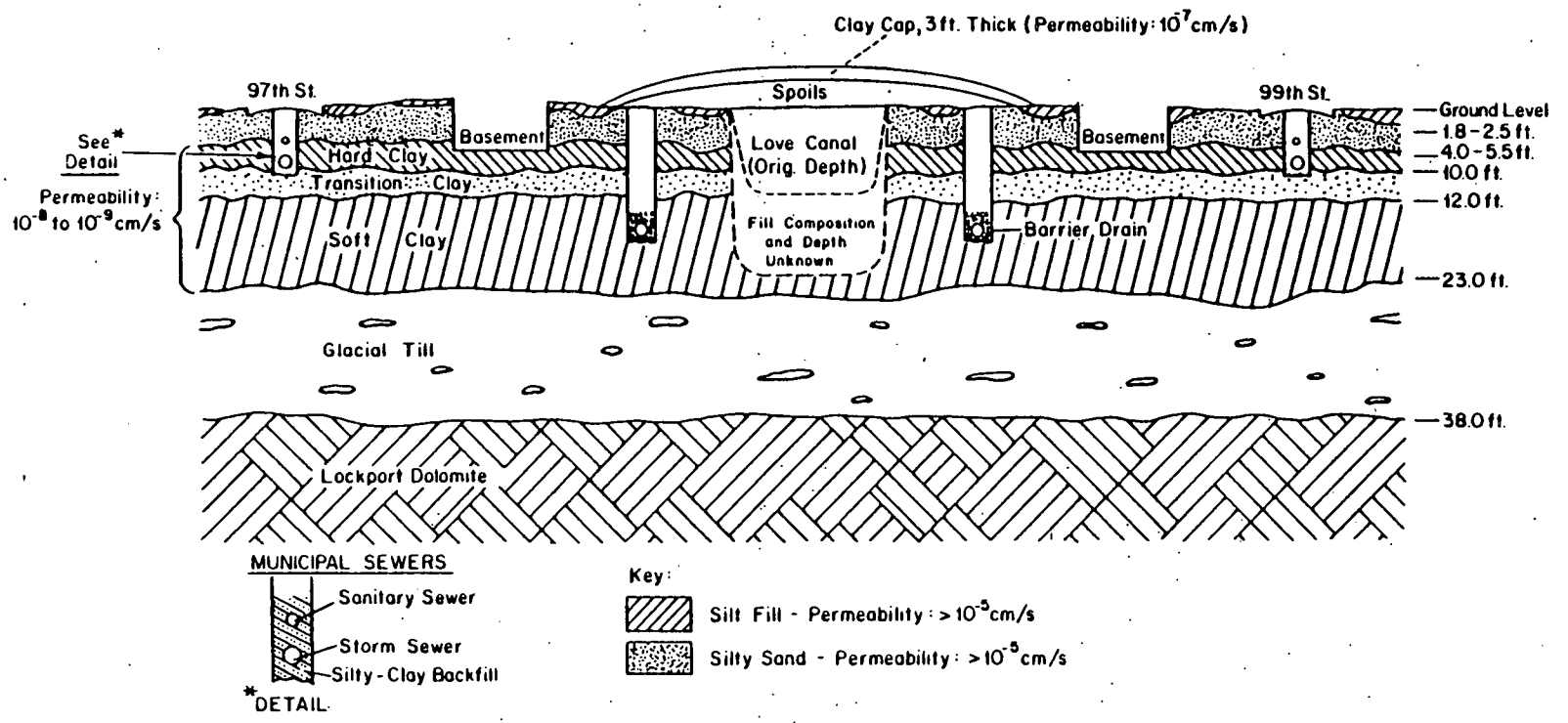


FIGURE I
REMEDIAL PROJECT: TRANSVERSE VIEW

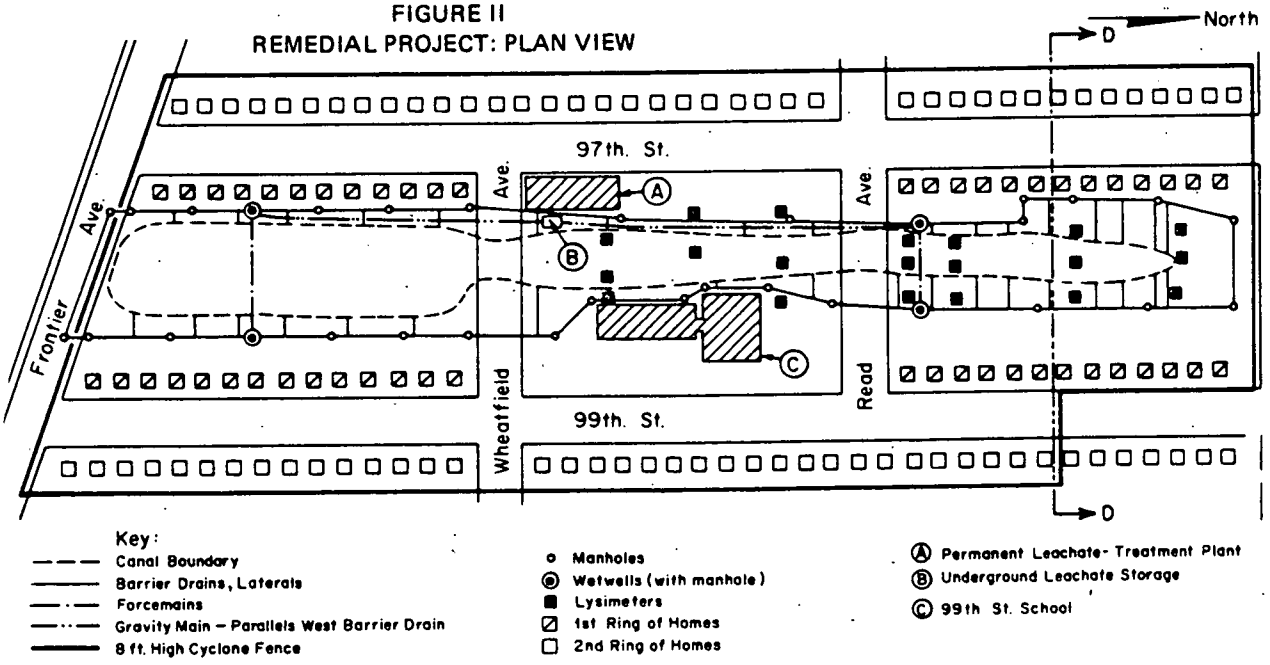


The City of Niagara Falls, under emergency order by the State of New York, initiated efforts preliminary to remedial construction work in the southern portion of the Love Canal in spring 1978. A barrier drain and capping system was designed for the southern section by the consulting engineering firm of Conestoga-Rovers and Associates, in an effort to prevent more water from soaking into the chemical waste disposal area and to intercept contaminated groundwater migrating from the landfill. Remedial work commenced on the southern end of the canal on October 10, 1978, and was completed in October, 1979. By November, 1978, Department of Environmental Conservation personnel were engaged in negotiations with Conestoga-Rovers and Associates for development of a proposal and contract for continuation of remedial work in the central and northern sectors of the canal and later for the development of performance specifications for an on-site leachate treatment plant. Construction operations under this proposal began May 29, 1979 and were substantially completed on December 10, 1979, with opening of the permanent leachate treatment facility at the Love Canal site.

Remedial Construction Plan: The remedial construction plan is designed to lower the water table in the landfill, to halt the outward flow of chemcials escaping via the upper groundwaters and through volatilization, and to drain surface runoff away from the site. The project consists of a barrier drain constructed around the entire perimeter of the canal, an on-site leachate pumping, storage and treatment system and a three-foot-thick clay cap to prevent further precipitation from entering the canal (see Figure I).

The barrier drain extends 12-20 feet below the surface into a clay substrata where perforated drain tile has been installed and backfilled with a permeable material. Due to the slope of the drainage system, the aqueous phase leachate migrating outward from the canal is gravity fed to several underground pumping chambers. This engineering design not only serves to lower the water table within the landfill, but also helps to achieve a reverse flow of underground water in the overburden immediately outside of the barrier drain system.

FIGURE II
REMEDIAL PROJECT: PLAN VIEW



All of the collected leachate is then pumped to an underground storage tank that acts as a reservoir for the on-site leachate treatment facility. The contaminated liquids are treated within the treatment plant by settling, filtration, and activated carbon. The effluent is then discharged into the municipal sanitary sewers for further processing by the City of Niagara Falls. The concentrated wastes or sludge, which arise from the settling operations, are pumped into a storage tank for accumulation and future disposal. Continuous testing of the effluent has indicated effective removal of toxic organic components.

During the placement of the barrier drains, a series of lateral drains also was constructed in the landfill to hasten the dewatering process. A high clay content soil was used to cover the contaminated soils excavated from the drainage trenches. The purpose of this clay cover was to reduce volatilization of toxic compounds, prevent contaminated dust from blowing off the exposed excavated soils, and prevent rainfall from eroding or transporting contaminated soils away from the site. Once the installation of the drains was complete, the clay cover was increased to a thickness of three feet and contoured to direct all rainfall into surface drains leading away from the site, thereby reducing the amount of precipitation filtering into the canal and the amount of leachate generated in the collection system. In late 1980, the clay cap in the central and northern sectors was covered with an additional six inches of topsoil and seeded with grass.

Safety Protocols: All work performed at the Love Canal was carried out in accordance with a comprehensive safety plan designed to protect workmen, local residents and the general public from possible hazards incident to the construction project. The plan, developed in cooperation with local governmental and community groups, included provisions for daily air monitoring at the site, medical examinations for workmen, safety clothing and employee rotation to minimize excessive or prolonged exposure to contaminants. The work area was fenced and all vehicular and pedestrian traffic to the worksite was restricted, with 24-hour patrols to maintain site security.

A detailed community evacuation plan developed for construction on the southern zone, called for the stationing of approximately 50 school buses, police vehicles equipped with public address systems, an ambulance and a fire pumper with crew at the worksite during all working hours. This evacuation plan was scaled down during construction in the northern and central sectors based on experience in the southern portion.

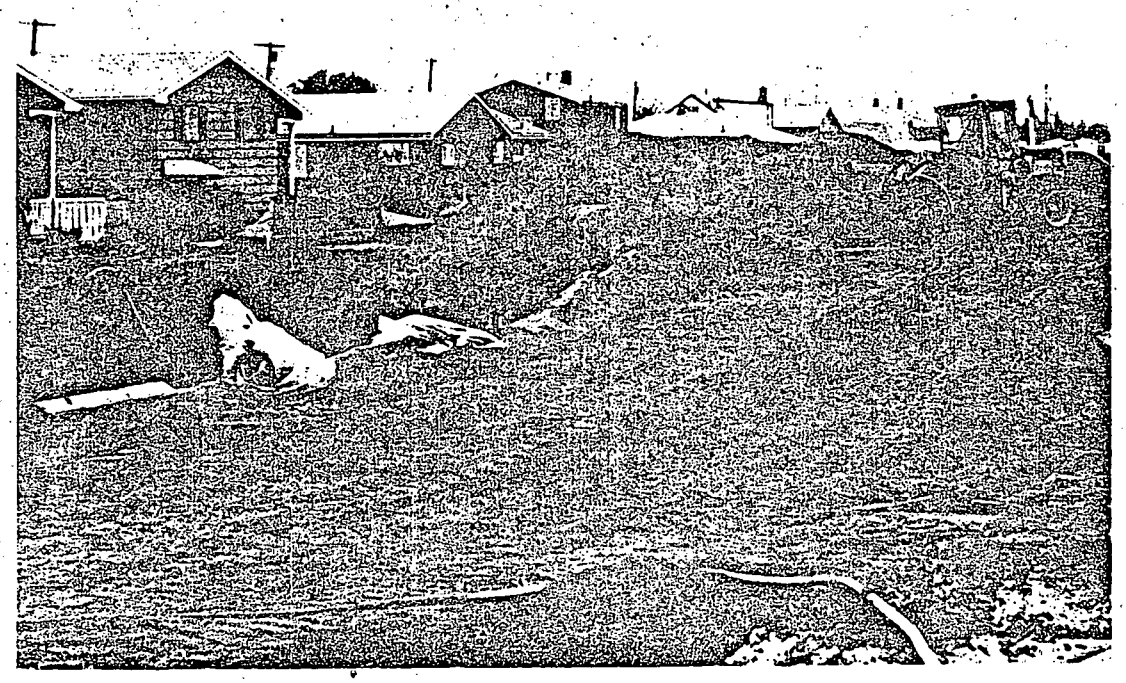
Cooperative Agreement: On April 24, 1979, the Department of Environmental Conservation and the U.S. Environmental Protection Agency entered into a cooperative agreement to conduct and evaluate, for demonstration purposes, abatement measures to contain and control the hazardous wastes escaping from the Love Canal. State and federal funding of $8 million was provided to cover costs associated with a five-year remedial effort, beginning on August 2, 1978 and ending August 1, 1983. In June 1980, the U.S. Environmental Protection Agency initiated and conducted a $5.3 million six-month monitoring program to analyze and characterize air, soil and water samples from the Love Canal. The objective of this major sampling effort is to define and characterize the extent of chemical contamination at Love Canal.

Approximately 170 monitoring wells were installed in grid-like fashion throughout the community to monitor any shallow or bedrock contamination. Large numbers of air and soil samples were collected for extensive chemical analysis. Efforts were undertaken to model the groundwater profile and to determine the direction of movement. The interpretation of this large data base is continuing and a final report of the findings is expected sometime in 1981.

Future Problems to be Addressed: The emergency remedial project was designed to address the problem of aqueous chemical leachate in the overburden within the immediate vicinity of the Love Canal. Although work done to date indicates that there is no contamination in the bedrock groundwater system, more investigation is necessary. Critical to the design of long-term remedial plans will be test results from the 170 shallow and bedrock monitoring wells which EPA had installed in the fall of 1980. Once the aquifer has been sampled and the effectiveness of the tile drain system is measured, DEC staff will determine if additional steps are necessary for long-term cleanup of the canal area.

The Department of Environmental Conservation is asking that the federal Environmental Protection Agency design and conduct remedial efforts to eliminate contamination of storm sewers which lie outside of the barrier drain system. In effect, the storm sewer lines would be plugged in the vicinity of the four corners of the Love Canal. Contaminated sediment would be removed for burial in a chemically secure landfill and the sewer lines would be tied to the existing barrier drain to create an expanded leachate collection system. The surface waters would be directed to storm sewer lines in neighboring streets.

Other problems still to be addressed include the clean-up of toxic contamination (including dioxin) in Black and Berkholtz creeks near the canal; evaluation of new disposal technologies for destruction of waste sludge generated at the Love Canal treatment facility and currently stored on-site; and site restoration, including demolition of vacant homes directly abutting the landfill.



LOVE CANAL Relocation Of Residents

. . .237 homes purchased by New York State

. . .pregnant women and children advised to temporarily relocate

The State Department of Transportation, with assistance from other task force agencies, coordinated the Love Canal relocation process, including temporary relocation of residents and purchase of area homes.

The day following the Commissioner of Health's August 2, 1978, Order recommending temporary relocation of pregnant women and children under two years of age from the first two rings of homes, interviewers from the regional offices of the departments of Transportation and Social Services opened an on-site relocation assistance office at the 99th Street School.

On August 7, the Governor expanded the State's relocation effort, directing permanent evacuation of all homes in the two rings immediately adjacent to the Canal regardless of family makeup. This directive called for the immediate relocation of 239 families to interim housing, a subsequent move to permanent housing of their choice, and provision of all relocation benefits which normally accompany State acquisition of right-of-way. The relocation effort was to be carried out with minimum economic burden to the affected families.

To accomplish this unprecedented undertaking, personnel with real property experience from around the State were called in to inventory available housing, interview residents to determine housing needs, survey and appraise homes, arrange for families to rent and move into temporary housing, provide security for the empty houses, purchase the 239 Love Canal homes in Rings I and II at fair market value, and help families make the move to permanent housing. The American Red Cross, the Salvation Army and the United Way of Niagara Falls also assisted in the relocation.

By January 1979, virtually all families living in Rings I and II had been temporarily relocated, and 232 purchase agreements had been signed by the State with the owners of eligible Love Canal properties.

To further assist Love Canal homeowners and help stabilize the area, the State approved a $1.2 million support program, including $1 million in State aid for a five-year graduated property tax relief program and a $200,000 contract with United Way of Niagara Falls to provide psychological and family counseling for area residents.

Based on continuing evaluation of environmental and health data, the Department of Health, on February 8, 1979, issued a supplemental order recommending that all pregnant women and children under the age of two (residing between 97th Street and 103rd Street and from Frontier Avenue north to Colvin Boulevard) be temporarily relocated away from the area. The Governor modified the order to apply to entire families with pregnant women or young children and to include residents of the LaSalle Development, a low-income housing project west of the Love Canal. Approximately 49 families became eligible for this temporary relocation and, of these, 45 were temporarily moved from the area at their request.

In response to a Show Cause Order filed by the Homeowners Association, a State Supreme Court Justice, in June 1979, ordered temporary relocation at State expense for area residents who claimed to be suffering illness or having breathing difficulties associated with site excavation work to lay the peripheral drains around the landfill. Throughout the summer and fall, particularly on smoggy days, varying numbers of area residents requested and were given temporary relocation to hotels or to nearby Niagara University because of such alleged illness or discomfort.

During July 1979, heavy rains, accompanied by hot, humid weather resulted in widespread chemical odors emanating from the landfill. The remedial construction project was proceeding in the central and northern sectors and extensive repair work was being done on the southern sector.

On August 24, the Homeowners Association Board of Directors met with the State Commissioner of Environmental Conservation to discuss their concerns

that, as a consequence of the remedial construction, chemicals were being volatilized into the air, causing many area residents to experience acute respiratory symptoms. The Commissioner agreed to modify the site safety plan and to restrict the time during which contaminated soils would be exposed to the atmosphere during excavation work.

. . .residents complain of respiratory illness due to construction

In the following few days, 45 persons checked into area hotels complaining of illness. By September 1, 1979, the number of Love Canal residents in hotels had grown to over 200; a total of 230 people spent all or part of Labor Day weekend at the Stella Niagara House, while an additional 100 people reportedly stayed with relatives.

The State attempted to establish a policy, effective Spetember 11, requiring a written physician's statement pertaining to illness for any resident seeking 48-hour relocation due to Love Canal remedial construction work. Residents subsequently complained that area doctors refused to provide such written statements. The State Health Department rejected 112 statements signed by the same physician on the same day, all citing "acute depression" as the reason for relocation.

On September 13, the State Supreme Court instructed the State task force to continue relocating elderly and severely ill Love Canal residents without the required medical certification and to extend temporary relocation to September 18, 1979, for the 112 individuals whose physicians' statements had been rejected

to allow such individuals to obtain and submit credible physicians' statements.

The number of persons in hotels stabilized by September 19 at about 425 individuals, all of whom had submitted physicians' affidavits which were acceptable to the State Health Department. The cost to the State for food and lodging of these individuals reached approximately $7,500 per day during September.

. . .more than 400 residents relocated during remedial construction

By mid-October 1979, three relocation programs were in progress at the Love Canal, with the following status:

1. Permanent Relocation Program for Rings I and II: of the 239 families eligible, 237 closings on property parcels had been completed.
2. Temporary Relocation Program for Families with Pregnant Women or Young Children: of the 49 eligible families, 33 sought and had been placed in apartments or other, longer term housing.
3. Temporary Relocation Based on Illness Associated with Remedial Construction Work: 91 families were being maintained in temporary accommodations.

On November 5, the last of the deep excavations at the construction site was completed and the temporary relocation program ordered by the Supreme Court was terminated; residents in hotels were notified that temporary housing in hotels would no longer be provided at State expense.

In response to a request from the Governor, President Carter declared a second federal emergency at Love Canal on May 22, 1980, paving the way for federal aid to relocate the more than 700 families who still lived near the former toxic waste dump. Under the terms of the presidential order, the federal government would pay for the evacuation and temporary housing of such families until it was determined whether the area was safe for their return.

Stating that the federal declaration did not go far enough, the Governor again asked for outright federal purchase of Love Canal homes. The White House responded that permanent relocation was not provided for under the Federal Disaster Relief Act and the cost of temporary housing could be borne only up to one year. There was also a provision for State sharing of costs.

On May 23, temporary relocation of Love Canal families to area hotels began for the third time. Within three days, the State Department of Transportation relocation team, again activated, reported that 338 applications for relocation had been received; 184 families had been relocated into hotels and 10 more into private accommodations.

On July 3, 1980, the U.S. Congress approved emergency appropriations allowing the President to spend up to $20 million on relocation of Love Canal area families. The measure was an amendment to the Emergency Appropriations Bill (co-sponsored by Senators Javits and Moynihan of New York) which removed legal barriers to federal participation in permanent relocation. Following several weeks of negotiations, terms of a State/federal financial agreement were finalized. The federal government would provide a $7.5 million grant and a $7.5 million advance to New York State for the acquisition of Love Canal properties. The $15 million total would be administered by the previously created Love Canal Area Revitalization Agency, which would act as agent for purchase of eligible properties and direct the revitalization of the area.

. . .federal/State agreement signed for permanent relocation

This unprecedented agreement was signed by the Governor and President on October 2, 1980, at ceremonies in Niagara Falls. On November 14, 1980, the third temporary relocation program ceased and on the following day the first closing under the State/federal buy-out program of Love Canal homes took place. By April 16, 1981, 257 homes out of a possible 550 had been purchased and 132 families who formerly lived in the LaSalle Housing Development had been permanently relocated.

LOVE CANAL Litigation

In the aftermath of the Love Canal environmental emergency, numerous lawsuits were filed by people claiming to have suffered health and financial losses as a result of the landfill.

More than 640 residents of the Love Canal area have filed lawsuits against Hooker Chemical & Plastics Corporation in the Supreme Court, Niagara County. The dollar claims in these lawsuits total between $12 and $14 billion dollars in damages.

About five percent of these claimants also have filed Notices of Intent to File Claim in the New York State Court of Claims, a preliminary step in claiming monetary damages from the State of New York; 50 of these Notices of Intent claim a specific amount of damage from the State, which alone totals $232,000,000. Most of these claims are based on alleged negligence and nuisance conditions, including allegations of the State's failure to inspect specific sites or conditions or to warn residents of potential health hazards.

Prior to the commencement of each phase of the Love Canal remedial construction work, a group of individual residents and the Love Canal Homeowner's Association sought to obtain an injunction against the State to preclude construction work until all residents were moved from the area. These actions were largely unsuccessful, however, temporary relocation was ordered for residents who presented physicians' statements certifying health problems which could be aggravated by construction activities.

In December 1979, the U.S. Department of Justice filed a lawsuit against Hooker Chemical & Plastics Corporation for damage to the environment due to Love Canal as well as financial damages incurred by the United States for necessary emergency measures. The claims asserted by the federal government cite violations of the Resource Conservation and Recovery Act, the Clean Water Act, the Federal Common Law of Nuisance, the Safe Drinking Water Act and the Rivers and Harbors Act. In addition to monetary damages the case seeks injunctive relief which would require Hooker Chemical Corp. to clean up toxic substances which have migrated from the landfill and to prevent further chemical migration from the site.

The State of New York initially filed its claims against Hooker Chemical on April 29, 1980, in New York State Supreme Court. The original $635 million State suit was seeking recovery of up to $95 million incurred by New York State in taking emergency action at the Love Canal; $250 million for injury to air, land and water resources of the State; and an added $250 million in punitive damages.

...Damages claimed by New York State total more than $635 million

As a result of a joinder motion by Hooker Chemical, granted in U.S. District Court, the State of New York and others became parties to the federal action. This ultimately resulted in the State lawsuit being stayed, pending resolution of similar issues in the federal action.

The Love Canal action now pending before the U.S. District Court for the Western District of New York is currently in the discovery phase. New York State, initially joined as a defendant in the federal suit, is now a co-plaintiff with the United States Government as a result of its motion to realign being granted in U.S. District Court. The current status of parties in the joint action is as follows:

Plaintiffs-The United States of America
The State of New York
Urban Development Corp. - Love Canal, Inc.

Defendants-Hooker Chemical & Plastics Corp.;
Hooker Chemical Corp.;
Occidental Petroleum Corp.;
The City of Niagara Falls;
The Niagara County Health Department
The Board of Education of the City of Niagara Falls

In February 1980 the United States government served a subpoena *duces tecum* upon the State Health Commissioner requiring him to produce numerous documents related to the Love Canal, including health records of Love Canal residents obtained under promise of confidentiality for use in Health Department health studies. The Department of Health objected to the production of these records on the grounds that such would constitute a breach of the promise of confidentiality. While the U.S. District Court has not decided the issue, the judge has granted the Health Department a time extension to seek permission from the residents themselves for release of their confidential medical records.

LOVE CANAL: ACTUAL/PROJECTED COSTS BASED ON COMMITMENTS THROUGH 12/31/80 AND ESTIMATED FEDERAL PARTICIPATION (MILLIONS)

	Total Cost	DOT	DEC	DOH	UDC,DSS Other NYS	Total NYS	City of Niagara Falls
Fencing & Security	.513	.513	—	—	—	.513	—
Temporary Housing & Relocation	2.985	2.985	—	—	—	2.985	—
Permanent Relocation & Acquisition of homes in Rings 1 & 2	10.700	—	—	—	10.700	10.700	—
Acquisition of homes beyond Rings 1 & 2	20.000	15.000	—	—	5.000	20.000	—
Health & Environmental Testing & Services	10.959	—	.060	10.899	—	10.959	—
Remedial Construction (Southern Section)	8.048	—	—	—	—	—	8.048
Remedial Construction (Northern & Central Sections)	3.761	—	3.761	—	—	3.761	—
Leachate Treatment Facilities	1.851	—	1.851	—	—	1.851	—
Standby Evacuation Bus Service	.478	.478	—	—	—	.478	—
Human Services Grant (UWN)	.242	.242	—	—	—	.242	—
State Aid for Property Tax Relief	1.000	—	—	—	1.000	1.000	—
Homeowners Consultant	.040	.040	—	—	—	.040	—
State Payment to City of Niagara Falls	—	1.200	—	—	—	1.200	(1.200)
Salaries, Travel, Overtime, Other	1.002	.844	.111	—	.047	1.002	—
TOTAL COSTS INCURRED	$ 61.579	21.302	5.783	10.899	16.747	$ 54.731	6.848
Estimated Federal Participation							
FEMA (FDAA) /1	17.098	10.370		.500		10.870	6.228
USEPA	4.000		2.500	1.500		4.000	
TOTAL FEDERAL PARTICIPATION	$ 21.098	10.370	2.500	2.000	—0—	$ 14.870	6.228

/1 Does not include federal loan ($7.5 million) repayable by NYS with 8¼% interest.

DOT — NYS Department of Transportation
DEC — NYS Department of Environmental Conservation
DOH — NYS Department of Health
DSS — NYS Department of Social Services
UDC — NYS Urban Development Corporation

STATE OF NEW YORK

13149

IN ASSEMBLY

June 22, 1978

Introduced by COMMITTEE ON RULES—read once and referred to the Committee on Ways and Means

AN ACT to amend the public health law, in relation to the study and alleviation of the hazard of toxic substances from certain landfill sites and making an appropriation therefor

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Article thirteen of the public health law is hereby amended by adding a new title twelve, to read as follows:

TITLE XII

TOXIC SUBSTANCES

Section 1385. Legislative intent.
1386. Duties of the commissioner.
1387. Contracts.
1388. Powers of the commissioner; emergencies.
1389. Reports.

§ 1385. Legislative intent. Sites formerly operated as landfills to dispose of toxic substances are exposing the citizens of the state to unnecessary hazards, the duration and extent of which is unknown. To develop a plan for the alleviation of these conditions, it is necessary to conduct a study to determine the extent of such hazards. The potential hazard believed to exist at a specific landfill site in the county of Niagara, has precipatated the need for immediate action to authorize the department of health to undertake such study and to conduct a pilot program to evaluate the effect of individual corrective systems in affected residences.

§ 1386. Duties of the commissioner. The commissioner of health shall conduct a study of both the long and the short term effects of health hazards associated with exposure to toxic substances emanating from certain landfills.

§ 1387. Contracts. The commissioner of health is authorized to enter into contracts and agreements with individuals, corporations and municipalities to perform the study herein directed to alleviate the specific hazard to which the general public or members thereto may be exposed as the result of toxic substances emanating from landfills.

§ 1388. Powers of the commissioner; emergencies. 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.

§ 1389. Reports. The commissioner of health shall make an initial report to the governor and the legislature on or before September fifteenth, nineteen hundred seventy-eight of his progress and a further report to the governor and the legislature on or before September fifteenth, nineteen hundred eighty-one.

§ 2. Appropriation. The sum of five hundred thousand dollars ($500,000), or so much thereof as may be necessary, is hereby appropriated to the department of health from any moneys in the state treasury in the general fund to the credit of the state purposes fund not otherwise appropriated, for its expenses, including personal service, maintenance and operation, in carrying out the provisions of this act. Such moneys shall be made payable out of the state treasury after audit by and on the warrant of the comptroller upon vouchers certified or approved by the commissioner of health.

§ 3. This act shall take effect immediately.

EXPLANATION—Matter in *italics* is new; matter in brackets [ ] is old law to be omitted.

LOVE CANAL
Legislation

LOVE CANAL Chronology

1940s—Residents complain of fly ash in the air due to dumping in canal (anecdotal).

1950s—Complaints abate after canal is covered with dirt (anecdotal).

mid-1960s—Residents complain of minor explosions and resultant fumes from Love Canal and 102nd Street landfills (anecdotal).

September 1976—DEC engineers first visit Love Canal while investigating the suspected discharge of Mirex by Hooker Chemical Corp.

Fall 1976—DEC collects basement sump and sewer samples for Mirex/PCB analysis; based on preliminary test data, DEC urges City of Niagara to hire a consultant to do a hydrogeological study and develop pollution abatement plan.

March 1977 — City of Niagara hires Calspan Corp. of Buffalo as Love Canal consultant.

September 1977—Environmental study conducted by Calspan Corp. for City of Niagara delivered to DEC for review.

October 1977—DEC asks EPA to assist in expanded study of groundwater pollution and sampling of air in basements of homes adjacent to canal.

February 28, 1978—Initial DOH analysis of composite sump samples from eight homes directly abutting the Love Canal reveals quantitatively significant levels of toluene, chlorobenzene, dichlorobenzene, trichlorobenzene, tetrachlorobenzene, pentachlorobenzene and other compounds.

March 14, 1978—EPA releases a report by Research Triangle Institute of air analyses conducted at six homes bordering the landfill, confirming the presence of significant chemical contamination.

April 13, 1978—Preliminary evidence prompts State commissioners of Health and Environmental Conservation to tour Love Canal area.

April 25, 1978—After further investigation and review of all information, State Health Commissioner issues an order to county health officials to remove visible pesticides and chemicals, cover exposed areas, restrict access to the site and conduct needed medical studies.

April 26, 1978—Top staff of DOH and DEC meet in Albany with EPA representatives to review Love Canal test data and develop a cooperative remedial action plan.

May 1978—To quickly evaluate the extent of chemical contamination in homes around the Love Canal, DOH scientists develop a gas chromatographic method to analyze air samples for seven "marker" chemicals (chloroform, benzene, trichloroethylene, toluene, tetrachloroethylene, chlorobenzene and chlorotoluene).

May 11, 1978—Commissioners of Health and Environmental Conservation brief State legislators and elected federal representatives on actions and findings to date.

May 15, 1978—EPA releases report (based on air sampling data) concluding that chemical vapors in basements of canal homes suggest a serious health threat; State officials meet with Love Canal residents at 99th Street School to provide information on State's plans.

May 19, 1978—DOH toxicologist meets with residents to explain potential hazards from exposure to toxic chemicals.

May-June 1978—DOH and DEC begin intensive environmental monitoring, with a focus on measuring chemicals in basement air of homes near the canal.

CDC—Center for Disease Control
DOH—NYS Department of Health
DEC—NYS Department of Environmental Conservation
EPA—U.S. Environmental Protection Agency
FDAA—Federal Disaster Assistance Agency
FEMA—Federal Emergency Management Agency

Chronology

June 13, 1978—State officials meet again with residents and local officials to discuss implementation of the Conestoga-Rovers engineering plan as an interim corrective measure.

June 19, 1978—DOH medical investigators begin drawing blood samples and making a house-to-house health survey of residents living in 97 homes bordering the canal.

Week of June 25, 1978—DOH collects air samples outside homes contiguous to the Love Canal site.

July 7, 1978—DOH researchers report results of analysis of air samples collected from basements and other rooms of homes showing high levels of toluene, chlorotoluene and chloroform.

July 14, 1978—Health Commissioner convenes meeting of interested State, federal, county and city officials to report on air sampling and epidemiologic work underway and to discuss proposed engineering studies.

July 19, 1978—State health officials conduct public meeting at 99th Street School to keep residents informed of State findings and actions to date.

July 20, 1978—Governor signs legislation granting State Health Commisssioner additional emergency powers to deal with the Love Canal problem and appropriating $500,000 in State funds to conduct long-range health studies.

July 31, 1978—Health Commissioner convenes meeting of nationally prominent experts in toxicology, epidemiology and industrial hygiene to present State's findings and seek recommendations and review of further actions to protect public health and correct environmental problems.

August 1978—At Governor's direction, DEC creates Interagency Task Force on Hazardous Wastes to identify all chemical waste dump sites in Erie and Niagara counties and to assess any hazards they may pose to human health.

August 2, 1978—State Health Commissioner declares state of emergency at Love Canal and issues a second, more detailed order to the county, city and school board recommending relocation of pregnant women and children under two years old from first two rings of houses (239 houses) and orders closure of the 99th Street School.

August 2, 1978—Governor appoints Love Canal interagency task force, headed by Commissioner of Transportation, to assist familes in dealing with health, environmental and social problems related to residence in Love Canal area. Task force is comprised of three lead agencies (Health, Environmental Conservation, and Transportation) and nine other State entities.

August 3, 1978—Governor telegraphs the President of the United States requesting federal assistance under Public Law 93-288 to combat the effects of the environmental emergency; Governor directs Love Canal task force to find housing for the familes affected by the health emergency and instructs State Banking Department to work with local banks to prevent foreclosures on homes in the Love Canal area; State officials meet with 600 residents at 99th Street School to assure them the State will pay for their temporary lodging.

August 4, 1978—Love Canal task force opens relocation and health offices at 99th Street School seven days a week to assist residents.

August 7, 1978—President of United States declares an emergency under Public Law 93-288 and authorizes actions necessary to save lives and protect property or to avert or lessen the threat of disaster; U.S. Senate by voice vote approves a "sense of Congress" amendment saying an environmental disaster has occurred and that federal aid should be forthcoming; Governor goes to Niagara Falls to inform residents that the State will purchase homes affected by Love Canal chemicals.

August 9, 1978—State officials meet in Washington with representatives of White House, Congress and federal agencies to discuss aid for Love Canal; State authorizes purchase of 239 houses, including all houses on both sides of 97th and 99th streets.

Chronology

August 10, 1978—DOH's chief medical investigator meets with group of Niagara Falls physicians to outline medical findings and assist physicians in evaluating their patients' conditions.

August 14, 1978—DOH installs nationwide, toll-free hotline to trace former residents of canal as part of health survey.

August 15, 1978—Governor visits Love Canal site to assure residents that a safety plan will be in place for the residents as well as the workers.

August 18, 1978—DOH medical investigators and technicians complete two weeks of collecting blood samples from 2,000 residents.

August 22, 1978—State installs eight-foot high chain-link fence around the Love Canal and first two rings of houses.

August 1978—Applications for federal assistance, totaling $23 million, are filed by the State, county, city and school board to deal with health hazards and environmental problems; FDAA approves less than $2 million in federal aid.

August-September 1978—DEC works with City of Niagara Falls and its consultant, Conestoga-Rovers, to complete design of a drainage and containment system to halt outward chemical migration from landfill.

August-December 1978—Departments of Health and Environmental Conservation undertake extensive air sampling of Love Canal neighborhood, ultimately testing basement air in approximately 700 houses; to expedite such testing, DOH sets up a field laboratory approximately 10 blocks from the Love Canal.

September 1978—State agencies in concert with the Love Canal Homeowners' Association and city and county officials devise safety program to protect workers and residents during remedial construction; DOH equips mobile testing laboratory for monitoring air quality at construction site.

September 9, 1978—DOH detects low levels of radioactivity near the 93rd Street Elementary School; these findings together with earlier elevated readings in the Love Canal prompt health officials to ask U.S. Department of Energy to conduct follow-up tests in the area.

September 11, 1978—DOH announces plans to expand health studies to include residents living between 93rd & 103rd streets.

September 13, 1978—FDAA approves $1.41 million for installation of drainage tile at southern end of canal; this follows earlier approval of $218,900 in federal support of resident relocation costs.

September 19, 1978—U.S. House of Representatives approves $4 million for Love Canal clean-up.

September 27, 1978—State Legislature authorizes $18 million in supplemental budget for Love Canal clean-up.

October 10, 1978—Remedial construction work begins, including installation of tile drains along southern periphery of canal; DOH initiates daily monitoring of air quality and chemical exposure of construction workers.

November 1978—Trace amounts of dioxin confirmed in Love Canal leachate.

November 10, 1978—Health Commissioner convenes second meeting of an outside "blue ribbon" panel of medical and scientific experts to review data from blood tests conducted on 4,000 Love Canal residents; panel concludes that abnormal liver function tests found among some residents may not be indicative of liver disease, but recommends clinical evaluations of selected individuals.

November 21, 1978—DOH officials inform several hundred residents at 99th Street School meeting of liver test findings and "blue ribbon" panel recommendations.

December 27, 1978—State announces financial aid package for Love Canal homeowners, including $200,000 to the United Way of Niagara Falls for administering a human services program and $1 million in State aid for a five-year graduated property tax relief package.

Chronology

January 1979—Committee of local officials and residents formed to examine possible future uses of the Love Canal area and recommend alternative approaches.

January 5, 1979—DOH announces plans to expand epidemiological study to include 250 families living north of Colvin Boulevard, bringing the total families involved in State health studies to more than 700.

January 16, 1979—Health Commissioner convenes Albany meeting of epidemiologists and scientists from the National Center for Disease Control, National Cancer Institute and the National Institute of Environmental Health Sciences to review DOH epidemiologic findings.

February 7, 1979—Health Commissioner convenes third meeting of "blue ribbon" panel of outside medical and scientific experts to review health data related to wet versus dry areas and make appropriate recommendations.

February 8, 1979—Health Commissioner issues supplemental health order recommending temporary relocation of all pregnant women and children under the age of two residing between 97th and 103rd streets, from Frontier Avenue north to Colvin Boulevard; Love Canal task force expands relocation recommendation to include entire families of high-risk individuals and eligible residents of the LaSalle Development.

February-March 1979—DOH designs and executes soil sampling program to test for conduction of chemical leachate along underground swales and utility pathways.

March 1979—DOT executes $200,000 contract with United Way of Niagara Falls to provide counseling and human services to Love Canal area.

March 9, 1979—DOH and DEC staff brief representatives of U.S. Justice Department, EPA, and Occupational Safety and Health Administration on State's actions during Love Canal crisis; Governor asks State attorney general to pursue legal action to protect the public health and the financial interests of New York State in the problem of chemical waste disposal.

April 5, 1979—Joint public hearings to consider questions of hazardous waste dump sites and toxic substance regulation in New York State held by State Senate Standing Committee on Conservation and Recreation, Assembly Standing Committee on Environmental Conservation, Senate Subcommittee on Toxic Substances and Chemical Waste and the Assembly Environmental Conservation Committee Task Force on Toxic Substances.

April 7, 1979—Governor signs into law a bill granting Love Canal homeowners a graduated five-year property tax reduction, amounting to nearly 80 percent of the assessed value of their homes in the first year.

April 26, 1979—Governor meets in Niagara Falls with representatives of Love Canal Homeowners' Association to discuss their concerns for permanent relocation of Love Canal residents.

May 26, 1979—Action taken to intercept flow in French drain located behind 99th Street School after preliminary DOH storm sewer sampling indicates the drain is a measurable source of chemical pollution.

May 29, 1979—Remedial construction begins on central and northern sections of Love Canal.

June 4, 1979—Love Canal homeowners file Show Cause Order, seeking to halt remedial construction on northern and central sectors of the canal.

June 18, 1979—State Supreme Court Justice denies injunction sought by Love Canal homeowners, but orders temporary relocation for any area residents who furnish physicians' certificates attesting to illness or breathing difficulties associated with remedial construction work.

June 28, 1979—Governor tours Love Canal construction project and meets with representatives of neighborhood associations.

July 6, 1979—Health Commissioner meets with a delegation of concerned

Chronology

residents of the 93rd Street area, on the western edge of the Love Canal landfill; Health Commissioner also meets with representatives of the Ecumenical Task Force to assist the group in their quest to win more federal aid to deal with social and environmental problems encountered at Love Canal.

July 17, 1979—Health Commissioner again meets with residents from the 93rd Street area to discuss their concerns about the alleged presence of beryllium; the substance was not found in subsequent soil testing.

July 26, 1979—Panel of scientists appointed by DHEW issues report on its evaluation of Love Canal epidemiological studies, confirming State health findings.

August 21, 1979—State Commissioners of Health, Environmental Conservation and Transportation meet with Love Canal area residents to discuss the concerns of the Homeowners' Association and Ecumenical Task Force.

August 24, 1979—Approximately 20 persons, complaining of illness associated with fumes coming from the Love Canal remedial construction project, are temporarily relocated to Niagara University under provisions of the safety plan; this was the first formal request for relocation although remedial construction had been underway since June.

August 29, 1979—State Commissioner of Environmental Conservation meets with Board of Directors of Love Canal Homeowners' Association to discuss their concerns about remedial construction.

September 10, 1979—Construction commences on the Love Canal permanent leachate treatment plant; 120 families (approximately 425 individuals) are temporarily relocated to area hotels pending receipt of physicians' statements indicating construction work is injurious to their health.

September 13, 1979—State Supreme Court Justice instructs Love Canal Task Force to continue relocating elderly and severely ill Love Canal residents who complain of ill effects associated with remedial construction work without requiring medical certification.

September 19, 1979—Number of temporary Love Canal relocatees in hotels is stabilized at approximately 425 persons; cost per day to the State reaches $7,500 for food and lodging.

October 11, 1979—Remedial construction in southern sector of Love Canal completed; excavation begun for 25,000-gallon holding tank adjacent to the permanent treatment plant.

October 15, 1979—DOH staff involved in the on-going studies at the Love Canal meet in Washington with federal scientists and physicians assigned by the Secretary of DHEW to discuss the results of health studies.

October 26, 1979—Governor announces formation of a State/local task force to stabilize and revitalize the Love Canal area and help it return to a vital and continuing community; State Urban Development Corporation is designated the lead agency and the Niagara Falls mayor is named to chair the group.

November 5, 1979—Residents in area hotels are notified that they may no longer stay at State expense since all deep excavation work at the canal site has been completed.

November 9, 1979—DOH scientists confirm the presence of dioxin in crayfish and sediment collected from the Black Creek, north of the Love Canal; EPA - Region II indicates that Section 311 of Clean Water Act might be source of clean-up funding.

November 15, 1979—A five-man team from EPA visits the Love Canal area to take air and sump samples from a small number of homes outside of Rings I and II to determine if further comprehensive testing should be undertaken by the federal government.

November 16, 1979—Governor's representatives and local legislators meet with residents of the LaSalle Development west of the Love Canal regarding a relocation program for renters.

Chronology

November 29, 1979—Love Canal Task Force is dissolved by the chairman and on-site offices are closed; DEC and DOH continue their respective responsibilities.

December 6, 1979—The new Love Canal Revitalization Task Force, chaired by the Niagara Falls mayor, holds its first meeting.

December 7, 1979—The permanent chemical treatment plant at Love Canal begins operation at 5:30 a.m.

December 20, 1979—U.S. Department of Justice files suit on behalf of EPA to force Hooker Chemical Corp. to spend more than $124 million to clean up Love Canal and three other waste sites in Niagara Falls area.

December 29, 1979—Love Canal Task Force on-site offices are closed; DEC and DOH continue their respective responsibilities.

January 10, 1980—Love Canal Homeowners' Association announces that it will conduct a series of health tests of area residents with the assistance of several western New York physicians.

January 24, 1980—President of the National Academy of Sciences indicates the Academy's willingness to undertake, at the urging of State Health Commissioner, a study of the health impact of industrial waste management practices at the Love Canal.

February 1980—The Environmental Defense Fund, headquartered in Washington, is seeking funds from a variety of sources to conduct an epidemiological and medical screening study in the Love Canal area, purportedly to resolve differences in health data compiled by the State Health Department and the Love Canal Homeowners' Association.

February 6, 1980 — U.S. Senate begins work on legislation to create a "superfund" to deal with the clean-up of hazardous waste dumps that threaten the health and safety of the public.

February 21, 1980 — EPA regional administrator meets with Love Canal residents and announces that EPA will proceed with a federally funded clean-up of storm sewers and the dioxin-contaminated Black Creek into which the sewers empty.

April 29, 1980 — State attorney general files $635 million suit against Hooker Chemical Corp.and its parent corporations to recover damages and abate the nuisance stemming from Love Canal.

May 17, 1980 — EPA announces it has found evidence that some residents of the Love Canal may have suffered chromosome damage from toxic chemicals buried at the Love Canal.

May 20, 1980 — Love Canal homeowners hold two representatives of EPA hostage for five hours in an effort to gain a hearing with the White House about their plight and their demand for immediate evacuation from the area; the hostages are released unharmed.

May 21, 1980 — Governor asks President Carter to declare an emergency in the Love Canal area, paving the way for federal aid to relocate the more than 700 families who live near the former toxic waste dump.

May 22, 1980 — President Carter declares a second federal emergency at Love Canal; panel of outside experts, formed by the National Institute of Environmental Health Sciences, concludes that the federally sponsored chromosome study of 26 Love Canal residents was an inadequate basis to determine health damage; EPA announces that additional health tests will begin within a few days.

May 23, 1980 — Temporary relocation of residents begins for the third time with DOT coordinating effort with FEMA & EPA.

May 25, 1980 — FEMA regional administrator tours Love Canal area.

May 28, 1980 — FEMA announces that participation in permanent relocation of Love Canal residents is not within its legal mandate; six area community groups announce intention to block federal health and medical studies unless they are

Chronology

assured of permanent relocation and purchase of homes.

May 29, 1980 — Report by State Assembly Task Force on Toxic and Hazardous Wastes charges the federal government with dumping barrels of lethal gases, corrosive acids and radioactive wastes in the Love Canal in the 1940s; the charge is based on allegations of eyewitnesses and recently declassified documents from the National Archives; Pentagon issues statement rejecting claims of Assembly subcommittee report.

June 3, 1980 — EPA invites leaders of various Love Canal community groups to Washington to discuss upcoming health tests to be conducted by CDC in cooperation with the State University of New York at Buffalo.

June 4, 1980 — White House announces it has closed the door on the federal government's purchase of homes at the Love Canal.

June 8, 1980 — Commissioner of Health testifies before U.S. Senate Judiciary Committee, chaired by Senator Edward Kennedy.

June 10, 1980 — Officials of the FEMA, CDC and EPA hold four public meetings in Niagara Falls to explain upcoming health and environmental tests in Love Canal area.

June 11, 1980 — CDC and EPA open joint on-site offices to coordinate federal environmental and health testing at Love Canal.

June 16, 1980 — U.S. District Court grants motion by Hooker Chemical Corp. to join New York State as a necessary party in the federal lawsuit against the company stemming from dumping at Love Canal.

June 18, 1980 — Governor signs legislation at Niagara Falls City Hall creating the Love Canal Revitalization Agency.

July 3, 1980 — U.S. Congress approves emergency appropriation allowing President Carter to spend up to $20 million on relocation of Love Canal area families; the measure, an amendment to the Emergency Appropriations Bill, removes legal barriers to federal participation in permanent relocation.

September 11, 1980 — U.S. District Court grants New York State's motion to realign as a plaintiff in the Love Canal federal action.

October 2, 1980 — At ceremonies in Niagara Falls, President Carter and Governor Carey sign joint agreement under which the federal government will provide $7.5 million advance to the State of New York and a $7.5 million grant to pay for voluntary relocation of residents; under terms of the agreement, the Love Canal Revitalization Agency will administer the program.

October 11, 1980 — The five-member scientific review panel appointed by the Governor in June 1980 issues its evaluation of Love Canal health studies, indicating that "chronic effects of hazardous waste exposure at Love canal have neither been established nor ruled out as yet."

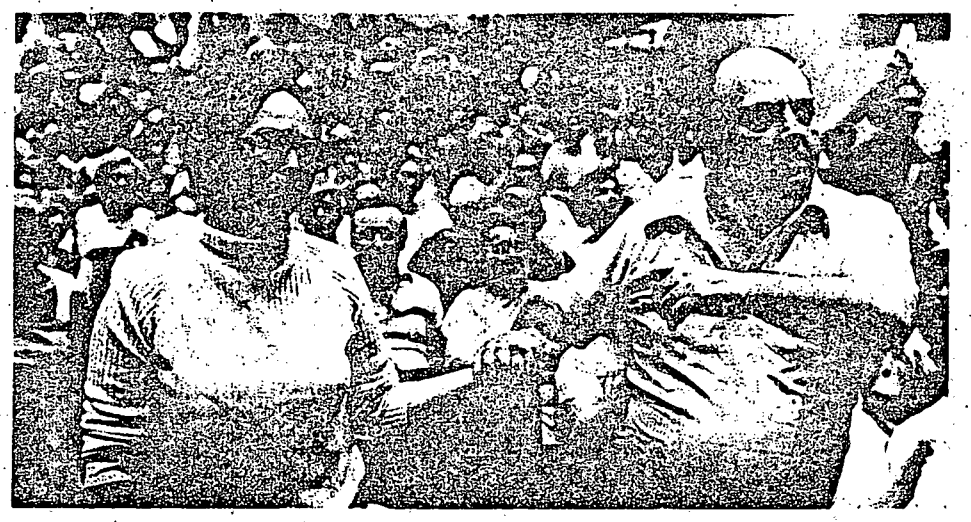
November 15, 1980 — First home sold to Love Canal Revitalization Agency under federal/State buy-out plan.

November 19, 1980 — New federal Resource Conservation and Recovery Act (RCRA) regulations take effect with "cradle-to-grave" concept to control toxic waste disposal.

December 12, 1980 — President Carter signs superfund legislation creating a $1.6 billion federal fund to aid in cleaning up chemical spills and toxic waste dumps across the U.S. the law authorizes the government to recover costs of corrective action from companies responsible for the contamination.

April 1981 — Federal government closes its on-site office in Niagara Falls since environmental testing is completed and funding is uncertain for the long delayed health studies.

April 16, 1981 — As of this date, 257 homes in the Love Canal area have been purchased under the State/federal buy-out program out of a possible 550 homes within the boundaries of the voluntary relocation agreement; 132 families who formerly rented living quarters in the LaSalle Housing Development or private sector also have been permanently relocated.



LOVE CANAL Health Department Orders

STATE OF NEW YORK : DEPARTMENT OF HEALTH

IN THE MATTER OF

THE LOVE CANAL CHEMICAL WASTE LANDFILL SITE
LOCATED IN THE CITY OF NIAGARA FALLS,
NIAGARA COUNTY, STATE OF NEW YORK

ORDER

WHEREAS, the Commissioner of Health of the State of New York, among other things, is directed by the Public Health Law to take cognizance of the interests of health and life of the People of the State, and of all matters pertaining thereto and to exercise the functions, powers and duties of the Department of Health prescribed by law and to enforce the Public Health Law; and

WHEREAS, Subdivision four of Section 1303 of the Public Health Law provides as follows:

"Whenever the commissioner shall by notice to the presiding officer of any local board of health, direct him to convene such local board to take certain definite proceedings concerning which the commissioner shall be satisfied that the action recommended by him is necessary for the public good, and is within the jurisdiction of such board of health, such presiding officer shall convene such local board of health, which shall take the action directed"; and

WHEREAS, Section 1304 of the Public Health Law provides:

"The local health officer of a health district having no local board of health and each county health commissioner shall have authority equal to a local board of health to investigate and abate public nuisances which may affect health."; and

WHEREAS, investigation by the Commissioner of Health of the State of New York and those acting by and on his behalf have disclosed that certain hazardous chemical wastes heretofore deposited at that certain site known as the "Love Canal Chemical Waste Landfill" located in the City of Niagara Falls, County of Niagara and State of New York constitute a public nuisance and an extremely serious threat and danger to the health, safety and welfare of those using it, living near it or exposed to the conditions emanating from it, consisting, among other things, of chemical wastes lying exposed on the surface in numerous places and pervasive, pernicious and obnoxious chemical vapors and fumes affecting both the ambient air and the homes of certain residents living near such site; and

WHEREAS, the undersigned State Commissioner of Health, pursuant to the statutory authority conferred upon him, heretofore did direct the Niagara County Health Commissioner to take certain actions deemed necessary to alleviate and lessen, for the public good, the dangers and hazards posed at the aforesaid landfill site to those affected by it; and

WHEREAS, it appears that the Niagara County Health Commissioner took some, but not all, of the actions so directed to be taken to alleviate and lessen such hazards and dangers; and

WHEREAS, it appears that certain actions are still necessary for the public good;

NOW, THEREFORE, I DO HEREBY ORDER AND DIRECT:

That the President of the Niagara County Board of Health convene the Board of Health of the County of Niagara and that said Board, together with the Niagara County Health Commissioner, take the following definite actions:

a. Take adequate and appropriate measures to cause the removal from the Love Canal Chemical Waste Landfill site of all chemicals, pesticides and other toxic material which lie exposed or visible on the surface of the site.

b. Take appropriate and adequate measures to limit accessibility to the site by the installation of suitable fencing or other effective means, together with periodic

surveillance and monitoring, to assure that access to the site is properly restricted or limited.

c. Take all other appropriate and necessary corrective action to abate the public health nuisance now existing at the Love Canal Chemical Waste Landfill site.

d. Make an initial report to the undersigned Commissioner of Health, not later than 15 days from the date of service of this Order, concerning the progress made in implementing the order and directions herein given and, thereafter, report on a monthly basis as to such progress.

ROBERT P. WHALEN, M.D.
Commissioner of Health of
the State of New York

DATED: June 20, 1978

STATE OF NEW YORK : DEPARTMENT OF HEALTH

In the Matter of

THE LOVE CANAL CHEMICAL WASTE LANDFILL SITE
LOCATED IN THE CITY OF NIAGARA FALLS,
NIAGARA COUNTY, STATE OF NEW YORK

ORDER

I, ROBERT P. WHALEN, M.D., Commissioner of Health of the State of New York, pursuant to the statutory authority conferred upon me, having conducted or caused an extensive investigation to be conducted in relation to that certain site known as the "Love Canal Chemical Waste Landfill" located in the City of Niagara Falls, County of Niagara, and State of New York, and having determined, by previous orders made and issued by me in this matter, that said site constitutes a public nuisance and an extremely serious threat and danger to the health, safety and welfare to those using it, living near it, or exposed to the conditions emanating from it, consisting, among other things, of chemical wastes lying exposed on the

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surface in numerous places and pervasive, pernicious and obnoxious chemical vapors and fumes affecting both the ambient air and the homes of certain residents living near such site and having directed that certain remedial action be taken with respect thereto and, pursuant to my order and direction, further inquiry and investigation of the said Love Canal Chemical Waste Landfill site having been made;

NOW, THEREFORE, based upon epidemiological studies made by personnel of the State Department of Health and air quality sampling and studies made by personnel of both the State Department of Health and the United States Environmental Protection Agency of both the ambient air and selected homes at or near the site, and upon a review and examination of matters contained in Calspan Report No. ND–6097–M–1 prepared for the City of Niagara Falls by the Calspan Corporation of Buffalo, New York; a review and examination of the Conestoga–Rovers and Associates proposal, entitled "Proposal–Love Canal Chemical Landfill–Niagara Falls, New York – Site Study and Preliminary Design of Ground Water Pollution Abatement Plan," commissioned by and presented to the City of Niagara Falls; and a review and examination of a report entitled, "Phase I – Pollution Abatement Plan-Upper Groundwater Regime" prepared by Conestoga-Rovers & Associates, Waterloo, Ontario, Canada, jointly commissioned by the City of Niagara Falls, the City of Niagara Falls Board of Education and the Hooker Chemical Corporation; and, further, upon a review and due consideration of discussions had and reports submitted at a meeting held in the Conference Room, Division of Laboratories and Research, State Health Department, on June 15, 1978, attended by representatives of the State Health Department, the State Department of Environmental Conservation, the United States Environmental Protection Agency, the State Division of the Budget, the Commissioner of Health of the County of Niagara and by representatives of the Research Triangle Institute, consultants to the United States Environmental Protection Agency, which such meeting was convened to share information and obtain advice in relation to environmental health studies planned by the Department of Health with respect to the Love Canal Chemical Waste Landfill site; and, further, upon a review and due consideration of discussions had and reports submitted at that certain meeting held on July 14, 1978 in the 14th floor conference room, Empire State Plaza Building, Albany, New York, attended by representatives of the State Department of Health, the State Department of Environmental Conservation, the United States Environmental Protection Agency, the Board of Health of Niagara County, including the Niagara County Health Commissioner, the City of Niagara Falls, Conestoga-Rovers, & Associates, Fred Hart & Associates, consultants to the United States Environmental Protection Agency, and by representatives of United States Congressman John LaFalce, and New York State Assemblymen Matthew Murphy and John Daley; and, further, upon a personal visit made to the Love Canal Chemical Waste Landfill site on April 13, 1978 by me in company with Peter Berle, State Commissioner of Environmental Conservation, and others; and, further, upon review and due consideration of discussions had and recommendations made at a meeting on July 31, 1978 in the Fiorello Room, Conference Center, LaGuardia Airport, New York, attended by me and members of my executive and scientific staff, by staff of the New York State Department of Environmental Conservation and by several of the nation's leading experts in epidemiology, toxicology and industrial hygiene called by me to render expert advice, concerning health hazards associated with the Love Canal Chemical Landfill site and upon all other proceedings, reports and discussions heretofore had herein and considered with respect to the Love Canal Chemical Waste Landfill site, including information that between the period 1940 and termination of the Korean War, that the Department of the Army deposited chemical wastes in said Love Canal landfill site,

I DO HEREBY FIND, CONCLUDE, RECOMMEND AND ORDER, as follows,

FINDINGS OF FACT

1. The Love Canal is a rectangular, 16 acre, below ground level landfill site located in the southeast corner of the City of Niagara Falls, Niagara County, New York, known as the "La Salle" area, with the southernmost portion of the site about ¼ mile from the Niagara River near Cayuga Island.

2. The site is bordered on the north by Colvin Boulevard; on the south by Frontier Avenue; on the west by 97th Street; and on the east by 99th Street.

3. The southern and northern sections of the site are bordered by single family homes on 97th and 99th streets, while the middle section is bordered by a grammar school.

4. In the early 19th century the site was excavated as part of a proposed canal project linking the Niagara River and Lake Ontario.

5. The Love Canal project was abandoned and never completed and the abandoned canal subsequently used as a chemical and municipal waste disposal site.

6. The Hooker Chemical Company, Niagara Falls, New York, used the site for the disposal of drummed chemical wastes, process sludges, fly ash, and other wastes, for a period of nearly 25 years, from on or about 1930 to on or about 1953.

7. The City of Niagara Falls, New York, also used the site for the disposal of municipal wastes for many years prior to and including 1953.

8. On or about 1953, the site was covered with earth and sold by the Hooker Chemical Company to the Board of Education of the City of Niagara Falls, New York.

9. The City of Niagara Falls Board of Education subsequently sold part of the site to others.

10. Ownership of the site is currently shared as follows:

City of Niagara Falls – 6.58 acres
City of Niagara Falls Board of Education – 3.53 acres
L. C. Armstrong – 5.98 acres

11. There are presently 97 families with 230 adults and 134 children living in the houses adjacent to the northern and southern sections of the Love Canal.

12. The basements of homes bordering the site are now suffering from toxic chemical waste leachate intrusion from the site.

13. The grammar school on the site has no basement, but a crawl space only, however, the possibility of standing water next to classroom windows provides a mechanism for the transportation of and exposure of the school children to toxic vapors.

14. The soil strata surrounding and underlying the wastes, generally consists of silts and fine sands of low permeability in the levels 4 to 6 feet below the surface; in the next levels 19 to 26 feet below the surface the soil is silts and clay of very low permeability; the next level to about 40 feet below the surface consists of compact loamy glacial till of low permeability; and the level 40 feet more or less below the surface consists of limestone bedrock.

15. The clay strata acts as a barrier and creates a perched groundwater condition.

16. Leachate containing both halogenated and unhalogenated organic compounds migrates in the top soil layer and is the conduit by which it reaches the basements of homes adjacent to the site.

17. More than 80 chemical compounds have been identified at the site itself.

18. Air samples taken in the basements of 14 houses adjacent to the site by the United State Environmental Protection Agency in February 1978 resulted in the identification of 26 organic compounds.

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19. Air samples to monitor 10 selected compounds were taken by the Division of Laboratories and Research of the State Health Department in July 1978 from the basements of 88 houses peripheral to those built adjacent to the landfill site with the following results:

COMPOUNDS	NO OF TIMES FOUND IN HOUSES	PERCENT OF TOTAL HOUSES SAMPLED	HIGHEST VALUE OBSERVED
Chloroform	23	26	24 ug/m^3
Benzene	20	23	270 ug/m^3
Trichloroethene	74	84	73 ug/m^3
Toluene	54	61	570 ug/m^3
Tetrachloroethene	82	93	1140 ug/m^3
Chlorobenzene	6	7	240 ug/m^3
Chlorotoluene	32	36	6700 ug/m^3
m+p xylene	35	40	140 ug/m^3
o-xylene	17	19	73 ug/m^3
Trichlorobenzene	11	13	74 ug/m^3

20. Seven of the chemicals identified in the air samples taken by the Division of Laboratories and Research are carcinogenic in animals and one, benzene, is a known human carcinogen.

21. In one home, in particular, the concentration of organic chemicals in the living space was well beyond the concentrations measured in the basement of any other house.

22. An epidemiologic study to determine whether residents presently living adjacent to the Love Canal are at increased risks for certain disorders was conducted by the Bureau of Occupational Health of the State Health Department in June 1978, utilizing spontaneous abortions and congenital defects as indicators of potential toxicity.

23. Based upon information obtained relating to maternal age, pregnancy order, and number of spontaneous abortions observed and expected among females residing in different sections of the Canal, the mean ages of females ever pregnant at the Love Canal, the duration of residence, and the mean age of the houses, the following was determined:

(a) A slight increase in risk for spontaneous abortion was found among all residents of the Canal and for the northern and southern sections, with the overall estimated risk 1.5 times greater than that expected.

(b) A significant excess of spontaneous abortions was localized among residents of 99th Street South.

(c) The miscarriage experience in the 99th Street North and 97th Street North and South sections approximated that which could be expected.

(d) A significant excess of spontaneous abortions occurred during the summer months of June through August.

(e) Congenital malformations were found among 5 children of adults presently residing on the Love Canal, with the distribution being 3 children from 99th Street South, 1 child from 99 Street North, and 1 child from 97th Street South.

(f) The mean ages of females ever pregnant on the Love Canal were comparable for 97th and 99th Streets.

(g) The average duration of residence on the Canal for 99th Street females was 16.5 years and 10.8 years for the 97th Street females.

(h) The mean ages of the houses located on 99th Street South was 26 years, for

99th Street North 21.6 years, for 97th Street North 18.6 years, and for 97th Street South 13.6 years.

CONCLUSIONS

1. A review of all of the available evidence respecting the Love Canal Chemical Waste Landfill site has convinced me of the existence of a great and imminent peril to the health of the general public residing at or near the said site as a result of exposure to toxic substances emanating from such site; that there is no evidence at present of unusual occurrence of acute illness of an allergic, neurologic, dermatologic or respiratory type among persons residing in the vicinity of the Love Canal; that there is growing evidence that there is a higher risk of subacute and chronic health hazards as well as spontaneous abortions and congenital malformations; and pursuant to the authority conferred upon me by Public Health Law Section 1388, enacted by Chapter 487 of the Laws of 1978, the existence of an emergency should be declared by me.

2. That the Conestoga-Rovers report, subject to appropriate modification and approval by the State Department of Environmental Conservation, represents a feasible interim plan with a reasonable probability of halting the migration of toxic substances through the soil of the Love Canal site to the houses at such site.

3. That the orders and directions heretofore given by me to the Niagara County Board of Health, and its Health Commissioner, to take certain remedial actions to alleviate the hazards emanating from the Love Canal site were reasonable and should be reaffirmed.

4. That further studies should be made to:

(a) delineate chronic diseases afflicting all residents who lived adjacent to the Love Canal landfill site, with particular emphasis on the frequency of spontaneous abortions, congenital defects, and other pathologies, including cancer;

(b) delineate the full limits or boundaries of the Love Canal with respect to possible toxic effects;

(c) determine, by continued air, water and ground sampling, the extent that leachate has spread through the site.;

(d) identify which groundwater aquifers, if any, have been contaminated by leachate;

(e) determine the possibility of minimizing the introduction of noxious odors and chemicals by way of drainage from outside the homes and to consider the utility or feasibility of installing customized ventilation systems, carbon filters, and/or the special venting of sumps.

RECOMMENDATIONS

1. That pregnant women living at 97th and 99th streets and Colvin Boulevard temporarily move from their homes as soon as possible.

2. That the approximately 20 families living on 97th and 99th streets and Colvin Boulevard arrange to temporarily relocate any children under two years of age as soon as possible.

3. That residents living in the vicinity assist local and State agencies in defining and abating hazardous conditions arising from the Love Canal landfill site.

4. That residents living on 97th and 99th streets and Colvin Boulevard avoid use of their basements as much as possible especially for sleeping and eating purposes thereby reducing their exposure to elevated levels of organic compounds present in the air of their basements.

5. That consumption be avoided of food products home-grown by residents of 97th and 99th streets and Colvin Boulevard.

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6. That the Department of the Army continue the investigation initiated by it to determine the extent to which the United States Army was involved in chemical waste disposal at the Love Canal landfill site and inform the New York State Department of Health of significant findings obtained through its search of Army archives and records, on-site inspections, or other sources utilized.

7. That the Niagara County Medical Society cooperate with staff of the State Health Department and the Niagara County Health Department in any study undertaken to identify former residents of the Love Canal area to determine what, if any, chronic or adverse health effects they now exhibit; further, that private physicians and the hospitals of Niagara County also cooperate with such staff; the physicians to assist in identifying and obtaining the necessary consents from such former residents and the hospitals with respect to supplying the necessary medical records.

8. That the Commissioner of the New York State Department of Environmental Conservation provide on-site supervision of any construction activity on the Love Canal Chemical Landfill site by a member of his department or other responsible party designated by him.

I DO HEREBY ORDER AND DIRECT:

1. AND DECLARE, pursuant to the authority conferred upon me by Public Health Law, Section 1388, enacted by Chapter 487 of the Laws of 1978, the EXISTENCE OF AN EMERGENCY and direct that the measures herein ordered are deemed reasonably necessary and shall be taken for the preservation and protection of the public health, and by virtue of the limited emergency nature of the action immediately necessary, which is herein directed to be taken, that the requirements of the State Environmental Quality Review Act are not applicable, except that neither any long-range plans to decontaminate the site, nor the implementation thereof, shall be exempt from the requirements of such act.

2. The Niagara County Board of Health and the Niagara County Health Commissioner to take the following definite actions:

(a) Take adequate and appropriate measure to cause the removal from the Love Canal Chemical Waste Landfill site of all chemicals, pesticides and other toxic material which lie exposed or visible on the surface of the site.

(b) Take appropriate and adequate measures to limit accessibility to the site by the installation of suitable fencing or other effective means, together with periodic surveillance and monitoring, to assure that access to the site is properly restricted or limited.

(c) Take all other appropriate and necessary corrective action to abate the public health nuisance now existing at the Love Canal Chemical Waste Landfill site, including immediate steps to determine the feasibility of lowering the elevated levels of organic compound contamination in the air of basements by the moisture-proofing and venting of such basements by use of carbon filtering devices in cooperation with the New York State Departments of Health and Environmental Conservation.

(d) Take all appropriate and necessary steps to undertake necessary engineering studies to provide a long-range solution for decontamination of the site. In connection therewith, that consultation and cooperation of the United States Environmental Protection Agency, the New York State Department of Environmental Conservation and the New York State Department of Health be sought, and approval of the New York State Department of Environmental Conservation.

(e) Make an initial report to me not later than 30 days from the date of service of this Order, concerning the progress made in implementing the orders and directions herein given, and thereafter report on a monthly basis as to such progress.

Health Department Orders

3. The City of Niagara Falls and County of Niagara Board of Health shall forthwith take all appropriate steps to implement the Conestoga-Rovers report entitled "Phase I–Pollution Abatement Plan – Upper Groundwater Regime," subject, however, to the approval of the Commissioner of Environmental Conservation, after due consideration is given by him of the feasibility of inclusion of a tile drainage system on at least the east and west sides of the school property, and they are hereby directed to respond to requests made by the Department of Environmental Conservation for additional information in relation to said report.

4. The City of Niagara Falls and County of Niagara Board of Health to report monthly as to progress in implementing the Conestoga-Rovers report.

5. That the City of Niagara Falls and Niagara County Board of Health, provided they receive approval of the Commissioner of Environmental Conservation for the implementation of the Conestoga-Rovers report, shall develop suitable plans for the safety of the workers employed to do the necessary work to implement the plan and to minimize hazardous exposure to residents that may occur during the course of the work, including appropriate steps to maximize dust control and minimize airborne pollution.

6. That the City of Niagara Falls Board of Education temporarily delay opening the elementary school on the Love Canal site to minimize exposure to school age children to waste chemicals while corrective construction activities take place.

7. The Niagara County Department of Health and the City of Niagara Falls, in cooperation with staff of the State Department of Health and State Department of Environmental Conservation to undertake additional studies to:

(a) delineate chronic diseases afflicting all residents who lived adjacent to the Love Canal landfill site, with particular emphasis on the frequency of spontaneous abortions, congenital defects, and other pathologies, including cancer;

(b) delineate the full limits or boundaries of the Love Canal with respect to possible toxic effects;

(c) determine, by continued air, water and ground sampling, the extent that leachate has moved out of the site to the surrounding neighborhood;

(d) identify which groundwater aquifers, if any, have been contaminated by leachate;

(e) determine the possibility of minimizing the introduction of noxious odors and chemicals by way of drainage from outside the homes and to consider the utility or feasibility of installing customized ventilating devices, carbon filtering devices, or the special venting of sumps.

8. That if monitoring shows that the levels of organic compounds in homes are not significantly reduced at the expiration of 12 months following corrective construction, or that if new evidence of hazards presently unrecognized of serious nature is forthcoming at any time, that a complete re-evaluation of the health hazards at the site shall be made by the State Health Department and other involved agencies at that time. Moreover, I shall periodically re-evaluate this situation and if necessary amend this Order, issue additional orders and public health advisories.

9. That this Order supercedes all other previous orders and directions heretofore made and issued by me in connection with this matter, except as may otherwise be specified herein.

Robert P. Whalen M.D.

ROBERT P. WHALEN, M.D.
Commissioner of Health

DATED: August 2, 1978

Health Department Orders

STATE OF NEW YORK : DEPARTMENT OF HEALTH

IN THE MATTER OF

THE LOVE CANAL CHEMICAL WASTE LANDFILL SITE
LOCATED IN THE CITY OF NIAGARA FALLS,
NIAGARA COUNTY, STATE OF NEW YORK

SUPPLEMENTAL ORDER

Heretofore, by Order dated August 2, 1978, ROBERT P. WHALEN, M.D., my predecessor as Commissioner of Health of the State of New York, declared the existence of an emergency, pursuant to Public Health Law § 1388, because of a great and imminent peril to the health of the general public residing at or near the Love Canal Chemical Landfill site in the "La Salle" section of the City of Niagara Falls, New York, resulting from exposure to toxic substances emanating from such site and by said Order directed that certain corrective action be taken including, among other things, that the City of Niagara Falls and the Niagara County Board of Health take all appropriate steps to (1) implement the Conestoga-Rovers Report, entitled "Phase I – Pollution Abatement Plan – Upper Groundwater Regime," subject, however, to an approval of a detailed safety plan for workers and persons living near the site, including monitoring and evacuation contingencies, which was required to be in place before the beginning of any corrective construction work; and to (2) undertake additional studies in cooperation with staff of the State Department of Health and the State Department of Environmental Conservation to (a) delineate chronic diseases afflicting all residents who live adjacent to the Love Canal site with special emphasis on the frequency of spontaneous abortions, birth defects and other pathologies, including cancer; (b) delineate the full limits or boundaries of the Love Canal with respect to possible toxic effects; (c) determine by continued air, water and ground sampling the extent of lateral migration of toxic chemicals from the site to the surrounding neighborhood; and (d) identify which groundwater aquifers, if any, have been contaminated by leachate; such measures directed to be taken were, of course, only a part of the massive total effort undertaken by both State and Federal officials to assist affected families and residents of the area in dealing with their evolving health, environmental and social problems, as more particularly exemplified by a proposed grant of disaster assistance monies by the Federal Disaster Assistance Administration upon the application of Governor Carey on August 2, 1978, with the support of President Carter, Senators Javits and Moynihan and Congressman La Falce following the issuance of the aforesaid Order; by the appointment on August 2, 1978, by Governor Carey of an interagency Love Canal Task Force headed by State Transportation Commissioner Hennessy; by the several public and group meetings held by State officials with residents of the Love Canal area, including several visits by both Governor Carey and variously, by Commissioner Whalen and by me during the months of August, September and December; by the appropriation of more than $18,000,000 in the Supplemental Budget by the New York State Legislature to deal with the problems arising from the Love Canal Chemical Waste Landfill site, including relocation where deemed necessary; by additional grants for similar purposes forthcoming from the Environmental Protection Agency; and it appearing, further, that the State Department of Health has obtained invaluable additional epidemiological and environmental information through its institution of a comprehensive medical survey and testing program to evaluate the health of residents of the Love Canal area by the establishment of blood clinics and house-to-house surveys, where necessary, resulting in the taking, completion and review of more than 4,000 medical questionnaires and blood samples; through the

creation of a nationwide hotline to search out former residents of the Love Canal area to determine what, if any, illnesses or conditions they might have developed in connection with their exposure to toxic chemicals emanating from the Love Canal Chemical Waste Landfill site, with the result that more than 400 phone calls from former residents living in 31 states were received within a few short weeks of the hotline's creation; through the taking of air, sump water and soil samples to determine the presence of chemicals in the homes and soils of the Love Canal area; and through a request made of staff of the Cornell University NASA-sponsored Remote Sensing Program to interpret extensive aerial and infra-red photographs of the area to obtain information on the hydrogeology of the Love Canal Landfill site locating any existing or formerly existing ponds, swamps, drainageway or stream bed sites; and further, upon a review and due consideration of discussions had and reports submitted at those certain meetings convened, respectively, on November 10, 1978, at La Guardia Field, New York, on January 16, 1979, at the Empire State Plaza Tower Building, Albany, New York, and on February 7, 1979, at La Guardia Field, New York, separately and variously attended by several of the nation's leading experts in pediatrics, epidemiology, toxicology and various other scientific and medical fields, including clinical experts involved in the treatment and pathology of liver disease, which said meetings were convened for the purpose of obtaining expert advice relating to the health hazards associated with the Love Canal Chemical Landfill site and surrounding areas;

NOW, THEREFORE, based upon the foregoing and, more particularly, upon the additional epidemiological and environmental information obtained since the issuance of the Order dated August 2, 1978, and the right and power specifically reserved in said Order to completely reexamine and reevaluate any of the health hazards that might exist at the site if new evidence of hazards of a serious nature previously unrecognized should be forthcoming at any time, and to amend such Order or issue additional or supplemental Orders and public health advisories, where necessary, I, DAVID AXELROD, M.D., as Commissioner of Health of the State of New York, do hereby reaffirm said Order and make the following Supplemental Findings of Fact, Conclusions, Recommendations, Orders and Directions:

FINDINGS OF FACT

1. Following the issuance of the August 2, 1978, Order in this matter, all residents residing in homes on 97th Street near the Love Canal site were relocated as well as most residents on 99th Street and on Colvin Avenue between 97th and 99th Streets.

2. To date, the New York State Department of Health, Division of Laboratories and Research, has carried out analyses of 656 air samples, 143 sump samples and 138 soil samples.

3. In response to a request from the Interagency Task Force on Hazardous Waste, the Hooker Chemical Company submitted a declaration of estimated disposition of chemical wastes in Niagara County. Portions of the declaration which may be pertinent to the Love Canal site are attached hereto as Appendix A.

4. The City of Niagara Falls hired the Newco Chemical Company as its contractor to implement the Conestoga-Rovers Report entitled "Phase I – Pollution Abatement Plan – Upper Groundwater Regime," as modified after consultation with appropriate Federal and State officials.

5. Construction to implement the Conestoga-Rovers Report, as modified, was begun on or about October 10, 1978, by Newco Chemical Company after a detailed safety and emergency evacuation approved by the State Commissioner of Health was put into place.

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6. Remedial construction in the southern third of the Love Canal utilizing a tile drain system designed by Conestoga-Rovers, and as modified by the New York State Department of Environmental Conservation has begun the process of lowering the water level within the canal.

7. About 20,000 gallons of leacheate are collected, treated by an on-site treatment plant and released into the sanitary sewers each day, the partial chemical composition of which is shown in Appendix B.

8. The tile drain system is controlling lateral migration not only by lowering the water level in the canal but also by intercepting chemical migration from the canal.

9. Installation of a clay cap to control surface water infiltration is scheduled for completion in the spring.

10. Preliminary specifications for remedial construction in the middle third of the Love Canal have been submitted for review with construction scheduled to begin this spring.

11. Three deep wells have been sunk in the Love Canal area to obtain chemical data relating to the deep aquifers.

12. During the trenching for the tile drain system, an east-west sand lense present on both sides of the canal was found.

13. Leachate collected from a hole dug in said lense, in what was the backyard of 775 97th Street, has shown the presence of trace amounts of 2, 3, 7, 8-tetrachlorodibenzodioxin as well as the presence of at least 200 different organic compounds.

14. Such extremely permeable sandy soil is characterized by qualitatively obvious chemical contamination both to the east and to the west.

15. Borings in the sand lense to the west of the Love Canal between houses at 771 and 775 97th Street revealed that qualitatively obvious chemical contamination had reached the eastern edge of 97th Street.

16. Holes dug on the westerly side of 97th Street did not indicate obvious chemical contamination.

17. Chemical tests are now underway to quantitate the level of chemical contamination in such soils.

18. Examination of a series of aerial photographs of the Love Canal taken during the period 1938 – 1953 indicates that the process of filling the canal was carried out by damming small sections of the canal starting from the south and from the north.

19. Displaced water in the dammed areas apparently flowed along existing surface drainage pathways to locations outside the canal proper.

20. New York State Department of Transportation topographic maps made in 1956 show the existence of a 20 foot hill in the southern portion of the Love Canal and two slightly smaller hills in the northern portion of the Love Canal.

21. Examination of aerial photographs made in the 1960s shows the absence of such hills.

22. Utility conduits underlie both Read Avenue and Wheatfield Avenue where they traverse the Love Canal and provide a possible channel for migration of chemical contamination.

23. Toxic chemicals have been found in the storm sewers draining to the south of the Love Canal and into the 102nd Street storm sewer which drains into the Niagara River.

24. Toxic chemicals have also been detected in sewers draining to the north into Black Creek.

25. During times of high water the 102nd Street storm sewer backs up and floods portions of 102nd Street and Frontier Avenue.

26. An area between 96th Street and 97th Street directly north of Read Avenue is also subject to flooding from backed up storm sewers draining north to Black Creek.

27. Directly north of Wheatfield Avenue between 100th Street and 101st Street is an area approximately 12 lots in extent which was a topographically low spot that was filled with various waste materials, mainly asphalt shingle clippings, before houses were constructed on the site.

28. The area presently known as Griffen Manor formerly was a low lying swampy area requiring filling before dwelling construction.

29. Blood samples of Love Canal area residents show a rate of abnormal combinations of liver tests which variously exceed an expected rate of 2.7% based on a survey of laboratory records for 26,000 persons tested at a Rochester hospital.

30. Liver tests relating to residents of the 1st and 2nd rings, to wit, those residing, respectively, in homes directly adjacent to the Love Canal and those residing in homes located across the street therefrom on the average reverted to normal ranges after relocation from the canal site area.

31. Repeat blood samples of residents of the 1st and 2nd rings show that initial normal liver test levels on the average remained normal after relocation from the canal site area.

32. Children residing in homes in an area bounded by 100th Street, 103 Street, Frontier Avenue and Colvin Avenue whose initial liver tests were in some instances abnormal, upon repeat examination had liver test results in normal ranges.

33. Spontaneous abortion or miscarriage rates are higher than expected among female residents of homes located in an area bounded by 97th Street, 103rd Street, Frontier Avenue and Colvin Avenue and built on historically "wet" properties (that is, homes built on former drainageways, stream bed sites, swales, ponds or historical wetlands), adjusted for age and parity, compared with actual rates occurring among female residents of homes in the same neighborhood built on historically "dry" properties.

34. In addition, infants born to female residents living on historically "wet" properties had a higher rate of occurrence of congenital defects as compared with children born of female residents of historically "dry" properties, with such congenital defects among the former group constituting about 13% of live births compared with a rate of about 5% among the latter group.

35. In addition, the percentage of infants of low birth weight born to mothers living on historically "wet" properties was significantly different from that of infants born in New York State (excluding New York City); in contrast there was no significant difference noted between infants born to mothers living on historically "dry" properties and infants born in New York State (excluding New York City).

36. Chemical studies of air samples collected in the basements of homes in the Love Canal area, to date, generally show no consistent correlation between concentrations of chemicals identified and the occurrence of birth defects, liver test abnormalities and spontaneous abortions.

37. Chemical studies of soil samples collected from various sites in the Love Canal area and samples of water collected from basement sumps show the presence of various isomers of hexachlorocyclohexane.

CONCLUSIONS

1. Review of the approximately 1,000 environmental samples corroborates the August 2, 1978, conclusion that there is substantial chemical contamination in houses in ring I and evidence of some chemical contamination of basement air, soil, sump water and storm sewer waters collected from homes and properties beyond the 1st ring of homes of the Love Canal site.

2. Examination of the declaration of estimated disposition of chemical wastes submitted by the Hooker Chemical Company indicates the deposition in the Love Canal of many hazardous and toxic substances in large amounts.

Health Department Orders

Health Department Orders

3. Remedial construction when completed should provide an effective means of controlling lateral migration of toxic chemicals from the Love Canal site.

4. If downward migration of toxic chemicals into the deep aquifer is occurring, the presently proposed remedial construction will not control this vertical migration.

5. Special soil conditions (i.e., sand lenses), surface drainage of displaced water contaminated with toxic chemicals, relocation of contaminated soil from the Love Canal, manmade paths of high permeability and transport and flooding of contaminated storm sewer waters represent actual and potential mechanisms for movement of Love Canal chemicals to the surrounding area.

6. Liver test abnormalities alone, in the absence of other clinical signs and symptoms of liver disease, are not diagnostic of liver disease *per se* but may reflect varying levels of exposure to chemicals in the environment over relatively short periods of time.

7. The consistency of observations relative to the outcomes of pregnancies of residents of historically "wet" properties when compared to pregnancy outcomes of (a) residents of historically "dry" properties, (b) residents of New York State excluding New York City, and (c) subjects studied and reported by Warburton and Fraser, as reported in "Human Genetics," Volume 16, No. 1, 1964, together greatly strengthen the hypothesis of past adverse health effects resulting from residence in such homes likely contaminated by chemicals.

8. That there is no generally consistent correlation, to date, between concentrations of chemicals identified in air, soil and sump water samples and the occurrence of birth defects, spontaneous abortions and liver test abnormalities is not surprising inasmuch as the occurrence of birth defects and spontaneous abortions extends over many years, the availability of environmental samples is limited to samples collected at a single point in time within recent months and the extent of chemical analyses of environmental samples is limited to nine chemicals.

9. While remedial construction is designed to contain any future lateral migration of chemicals, the mass of previously transported toxic chemicals outside the boundaries of the remedial construction is not known.

10. An estimate of the mass of toxic chemicals, and their location is required to evaluate the need for additional remedial construction outside the immediate vicinity of the Love Canal.

11. Presence of chemicals to the east and west of the Love Canal may be due to separate and discrete dumping of contaminated wastes and/or transport through natural or manmade hydrogeologic pathways in the area.

12. A review of all the available evidence respecting the Love Canal site shows that the health emergency declared by the August 2, 1978, Order should be continued.

13. Remedial construction in the middle and upper third of the Love Canal, subject to approval by the New York State Department of Environmental Conservation and the Environmental Protection Agency of preliminary specifications submitted for review, should be undertaken.

14. While a great deal of environmental and epidemiological information has been obtained since the August 2, 1978, Order, further studies must continue to obtain additional information to delineate the full limits or boundaries of the Love Canal with respect to possible toxic effects; to determine by continued sampling, the extent to which toxic chemicals have migrated from the site to the surrounding neighborhood; to identify which groundwater aquifers have been contaminated by leachate, if any; and to identify adverse health effects and the presence of toxic chemicals and their masses located outside the Love Canal in the area bounded by 93rd Street on the west, 103rd Street, on the east, Frontier Avenue on the south and Black Creek on the north.

Health Department Orders

RECOMMENDATIONS

1. Based on the best available data, that pregnant women and children under two years of age presently residing in homes between 97th and 103rd streets bounded by Colvin Boulevard and Frontier Avenue and in those homes which abut Colvin Boulevard on the north between 97th Street on the west and 100th Street on the east, temporarily move from such homes.

2. The Niagara County Medical Society and private physicians and hospitals in Niagara County should continue their cooperation with staff of the State-Health Department and the Niagara County Health Department in studies undertaken to identify former residents of the Love Canal area exhibiting chronic or adverse health effects.

3. That the Commissioner of the Department of Environmental Conservation continue on-site supervision of the on-going remedial work at the Love Canal Chemical Landfill site.

4. That appropriate public officials diligently pursue and explore all avenues or sources of potential funding to assist those affected by toxic hazards emanating from the Love Canal Chemical Landfill site and to develop procedures for abating confirmed exposure to chemicals in the environment.

5. That studies undertaken to estimate the mass and location of toxic chemicals in the Love Canal area be continued.

6. That geological and engineering studies be undertaken to assess the feasibility of corrective action.

ORDERS AND DIRECTIONS

I DO HEREBY ORDER AND DIRECT:

1. That the emergency declared by the August 2, 1978, Order issued by former Commissioner Whalen, shall continue in full force and effect.

2. That the on-going remedial corrective work be continued and that the tile drainage system installed to implement the Conestoga-Rovers Report entitled "Phase I – Pollution Abatement Plan – Upper Groundwater Regime," be extended to the central and northern sections of the Love Canal site, subject to approval of the New York State Department of Environmental Conservation.

3. That the Niagara County Department of Health and the City of Niagara Falls in collaboration with the staff of the Department of Health and Department of Environmental Conservation continue studies to:

(a) delineate the full limits or boundaries of the Love Canal with respect to possible toxic effects;

(b) determine by continued sampling the extent that toxic chemicals have migrated from the Love Canal site to the surrounding neighborhood;

(c) identify which groundwater aquifers may have been contaminated by toxic chemicals; and

(d) identify adverse health effects and the presence of toxic chemicals and their masses located outside the Love Canal in the area bounded by 93rd Street on the west, 103rd Street on the east, Frontier Avenue on the south, and Black Creek on the north.

4. This Order supplements the previous Order issued on August 2, 1978, and periodic reevaluation of the situation at the Love Canal shall be made with further additional orders and public health advisories to be issued by me as I deem necessary.

DATED: February 8, 1979

DAVID AXELROD, M.D.
Commissioner of Health

LOVE CANAL Bibliography

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