


# Public Health Assessment for



UPJOHN CO-FINE CHEMICALS DIVISION  
NORTH HAVEN, NEW HAVEN COUNTY, CONNECTICUT  
CERCLIS NO. CTD001168533  
MARCH 8, 2000

**U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES**  
**Public Health Service**  
**Agency for Toxic Substances and Disease Registry**



## THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This public health assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H), for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Agency for Toxic Substances and Disease Registry ..... David Satcher, M.D., Ph.D., Administrator  
Barry L. Johnson, Ph.D., Assistant Administrator

Division of Health Assessment and Consultation ..... Robert C. Williams, P.E., DEE, Director

Exposure Investigations and Consultation Branch ..... John E. Abraham., Ph.D., Chief

Federal Facilities Assessment Branch ..... Sandra G. Isaacs, Chief

Petitions Response Branch ..... Acting Chief

Superfund Site Assessment Branch ..... Sharon Williams-Fleetwood, Ph.D., Chief

Program Evaluation, Records, and Information Services Branch ..... Max M. Howie, Jr., M.S., Chief

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**UPJOHN CO-FINE CHEMICALS DIVISION**

**NORTH HAVEN, NEW HAVEN COUNTY, CONNECTICUT**

**CERCLIS NO. CTD001168533**

**Prepared by:**

**Connecticut Department of Public Health  
Under Cooperative Agreement with the  
Agency For Toxic Substances and Disease Registry**

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Agency for Toxic Substances & Disease Registry. . . . . Jeffrey P. Koplan, M.D., M.P.H., Administrator  
Henry Falk, M.D., M.P.H. Assistant Administrator

Division of Health Assessment and Consultation. . . . . Robert C. Williams, P.E., DEE, Director  
Sharon Williams-Fleetwood, Ph.D., Deputy Director

Community Involvement Branch . . . . . Germano E. Pereira, M.P.A., Chief

Exposure Investigations and Consultation Branch. . . . . John E. Abraham, Ph.D, Chief

Federal Facilities Assessment Branch. . . . . Sandra G. Isaacs, Chief

Program Evaluation, Records, and Information . . . . . Max M. Howie, Jr., M.S., Chief

Superfund Site Assessment Branch. . . . . Acting Branch Chief

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(703) 605-6000

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1-888-42ATSDR  
or  
Visit our Home Page at: <http://atsdr1.atsdr.cdc.gov:8080/>

## FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

**Exposure:** As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

**Health Effects:** If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

**Conclusions:** The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

**Interactive Process:** The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

**Community:** ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

**Comments:** If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Chief, Program Evaluation, Records, and Information Services Branch, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-56), Atlanta, GA 30333.

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*The conclusions and recommendations in this public health assessment (PHA) are based on the data and information made available to the Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry. The Connecticut Department of Public Health and the Agency for Toxic Substances and Disease Registry will incorporate additional information when received. The incorporation of additional data could change the conclusions and recommendations listed in this document.*

## SUMMARY

The Upjohn Company operated the North Haven Fine Chemical (NHFC) plant in North Haven, Connecticut from 1962 to 1993. From the mid-1940's through 1962, the Carwin Company operated the NHFC facility (1). The Upjohn Company still maintains ownership of the NHFC facility. All buildings except an administration building have been demolished. The facility is surrounded by fencing on three sides. The fourth side can be accessed via the Quinnipiac River. Signs indicating hazards and restricting trespassing have been posted in this area (2). Most of the NHFC facility is covered with asphalt (2).

SRA Technologies completed a cancer incidence study of Upjohn workers in September, 1995 (1). The standardized incidence ratio (SIR) is the total number of observed cancer cases among Upjohn workers divided by the total number of expected cancer cases among Upjohn workers. The study found a statistically significant increase in the SIR for male bladder cancer. The SIR for male bladder cancer was 8.3 (95% confidence interval [CI] = 3.3, 17.0) (1).

The study concluded that the increase in bladder cancer was associated with an occupational exposure. The community is concerned that residents around the Upjohn facility may be experiencing higher than expected bladder cancer rates.

Benzene was detected in the ambient air during off-site sampling in August, 1989. Benzene was also detected in the ambient air on-site. The Upjohn facility had a history of benzene releases. Benzene releases occurred as fugitive emissions during production, as well as accidental releases. Benzene releases were at or above levels of health concern.

Based on the above information, the Agency for Toxic Substances and Disease Registry and the Connecticut Department of Public Health have concluded that this site represented a public health hazard due to past air exposures from the Upjohn NHFC facility. The site currently represents no public health hazard.

A review of bladder cancer and acute myeloid leukemia incidence in the community around the Upjohn facility is recommended because of exposures to benzene air emissions from the facility in the past.

## PURPOSE AND HEALTH ISSUES

On September 29, 1995, the North Haven First Selectman requested that the Connecticut Department of Public Health (CTDPH) examine the health impacts of the Upjohn Company facility on residents (3). This was followed by a similar request by a North Haven based community organization (4). The First Selectmen's petition included a request to "...determine if residents, living in close proximity to the Upjohn plant, possess an unusually high rate of bladder cancer." The later petition requests a bladder cancer incidence study as well as a review of possible well contamination. The scope of this public health assessment is to determine if the NHFC facility discharged contaminants into the environment, potentially exposing the surrounding community.

The CTDPH initially became involved with the Upjohn facility in the late 1970's. Involvement included attending public meetings, reviewing environmental sampling data, and addressing citizens concerns. This involvement was at the request of citizens concerned about the odors emanating from the Upjohn facility (5). The CTDPH involvement lessened as complaints subsided with the closure of the facility. The plant ceased all production in 1993 (1).

## BACKGROUND

### A. SITE DESCRIPTION AND HISTORY

For the purposes of this Public Health Assessment (PHA), the site will be referred to as the Upjohn site or the New Haven Fine Chemical (NHFC). Upjohn's current name is Pharmacia & Upjohn Company.

The Upjohn Company operated the North Haven Fine Chemical (NHFC) plant in North Haven, Connecticut from 1962 to 1993. From the mid-1940's through 1962, the Carwin Company operated the NHFC facility (1).

The Upjohn Company still maintains ownership of the NHFC facility. All buildings except an administration building have been demolished. The facility is surrounded by fencing on three sides. The fourth side can be accessed via the Quinnipiac River. Signs indicating hazards and restricting trespassing have been posted in this area (2). Most of the NHFC facility is covered with asphalt (2).

The NHFC site is approximately 162 acres. The NHFC site is bordered by the Quinnipiac River to the east, railroad tracts to the west, Connecticut Route 40 to the north, and Sackett Point Drive to the south (6). A map of the facility and its surrounding areas (Figure 1 Map of Upjohn Facility) is located in Appendix A.

Upjohn acquired The Carwin Chemical Company in 1962. The Carwin Chemical Company started in North Haven in 1946 manufacturing chemicals for perfumes. Carwin Chemical started manufacturing organic intermediates (chemical compounds used as raw materials in industries) for domestic dyestuff and pigment manufacturers. When Upjohn purchased Carwin Chemical in 1962, they continued the manufacturing processes previously performed by Carwin. This included the manufacture of dichlorobenzidine (DCB) (2).

Manufacturing of isocyanates was pioneered at the North Haven facility in the mid-1950's. Until its closure in 1993, Upjohn's North Haven Fine Chemical (NHFC) produced raw materials, organic chemical intermediates, and technical grade chemicals (7). Upjohn's products included: dichlorobenzidine, dihydrochloride, o-dianisidine dihydrochloride, 4-sulfophthalic acid, benzophenone, 2,2-diethoxyacetophenone. Upjohn also produced chemical compounds for instant-photography film, protecting fruits from decay, and intermediates for prescription pharmaceuticals (7). Table 1 is a NHFC product listing as of July 1979. Information on the products and production start date for each product was obtained from Upjohn company officers during a site visit on July 16, 1979 by CTDPH staff (8).

Examples of the manufacturing processes to create the products are contained in Table 2. Raw materials used in the Upjohn production facilities include chlorine, caustics, organic and inorganic acids, and various hydrocarbons (2). These materials were shipped to Upjohn by truck or rail car.

Waste was stored on site in a series of lagoons. A total of nineteen lagoons were in use during the operating period of NHFC. By January 17, 1986, seven years before operations at the facility were permanently suspended, many of the lagoons had been filled. Table 3 lists the status of the lagoons as determined by the Environmental Protection Agency (EPA) site analysis, as of January 17, 1986. The site analysis was conducted from a review of aerial photos. The aerial photos were analyzed from 1949 through 1986. The lagoons were contained in approximately 15 - 20 acres out of a total of 162 acres (6).

Not all of the lagoons were concurrently in use. Over time lagoons were drained and filled. Once filled, some of the older and smaller lagoons (L1 - L3) were used for other purposes such as non-covered storage areas.

**Table 1 Upjohn's North Haven Facility Product List**

Product	Product Description	Production Start Date
Benzophenone - Perfume Grade	additive to soaps, toiletries and perfume to prevent loss of fragrance	1977
Benzophenone Technical - Flaked	additive to ultraviolet curable ink, coating and adhesive formulations	1977
O-Chloroaniline Technical (OCA)	intermediate compound (dyes, pigments, and urethane curing agent)	1978
Dichlorbenzidine	intermediate compound (curing agent for plastics)	1946
D-300 Concentrate (4-Sulfophthalic Acid - 50% Solution)	forms a decorative and protective coating on structural aluminum parts; pigment intermediate; leather tanning agent	early 1950's
O-Dianisidine Dihydrochloride	intermediate compound (organic pigments - textile and paper inks; blue textile dyes)	1948
Dichlorobenzidine Dihydrochloride (DCB)	intermediate compound (yellow pigments - textile and paper inks)	1947
2, 6 Dichloro-4-Nitroaniline (DCNA)	intermediate compound (orange dyes - for nylon & polyester fiber; fabric); as trade name "Botran" (agricultural fungicide)	1965
Diethoxyacetophenone (DEAP)	photo initiator or catalyst in ultraviolet curable coatings (floor tiles, cans, and paper products)	1979
2,5 Dimethoxybenzaldehyde (DMB)	products for photographic film	1960
Diosgenin	steroid pharmaceutical products	1977
Diphenamid Technical (N,N-Dimethyl-2,2-Diphenylacetamide)	agricultural herbicide	1964
Photographic Dye Intermediates	dyes	1970
p-Toluene Sulfonyl Isocyanate (PTSI)	additive in urethane adhesives, coatings and sealants; drug intermediate	1970

Data obtained from an Upjohn Company Product List (7/12/1979)

**Table 2 Manufacturing Process**

Manufacturing Process *	Example
Chemical Reactions	Reductions
	Oxidation
	Neutralization
	Condensation
Physical Processes	Drying
	Filtration
	Decanting
	Distillation
	Extraction

\* Data from Rust Environment & Infrastructure: Human Health Risk Assessment, July 1996.

**Table 3 On-Site Lagoon Status, 1986**

Lagoon Number	Purpose of Lagoon	Status
L1	not available	filled
L2	contained liquids	drained
L3	contained liquids	filled
L4	contained liquids	n/a <sup>1</sup>
L5	probable pickle liquor lagoon	filled
L6	probable pickle liquor lagoon	filled
L7	probable pickle liquor lagoon	filled
L8	not available	n/c <sup>2</sup>
L9	probable settling basin - sludge	filled
L10	probable settling basin - sludge	filled - partial
L11	probable settling lagoon - sludge	filled
L12	probable settling lagoon - sludge	partially covered
L13	probable pickle liquor lagoon	filled
L14	probable pickle liquor lagoon	filled
L15	sludge receiving area	filled
L16	aeration lagoon	dome constructed to contain caustic vapors
L17	not available	filled
L18	unlined primary sludge settling	n/c
L19	old sludge disposal area	filled

<sup>1</sup> data not available

<sup>2</sup> no significant change from previous aerial photos

The Upjohn facility operated an on-site wastewater treatment facility. This facility, constructed in the mid-1980's, treated wastewater generated from production prior to being discharged into the Quinnipiac River. Before the treatment facility was active, wastewater was treated in several lagoons. The sludge generated from treating wastewater was disposed of on-site in two waste piles (North & South Waste Piles). The practice of disposing sludge in the on-site waste piles ended in 1985. After 1985, the sludge was disposed of off-site in a licensed facility (2). Other wastes generated during the last several years of production are listed in Table 4. Previous disposal methods include using the lagoons and waste piles.

Currently, the wastewater treatment facility is operating to remove contamination from the groundwater. The wastewater treatment consists of a fluidized bed reactor. It is an enclosed bio-treatment process that releases the water into an activated sludge lagoon. This lagoon is surrounded by a containment bubble. The water is then released into the Quinnipiac River (9).

**Table 4 Production Waste Disposal Methods During the Last Years of Production**

Waste #	Approximate Amount (lbs. per year)	Stored On-Site	Disposal Method
Spent Aromatic Solvents	300,000	Yes *	Off-site Incineration
Spent Chlorinated Solvents	100,000	Yes *	Off-site Incineration
By-product Solvents	700,000	Yes *	Off-site Incineration
Still bottoms	450,000	Yes *	Off-site Disposal
Sulfuric Acid	4,000,000	Yes *	Off-site Recovery
Sulfuric Acid	50,000,000	Yes	On-site Recovery
Muriatic Acid	7,500,000	Yes	On-Site Recovery

# Data from Rust Environment & Infrastructure: Human Health Risk Assessment, July 1996.

\* Material was stored on-site in drums and tanks for bulk shipping.

## B. COMMUNITY HEALTH CONCERNS

There is currently citizen and local political concern over bladder cancer in the residential community around the facility. These concerns were further heightened with the strong association found in the occupational study conducted on the NHFC workers.

### C. DEMOGRAPHICS AND LAND USE

According to the 1990 U.S. Census, approximately 6451 people live within one mile of the Upjohn facility (10). Table 5 contains information on the population breakdown for the area within one mile of the Upjohn facility. Maps of the demographic data can be found in Appendix A.

North Haven potable water is supplied by a public water supply. There are no public water supply wells within two miles of the Upjohn facility (11). The nearest resident to the Upjohn facility is approximately 620 feet.

**Table 5 Demographic Statistics Within One Mile of Site**

<u>Demographics *</u>	<u>Frequency</u>
Total Population	6,493
White	6,151
Black	147
American Indian, Eskimo, Aleut	0
Asian, Pacific Islander	154
Other Race	2
Hispanic Origin	39
Children Aged 5 and Younger	327
Adults Aged 65 and Older	1,251
Females Aged 15-44	1,317
<u>Total Housing Units</u>	<u>2,705</u>

\* Demographic data obtained from the 1990 U.S. Census, STF3A. Demographics were calculated using an area-proportion spatial analysis technique.

Most of the area surrounding the NHFC facility is classified as residential, industrial, marsh/wetlands, water, and forest. The land use and land cover information can be found in Figure 2 Map of Land Use/Land Cover in Appendix A. The land use/land cover is a representation of satellite imagery.

### D. HEALTH OUTCOME DATA

The Connecticut Department of Public Health, formally Department of Health Services, published a study on cancer in North Haven. The study, published in *Connecticut Medicine*, January 1981, reviewed cancer in North Haven and its surrounding towns. The review of cancer was conducted because of a suspicion of excess cancer cases near the Upjohn facility.

Cancer mortality was studied during the time periods 1969 - 1971 and 1974 - 1976. Seven primary cancer sites were reviewed. Age adjusted rates by tumor site, town, gender, and time period are presented. Cancer morbidity was studied during the time period 1973 - 1978. Nineteen primary sites were compared to expected values based on Connecticut state rates (Standard Morbidity Ratios - SMR). The ratios were adjusted to the North Haven age distribution for males and females (12). While not significant, the SMR for male leukemia was 2.0  $p \leq 0.095$ .

The study concluded that "...the data provided no convincing evidence that North Haven has had a cancer experience different from surrounding towns or from the State as a whole." However, the study also concludes that more sensitive methods need to be derived to examine the effect of low-level carcinogens in small area analyses (12).

SRA Technologies completed a cancer incidence study of Upjohn workers in September, 1995 (1). The study was initiated after three employees developed bladder tumors after benzidine, a known bladder carcinogen, production had been discontinued. The study examined the relationship between arylamine exposure such as dichlorobenzidine, ortho-tolidine, and ortho-dianisidine and cancer. These arylamine exposures were selected because they were being produced at the Upjohn facility after production of benzidine had stopped in mid-July, 1965 (1).

The study cohort consisted of 704 workers employed at the Upjohn North Haven facility between July 1, 1965 and December 31, 1989. This time frame allowed researchers to examine the effects of arylamine exposure other than benzidine. This cohort study found 27 confirmed cancer cases. Case data were ascertained through a worker survey, death certificates, the Connecticut Tumor Registry, and the company health/surveillance program (1).

The researchers used the standardized incidence ratio (SIR) in their analysis. An SIR is the total number of observed cancer cases among Upjohn workers divided by the total number of expected cancer cases among Upjohn workers. The study found a statistically significant increase in the SIR for male bladder and testicular cancer. A non-significant SIR was found for breast cancer. The elevated SIRs for testicular and breast cancer were based on three or fewer cases. They were also not associated with arylamine exposure. The SIR for male bladder cancer was 8.3 (95% CI = 3.3, 17.0) (1).

The study concluded that the increase in bladder cancer was associated with an occupational exposure (1).

## DISCUSSION

### A. ENVIRONMENTAL CONTAMINATION & EXPOSURE PATHWAYS

The Connecticut Department of Environmental Protection archived data on the Upjohn site. This data comes from a variety of sources. All of the data were collected for purposes other than this PHA.



## Ambient Air

Ambient air samples were not taken on a routine basis around the Upjohn facility. However, during the time period August 8-11, 1989, ambient sampling was conducted by the Environmental Protection Agency (EPA) (13). Samples were collected both on the Upjohn property and in the surrounding neighborhoods utilizing the EPA Trace Atmospheric Gas Analyzer (TAGA). Table 6 contains information on elevated air sampling results. Because of the industrial nature of the area, other industrial facilities may be responsible for some of the ambient air findings.

**Table 6 Chemicals Detected in Air**

Sample Location	Chemical	Maximum Concentration ppb	Comparison Value ppb	Source	EPA Group
On-site	Benzene	5,500	0.03	CREG	A
	Chlorobenzene	350	#	#	Not Classified
	1,2-Dichloroethane	0.07	0.01	CREG	B2
Off-site	Benzene	300	0.03	CREG	A
	Dichlorobenzene *	30	100 <sup>@</sup>	CEMG	Not Classified
	1,4-Dioxane	18	#	#	B2
	Toluene	1,700	1,000	Chronic MRL	Not Classified
	1,1,1-Trichloroethane	1,100	700	Int MRL	Not Classified

# There are no ATSDR health comparison values for these compounds

\* Unspecified isomer

@ For 1,4-dichlorobenzene

A Human carcinogen

CEMG Chronic Environmental Media Guideline

B2 Probable human carcinogen

Chronic MRL Chronic Minimal Risk Level

CREG Cancer Risk Evaluation Guideline

Int MRL Intermediate Minimal Risk Level

ppb parts per billion

The TAGA is designed to identify air contaminant plumes. The results represent an instantaneous sample for the space and time it was collected. In a 1989 Health Consult, the Agency for Toxic Substances and Disease Registry (ATSDR) evaluated these data. ATSDR concluded the data were difficult to interpret with regards to public health implications. ATSDR also concluded that the benzene readings, both on and off site, may reflect a public health concern to area residents (13). The off-site reading of 300 ppb benzene was taken south of the site, north of Republic Drive. It is a non-residential area. There is limited information available regarding the sampling location. It is unknown if the sampling location was selected because it would represent off-site emissions.

In December, 1988, Upjohn reported an accidental release of benzene (2,197 lbs) to the air. The CTDPH, conducted a risk assessment on the release. The CTDPH concluded that because the benzene release occurred early on a winter morning (approximately

4:00am), the potential for acute exposure was averted. This was due to most individuals being indoors (14). The CTDPH report raised the issue of process and fugitive benzene emissions as being a potential problem.

People living near the UpJohn facility may have been exposed to elevated levels of benzene and other compounds in the air. These exposures occurred as a result of fugitive emissions as well as accidental releases.

Since comprehensive ambient air sampling, both on and off site, were not conducted, little information is known regarding which contaminants became airborne, what the levels may have been in the community, and for how long residents may have been exposed. While it is important to note that air exposures from the facility have been eliminated, the lack of historical data will limit the evaluation of this completed exposure pathway.

### Ground Water Monitoring Wells

Ground water samples have been collected from fifteen on-site monitoring wells. Ground water sampling occurred quarterly from 1984 to the present. These data were obtained from two of the sampling reports, July 1993 and April 1995 (15,16). There were four chemicals detected above health comparison values (benzene, 1,4 dioxane, chlorobenzene, and manganese). Because of difficulties in obtaining historical data, the ground water monitoring well evaluation is limited to two of the sampling reports. Table 7 lists the chemicals that were identified above health comparison values. The Water Supplies Section of the Connecticut Department of Public Health reviewed the area around the Upjohn site. There are no public water supply wells in the Upjohn site area (11). The public water supply exposure pathway has been eliminated (17). Therefore, this addresses one of the petitioners request to review possible public well contamination.

**Table 7 Chemicals Detected in Groundwater Monitoring Wells**

Chemical	Maximum Concentration ppb	Comparison Value ppb	Source	EPA Group
Benzene	200	1	CREG	A
Chlorobenzene	100	100	LTHA	Not Classified
1,4-Dioxane	100	3	CREG	B2
Manganese	200	50	RMEG	Not Classified

- A Human carcinogen
- B2 Probable human carcinogen
- CREG Cancer Risk Evaluation Guideline
- LTHA Lifetime Health Advisory for Drinking Water
- ppb parts per billion
- RMEG Reference Dose Media Evaluation Guideline

## Ground Water Private Wells

There are historical documents that suggest that private wells (residential) in the area of the site were active while Upjohn was still operational. The CTDPH collected samples from eight private wells in the area of Upjohn during the end of 1979. Two of the wells were used for gardening and not as the main source of potable water for the household. Additional sampling was done during the summer of 1982. The wells were sampled for organohalides, cyanide, phenol, and heavy metals. In all cases, the wells were determined to be potable. There are very few private water supply wells in North Haven (17). Currently, there are a few residents in the Upjohn area serviced by a private well for potable water (13,17). These wells are located over one-half mile from the site, east and upstream of the Quinnipiack River. The Upjohn facility is west of the Quinnipiack River. Therefore, we are eliminating private wells as an exposure pathway.

Of the eight wells sampled, only one had a chemical detected above health comparison values. The chemical detected was chloroform (13.0 ug/L). This was found only during the 1982 sampling period. It was not detected during the previous sampling period (1979).

## Sediment

The Upjohn Company conducted a Quinnipiac River sediment study in the early 1980's. This was accomplished in accordance with National Pollutant Discharge Elimination System (NPDES) permit requirements (19). Upjohn discharged treatment system effluent into the Quinnipiac only when the treatment system malfunctioned. In 1984 there were 34 permitted NPDES discharges into the Quinnipiac River. Of the 34, 21 were industries upstream from Upjohn's discharge point. Because of this, lead and calcium were selected as indicators of Upjohn waste (19). Upjohn used lead in its elemental form and it easily settled in the river making it an ideal indicator of Upjohn waste. Upjohn also used large quantities of lime to neutralize sulfuric acid. Due to this, calcium was also selected as an indicator of Upjohn waste (19). Elevated levels of lead were detected in the sediment. Table 9 contains data on the sediment sampling. Because access to this area is restricted by a fence or very difficult to reach, exposure to sediment is being eliminated as a pathway of concern.

**Table 8 Indicator Chemicals Detected in Sediment**

Chemical	Maximum Concentration ppm
Calcium	7,700
Lead	2,100

ppm parts per million

## **B. PUBLIC HEALTH IMPLICATIONS--Adult and Children's Health Issues**

We evaluated the possible exposure pathways for the following media: air, ground water, private wells, and sediment. After evaluating environmental sampling data for these media as well as the ways in which residents could come in contact with these media, it was determined that the pathway that posed a risk to the community was off-site air. Private wells and groundwater were eliminated as pathways because no one is using groundwater for potable purposes and sediments were eliminated because of restricted access.

### **Toxicologic Evaluation**

To evaluate health effects, the ATSDR has developed Minimal Risk Levels (MRLs) for contaminants commonly detected at hazardous waste sites. The MRL is an estimate of daily human exposure to a contaminant below which non-cancerous, adverse health effects are unlikely to occur. MRLs are developed for each route of exposure such as ingestion, inhalation, and dermal absorption. MRLs are also developed for the length of exposure, such as acute (less than 15 days), intermediate (15 to 364 days), and chronic (greater than 364 days).

#### *Summary*

The public health concern of interest is benzene and acute myeloid leukemia (AML). While residents near the Upjohn site may have been exposed to other chemicals, those chemicals may not be associated with AML. Because of the limited nature of the available data, the effects of multiple chemical exposures and interactions were not evaluated.

#### *Exposure Assumptions*

The exposure pathways examined in this section is the inhalation route. The exposure period is assumed to coincide with the start of the chemical manufacturing process in 1946. The exposure period for the inhalation route of exposure terminated in 1993, when the facility ended chemical production. Consequently, the maximum exposure duration used in this analysis is 46 years.

#### **Benzene**

Benzene was measured in the ambient air adjacent to the Upjohn facility at a maximum concentration of 300 ppb. The sample was collected in 1989, and represents the only sampling event for benzene measured near the Upjohn facility. During that sampling event, there were several locations where benzene was also detected at elevated levels. The elevated levels of benzene were: 14, 25, 45, 60, 110, 200, 240, and 300 ppb. While these levels are above the intermediate MRL of 4 ppb, it is unlikely that non-cancer health effects will occur. Adverse health effects of benzene exposure include the blood forming tissues including a reduction in various cellular components of the blood. Occupational studies of workers exposed to benzene at concentrations up to 500 ppb for as long as 15 years indicated that exposures at these levels did not result in adverse effects.

**Carcinogenicity Classification:**

Benzene has been classified by the EPA as a known human carcinogen (EPA group A). The cancer risks were calculated for residents living near the Upjohn facility, and being exposed to benzene in the ambient air. We used the maximum benzene concentration (300 ppb), and conclude that there is a moderate increased risk for developing acute myeloid leukemia (AML). The risk estimation was based on the maximum detected benzene during the 1989 sampling round, and also the value based on an estimate of the annual average benzene concentration.

**Brief Description of Chemical:**

Benzene is a colorless liquid with a sweet odor. This compound dissolves in water easily and evaporates readily into the air. Benzene is a highly flammable liquid and is a component of gasoline (20). Benzene has been linked to the development of AML and other adverse affects related to the hematopoietic (blood related) system.

**Toluene**

Elevated levels of toluene were measured in the ambient air off-site at a maximum concentration of 1,700 ppb. The sample was collected in 1989, and represents the only sampling event for toluene measured near the Upjohn facility. This concentration (1,700 ppb) exceeds the chronic minimum risk level for toluene (1,000 ppb). Sensitive individuals may experience reversible non-cancerous health effects including headaches and dizziness. These symptoms usually disappear when exposure is stopped (21).

Occupational studies have been conducted examining the effects of long-term exposure to toluene. These investigations examined exposure to concentrations five times higher than the measured concentration in the ambient air off-site from the Upjohn facility. Some of the workers in these investigations were exposed day-after-day for as long as 43 years, and they reported experiencing headaches and dizziness (21).

**Carcinogenicity Classification:**

Scientific investigations involving workers and animals exposed to toluene indicate that this compound does not cause cancer. The EPA has determined that toluene is not classifiable as to its human carcinogenicity.

**Brief Description of Chemical:**

Toluene is a clear solvent with a distinctive smell. This compound is one of many compounds added to gasoline. Toluene is found in the tolu tree and in crude oil. It is also produced during the production of gasoline and other fuels from crude oil. Toluene is used in many products including: paints, paint thinners, nail polish, lacquers, and adhesives (21).

### **1,1,1-Trichloroethane**

Elevated levels of 1,1,1-trichloroethane were measured in the ambient air off-site at a maximum concentration of 1,100 ppb. The sample was collected in 1989, and represents the only sampling event for 1,1,1-trichloroethane measured near the Upjohn facility. This concentration (1,100 ppb) exceeds the intermediate minimum risk level for 1,1,1-trichloroethane (700 ppb exposure >7 days up to 1 year). Occupational studies have been conducted examining the effects of long-term exposure to 1,1,1-trichloroethane. These investigations examined exposure to concentrations one hundred times higher than the measured concentration in the ambient air off-site from the Upjohn facility. These workers were exposed day-after-day for as long as 6 years and experienced no adverse health effects. Consequently, residents living near the Upjohn facility are not likely to experience adverse non-cancerous health effects resulting from airborne exposure to 1,1,1-trichloroethane (22).

#### **Carcinogenicity Classification:**

Scientific investigations involving workers and animals exposed to 1,1,1-trichloroethane indicate that this compound does not cause cancer. The EPA has determined that 1,1,1-trichloroethane is not classifiable as to its human carcinogenicity.

#### **Brief Description of Chemical:**

1,1,1-Trichloroethane is a clear liquid that has a noticeable sharp, sweet odor. This chemical evaporates quickly and becomes a vapor. It is also known as methyl chloroform, methyltrichloromethane, and trichloromethylmethane. 1,1,1-Trichloroethane is not a naturally occurring chemical. It is used in the manufacture of in many common products including: paint, glue, industrial degreasers, and aerosol sprays. 1,1,1-Trichloroethane is one of several compounds that have been determined to adversely effect the atmospheric ozone layer.

### **1,4-Dioxane**

Elevated levels of 1,4-dioxane were measured in the ambient air off-site at a maximum concentration of 18 ppb. The sample was collected in 1989, and represents the only sampling event for 1,4-dioxane measured near the Upjohn facility. The concentration at which people first notice this compound in the air is 24,000 ppb. 1,4-Dioxane can be irritating to the mucus membranes, skin, and lungs at high levels (23). These adverse effects would not be expected at the levels identified around the site.

#### **Carcinogenicity Classification:**

1,4-Dioxane has been classified by the EPA as a probable human carcinogen (EPA group B2). There is insufficient information to calculate the carcinogenic health risks of exposure to 1,4-dioxane.

#### **Brief Description of Chemical:**

1,4-Dioxane is a liquid with a pleasant odor. This compound is used in the production of many industrial compounds, including oils, waxes, and dyes.

### **1,4-Dichlorobenzene**

Elevated levels of dichlorobenzene were measured in the ambient air off-site at a maximum concentration of 30 ppb. The sample was collected in 1989, and represents the only sampling event for dichlorobenzene measured near the Upjohn facility. This concentration (30 ppb) is below the chronic minimum risk level for 1,4-dichlorobenzene (100 ppb). Sensitive individuals may experience reversible non-cancerous health effects including headaches and dizziness at the levels near the Upjohn facility. These symptoms usually disappear when exposure is stopped (24).

#### **Carcinogenicity Classification:**

This substance has not undergone a complete evaluation and determination by the EPA's program for evidence of human carcinogenic potential.

#### **Brief Description of Chemical:**

1,4-Dichlorobenzene is a white solid with a strong odor like the smell of mothballs. When 1,4-dichlorobenzene is exposed to the air, it slowly sublimates (changes from solid to gas). 1,4-dichlorobenzene has been detected in some homes and public rest-rooms at concentrations as high as 270 ppb. The outdoor concentration of 1,4-dichlorobenzene ranges from 0.02 to 20 ppb. This compound has also been detected in foods such as chicken, eggs, and pork. This is due to use of 1,4-dichlorobenzene as an odor control product in animal pens. 1,4-Dichlorobenzene is used mainly as a space deodorant for rest-rooms and trash containers, as well as for controlling moths, molds, and mildews. This compound is also used as an intermediate in many chemical manufacturing processes.

## **C. COMMUNITY HEALTH CONCERNS EVALUATION**

There is currently citizen and local political concern over bladder cancer. These concerns are enhanced due to the strong association found in the occupational study conducted on the NHFC workers. Concerns exist that those living near the NHFC facility may be experiencing higher levels of bladder cancer than should be expected.

There is generally a large difference between occupational exposures and environmental or residential exposures. The occupational exposures are likely to be considerably higher than what you would find in the residential areas. The exposures are different for many reasons such as workers being in close contact with the chemicals and poor ventilation. As chemicals are released into the environment, they each react differently depending on their properties.

During its operation, past exposures to area residents from the NHFC facility via air were likely. While we only have actual sampled data for a few compounds, it is likely that air emissions included many other chemicals. The exposures would have occurred from processing and manufacturing, as well as through the handling and storage of waste. These exposures cannot be quantified.

This public health assessment indicates that past air exposure to area residents is likely to have occurred from chemicals manufactured and stored at the NHFC facility. This public health assessment did not review possible emissions from other industrial sources around the NHFC facility.

A Public Comment period for this document was held between September 1999 - November 1999. The public comments received during this period and the responses to these comments are shown in Appendix B.

## CONCLUSIONS

Based on the information reviewed, the CTDPH has concluded that this site represented a public health hazard in the past due to air exposures from the Upjohn NHFC facility. This conclusion was based on limited data and information. Of primary concern is the increased risk of AML associated with exposure to benzene. The site currently represents no public health hazard because there are no ongoing exposures to air emissions or other environmental media.

1. Exposures from production at the NHFC facility ended in 1993.
2. The occupational epidemiology study found elevated bladder cancer among male workers. Bladder carcinogens were used at the facility and disposed in on-site waste piles. There is a biological plausible association between bladder cancer and the chemicals used at the facility.
3. The review of cancer rates by the DPH in 1981 found an elevated SMR for male leukemia. Contaminants that cause acute myeloid leukemia (i.e. benzene) were released into the environment. There is a biological plausible association between AML and the contaminants released into the environment.

## RECOMMENDATIONS

The Agency for Toxic Substances and Disease Registry and the Connecticut Department of Public Health have evaluated the findings of this Public Health Assessment and recommend that an analysis of bladder cancer and AML be conducted. These two tumor sites are suggested for analysis because of the strong correlation between the contaminants and the disease. The past work by the CTDPH was limited because of methodological restrictions. With the use of Geographic Information Systems (GIS) in epidemiology, we now have the ability to characterize exposures and examine cancer data in relation to the exposures.

This analysis will provide a picture of cancer incidence in North Haven. The study will not determine if the cancers were caused by the NHFC facility. It will only provide an overview of cancer incidence (bladder and AML) in North Haven, in relation to possible exposures from the NHFC facility.



## **PUBLIC HEALTH ACTION PLAN**

The Public Health Action Plan (PHAP) for the Upjohn site contains a description of the actions to be taken by the ATSDR, the CT DPH, the CT DEP, and/or the EPA in the vicinity of the site. For those actions already taken at the site, please see the Background section of this Public Health Assessment. The purpose of the PHAP is to ensure that this health assessment not only identifies public health hazards, but provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included, is a commitment on the part of the ATSDR and the CT DPH to follow up on this plan to ensure that there is implementation. The public health actions to be implemented by the ATSDR, the CT DPH, and the CT DEP are as follows:

1. The CT DPH will evaluate the health statistics in the community around the Upjohn facility. The findings of this evaluation will be documented and made available to the public.
2. The CT DPH will provide environmental health education for local public health officials, the local medical community and local citizens to assist the community in assessing possible adverse health outcomes associated with exposures to toxic substances.

ATSDR will re-evaluate and expand the Public Health Action Plan when needed. New environmental, toxicological, or health outcome data, or the results of implementing the above proposed actions may determine the need for additional action at this site.

## **PREPARERS OF REPORT**

Gary V. Archambault, M.S.

Epidemiologist

Environmental Epidemiology and Occupational Health

Connecticut Department of Public Health

### **ATSDR Regional Representative:**

William Sweet, Ph.D., DABT

Agency for Toxic Substances and Disease Registry, Region 1, Boston, MA

### **ATSDR Technical Project Officer:**

Tina Forrester, Ph.D.

Office of Regional Operations

Agency for Toxic Substances and Disease Registry, Atlanta, GA

Greg Ulirsch

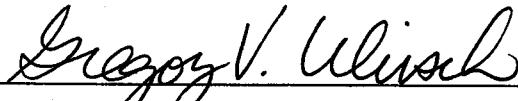
Superfund Site Assessment Branch

Division of Public Health Assessment and Consultation

Agency for Toxic Substances and Disease Registry, Atlanta, GA

## CERTIFICATION

The Public Health Assessment for the Upjohn Co-Fine Chemicals Division, North Haven, Connecticut was prepared by the Connecticut Department of Public Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was initiated.



Technical Project Officer, SPS, SSAB, DHAC

The Division of Health Assessment and Consultation, ATSDR, has reviewed this Public Health Assessment and concurs with its findings.



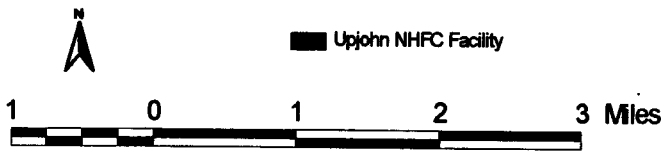
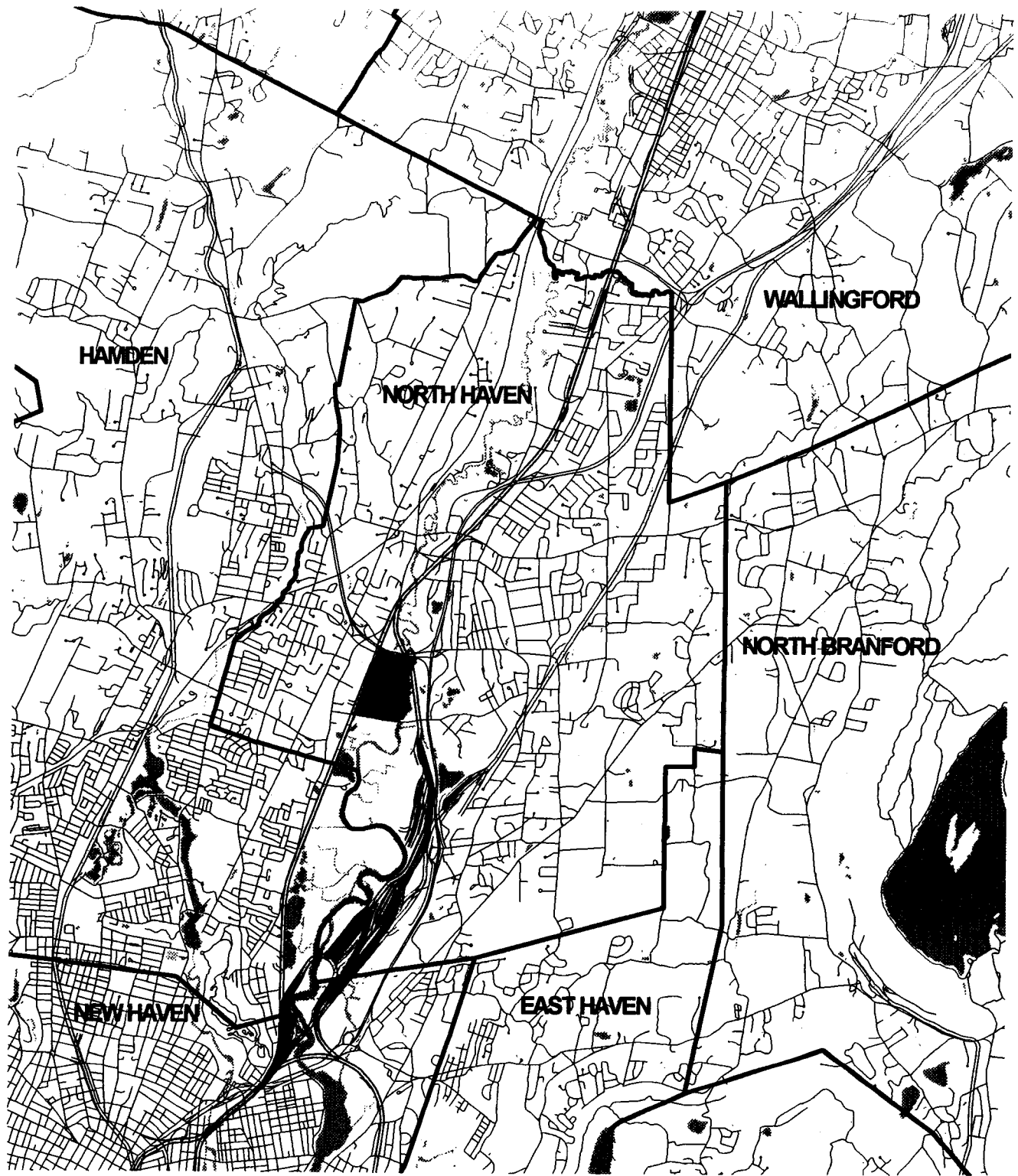
Chief, SPS, SSAB, DHAC, ATSDR

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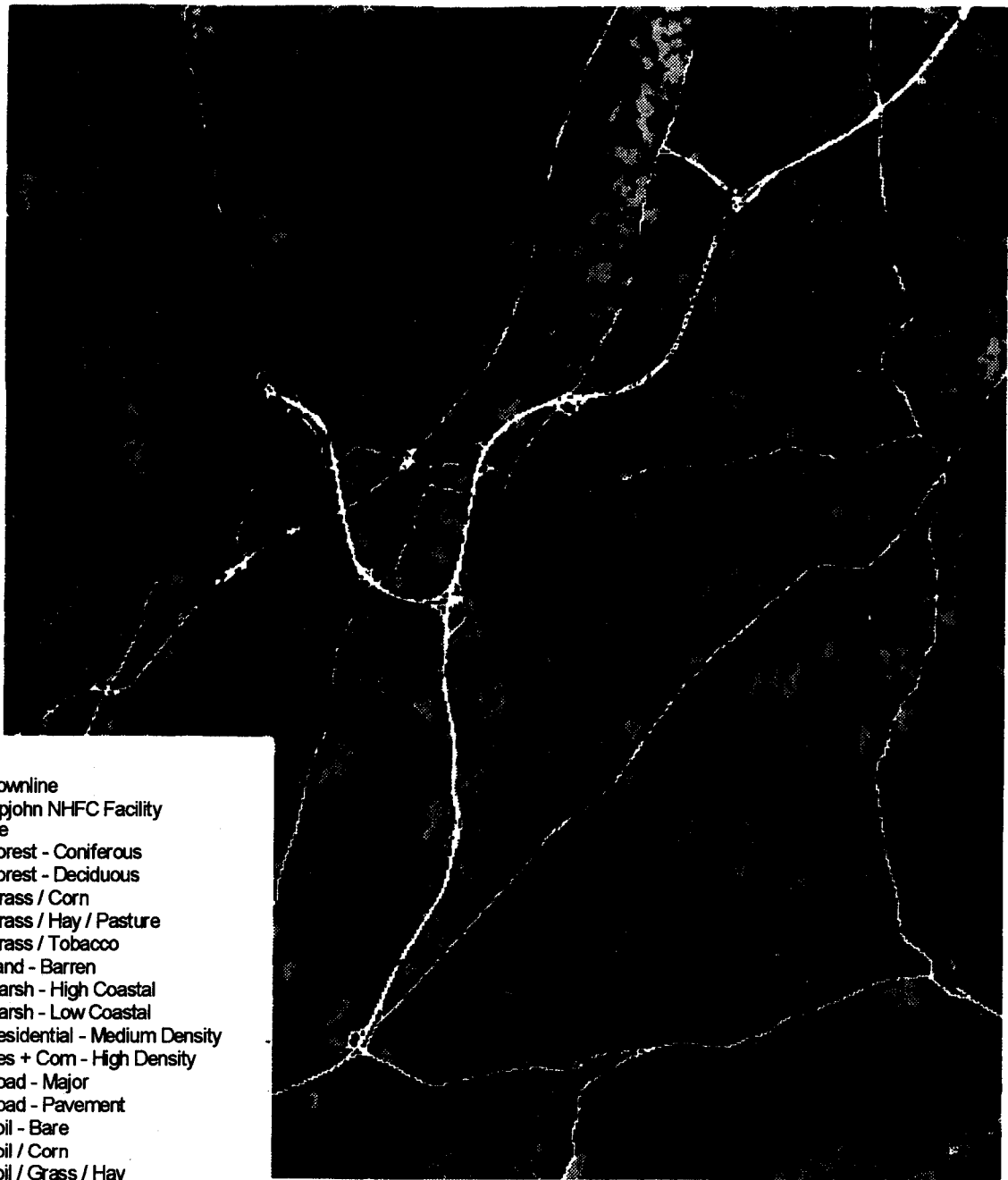
## **APPENDIX A: FIGURES**



■ Upjohn NHFC Facility

Figure 1  
**North Haven Connecticut and  
 Surrounding Communities**





- Townline
- Upjohn NHFC Facility
- Landuse
- Forest - Coniferous
- Forest - Deciduous
- Grass / Corn
- Grass / Hay / Pasture
- Grass / Tobacco
- Land - Barren
- Marsh - High Coastal
- Marsh - Low Coastal
- Residential - Medium Density
- Res + Corn - High Density
- Road - Major
- Road - Pavement
- Soil - Bare
- Soil / Corn
- Soil / Grass / Hay
- Soil / Tobacco
- Surface - Impervious
- Surface - Roof
- Turf / Grass
- Water - Deep
- Water - Shallow
- Wetland - Forested
- Wetland - Nonforested

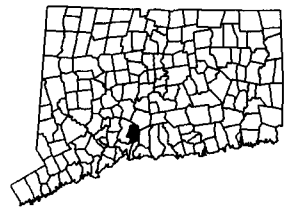
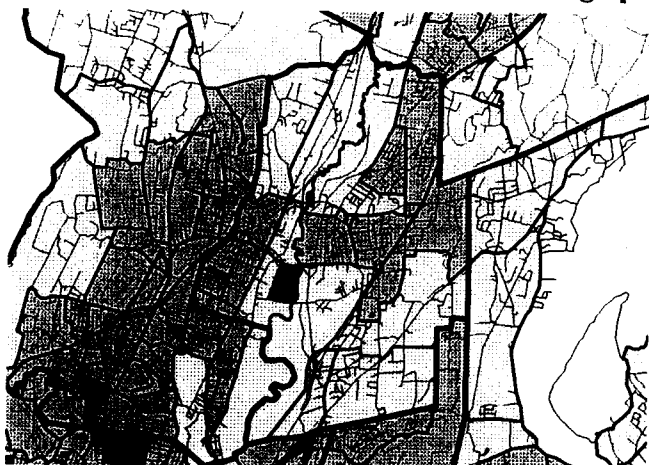


Figure 2  
**North Haven Connecticut**  
**Land Use/Land Cover**



Figure 3  
**Upjohn Facility**  
 North Haven, Connecticut  
**Demographics A**

Population Density



- Town Boundaries
- Streets
- Upjohn NHFC Facility
- Population Density
  - Less than 100/mile sq.
  - 100 - 1,000/mile sq.
  - 1,000 - 10,000/mile sq.
  - Greater than 10,000/mile sq.

Percent Children < Age 6



- Town Boundaries
- Streets
- Upjohn NHFC Facility
- Percent Children < Age 6
  - 0
  - 1 - 10%
  - 11 - 20%
  - 21 - 30%
  - Unpopulated Area

Percent People >= Age 65



- Town Boundaries
- Streets
- Upjohn NHFC Facility
- Percent People >= Age 65
  - 0 - 20
  - 21 - 40
  - 41 - 60
  - >60
  - Unpopulated Area

2 0 2 4 Miles



Source (10)

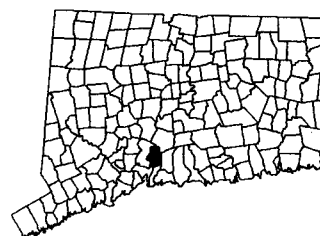
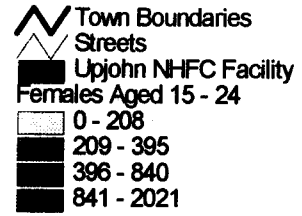


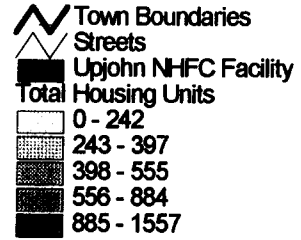
Figure 4

### Upjohn Facility North Haven, Connecticut Demographics B

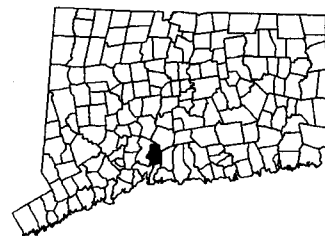
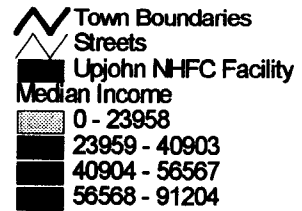
Females Aged 15 - 44



Number of Housing Units



Median Income



Source (10)

## **APPENDIX B: PUBLIC COMMENTS**

### **COMMENTS ON SEPTEMBER, 1999 PUBLIC HEALTH ASSESSMENT**

#### **COMMENTS RECEIVED FROM CITIZEN 1**

##### **GENERAL COMMENT NO 1.**

The health community concerns are broader than just bladder cancer. When I contacted 1st selectman Rescigno asking for a somewhat broad cancer study for the surrounding area of the Upjohn Plant, the high incidence of bladder cancer inside the plant had just been reported in the newspaper. That bladder cancer report somehow got translated into Rescigno's asking for a bladder cancer study instead of the broader cancer study that was wanted. This mistake was never corrected. What is needed is a cancer study, broader than just a bladder cancer study, in the geographic area near the plant.

##### **RESPONSE TO GENERAL COMMENT NO 1.**

Cancer is the uncontrolled growth and spread of abnormal cells anywhere in the body. There are many different types of cancer. Cancer is usually not caused by only one factor, but is almost always caused by a combination of factors including lifestyle (smoking, diet, and exercise), heredity, and environment. The risk factors for development of one type of cancer are likely to be very different from the risk factors associated with another type of cancer. Therefore, it is unlikely that a review of all tumors would be meaningful. The tumor sites that were recommended for study, AML and bladder were selected because of available data on releases to the environment and associations with the tumors sites. The health statistics review will provide information regarding whether residents living close to the Upjohn facility are experiencing, or did experience more cancer than those living further away.

##### **GENERAL COMMENT NO 2.**

The health data outcome from a study such as described in this section (PAGE 12) would never show any significant increase in cancer rates due to the Upjohn plant, because the geographical area studied was too big. You cannot study a whole town and expect to find any significant cancer data related to a plant in one part of town. That is why a study of a two mile area around the Upjohn plant needs to be done.

##### **RESPONSE TO GENERAL COMMENT NO 2.**

This is a limitation; however, it is a necessary step in reviewing cancer rates in an area. It is accepted practice to report disease rates by town and compare them to the rate of disease for the State of Connecticut. The evaluations of smaller geographic areas were not conducted by the CT DPH at the time the work was completed in 1981. This was primarily due to not having the tools available to conduct analyses other than at the town level. The analysis would also not have been able to show an increase in cancer rates due to the Upjohn facility. It is unlikely that any study would be able to make that

determination. However, the CT DPH will employ methods that will reflect the cancer rates around the Upjohn plant.

### **GENERAL COMMENT NO 3.**

As explained above, the concern is broader than bladder cancer. Because we now have TRI data and we now know what the citizens around the plant were actually exposed to, this current information warrants a broader cancer study.

### **RESPONSE TO GENERAL COMMENT NO 3.**

The goal of TRI (Toxic Release Inventory) was to "... help citizens, officials, and community leaders to be better informed about toxic and hazardous materials in their communities." TRI data should not be used as exposure data. Not all chemicals/compounds reported in TRI for Upjohn would have been released into the environment. A lot of different chemicals/compounds were used at the Upjohn facility. Not all of these chemicals/compounds found their way into the community. The fact remains that we do not know what or how much the citizens around the plant were actually exposed. It would be inappropriate to base a broader cancer review based on TRI data.

The cancer review is based on known chemical releases and biological plausibility. The literature is reviewed and tumor sites are selected based on whether there is an established link between the chemical and tumor. The two tumor sites selected, bladder cancer and AML meet that requirement.

### **GENERAL COMMENT NO 4.**

Please expand the tumor sites from the two proposed sites which are bladder and acute myeloid leukemia (AML) to all acute leukemia's as well as AML, to all lymphomas, including non-Hodgkin's lymphoma, colon, bladder, kidney, breast, and ovarian. Because many of the chemicals that came out of Upjohn's stacks and lagoons are suspected endocrine disrupters, the two cancers of reproductive organs, breast and ovarian, need to be added. As well, many of the chemicals that people were exposed to were ones that affect the kidneys. Furthermore, we know that there is no health data for the exposures of one, two, three, or four carcinogens together in the air being taken up into the human body as a soup of carcinogens in a single breath, and that is why it is also important to call for the study to include the expanded list of cancer sites. Many of the chemicals that people were exposed to for twenty years were carcinogens that could have had impacts on these organ sites.

### **RESPONSE TO GENERAL COMMENT NO 4.**

The methodologies and protocols for the future health statistics review have not been finalized. The tumor sites that were recommended for study, AML and bladder, were selected because of available data on releases to the environment and associations with the tumors sites. However, the request for additional tumor sites will be considered for the health statistics review.

**GENERAL COMMENT NO 5.**

Please contain the study to a radius of two miles around the plant. As there was a dilution of the contaminants in the air as you moved further and further from the plant, so too, if the study is much larger than a two mile radius, there will be a dilution of the statistics.

There also needs to be included in this study the tumor sites of those people who worked in businesses that were located around the Upjohn Plant. There were many people who worked in businesses on State Street and Sackett Point Road during the years of high exposures. Therefore they too would have been heavily exposed during their working hours and should be included in the study if possible.

**RESPONSE TO GENERAL COMMENT NO 5.**

The CT DPH will employ methodologies that will reflect the cancer rates around the Upjohn plant. The suggestion for reviewing tumors of worker in business near the Upjohn facility will not be possible. The health statistics review will be conducted using existing data from the Connecticut Tumor Registry (CTR). The CTR does not collect information on work place at time of diagnosis. The CTR is an excellent resource for the evaluation of cancer in a community. It is the oldest population based registry in the United States, with data going back to 1935. It allows for the historical review of cancer rates within Connecticut. The health statistics review will provide information regarding whether residents living close to the Upjohn facility are experiencing, or did experience more cancer than those living further away.

**PUBLIC COMMENTS RECEIVED FROM CITIZEN (2)**

**GENERAL COMMENT NO 1.**

I am concerned about contamination from Upjohn after reading the report. I have a private well. I use the well water for drinking. Please consider asking the local health department to investigate wells in my area.

**RESPONSE TO GENERAL COMMENT NO 1.**

The local health department has been contacted and made aware of the private well. Any additional private well information will be reviewed by CTDPH/ATSDR in a separate health consultation for the site.