ASSESSMENT OF EXPOSURE TO MIREX ASSOCIATED WITH THE NEASE CHEMICAL COMPANY SUPERFUND SITE IN SALEM, COLUMBIANA COUNTY, OHIO

FINAL REPORT

CASE LOG NUMBER 900508

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INTRODUCTION

In 1983, the former Nease Chemical Company Plant in Salem, Ohio was added to the **National Priority List** (also known as **Superfund**) by the United States Environmental Protection Agency indicating the potential threat to public health from exposure to toxic agents from the site (Figure 1). Environmental data collected both on-site and off-site by the United States and Ohio Environmental Protection Agencies (USEPA and Ohio EPA) in the early to mid 1980s revealed potential pathways by which persons living in the vicinity of the Ruetgers-Nease (Nease) superfund site in Columbiana County may have been exposed to chemical contaminants associated with the site. The likelihood of human exposure to mirex and the concerns of residents and elected officials led the Ohio Department of Health (ODH) to initiate an investigation. Its purpose was to determine whether any residents had detectable amounts of mirex in their blood and to more closely examine the environmental pathways that may have contributed to this body burden. Blood testing was chosen to assess uptake and because it best met the conditions and constraints of the study.

Located on the outskirts of Salem in Columbiana County, the Nease Chemical Company produced pesticides and other compounds from approximately 1961 until the operation was forced to permanently close by the Ohio EPA in 1973. Nease manufactured mirex along with other chemical compounds. Mirex was primarily used in the United States as a pesticide to combat fire ants in the southern states but also had a minor use as a fire retardant. Because it was not used widely or in agriculture in Ohio, its presence in the environment in parts of Mahoning and Columbiana counties probably indicates contamination from Nease. USEPA has reported extensive contamination of the Nease property (USEPA Summary Report, Jan. 6, 1989). USEPA has stated that "the mirex contaminated sediments and fish in Middle Fork Little Beaver Creek (MFLBC) are due to past poor operating procedures and wastewater discharge violations at the Nease facility. These actions caused mirex to flow into MFLBC where it was absorbed into the sediment" (USEPA Summary Report, Jan. 6, 1989).

Toxicology of Mirex

Mirex is a **stable chlorinated hydrocarbon** pesticide. The chemical name for mirex is 1,1a,2,2,3,3a,4,5,5,5a,5b,6-dodecachlorooctahydro-1,3,4- metheno-1H-cyclobuta[cd]pentalene. It is also known by the brand name Dechlorane. It is highly soluble in fat and accumulates in fatty tissue. It is not well absorbed through the skin, and while not highly volatile, pesticide-laden aerosol or dust particles trapped in respiratory mucous and then swallowed may lead to significant uptake (Morgan, 1989). Absorption in the intestine is enhanced by fats.

The USEPA classifies mirex as a class B2 -a probable human carcinogen- based on studies in which it increased the incidence of cancer in animals, but there is inadequate human data to determine whether it might cause cancer in humans(USEPA Health Effects Assessment for Mirex, August 1987). In animals, mirex has been associated with a number of other health effects such as adverse reproductive outcomes and cataract formation. Rats fed a concentration of 20 ppm for an extended time did not develop adverse effects, but a dietary concentration of 25 ppm interfered significantly with the reproduction of rats (Larson et al., 1979b). The toxicity of mirex differs greatly from species to species. Studies show young chickens tolerated a dietary concentration of 400 ppm for 5 weeks without significant effect in body weight or on a number of immunological parameters (Davison and Cox, 1974). Very little is known about the human health effects of small doses of mirex.

Possible Pathways for Exposure to Mirex

Samples of fish and sediment taken by Ohio EPA and US EPA in 1986 and 1987 indicated mirex contamination beginning in MFLBC in the vicinity of the Nease property and extending downstream to the dam at Lisbon (approximately river mile 25) (Figure 1). Mirex concentrations were highest near the site, declined downstream but then increased again where stream sediment settles in Egypt Swamp (north of Lisbon). Fourteen of twenty fish samples taken above Lisbon in 1987 had mirex concentrations exceeding the U.S Food and Drug Administration (FDA) action concentration of 100 parts per billion (ppb). Although some mirex contaminated fish were captured downstream of the Lisbon dam, sediments below the dam and downstream to the Ohio River were not contaminated with detectable concentrations of mirex.

The fish tissue and sediment data prompted ODH in 1987 to issue a fish consumption advisory and in 1988 to expand the advisory to include a warning against contact with sediments in the most contaminated stretch of the creek from Salem down stream to the Lisbon dam.

The Middle Fork of the Little Beaver Creek originates near the Nease property in Salem and is connected with the Nease property via Feeder Creek. MFLBC flows northward into Mahoning County and then bends south into Columbiana County where it eventually joins other tributaries to become Beaver Creek. Beaver Creek flows into the Ohio River near East Liverpool (Figure 1). The lower reaches of Beaver Creek support a thriving bass fishery. Between Salem and Lisbon, the creek is easily accessible to residents who live nearby. Reportedly, many people fish and swim in MFLBC. There are also three dairy farms along the banks of the creek. The creek (MFLBC) was used as a water source for the cattle. Cattle access to the creek has been limited since 1989 when Nease paid for the construction of fences along the creek on affected property.

Bulk tank milk samples collected by the ODH Bureau of Environmental Health Milk Inspection Program and analyzed by the Ohio Department of Agriculture Laboratory in 1987 indicated the presence of mirex in samples from two of the herds. The highest concentration in milk from a bulk tank sample was 76 parts per billion (ppb), a concentration below the **FDA action level** of 100 ppb. A slaughtered dairy animal from one of the herds had tissue concentrations of mirex exceeding the FDA action level.

There are also at least two non-dairy commercial operations associated with the contaminated areas of MFLBC. Prior to August 1989, a local landscape and garden store had been selling topsoil comprised of dredged creek sediments mixed with peat moss. USEPA analysis of the dredge material indicated that it was contaminated with mirex at 80 ppb. There is also a gravel/aggregate operation at approximately river mile 10 which previously used creek water in its operations.

On the basis of USEPA reports, direct observation by ODH staff and anecdotal information, we concluded that a number of pathways exist by which people may have been exposed to mirex. Consideration of mirex toxicology suggests that the most important routes of uptake would be ingestion, especially of fatty products, and inhalation of small particles of mirex or of pesticide laden dust.

Possible Environmental Pathways

1. Consumption of farm or garden products from areas along the creek contaminated by flooding or where creek water has been used to irrigate crops or to water animals.

2. Consumption of fish taken from the creek above the Lisbon dam.

3. Consumption of game animals which live along the creek, especially those which feed on aquatic plants and animals.

4. Direct contact with the creek during recreation activities via incidental ingestion of suspended sediments. Mirex has very low solubility in water and ingestion of the compound dissolved in water is not likely to be a significant exposure.

Occupational Setting

5. Employment by the Nease Chemical Company or in an activity otherwise associated with its operations.

6. Employment involving activity in contaminated areas of MFLBC, such as the gravel cleaning operation.

Given the potential pathways for human exposure and the strong association of mirex in Ohio with the Nease Chemical property, we developed the following strategy to rapidly undertake a study to delineate uptake of mirex by humans and to define the pathways by which mirex was acquired:

1. Identify a small group of households with some likelihood of uptake of mirex based on their exposure in the plausible pathways.

2. From that group, select households with varying potential risk of exposure to mirex (oversampling in highest potential exposure categories) to increase the chance of finding anyone with mirex in their serum.

3. Measure uptake of mirex by determining its concentration in serum.

4. Determine by a questionnaire which reported exposure pathways are associated with detectable levels of mirex in human serum.

5. Based on the pathways by which persons had acquired mirex and on the serum concentrations, decide whether there appears to be a general risk of uptake of significant amounts of mirex.

6. Make recommendations about whether further widespread testing in the general population would have some public health benefit.

These activities were pursued under the authority of Ohio Revised Code 3701.14, 3701.262 and Ohio Administrative Code 3701-2-29.

METHODS

Determination of the Most Likely Exposed Population

The goal of this study was to try to determine quickly on a very limited budget if people living in the vicinity of the Nease Superfund site and MFLBC have been exposed to mirex as a result of contamination from Nease. In order to do this, our sampling frame was comprised of people we believed were most likely to have been exposed. Therefore, the sample was not random or entirely systematic. To find people likely to have been exposed to mirex through environmental and occupational pathways, we mailed 575 questionnaires to residents in the vicinity of MFLBC between Salem and Lisbon. The names and addresses of these residents were obtained from the tax records of Goshen and Green townships in Mahoning county and Center, Salem and Perry townships in Columbiana County. County road maps were used to determine which roads in these townships run adjacent to the creek. Residents who lived on these roads were sent questionnaires with stamped, return envelopes. An additional 100 questionnaires with stamped, return envelopes were placed at the public libraries in Salem and Lisbon. A public service announcement was placed in three local newspapers, The Lisbon Lantern, The Salem News, and The Morning Journal, to find other potentially exposed people. Other attempts to recruit subjects were made at public meetings.

The survey included questions about fishing and recreational contact with the creek, about consumption of game and farm products and employment history. A copy of the questionnaire can be found in appendix A.

Families who returned the questionnaire were classified into high, medium, low, and no potential exposure groups based on responses to the questionnaire and the known likelihood that a pathway would contribute to human uptake, as indicated in published literature. This was used to develop a relative exposure scale that took into account each activity, the frequency of the activity and the location of the activity along the creek. Higher rankings were given to activities which involved ingestion of food likely to contain mirex (fish from MFLBC and consumption of animal products which had contact with the creek). Activities which occurred closer to the Nease site were given a higher ranking than similar activities occurring further away. Although we intended to collect potential exposure data on all individuals in the household, an error in the form resulted in getting individual data only for age, occupational exposure, and coincidentially consumption of farm animal products. See appendix B for exact scoring procedures.

Families were ranked in ascending order based on their total exposure score from the questionnaire. Those who had potential exposure were divided into quintiles (five categories of equal number). The first quintile was used to represent the low exposure group, the third quintile to represent the medium exposure group and the fifth quintile to represent the high exposure group. The pre-determined maximum number of 60 serum **assays** for mirex (based on the project budget and cost of the assays) limited the number of individuals from each group who could be tested. To screen across varying exposure levels and to oversample the high exposure category, we selected ten families from each of the low and medium exposure groups and also from the group that reported no exposure to be certain we had not missed an unknown exposure factor. Every household from the high ranked exposure group was asked to participate.

When a household was chosen, individuals in the family were asked to participate. Initial selection was done systematically from the list of exposure scores, starting with the highest ranking. Those selected were sent a letter (see appendix C) explaining the nature of the screening and asking them to participate. Those who chose to participate were asked to return an enclosed form (see appendix D) indicating the family member, or members, who desired, and would be able, to participate. If an eligible household was unable or chose not to participate, the next household on the list was selected as an alternate and sent the same letter. All enrolled subjects were also asked to participate in the Caffeine Breath Test (CBT), but only some of the potential subjects chose to participate in this additional procedure.

Participants provided a 30 ml sample of blood for mirex quantitation. After 30 minutes, the sample was placed in a centrifuge and spun down to produce at least 5 ml of serum. The serum samples were placed in a cooler containing dry ice before being moved to a freezer in the Ohio Department of Health Laboratories. They were later packed in a dry ice cooler and sent on December 18, 1989 to the Centers for Disease Control, Division of Environmental Health Laboratory Sciences in Atlanta, Georgia where the analytic work was done.

In addition, some participants took part in the Caffeine Breath Test. This test quantifies induction of the cytochrome P1-450 enzyme system which metabolizes chlorinated organic compounds such as mirex. It involved drinking a solution containing isotopically labeled carbon-13 atoms which would be measured in exhaled breath to determine the rate at which the carbon atoms were induced. This procedure has not been fully validated as a test to measure the effects of mirex, but it is hoped that the results will provide evidence about whether there is an association between mirex levels and enzyme induction.

The protocols for serum determination and CBT are included in appendeces E and F. The protocol was reviewed and approved by the Ohio Department of Health Internal Review Board Human Subjects Committee prior to collecting the samples. A copy of the approval can be found in appendix G.

Statistical Analysis

Frequency distributions and general descriptive statistics were calculated and two by two tables were constructed for each variable (variables were dichotomized only for the two by two table analysis) to calculate chi-square, p-values and odds ratios.

Calculations were performed using the EpiInfo program for Personal Computers and univariate were done with Statistical Analysis System (SAS) for the Personal Computer.

RESULTS

Determination of the Most Likely Exposed Population

Two hundred of the 675 questionnaires mailed or placed in the libraries were completed and returned. Seventy eight responding familes reported no exposure pathways for any family member listed in the questionnaire and 122 families reported varying degrees of exposure.

The most commonly reported potential pathway for mirex exposure among questionnaire respondents was physical contact with the creek and its sediments (from swimming, wading, etc.) in the advisory area, with 40.5% of the survey respondents reporting some kind of contact (Table 1). The second most frequently cited potential exposure pathway was consumption of game hunted or trapped in the area of MFLBC (32.5%). Consuming fish from within the advisory area of MFLBC was reported by 17% of the survey participants. Seventeen respondents (8.5%) reported using water from MFLBC to irrigate crops that they later consumed. Consumption of animal products which had access to the creek was reported by 4.5% of the survey respondents. Despite efforts to reach as many former Nease employees as possible via newspaper announcements and public meetings, we received completed questionnaires from seven (3.5%) former Nease employees and four agreed to participate. Only one of these had worked at Nease for more than one year.

A total of 48 households selected from the four exposure categories list were sent letters, and of these 27 households agreed to participate, for a total of 42 area residents. Two ODH employees were added as field controls. There were 24 male and 18 female residents and 2 female ODH employees. All analysis and descriptions refer to the 42 area residents unless specified.

Participants ranged in age from 8 to 75 years with a median of 40.4 years and a mean of 40.4 years. Four people reported events that are known to decrease body burdens of fat soluable pesticides. Three of the eighteen women tested reported breast-feeding an infant within the last five years. Only one person (a female) reported losing a significant amount of weight (20 pounds) in the past year.

Twenty-eight of the forty-two people tested and the two ODH staff had no mirex in their blood. Mirex was detected in nine of the twenty-seven participating families for a total of fourteen individuals. Thirteen of these were male, one was female. The smallest amount of mirex that could have been detected (detection limit) was 0.16 parts per billion (ppb). The values ranged from 0.25 ppb to 2.2 ppb, with an average value among those who tested positive of 0.84 ppb and a median of 0.68 ppb. Three of seven children (18 years or younger), all in one family, tested positive.

The descriptive analysis of the original grouping of all people into the four exposure categories - no, low, medium and high - produced a complex array of potential multiple exposures. It appeared that occupational exposure itself was a critical pathway separate from the high risk environmental pathways. The comlexity resolved when the occupational group was separated from the groups without an occupational exposure pathway. The distribution of serum mirex concentrations by exposure risk level with occupational exposures separated is shown in Table 2.

Two categories contain most of the positive results, the occupational and high risk categories. These two categories contained thirteen of the fourteen people (fifteen of twenty-seven families who were tested) with detectable levels of mirex. In the three remaining categories one person out of sixteen (twelve families) had detectable mirex and this was the lowest concentration in the group. The highest mean and individual levels were in those with occupational exposure.

Table 3 shows the specific activities reported by each family along with their serum mirex levels. The table represents only whether a family reported participation by one or more family members in the activity. For those who reported some activity in an category it does not necessarily reflect the actions of an individual nor the frequency or the location of the activity.

A total of 18 area residents and two ODH employees participated in the caffeine breath test. There were 10 males and 8 females (plus the two ODH employees). The ages of the participants ranged from 18 to 74 years with a median of 43.0 years and a mean age of 44.3 years. The results and their interpretation will be forthcoming.

We attempted to determine which specific factors were associated with serum concentrations of mirex. Eight variables were considered (Table 4). However the error in collecting data on activity at the family level, instead of for each individual in a family, limited our ability to use more sophisticated analysis. This is because serum results are for a specific individual and positive answers to questionnaire data may or may not represent an individual's activities. Data for occupational exposure was specific to an individual. For families consuming farm animal products, all individuals in these families did consume the products, and their positive answers to exposure pathways apply. Negative answers also obviously apply to all family members.

Three variables showed a strong association with detectable amounts of mirex in the serum, male gender, former Nease employment, and consuming animal products that had contact with the contaminated portions of MFLBC.

Men were twenty times more likely than women to have detectable concentrations of serum mirex. Former Nease employees had thirteen times the risk of showing detectable concentrations of mirex as people who were tested but who never worked at Nease. Consuming animal or animal products that had contact with the contaminated portion of the creek was also highly associated with detectable concentrations of mirex. These individuals were eight times more likely than those not consuming farm animal products to have detectable mirex.

For the other five varibles the results are less conclusive. Eating fish, wild game or garden products from the area having significanct contact with the contaminated creek, could not be directly tested for statistical association due to the data collection method problem discussed. However eighteen people had no detectable mirex, even though sixteen of these reported exposure to mirex in one or more pathways.

DISCUSSION

Some people who had activities that we rated as a high risk of exposure, based on knowledge of exposures seen for similar chemicals (such as DDT and PCB), had detectable amounts of mirex in their bodies. Two exposure risk groups stand out clearly, those with occupational exposure at the Nease facility and those rated as having high risk for environmental exposures. Most of these people reported many possible sources of uptake of mirex, but detailed analysis found only one important environmental risk factor (environmental pathway) for uptake of mirex from the Nease Superfund site, consumption of farm animal products of animals known to have access to the contaminated part of MFLBC.

Twelve out of the fourteen people with detectable mirex either consumed probably contaminated animal products or worked at the Nease facility. The two other people with mirex both reported eating wild game and one reported contact with the creek. Families in the two lowest risk categories reported opportunies for exposure to mirex but had not taken up measurable amounts, and even in the high risk categories, seven out of eleven had not taken up a measurable amount of mirex. No one in the no risk category had mirex in their serum.

Statistical analysis indicated that the same implicated activities, being a former employee at Nease and consuming animal products (ie, milk and meat) from animals that had contact with MFLBC, plus male gender, were significantly associated with presence of mirex in serum.

In this group other factors did not appear to be associated with presence of mirex in serum: age, eating fish from MFLBC, contact with the waters or sediment of MFLBC, and consuming garden products grown on the flood plain of MFLBC. The one exception may be hunting and consuming game from the MFLBC area. We are awaiting mirex results from samples taken from animals most likely to be exposed to mirex.

Data from Other Studies of Human Exposure to Mirex

The limited data from studies of the occurence of mirex or related compounds in humans are summarized in Table 5. We looked for two types of information: how likely is a person to have any mirex in their body, and what were the concentrations in people who did have some mirex.

Mirex is rarely detected in humans and many of the samples positive for mirex were from the southeastern United States where the compound had been used extensively to control fire ants. The occurrence of mirex in human fat was reported first by Kutz et al. (1974) in connection with samples collected in 1971-1972 as part of the National Human Monitoring Program for Pesticides. In 1400 samples, mirex was found in six (<0.01%). All six samples came from southern states and five of these were from rural areas. The method used was capable of detecting a concentration of about 100 ppb. Values ranged from a low of 160 ppb to a high of 5,940 ppb, with a mean 2,490 ppb. Using the mean concentration ratio of adipose tissue to serum reported by Burse et al, 1989, of 365:1 this would give a mean of about 8 ppb in serum.

In a larger study designed specifically to determine the prevalence and concentration of mirex in tissue from persons living in the southeastern U.S. where large amounts of mirex were widely applied the mirex was detected at a frequency of 10.2%. The geometric mean lipid concentration of mirex in these samples was 286 ppb (Kutz et al. 1985). Mirex was found at concentrations of 100 to 600 ppb in three samples of human milk collected in cities on Lake Ontario or Lake Erie (Mes et al., 1978).

Lloyd et al. (1974) analyzed the serum of pregnant women in the Jackson and Mississippi delta areas for chlorinated pesticides including mirex. Mirex was found in 106 of the 142 samples of this survey at a mean serum concentration of 500 ppb.

Burse et al., 1989, examined the concentration of mirex in the serum and adipose tissue of residents living near a dump site in Memphis, Tennessee. The exact route of exposure to mirex in that population is unclear. It may have been as a result of contamination from the dump site with mirex; it also may be a result of living in an area that was presumably treated with mirex for fire ant control. Mirex was detected in 19/297 adipose samples and 13/370 (35%) serum samples. The mirex serum concentrations ranged from 16.8 ppb to 1.56 ppb (detection limit <0.33) with a mean of 4.69 ppb and a median of 2.75 ppb. The elevated mirex levels in the Great Lakes region are thought to have resulted from consumption of contaminated fish. A production facility near a lake released mirex into the lake waters.

There is no published data on mirex concentrations in persons with occupational exposure to the compound.

Mirex in Ohio

The likelihood of detecting mirex in the general population in Ohio appears to be quite small. Mirex was not used in agriculture in the midwestern region, including Ohio. Even in areas of the southern U.S. where mirex has been used extensively, the compound has been infrequently detected in residential populations (Savage et al., 1981; Harrod and Asquith, 1980; Barnett et al., 1979). Its presence in the sera of people living and working in the area of the Nease superfund site is strong evidence of exposure to releases of the chemical from the former Nease Chemical Plant.

The relatively low frequency of occurence of mirex in human samples taken from the general United States population (one percent or less) suggests that uptake through common exposure pathways is rare. In some of the smaller studies in specially selected groups in the southern United States, the percentage of people who tested positive for mirex was much higher and the concentrations tended to be higher than those in this study. Where mirex is distributed widely at relatively high concentrations in the environment, as in the south, some environmental pathways are clearly important sources of uptake of mirex. We cannot tell from the studies which pathways are involved or their relative importance.

The serum mirex concentrations of the people in this study were lower or substantially lower than the published values where we could compare them. The National Pesticide Monitoring data would probably have had serum values in the 5-10 ppb range, if the results are extrapolated from the fat levels. This is several times the levels seen in Ohio. The Memphis population had an mean value more than 5 times those seen in this study, and women in Mississippi had values that were 500 times greater than the those in Ohio.

Limitations of the Study

Our ability to extrapolate from the findings of the study is somewhat limited due to the small sample size and our selection of people we considered most likely to have taken up mirex. We cannot say much about the likely doses that exposed individuals might have had because we do not know the time of the last exposure, and thus the amount of time their body has had to excrete the compound.

Mobilization of body fat will tend to move hydrocarbons stored in the adipose tissue into the blood stream or breast milk. Three women in the study reported nursing an infant within the last five years. None of the women showed the presence of mirex. Nursing has been reported to decrease the body burden of chlorinated hydrocarbons similar to mirex by mobilizing body fat during lactation. This could possibly be a factor affecting the sex distribution of those with detectable concentrations of mirex. In addition, one participant (a female) reported losing 20 pounds within the past year. The individual did not have a detectable amount of mirex. Losing a significant amount of weight would also mobilize body fat and possibly effect the serum measurement of mirex.

A confounder in the analysis (a factor related to both exposure and the presence of mirex in the serum) was gender, due in part to the bias towards males in the type of work done at the former Nease plant and the much larger percentage of males than females who reported consuming animal products.

None of the families who reported consuming fish had detectable concentrations of mirex. We believe this may have resulted from a limitation of the questionnaire, since the person who ate the fish may not have been the one who was tested. We also do not know whether the fish that were reported eaten actually contained mirex.

Although the results of this study apply strictly only to those who participated in the study, we can make some inferences from this data since we selected those who had the highest risk of uptake of mirex. It is reasonable to assume that people with less risk of significant exposure would have lower serum concentrations or no detectable mirex.

CONCLUSIONS AND RECOMMENDATIONS

We found strong evidence that some people living near the Nease Superfund site and MFLBC have acquired body burdens of mirex released from the site or acquired while working there. However, most people who reported activities that could have resulted in uptake of mirex did not have detectable amounts of mirex in their serum.

Having mirex in the blood was associated with two activities: 1) consuming animal products from animals probably contaminated with mirex and 2) work at the Nease chemical plant.

In the group participating in this study, fishing, contact with contaminated stream sediment and soil, and eating gardens products grown in possibly contaminated soil were not associated with the presence of mirex in serum. Only two of the fourteen people with mirex in their serum did not report exposure to either contaminated food products or occupational exposure, but did report a variety of other activities which may have lead to their uptake of mirex.

This study does not provide any evidence of widespread human uptake of mirex in people living in the vicinity of the site or MFLBC. The total number of samples was not large and the selection of the people was biased toward participation by people who we thought would be most likely to have taken up mirex.

The mirex levels in this study population were slightly lower or much lower than in all groups reported in published account to have any amount of mirex in their serum. Most reported exposures were in people who were probably exposed to mirex applied widely in large amounts to kill fire ants in the southern United States or who ate mirex contaminated fish from Lake Ontario.

Even if widespread testing were to reveal additional people with levels similar to what this study found, we see little benefit to the community or to individuals.

There are three reason for this

1) We are not able to tell what, if any, adverse health effects might result from past exposures.

2) We would not know any more than we know now about how to avoid exposure.

3) We cannot tell anyone how to safely reduce the amount of mirex already in a person's body.

Further widespread testing might reveal additional people with mirex in the exposure categories we have already identified: those who worked at the plant, those who had eaten contaminated animal products, and perhaps a very small number of others for which there was no plausible or obvious exposure pathway.

A woman who has mirex, or other fat soluble pesticides in her body, will certainly pass some of the chemical in her milk to a child when she nurses. We do not know if this would have any adverse effect on the health of the child. Someone with mirex in their body who is contemplating nursing a child should be aware of the high likelihood of passing the chemical in her milk and perhaps discuss the positive and negative aspects of nursing with a health care provider.

This study revealed several ways to prevent or reduce exposure to mirex. This includes reducing or eliminating consumption of farm animal products which contain mirex. We think that the families at greatest risk for this exposure are already aware of the potential problem. Contaminated fish in Middle Fork of Little Beaver Creek are an additional possible source of exposure to mirex. The Ohio Department of Health urges all area residents to continue to abide by the current ODH advisory against fish consumption and contact with the creek and its sediments. Occupational exposure at Nease is no longer possible, but there is evidence that the property is still contaminated in some areas and even though there is no evidence that contact with contaminated soil is a significant route of uptake for mirex, it is prudent to suggest that the general public should not have direct contact with contaminated soils at the site.

Respectfully,

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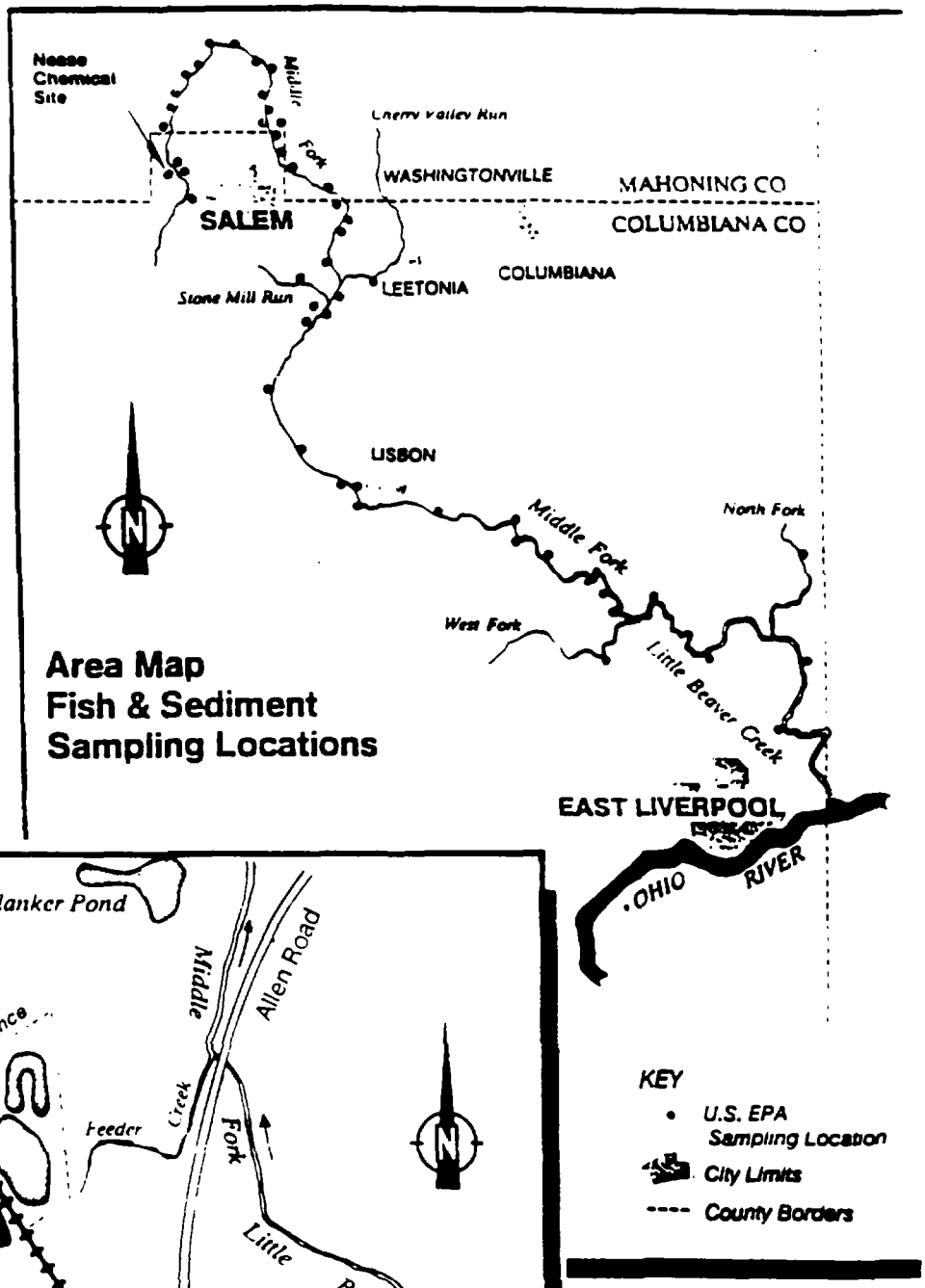
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WASHINGTONVILLE
MAHONING CO
SALEM
COLUMBIANA CO
COLUMBIANA
Stone Mill Run
LEETONIA
LISBON
Middle Fork
North Fork
West Fork
Little Beaver Creek
EAST LIVERPOOL
OHIO RIVER
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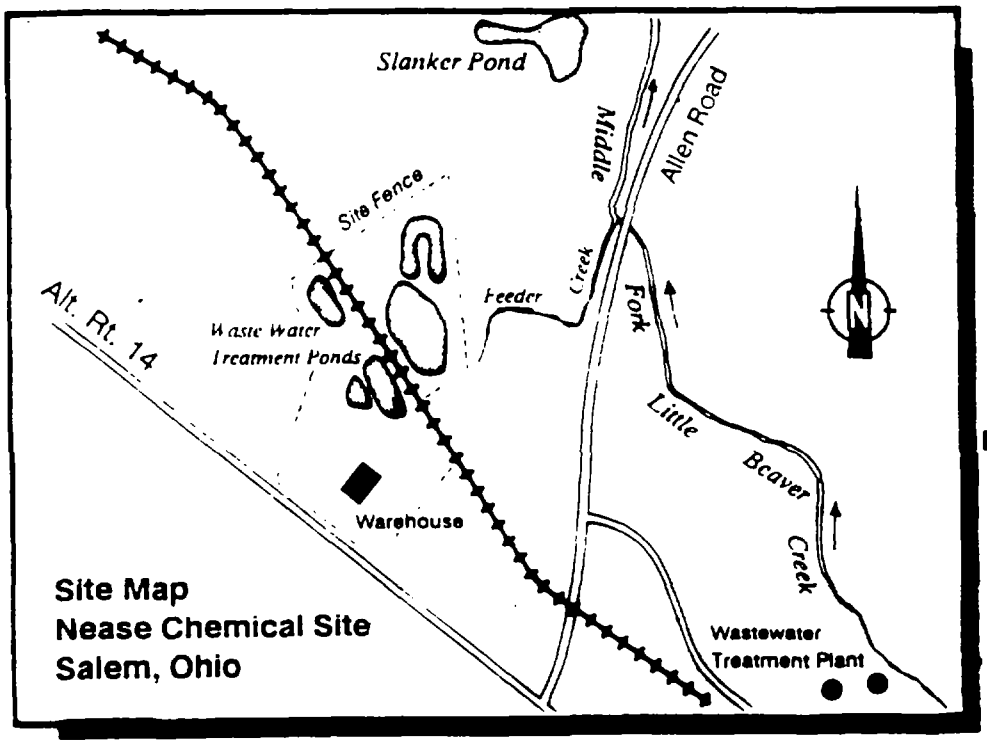
Area Map
Fish & Sediment
Sampling Locations
KEY
U.S. EPA Sampling Location
City Limits
County Borders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Allen Road
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Feeder
Creek
Fork
Alt. Rt. 14
Waste Water Treatment Ponds
Warehouse
Little
Beaver
Creek
Wastewater Treatment Plant
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Site Map
Nease Chemical Site
Salem, Ohio

Table 1: Frequency of Activities Related to the Nease Superfund Site and MFLBC as Reported Among 200 Survey Respondents, December, 1989

type of contact	number of families	percent of total responding*
none	78	39.0%
physical contact w/MFLBC	81	40.5%
consuming game	65	32.5%
consuming fish	34	17.0%
garden products	17	8.5%
animal products	9	4.5%
Nease employment	7	3.5%

*Column total represents more than total or 100% because respondents reported more than one type of activity.

Table 2. *Serum Mirex Concentrations by Risk Exposure Categories and Former Nease Employees For Participants in Nease Superfund Site Study, December, 1989.*

	No. Tested		No. POSITIVE			
Category	People	Families	People	Families	Mean(ppb)	Range(ppb)
no	3	2	0	0	-	-
low	4	3	1	1	0.25	0.0-0.25
medium	9	7	0	0	-	-
high	22	11	9	4	0.69	0.0-1.4
occupational	4	4	4	4	1.34	0.46-2.2
TOTALS	42	27	14	9	0.84	0.25-2.2

Table 3. Serum Mirex Results and the Activities Related to Potential Exposures Reported by Households and Nease Superfund Site Study, December 1989[1]

Avg Serum Mirex (ppb)	Former Nease Employee	Fish MFLBC	Hunt MFLBC	Contact w/MFLBC	Consume Animal Product	Consume Garden Product
nd[2]			X		X	
nd		X	X	X		
nd				X		
nd						
nd		X	X			X
nd				X		
nd			X	X		X
nd		X		X		
nd						
nd		X	X	X		
nd		X		X		X
nd			X	X		
nd				X		
nd			X	X		
nd		X	X	X		X
nd		X	X	X		
nd			X	X		
nd		X		X		X
0.17			X			
0.33			X	X	X	X
0.46	X		X			
0.48				X	X	X
0.79	X		X	X		
0.90			X	X		
0.91					X	
1.20	X		X	X		
2.20	X			X		

[1]his information was taken from completed surveys. It does not represent the frequency or location of the activity, only whether or not the household reported participation.

[2]"nd" signifies "not detectable", meaning that if mirex was present, it was less than 0.16 parts per billion, the limit of detection. It may also mean that the level of mirex in the blood is zero.

[3]A dot (".") signifies missing data, meaning that a completed questionnaire was not received.

Table 4. Results of Univariate Analysis for Factors Potentially Related to Serum Mirex Concentration in Nease Superfund Site Study, December 1989

Exposure	Chi-Square[1]	Odds Ratio(CI)[2]		p-value
gender(male)	8.86	20.09	(2.12<OR<472.3)	0.003*
Nease employee	4.92	13.18	(1.22<OR<334.97)	0.027*
animal products	6.43	8.00	(1.46<OR<48.53)	0.011*

eat fish, age(<=18 yr), eating wild game, contact w/creek, eating out of garden could not be tested due to sampling at the family

*(significant at 0.05 level)

[1]Chi-squares and p-values are reported as Yates corrected values.
[2]CI=Cornfield 95% confidence limits for odds ratios.

Table 5: Results of Previous Studies of Prevelance of Mirex in Human Populations

Study	Medium	#pos/tot. sample	Mean (ppb)	Range (ppb)
National Sample				
Kutz et al.(1974)	fat	6/1400	2490	160-5940
Harrod & Asquith(1980)	milk[1]	0/25	na	na
Savage et al.(1981)	milk	0/1436	na	na
Murphy et al.(1983)	serum	>1% of 4200	*	*
Southern U.S.				
Lloyd et al.(1974)	serum	106/142	500	*
Barnett et al.(1979)	milk	0/34	na	na
Greer et al.(1980)	fat	20/22	152	10-600
Kutz et al.(1985)	fat	10.2%/624	286	*
Burse et al.(1989)	fat	19/297	1,080	0-4,680
Burse et al.(1989)	serum	13/370	4.7	1.56-16.8
Great Lakes Region				
Mes et al.(1978)	milk	3/14	*	100-600
Bush et al.(1983)	milk	18/46	0.1	.01-6.00
ODH(1990)	serum	14/44	0.842	0.25-2.20

[1]milk refers to human breast milk
*data not available
na=not applicable

GLOSSARY OF TERMS

chlorinated hydrocarbons

A class of persistent, chemical compounds that linger in the environment and accumulate in the food chain. Mirex is a type of chlorinated hydrocarbon.

ppm/b

Units of measurement. ppm = parts per million = mg/liter.
ppb = parts per billion = ug/l

FDA (Food and Drug Administration) action level

Regulatory levels used by the FDA and USDA when chemical residues occur in food or feed commodities. FDA action levels are used as standards by other state and federal agencies.

serum

The clear portion of human blood separated from its more solid elements.

assay

Another term for scientific test.

National Priorities List (NPL) or Superfund sites

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial action.

APPENDICES

APPENDIX A: QUESTIONNAIRE

246 N. High Street
Post Office Box 118
Columbus, Ohio 43266-0118

Telephone (614) 466-3543

RICHARD F. CELESTE
Governor

Dear Resident;

The Ohio Department of Health (ODH) is attempting to find out how man people in the Salem to Lisbon area have had exposure to the pesticide Mirex, either through the contaminated Middle Fork of the Little Beaver Creek or from the Nease Chemical Company. Mirex is classified as a potential human carcinogen. ODH and the Ohio Environmental Protection Agency are concerned about people who regularly used the upstream part of the creek because the sediments and fish are contaminated with pesticides. The Nease Chemical Company operated a plant just outside of Salem from 1961 until the EPA closed it in 1973. We are also concerned that former employees of the Nease Chemical Company may have been exposed to high levels of Mirex.

Many citizens in the area have expressed health concerns related the pollution of the Middle Fork of the Little Beaver Creek and the Nease Chemical Company. Before we investigate any possible health problems, it is first very important to find out how many people were potentially exposed to Mirex in the creek or while working for the Nease Chemical Company. This survey is designed to assess how many people may have been exposed and for how long.

In order that the results truly represent the exposure level of the people living in the Middle Fork of the Little Beaver Creek area, it is important that each survey be completed and returned. We would like the questionnaire to be filled out by an adult member of your household, but include information about all members of the household. Please return the completed survey in the enclosed stamped return envelope as soon as possible.

Results of this survey will be released only in aggregate form. Your identity will be kept confidential. The first page of the survey containing your name and address will be separated from the remainder of the form and used only to identify who has completed the survey.

The results of this research will be made available to officials and representatives in the state and local government, members of Congress, the Ohio EPA, the U.S. EPA, the Ruetgers-Nease Company, and all interested citizens.

Your contribution to this effort is greatly appreciated. We would be happy to answer any questions you might have. Please write or call Mary Rouse in the Division of Epidemiology and Toxicology. The toll-free telephone number is 1-800-282-0546.

Sincerely,

Deborah Gray
Chief, Toxicology Branch

DLG/mar

MIDDLE FORK OF THE LITTLE BEAVER CREEK
COLUMBIANA AND MAHONING COUNTIES
OHIO DEPARTMENT OF HEALTH SURVEY

1. Please list all of the people who have lived in your household since 1961 by first and last name, sex, date of birth, and years of residence at the current address:

Name (first and last)	Sex (M/F)	Date of Birth (mo/day/yr)	Years of Residence (ex: 1961-1980)

(If you need more space, please attach another piece of paper.)

2. Please list your current address:

_____

_____

home phone number: _____

daytime phone number: _____
(if different from home)

3. Please list your former address within the Salem-Lisbon area and years of residence (if any):

Address	Years of Residence

The above information will be kept strictly confidential and separate from the rest of the survey. It is needed to identify who has completed the survey. For the remainder of the questionnaire, please identify household members by age and sex only (for example: female, 52 years old).

4. Please list present employer and all former employers since 1960 of all adult residents of this household listed in question 1, along with the dates of employment and their current age.

Employee's present age and sex	Employer	Dates of Employment

5. Did you know that the Ohio Department of Health issued a fish consumption advisory for the Middle Fork of the Little Beaver Creek between Salem and Lisbon in October 1987? (circle)

1 NO
2 YES

6. From 1961 until the fish advisory was issued in October 1987, did you or anyone in your household eat fish caught from the Middle Fork of the Little Beaver Creek between Salem and Lisbon?

1 NO ----------->IF NO, SKIP FROM HERE
<-------- 2 YES TO QUESTION 10

(IF YES)

7. Approximately how often?

1 ONCE A WEEK OR MORE
2 ONCE A MONTH
3 ONCE OR TWICE EVERY SIX MONTHS
4 ONCE A YEAR
5 LESS THAN ONCE A YEAR
6 OTHER(SPECIFY):_____

8. Using the map on page 8, put "8" by the location(s) that was most frequently fished.

9. What type of fish from this area was most often consumed?

_____

10. Since the fish advisory was issued in October 1987, have you or anyone in your household eaten fish caught from the Middle Fork of the Little Beaver Creek between Salem and Lisbon?

_ 1 NO ----------->IF NO, SKIP FROM HERE
<---------- 2 YES TO QUESTION 14
(IF YES)
11. Approximately how often?

1 ONCE A WEEK OR MORE
2 ONCE A MONTH
3 ONCE OR TWICE EVERY SIX MONTHS
4 ONCE A YEAR
5 LESS THAN ONCE A YEAR
6 OTHER(SPECIFY):_____

12. Using the map on page 8, put "12" by the location(s) that is most frequently fished.

13. What type of fish from this area is most often consumed?

_____

14. Since 1961, have you or any member of your household eaten game other than fish (such as deer or rabbit) hunted or trapped from the Columbiana/Mahoning County area near the Middle Fork of the Little Beaver Creek between Salem and Lisbon?

1 NO ----------->IF NO, SKIP FROM HERE
<---------- 2 YES TO QUESTION 18
(IF YES)
15. Approximately how often?

1 ONCE A WEEK OR MORE
2 ONCE A MONTH
3 ONCE OR TWICE EVERY SIX MONTHS
4 ONCE A YEAR
5 LESS THAN ONCE A YEAR
6 OTHER(SPECIFY):_____

16. What type of game from this area is most often consumed?

_____

17. Where is the location most frequently used for hunting or trapping? If possible, use the map on page 8 and put "17" by the location(s) that is most frequently used to hunt or trap.

_____

18. Did you know that the Ohio Department of Health issued a contact advisory warning against swimming, wading, etc, for the Middle Fork of the Little Beaver Creek between Salem and Lisbon in March 1988?

1 NO
2 YES

19. From 1961 until the contact advisory was issued in March 1988, did you or members of your household swim, wade or play in the Middle Fork of the Little Beaver Creek anywhere between Salem and Lisbon?

1 NO ----------->IF NO, SKIP FROM HERE
<---------- 2 YES TO QUESTION 22

(IF YES)
20. Approximately how often?

1 ONCE A WEEK OR MORE
2 ONCE A MONTH
3 ONCE OR TWICE EVERY SIX MONTHS
4 ONCE A YEAR
5 LESS THAN ONCE A YEAR
6 OTHER(SPECIFY):_____

21. Using the map on page 8, put "21" by the location(s) that was most frequently used.

22. Since the contact advisory was issued in March 1988, have you or any member of your household been swimming, wading, or playing in the Middle Fork of the Little Beaver Creek anywhere between Salem and Lisbon?

1 NO ----------->IF NO, SKIP FROM HERE
<---------- 2 YES TO QUESTION 25

(IF YES)
23. Approximately how often?

1 ONCE A WEEK OR MORE
2 ONCE A MONTH
3 ONCE OR TWICE EVERY SIX MONTHS
4 ONCE A YEAR
5 LESS THAN ONCE A YEAR
6 OTHER (SPECIFY):_____

24. Using the map on page 8, put "24" by the location(s) that is most frequently used.

25. Do you live on a farm near the creek?

1 NO ----------->IF NO, SKIP FROM HERE
<---------- 2 YES TO QUESTION 31

(IF YES)

26. Do you use water from the Middle Fork of the Little Beaver Creek for irrigation?

1 NO
2 YES

27. Are any of the fields or pastures on your farm on the flood plain of MFLBC?

1 NO
2 YES

28. Are any animal or vegetable products from your farm consumed?

1 NO ---------->IF NO, SKIP FROM HERE
<---------- 2 YES TO QUESTION 31

(IF YES)

29. What type of animal and/or vegetable products from your farm are most often consumed?

_____

30. How often are any animal or vegetable products from your farm consumed?

1 ONCE OR MORE A DAY
2 THREE TO FOUR TIMES A WEEK
3 ONCE OR TWICE A WEEK
4 ONCE OR TWICE A MONTH
5 ONCE OR TWICE EVERY SIX MONTHS
6 ONCE A YEAR OR LESS
7 OTHER (SPECIFY):_____

31. Do you or anyone in your household ever eat fruit or vegetables grown in your garden or a garden in the area of the Middle Fork of the Little Beaver Creek between Salem and Lisbon?

1 NO ---------->IF NO, SKIP FROM HERE
<---------- 2 YES TO QUESTION 35

(IF YES)

32. Is water from the Middle Fork of the Little Beaver Creek used for irrigation in the garden?

1 NO
2 YES

33. What types of fruits or vegetables from that garden are most often consumed?

_____

34. How often do are any fruits or vegetables from that garden consumed?

1 ONCE A DAY OR MORE
2 THREE TO FOUR TIMES A WEEK
3 ONCE OR TWICE A WEEK
4 ONCE OR TWICE A MONTH
5 ONCE OR TWICE EVERY SIX MONTHS
6 ONCE OR LESS A YEAR
7 OTHER (SPECIFY):_____

35. What is the source of the water that comes into your home for drinking, bathing, etc?

1 CITY SUPPLY
WHAT CITY?_____
2 DUG WELL
3 DRILLED WELL
4 OTHER (SPECIFY):_____

36. Have you ever used the Middle Fork of the Little Beaver Creek or its water for anything else not already covered in this survey, such as dredging or other work-related activities?

1 NO
2 YES (SPECIFY):_____

37. Approximately how close do you live to the nearest part of the Middle Fork of the Little Beaver Creek?

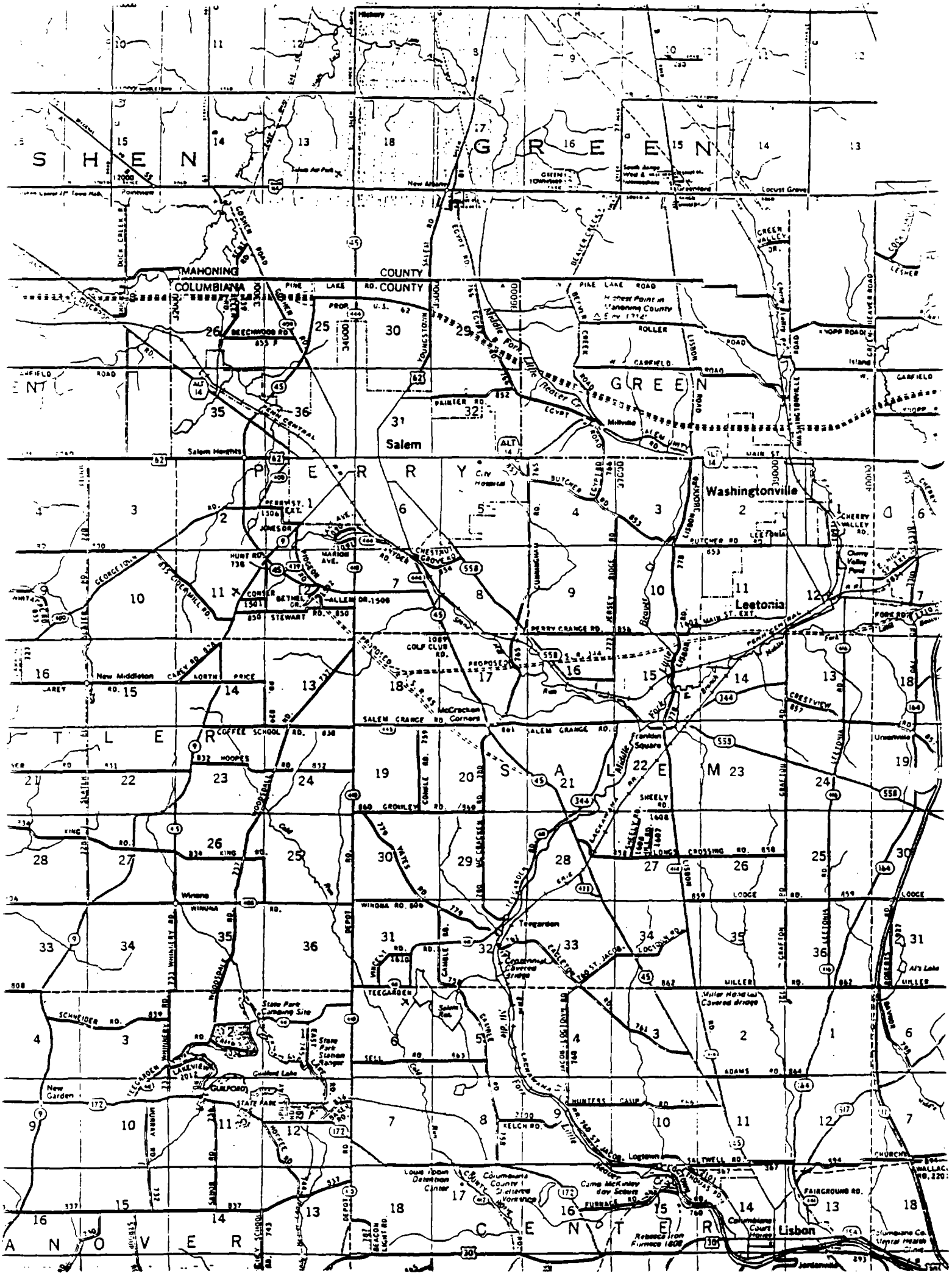
1 LIVE ON THE BANKS OR FLOODPLAIN
2 A QUARTER OF A MILE OR LESS
3 ONE QUARTER TO ONE HALF OF A MILE
4 ONE HALF TO ONE MILE
5 ONE TO TWO MILES
6 MORE THAN TWO MILES

38. Using the map on page 8, put an "X" at the location where you live.

Is there anything else you would like to tell us regarding the Midd. Fork of the Little Beaver Creek, the Nease Chemical Company, or a possible health conditions you feel may be related to the above? If s. please use this space and the back of this sheet as needed.

Also, any comments you wish to make that you think may help us future efforts to better understand the situation will be appreciate either here or in a separate letter.

MAR/mar
8/89


SHEN
GREEN
MAHONING COUNTY
COLUMBIANA COUNTY
PERRY
Salem
Washingtonville
Leetonia
TYLER
SALEM
ANOVER
CENTER
Lisbon
Teegarden
Winona
New Middleton
New Garden
Franklin Square
McCracken Corners
Salem Heights
Millville
Logtown
Columbiana County Jail
Columbiana County Courthouse
Columbiana County Detention Center
Rebecca Furnace 1808
Covered Bridge
Miller Hollow Covered Bridge
State Park Camping Site
State Park Nature Ranger
Guilford Lake
Lake Cairo
Lake Lisbon
Middle Fork Little Beaver Creek
Beaver Creek
Little Beaver Creek
Salem Creek
Lake Lisbon
Lisbon Cemetery
Columbiana County Fairgrounds
Columbiana County Mental Health Clinic
Jordanville
Wallace
Unionville
Locust Grove
Pennsville
Hickory
New Athens
Salem Air Park
Lisbon Air Park
Highest Point in Mahoning County
Pine Lake Road
Beechwood Rd.
Youngstown Salem Rd.
Egypt Rd.
Beaver Creek Rd.
Roller Rd.
Garfield Road
Painter Rd.
Penn Central
Main St.
Salem Grange Rd.
Coffee School Rd.
Hoopes Rd.
Crowley Rd.
King Rd.
Winona Rd.
Schneider Rd.
Teegarden Rd.
Miller Rd.
Adams Rd.
Hunters Camp Rd.
Kelch Rd.
Fairground Rd.
Furnace Rd.
Lockport Rd.
St. Jacob
Lockport Rd.
Lisbon Rd.
Graftion Rd.
Lockwood Rd.
Lodge Rd.
Sheely Rd.
Longs Crossing Rd.
Perry Grange Rd.
Stewart Rd.
Allen Dr.
Hurt Rd.
Jones Dr.
Perry St. Ext.
Main St. Ext.
Butcher Rd.
Cherry Valley Rd.
Crestview
Unionville
Carey Rd.
North Price
Golf Club Rd.
Proposed
Prop.
Hickory Creek
Duck Creek Rd.
Corner Road
Salem Rd.
Egypt Rd.
Kersey Ridge
Summerhill
Lisbon
Graftion
Lockwood
Lockport
Teegarden
Whinney Rd.
Whitney Rd.
Schneider Rd.
Teegarden Rd.
Lake Cairo
Guilford Lake
New Garden
Lake Lisbon
Lisbon Cemetery
Columbiana County Fairgrounds
Columbiana County Mental Health Clinic
Jordanville
Wallace
Unionville
Locust Grove
Pennsville
Hickory
New Athens
Salem Air Park
Lisbon Air Park
Highest Point in Mahoning County

APPENDIX B
MEASUREMENT SCALE FOR MIREX EXPOSURE SURVEY

Variables measured in questionnaire

1. location of current residence
2. number of years at current residence
3. location previous residence
4. number of years at previous residence
5. age, sex and length of residence for each member of the household
6. type of employment and duration for each household member
7. knowledge of fish consumption advisory: yes, no
8. knowledge of contact advisory: yes, no
9. type of activity: fishing, hunting, or contact with creek
10. frequency of activity: 1/week<, 1/month, 1-2/6 months, 1/year, <1/year, other
11. location of activity: Perry/Green/Goshen Twp., Salem Twp., Center Twp., Other Twp.
12. type of consumption: fruit/vegetable, animal/animal product
13. frequency of above consumption: 1/day<, 3-4/week, 1-2/week, 1-2/month, 1-2/6 months, 1/year>
14. origin of consumption product: Perry/Green/Goshen Twp., Salem Twp., Center Twp., Other Twp
15. source of drinking water: municipal, dug well, drilled well, spring, other

Variables which measure possible exposure to mirex:

1. type and duration of employment
2. type, frequency and location of activity
3. type, origin and frequency of consumption product

Proposed Measurement Scale:

1. multiply type of employment by duration of employment using the following values:

   Type:
   - Nease/related possible direct contact = 2
   - Deming/related possible indirect contact = 1
   - Other = 0

   Duration:
   - 11 year< = 4
   - 6-10 years = 3
   - 2-5 years = 2
   - 1 year> = 1

2. multiply type by frequency by location of activity using the following values:

   Type:
   - fishing = 2
   - contact = 1
   - hunting = 1
   - none = 0

Frequency:
1/week< = 5
1/month = 4
1-2/6 months = 3
1/year = 2
>1/year = 1
other = try to fit into above category
Location:
Perry, Green or Goshen Twp. = 3
Salem Twp. = 2
Center Twp. = 1

3. multiply type by frequency by origin of consumption product using the following values:

Type:
animal/animal products from flood plain or banks = 2
root crops on flood plain or banks or Wilm's soil = 2
non-root crops on flood plain or banks = 1
all others/none = 0
irrigate with MFLBC water = 1
garden/pasture on floodplain or banks of MFLBC = 1
Frequency:
1/day< or 3-4/week = 5
1-2/week = 4
1-2/month = 3
1-2/6 months = 2
1/year> = 1
other = try to fit into above category
Location:
Perry, Green or Goshen Twp. = 3
Salem Twp. = 2
Center Twp. = 1
Other Twp. = 0

Add together scores from each of the three possible sources of exposure. All non-zero scores will be arranged in ascending numerical order then broken into tertiles to represent high, medium and low exposure levels. All zero scores will be considered no exposure. Weighted stratified sampling will occur across all four exposure categories to select participants for biological monitoring.

MAR/mar
9/28/89

APPENDIX C: POTENTIAL SUBJECT PARTICIPATION REQUEST

November 21, 1989

&Name&
&Add&
&City& Ohio &Zip&

Dear &Sal& Residence:

I would like to thank you for completing the questionnaire we sent to you regarding the Nease Superfund Site and the contamination of the Middle Fork of the Little Beaver Creek.

The next step in our exposure assessment is to test individuals for the possible presence of mirex in their bodies. We wish to compare people of different exposure levels in order to ascertain potential pathways of mirex exposure and the relative body levels. In order to determine the levels of mirex in peoples' bodies, the Columbiana County Health Department and the Ohio Department of Health are sponsoring a free mirex screening clinic at the Columbiana County Health Department in Lisbon on Tuesday, December 12 and Wednesday, December 13.

We have selected your household to participate in this clinic. We would like one or two people (adult or child) to attend. The screening will involve drawinng 15 milliliters of blood (less than a quarter of a cup). A short questionnaire will be administered at the time to further identify possible sources of exposure and health conditions. Obtaining the blood sample and the interview will take approximately 25 minutes. Results of the blood testing and the interview will be kept strictly confidential. You will receive a written notice of the results of the blood test for your records and to give to your personsal physician.

We are also looking for people who are willing to participate in an additional test for mirex which involves drinking a special solution and measuring exhaled breath over a period of two hours. This is a new technique that tests for certain biochemical changes which occur in the body when different types of pesticides are present.

Please return the enclosed attachment within five days. If you are unable to participate, we need to know as soon as possible in order to select another household. If you have any questions or concerns regarding this matter, please contact Mary Rouse at (614) 644-6447.

Respectfully,

Deborah L. Gray, M.S.
Division of Epidemiology
Ohio Department of Health

APPENDIX D: POTENTIAL SUBJECT RESPONSE INDICATOR

PLEASE RETURN BY DECEMBER 4, 1989

Please check one:

____I will not be able to participate in the mirex screening clinic.

____I will be able to participate in blood sampling for the mirex screening clinic on the following date (check one):

____Tuesday, December 12, 1989

____Wednesday, December 13, 1989

The best time for me would be (check any or all that apply):

____morning (8am-noon)

____afternoon (noon-4pm)

____I would like to participate in the breath analysis for mirex.

You will need to fast for 12 hours before the test.
You may drink water and eat dry toast.

Name of Participant: _____

Date of Birth: _____

Address: _____

_____

Daytime Phone Number: _____

/datechan

APPENDIX E: SERUM PROTOCOL

AN ASSESSMENT OF EXPOSURE TO MIREX RELATED TO THE RUETGERS-NEASE SUPERFUND SITE IN COLUMBIANA COUNTY, OHIO

FINAL PROTOCOL

Introduction

The Division of Epidemiology and Toxicology proposes to attempt to document body burdens of the pesticide mirex in persons most likely to have been exposed to contaminants from the Ruetgers-Nease Superfund site in Columbiana County, Ohio. We propose to conduct this assessment in cooperation with the Centers for Disease Control Toxicology Laboratories. The exclusive purpose of this project is to quantify exposure to mirex. This compound is not ubiquitously distributed in Ohio. Detection of mirex in the serum of individuals meeting specified criteria for exposure would be almost certainly attributable to contaminants from the site.

Background

From 1961 until 1973, the Nease Chemical Company owned and operated a pesticide manufacturing plant located on the outskirts of Salem in Columbiana County. The facility produced pesticides (most notably mirex), fire retardants, cleaning compounds and other agricultural chemicals. During this time period, the Water Pollution Control Board temporarily closed the facility on a frequent basis as a result of wastewater discharge violations and fish kills. In 1973, the Ohio Environmental Protection Agency (OEPA) permanently closed the facility due to wastewater discharge violations. Subsequent investigation by OEPA and U.S. EPA revealed that the Nease property was heavily contaminated. In addition, rainwater runoff from the 44 acre site drains into the headwaters of the Middle Fork of the Little Beaver Creek (MFLBC). Monitoring activities undertaken by the company's new management (Ruetgers) discovered extensive contamination in soil, surface and groundwater, on site. Sampling conducted by U.S. and Ohio EPA during the Fall of 1987 confirmed the presence of mirex and related compounds in fish and sediment taken from MFLBC.

A remedial investigation/feasibility study (RI/FS) is currently being conducted by the Ruetgers-Nease Company under the direction of U.S. and Ohio EPAs. Figure 1 and Table 1 display the locations of fish and sediment samples taken from the Creek.

Documented Off Site Contamination

EPA monitoring activites have documented mirex contamination of fish and sediment in MFLBC from near the Nease property in Salem downstream to the Lisbon dam. The highest concentrations of mirex were detected in fish and sediments taken from the upper

reaches of MFLBC close to the site. The contamination decreases downstream but then increases again in the sediment depositional zone of Egypt swamp (sample stations 8b and 8c).Sediment and fish are contaminated downstream to the Lisbon dam, but the levels of contaminants decline markedly after Egypt swamp. Both upper and lower trophic level fish were shown to have body burdens of mirex and related compounds, with some samples exceeding the Federal Food and Drug Administration action level of 100 ppb. Most of the contaminated fish samples were taken from the creek between Salem and the Lisbon dam. Mirex was tentatively detected but not quantitatively confirmed in two out of five fish samples caught downstream of Lisbon. However, corresponding sediment samples from the same locations were not contaminated with mirex in 1987. Consequently, it is likely that the contaminated fish migrated from more contaminated areas upstream of Lisbon.

In October of 1987, the Ohio Department of Health issued an advisory against consuming any fish caught in Middle Fork Little Beaver Creek from Salem downstream to the State Route 11 bridge below the Lisbon dam. The following year, the advisory was revised to caution people against contact with contaminated sediments along the same stretch of the creek.

Fish and sediments in MFLBC are contaminated for approximately 26 river miles between Salem and Lisbon. There are a number of residences and farms which either border or incorporate the creek and many other residences which are within easy walking or bicycling distance. The creek is extremely attractive. Below Lisbon, it becomes Little Beaver Creek which is designated as a State scenic resource water. Beaver Creek State Park lies between Lisbon and the Ohio River. Reportedly, Little Beaver Creek supports a thriving bass fishery. Downstream from Lisbon, the creek is also used for contact recreation such as canoeing and rafting. Even though the upstream portion is smaller, Middle Fork Little Beaver Creek also supports recreational activities such as fishing, wading and hunting.

We have identified several highly plausible pathways by which local area residents could have been exposed to mirex.

1) As mentioned earlier, consumption of contaminated fish is a direct route of exposure.
2) Although mirex is not a particularly water soluble compound, (less than 1ppb) people wading or swimming in MFLBC or Egypt swamp may accidentally ingest small quantities of water containing suspended sediments to which mirex is adsorbed.
3) Game animals such as raccoons or ducks may also accumulate mirex through feeding activities. Such animals could pose an additional pathway of exposure if consumed by hunters.
4) There are three dairy farms along the creek. Cattle in these herds were known to have watered from MFLBC before the extent of the contamination was discovered. Mirex was detected in bulk tank samples of milk from two of the farms. In one sample the mirex content of 76 ppb approached the FDA action level of 100 ppb. Furthermore, subsequent analysis of slaughtered cows from these

farms also revealed detectable levels of mirex. Fat from one culled animal was found to exceed the FDA action level of 100 ppb and the carcass was impounded. Persons at greatest risk from contaminated meat or milk would be farm families consuming their own products.

5) There is anecdotal evidence that some area farmers have used water from the creek to irrigate fields, especially during times of drought. Possible exposure could occur from sediments suspended in the irrigation water. However, plants do not readily take up heavy organic compounds such as mirex so ingestion of the aerial parts of crops would not be a likely route of exposure. Of greater concern would be livestock which consumed forage containing some root mass with adhered soil.

6) Occupational exposure to sediments or gravel dredged from the creek.

7) Persons who were employed by the Nease company during the time mirex was manufactured at the facility.

8) Shallow dug wells (20 feet deep or less) located on the flood plain where contaminated water and sediments could enter the wells when the creek overflows.

Identification of a Potentially Exposed Population

The Division of Epidemiology and Toxicology proposes to assemble a group of potentially exposed individuals from responses to a questionnaire which solicits information about contact with the creek and other contaminated areas. We began mailing out the questionnaires the third week in August. A stamped,return addressed envelop was included to help increase response. Names and adresses of potentially exposed persons were obtained from several sources including; the Ohio EPA project officer, the local citizens group known as Citizens Opposing Pollution (COP), and the Columbiana and Mahoning County engineers. We actually sent out in excess of 600 questionnaires. We also know the identities of several area farmers and former employees of the Nease Company which we have contacted directly. In order to reach as many people as possible, we also ran advertisements in the Salem and Lisbon newspapers, and placed copies of the questionnaires in the City libraries.

Based on information provided by the questionnaires, individuals were assigned to groups representing a range of potential exposures to mirex.

Biological Sampling

We intend to sample as many of the potentially highly exposed individuals as possible. We also plan to invite representatives from the lower exposure rankings to participate in the biological sampling, including at least ten individuals with no known exposure. Unless there are extremely convincing reason to do otherwise, only persons 18 years and older will be included in this study. Based on preliminary conversations with the Centers for Disaese Control Toxicology Laboratory, we hope to

enroll a maximum of sixty individuals in the biological monitoring study.

Mirex and related compounds can be quantified by Gas Chromatography/Mass Spectroscopy from serum and fatty tissues. We propose to obtain approximately 15 ml of blood from each participant in a standard red top vacutainer tube . This should yield approximately 6 ml of serum. Serum specimens will be frozen for shipment .Mirex determinations will be performed by the Centers for Disease Control Laboratories. Prior to collecting blood, participants will be asked to sign an informed consent which explicitly states what test will be performed and who will have access to the results. Some additional information will also be collected from each participant about other sources of exposure to mirex or related compounds which may interfere with mirex determination.

In addition to quantifying mirex in serum, we are also proposing to use a relatively new technique known as the Caffeine Breath Test or CBT.The Caffeine Breath Test was developed by George Lambert M.D. of Loyola University who has also agreed to conduct the actual analyses on a small number of subjects enrolled in the biological monitoring study. This test measures induction of the P1-450 cytochrome fraction. The P1-450 mixed function oxidase enzymes are the major route by which exogenous compounds such as chlorinated organic pesticides are metabolized. Induction of P1-450 cytochromes is a fairly sensitive indicator of low level exposure to xenobiotic chemicals. The CBT is performed by having the subject drink a solution containing a known amount of carbon-13 labelled caffeine. Caffeine is metabolized through the P1-450 system to yield CO2. A Breath sample is taken prior to caffeine administration to quantify endogenously produced C-13 labelled CO2. After dosing, the samples of the subject's breath are collected at 30 minute intervals over a two hour time span. The rate at which CO2 is produced over time is indicative of the rate limiting step (N-demethylation) in the metabolism of caffeine.

Other exposures such as tobacco smoking also induce P1-450 enzymes and must be accounted for in interpreting the results. We would propose using only a small group of adults for this additional study. Children under the age of about eighteen have normally high levels of enzyme activity and do not make valid subjects for this type of research. For each person who choses to participate in the CBT, a serum specimen will also be analyzed for comparison.

The Central Ohio Poison Center is collaborating with the Division of Epidemiology and Toxicology to make arrangements with Dr. George Lambert to actually conduct the tests. Dr. Lambert has tentatively indicated that he would be willing to provide the tests at no charge in the interest of further validating this new method.

Proposed Timeframe for Activities

Late August-Early September 1989: Mail out exposure questionnaires and run advertisements in the Salem and Lisbon newspapers.

September-Early October: Sort returned questionnaires according to potential exposure status. Assemble group to be invited to biomonitoring clinic.

December: Hold the clinic at the Columbiana County Health Department in Lisbon or at a local hospital.

March-April 1990: Receive analytical results from CDC laboratory.

June-July 1990: Issue report on findings.

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APPENDIX F: CAFFEINE BREATH TEST PROTOCOL

Study Protocol

Prior to entrance to the study the subjects must:

- Fast for 6-8 hours, may drink water. The best time to conduct the study is the first thing in the morning and the subjects can then come to clinic after fasting from midnight.

- Drink no caffeine or take any chocolate for at least 20 hrs prior to the study.

- Have meet the entrance criteria and have signed the consent form.

On the clinic day the subjects will:

- Be screened to be sure they followed the protocol and meet entrance criteria.
- Have their blood pressure, heart rate, weight, and height recorded. If there is a persistent arrhythmia or severe hypertension (greater than 140/100) the subject will not be studied.
- Sit for 15 minutes before the caffeine is administered and through out the test.
- Blow up a small plastic bag just prior to and 30, 60, 90, and 120 minutes after the caffeine is administered.
- Be given [3-^{13}C-methyl] caffeine at a dose of 3mg/kg with a maximal dose of 200mg. The caffeine will be dissolved in 20 ml of sterile water which will be ingested, then the container will be washed out with 20 ml of sterile water and the water will also be ingested.
- Have their blood drawn by the Public Health Staff during or at the end of the study.
- Be offered and encouraged to drink orange juice and eat some cookies or donuts at the end of the study.

After the clinic the:

- Samples will be taken back to Chicago in the vacutainers for analysis.
- data will be shared with the staff of the Health Department
- letters will be sent to the volunteers with their test results and an interpretation of the results (this letter will be reviewed by the health department staff and CDC before it is sent to the subjects).
- The breath test data in comparison to the data from our other cohorts of exposed or non-exposed subjects will be compared using the Wilcoxon rank test. The correlation between the serum levels of mirex or other chemicals (PCBs, DDT, etc) and the breath test will be determined using regression analysis.