



Summary of Risk Assessment and Proposed Risk Management Actions

Midland, Michigan

April 1988

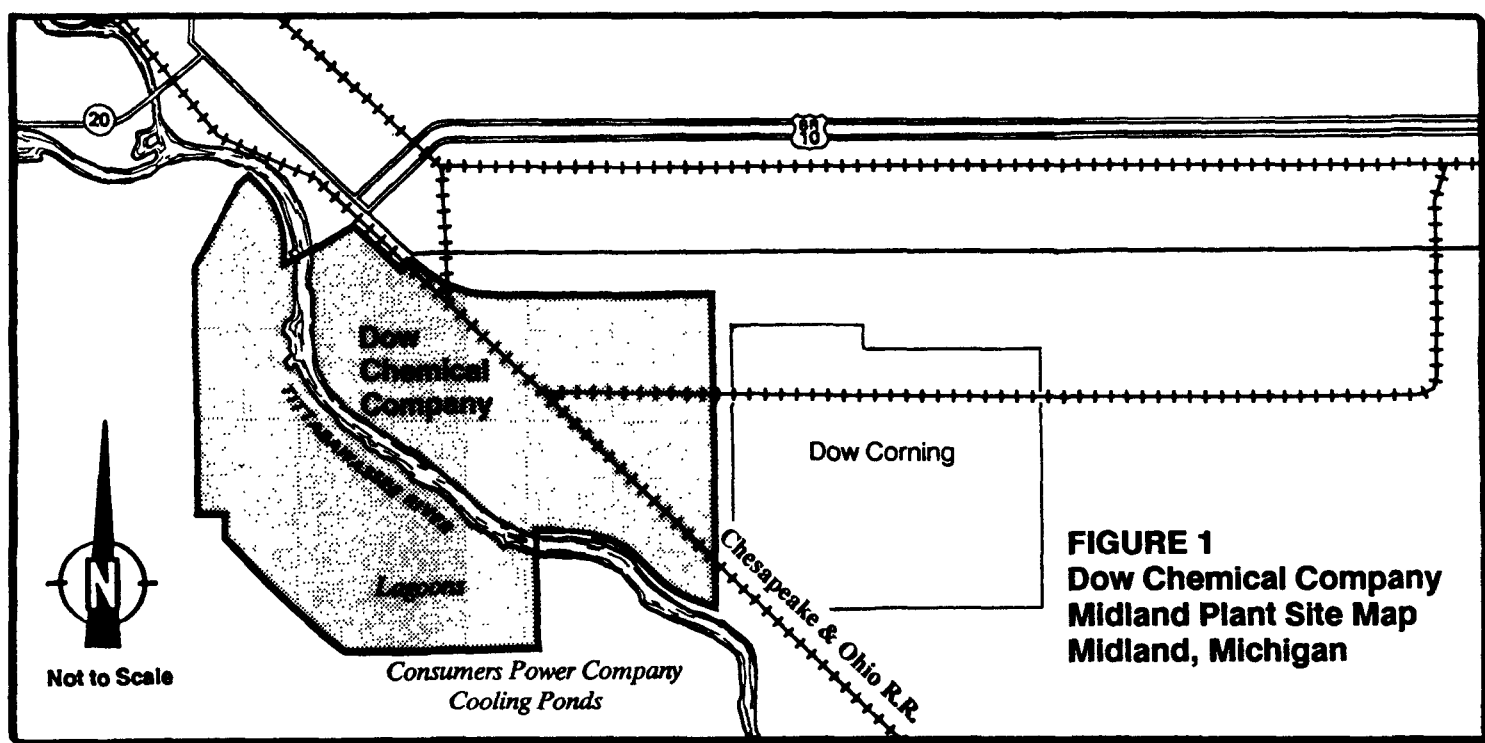


FIGURE 1
Dow Chemical Company
Midland Plant Site Map
Midland, Michigan

INTRODUCTION

In 1983, at the request of the Michigan Department of Natural Resources (MDNR), the U.S. Environmental Protection Agency (U.S. EPA) initiated a series of environmental studies in the Midland, Michigan, area for dioxins and other toxic pollutants. Much of this investigative work focused on sources of dioxins at the Dow Chemical Michigan Division Midland Plant. The results of different parts of these studies were released in 1985 and 1986.

U.S. EPA is now releasing a summary of the final results of each study, and an assessment of the possible public health risks associated with dioxin exposures in the Midland area.

U.S. EPA is also seeking public comment on the risk assessment and proposed risk management actions it believes are appropriate to further reduce dioxin emissions and discharges from Dow Chemical, and to further reduce public exposures to dioxins. This fact sheet summarizes the results of the risk assessment and risk management study.

The public will have an opportunity to comment on the risk assessment and risk management reports during a public comment period beginning April 25, 1988. More information about these studies and the comment period is located at the end of this fact sheet under "Opportunities for Public Involvement." ♡

MAJOR FINDINGS AND CONCLUSIONS

- Point source and environmental studies conducted by U.S. EPA, the State of Michigan, and Dow Chemical over the past several years indicate that the Dow Chemical Midland plant has been the most significant, if not the only significant, source of dioxin contamination at the plant site and the general Midland area.
- 2378-TCDD and other dioxins and related compounds have been found in native fish from the Tittabawassee River; in surface soils at the Dow plant and at relatively low levels in the community; and in ambient air outside of the plant. Dioxins have not been found in the public or private drinking water supplies that were tested.
- Discharges and emissions of dioxins from Dow Chemical have been reduced, and levels in Tittabawassee River fish may be declining. Corrective actions implemented by Dow Chemical over the past several years appear to have lowered the levels of dioxins outside the plant.
- Levels of dioxins found in surface soils in the community, and in ambient air generally do not present unacceptable public health risks. Health risks associated with living in Midland are probably not different from those experienced in other industrialized communities.
- The levels of dioxins found in Tittabawassee River fish present a potential public health concern for people who eat those fish, particularly children, pregnant women, and women of child-bearing age.
- U.S. EPA is proposing certain risk management actions to further reduce public exposures and the risk of dioxin contamination. These include:

Additional Point Source Controls at the Dow Chemical Midland Plant

- Research on additional wastewater treatment for dioxins.
- Studies of the possible effects of incinerator wastewater treatment and pond sediments on dioxin wastewater discharge levels.
- Further improvement of combustion and pollution controls at the hazardous waste incinerator.
- Continuation of programs to minimize windblown dust from the plant site.

Precautionary Measures Recommended to the Public for Minimizing Exposures to Dioxins

- In Michigan, responsibility for advising the public on the health risks of fish consumption lies with the Department of Public Health (MDPH). The MDPH currently advises against any consumption of catfish or carp from the Tittabawassee. The U.S. EPA risk assessment findings provide clear support for the existing advisory and also point to possible risks from consumption of walleye and other game fish from the river. The MDPH will consider the risk assessment findings along with any new data on fish contaminant levels and local consumption rates when it reviews its fish consumption advisory for the Tittabawassee River.
- Individuals who choose to eat fish from the Tittabawassee River should clean them in accordance with Michigan Department of Public Health recommendations.
- Parents of toddlers and children with pica (those who eat large amounts of soil) should encourage their children to keep dirt or soil out of their mouths.

U.S. EPA is also proposing a number of supplemental monitoring programs for Dow Chemical. These are outlined on page 6.

HISTORY OF DIOXIN STUDIES IN MIDLAND

The Dow Chemical Company has manufactured more than 1,000 different chemicals at its Midland facility between the 1930s and 1970s, including pesticides and other chlorinated products. Dow Chemical no longer manufactures those chemicals most often associated with dioxin formation. Hazardous and non-hazardous wastes have been incinerated at the site since the 1930s.

In June 1978, Dow Chemical informed the MDNR that rainbow trout exposed to Dow's treated wastewater had accumulated significant levels of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2378-TCDD), the most toxic of the dioxin compounds. Based on the results of that study and analysis of native catfish from the Tittabawassee River, the Michigan Department of Public Health (MDPH) issued a formal advisory in June 1978 warning against consumption of any fish collected from the Tittabawassee River downstream of the Dow Dam. The advisory remained in effect until March 1986, when the MDPH modified it to apply only to catfish and carp, after reviewing 1985 monitoring data indicating lower levels in the game fish.

In response to the Dow Chemical findings, the MDNR and U.S. EPA conducted a number of investigations from 1978 through 1981 to determine whether or to what extent the Dow Chemical Midland Plant had contributed to 2378-TCDD contamination in Tittabawassee River fish. The 1981 study results showed that wastewater originating from the plant was a significant source of 2378-TCDD in the Tittabawassee River. The preliminary results from those studies were released in March 1983 with a series of recommendations for additional dioxin studies in Midland and elsewhere. Those recommendations were reflected in U.S. EPA's Dioxin Strategy and National Dioxin Study.

In March 1983, the State of Michigan made a formal request to the U.S. EPA for assistance in conducting a series of

dioxin studies at the Dow Chemical Midland Plant, and assessing dioxin contamination in the Midland area. In the spring and summer of 1983, U.S. EPA coordinated planning for the studies with several state agencies. The studies, collectively called the Michigan Dioxin Studies, included the following elements:

- Native fish and sediment sampling in the Tittabawassee River.
- Surface soil sampling at the Dow Chemical Midland Plant, in the city of Midland, and at comparison sites.
- Evaluation of public and private drinking water supplies and Dow Chemical brine operations.
- Dow Chemical wastewater and sewer system sampling.
- Incinerator emissions and limited air monitoring.

These investigations included analyses for dioxins and other toxic pollutants that might be present.

In 1983, Dow Chemical initiated its own investigation of dioxins at the Midland Plant. That work included surface soil sampling at the plant, untreated and treated wastewater sampling, incinerator emissions testing and limited air monitoring.

In 1987, Dow Chemical conducted additional incinerator emissions testing, monitoring of Tittabawassee River fish in response to a consent order with U.S. EPA, and twice monthly monitoring for 2378-TCDD in process wastewater discharged to the Tittabawassee River.

Studies by Dow Chemical and U.S. EPA revealed widespread contamination of surface soil at Dow's Midland facility, with an average concentration of 0.5 ppb 2378-TCDD. Several small areas within the facility were found to be more highly contaminated (2 ppb to 50 ppb). U.S. EPA studies also found lower level dioxin contamination of soils throughout the community, with an average concentration of less than 0.1 ppb.

Since then, Dow has paved over the heavily contaminated soil at the plant in response to U.S. EPA orders. The sources of on-site soil contamination appear to have been leaks or emissions from the production processes and the waste incinerator. The off-site soil contamination has been attributed to airborne incinerator emissions of dioxins, wind-borne contaminated soil from the facility, and past emissions from production operations.

Significant levels of dioxins have also been detected in treated Dow Chemical wastewater which is discharged to the Tittabawassee River. Studies conducted between 1979 and 1985 determined that 2378-TCDD persisted at levels of concern in Tittabawassee River native fish, despite the shut-down of the Dow Chemical Midland Plant production facilities principally associated with dioxin formation.

The most recent information indicates 2378-TCDD levels in native fish may be declining. Data collected in 1985 show that native Tittabawassee River fish collected downstream of the Dow Chemical Midland plant area are also contaminated with other organic chemicals, including PCBs. The Dow Chemical Midland Plant is not believed to be a significant source of PCBs.

The U.S. EPA has evaluated data from its testing programs and available data from other studies in a risk assessment for people living in the Midland area. A summary of the risk assessment is presented in the following section. ♥

RISK ASSESSMENT

There are four components to a risk assessment:

Hazard identification - Identifies the hazards and potentially toxic effects a contaminant may produce on human health and the environment.

Dose-response assessment - Determines the dose or amount of the contaminant that may produce an adverse human health response.

Human exposure assessment - Assesses the potential for people to come in contact with the contaminant, as well as the maximum amount of exposure which may occur.

Risk characterization - Combines all the above factors to estimate the potential health impacts from the contaminant in question. Also, the uncertainty associated with the risk estimates is reviewed.

HAZARD IDENTIFICATION

Chlorinated dibenzo-p-dioxins (CDDs, or simply dioxins) are a family of 75 related chemical compounds with varying chemical, physical, and toxicologic properties. The form of dioxin that appears to be the most toxic, and has generally raised the greatest health concerns, is 2,3,7,8-tetrachlorodibenzo-p-dioxin, abbreviated as 2378-TCDD.

Experimental studies with 2378-TCDD in laboratory animals have shown a variety of toxic effects. These include cancer, reproductive effects, liver damage, effects on the skin and thyroid, and effects on unborn offspring.

U.S. EPA has determined that the critical concerns associated with exposure to dioxins in the Midland area are cancer, reproductive and teratogenic effects, and liver damage. A teratogen is a substance which has adverse effects on an unborn child, when the mother is exposed.

DOSE-RESPONSE ASSESSMENT

The evidence for the cancer-causing effects of 2378-TCDD comes mainly from several long-term studies of laboratory animals exposed to the substance. Based on these studies and other factors, U.S. EPA has concluded that 2378-TCDD causes cancer in animals and should be regarded as a probable human carcinogen. U.S. EPA used the experimental animal data to develop dose levels at which various health effects may occur. U.S. EPA is currently re-evaluating its estimates of the cancer potency of 2378-TCDD.

Many of the samples of fish, soil, water, and air analyzed in U.S. EPA's studies were found to contain several different types of dioxins and related compounds called chlorinated dibenzofurans. U.S. EPA has developed a procedure for estimating the toxicity of mixtures of dioxins and the related compounds by converting the results to equivalent amounts of 2378-TCDD. This approach was used in the risk assessment to take into account the possible toxic effects of the other dioxins and related compounds.

HUMAN EXPOSURE ASSESSMENT

Exposure to Ambient Air

Midland has a total population of approximately 32,000 people. About 26,000 of these people live within three miles of the Dow Chemical Midland Plant. Most of the population lives between 0.5 and 3.5 miles north of the plant. However, several residences are located closer to the facility. Based on the results of ambient air studies, many of Midland's residents have been exposed to low levels of dioxins in the air. For the risk assessment, U.S. EPA evaluated the exposures of two groups of people: (1) a group who would theoretically live their lives near the fence line of the Dow plant and (2) another group who live in the more heavily populated area north and northeast of the plant.

Exposure to Soil

Soil studies conducted by U.S. EPA indicate that the average level of 2378-TCDD in Midland soils outside the Dow Chemical plant is less than 0.1 ppb. This is well below the 1 ppb level in residential soils at which the Centers for Disease Control (CDC) recommends consideration of actions to minimize exposures.

Some possible routes of exposure to dioxins in Midland soils include: direct ingestion by children playing outdoors; ingestion of household dusts which may be contaminated from outdoor soils; ingestion of soil attached to home-grown vegetables; absorption through the skin which comes in contact with the soil through play, gardening, or other activities; and inhalation of contaminated particulates from the soil.

U.S. EPA soil studies in Midland have shown that dioxins tend to concentrate in areas near roof downspouts or drip lines. Toddlers and children with pica are likely to ingest more soil than older children or adults. Children with pica intentionally consume large amounts of soil; this is considered a medical disorder.

For the risk assessment, U.S. EPA evaluated two levels for people exposed to contaminated soils under normal conditions. Children with pica were considered as a separate group.

Exposure to Drinking Water

Based on testing and follow-up surveys, U.S. EPA concluded that 2378-TCDD was not present in the major public and the private drinking water supplies tested.

Exposure to Contaminated Fish

Fish consumption presents the most significant exposure to dioxins in the Midland area for people who eat fish caught in the Tittabawassee River. This is because toxic substances such as dioxin (and PCBs) tend to collect and concentrate in the fatty tissues of fish and are directly ingested into the body by those who eat fish. Although the Tittabawassee River is not used for commercial fishing, it is heavily used by sport fishermen.

Fishermen and their families who may eat fish from the Tittabawassee River as a significant portion of their diet are of most concern. Bottom-feeding fish, such as catfish and carp have been shown to accumulate higher levels of contaminants than game fish. These fish are usually more fatty than game fish and obtain more of their food from river sediments which may be contaminated. Tittabawassee River game fish, such as walleye, smallmouth bass, crappie, northern pike, and yellow perch, contain lower levels of 2378-TCDD, with an overall average concentration of less than 5 ppt.

For the risk assessment, U.S. EPA evaluated risks for several groups of people who might eat Tittabawassee River fish. The highest group might eat as much as 80 lbs/year, half of which would be game fish and half bottom-feeding fish. The lowest group would eat only 6 lbs/year, half of which would be game fish from the Tittabawassee River and half uncontaminated fish from another source.

Other Routes of Exposure

Infants may be exposed to dioxin when breast fed. Compounds such as dioxin are retained in the fatty tissues of the

mother, and are secreted in fat-rich milk. Infants who depend on their mother's milk for most or all of their diet, could be exposed to higher levels of dioxin than the mother herself. However, the many important benefits of breast feeding probably outweigh these risks in most cases.

RISK CHARACTERIZATION

As noted earlier, U.S. EPA's risk assessment focuses on cancer, reproductive and teratogenic effects, and liver damage as the critical public health concerns for dioxin contamination in Midland. U.S. EPA evaluated possible public health risks associated with cancer, in terms of the excess rate of cancer expected beyond the national average cancer rate which is about one in four. The estimated excess lifetime cancer risks associated with dioxin exposures in the Midland area are presented in Table 1. Note that these "upper-bound" risks are based on conservative assumptions. Actual risks to Midland residents are likely to be lower than the values shown below.

Cancer risks from consumption of Tittabawassee River fish are estimated to be the most significant and much higher than risks associated with exposure to Midland soils or ambient air.

The greatest estimated non-cancer risks are also associated with activities where people eat or ingest materials containing dioxins. These activities include fish consumption, soil ingestion by children with pica, and breast feeding by mothers who have had high rates of exposure. Again, fish consumption is by far the most significant. Non-cancer effects include adverse effects on the reproductive systems and the liver.

U.S. EPA believes actions should be considered to minimize exposure to substances when the estimated excess lifetime cancer risk levels exceed 1 in 100,000 to 1 in 1,000,000 range, or when non-cancer risks are estimated to be significant based on comparison with reference doses and health advisories.

The following section discusses actions that have been taken and should be taken to reduce risks to Midland residents from dioxin exposure.

**SUMMARY OF ESTIMATED UPPER BOUND CANCER RISKS
FROM EXPOSURE TO DIOXIN CONTAMINATION
IN MIDLAND, MICHIGAN**

Exposure Route	Estimated Excess Lifetime Cancer Risk	
	Higher Estimate	Lower Estimate
Fish	1 in 100 (maximum consumer)	-----
	1 in 1,000 (high sports fisherman)	1 in 10,000 (occasional consumer)
Soil	1 in 100,000 (upper estimate)	1 in 1,000,000 (lower estimate)
	1 in 10,000 (child with pica)	-----
Air	1 in 10,000 (fenceline)	1 in 100,000 (residential area)

PROPOSED RISK MANAGEMENT ACTIONS

Collectively, the point source and environmental studies conducted by U.S. EPA, the State of Michigan, and Dow Chemical over the past several years clearly indicate that the Dow Chemical Michigan Division plant at Midland has been the most significant, if not the only significant, source of dioxin contamination at the plant site and the general Midland area. As a result of these investigations Dow Chemical has completed or is implementing several actions to minimize emissions and discharges of dioxins and other toxic pollutants. They are as follows:

- Terminated production of certain chlorinated chemical compounds.

- Installed a riverbank revetment system to collect contaminated ground water.
- Upgraded operations and air emission controls on the hazardous waste incinerator.
- Paved areas in the plant with high levels of surface soil contamination.
- Replaced open wastewater ditches at the plant with enclosed sewers.
- Installed a wastewater effluent filtration system for the entire treated wastewater discharge to the Tittabawassee River. Provided preliminary treatment of incinerator scrubber waters.

- Implemented a dust suppression program on the plant site.

Recent data have shown reduced incinerator emissions, reduced wastewater effluent discharge levels and to some extent, reduced fish contamination levels. Overall, conditions have improved significantly over the last ten years. Despite this, the levels of discharge and environmental contamination as depicted by point source and environmental data collected during the 1983-1986 period indicate that further remedial work at the plant site may be necessary. Minimization of exposures through precautionary measures by the public could be helpful in reducing the possible public health risks described earlier.

U.S. EPA is proposing that the following programs be conducted by Dow Chemical:

PROPOSED REMEDIAL ACTIONS BY DOW CHEMICAL

WASTEWATER DISCHARGES

- Feasibility and end-of-pipe wastewater treatability studies for dioxins.
- Assessment of the amount of 2378-TCDD in pond sediments and a study to determine to what extent resuspended sediments containing dioxins pass through the filtration system.
- Evaluation of the effectiveness of the incinerator wastewater pretreatment system.

AIR EMISSIONS

- Continue efforts to improve combustion conditions in the waste incinerator, and operation of air pollution control equipment to reduce dioxin emissions.
- Continue programs to reduce the amount of windblown dusts from the plant site.

PROPOSED POINT SOURCE AND ENVIRONMENTAL MONITORING PROGRAMS BY DOW CHEMICAL

U.S. EPA proposes that the following programs be conducted by Dow Chemical to confirm that control measures installed from 1984 to 1987 are effective:

- Continued wastewater discharge monitoring.
- Supplemental incinerator emissions and ambient air testing.
- Continued Tittabawassee River fish monitoring.
- Tittabawassee River sediment monitoring.
- Limited food chain studies (dairy sampling; garden vegetable sampling; animal, aquatic life, and bird sampling).

PRECAUTIONARY MEASURES RECOMMENDED TO THE PUBLIC

Although operations at Dow Chemical have caused widespread contamination of the Midland area with 2378-TCDD and other dioxins, U.S. EPA believes the levels of contamination, with the exception of Tittabawassee River fish, do not present unacceptable or unmanageable health risks to the Midland community. There are, however, a number of actions people can take to minimize exposures, and thus minimize possible health risks associated with dioxins. Most of these recommendations focus on avoiding or reducing ingestion of materials that contain dioxins.

TITTABAWASSEE RIVER FISH

In Michigan, legal responsibility for evaluating health risks and issuing health advisories resides with the MDPH. At this time, the MDPH has in place a fish advisory warning against consumption of catfish and carp taken from the Tittabawassee River. These fish contain much higher levels of 2378-TCDD and other organic chemicals than other fish. As shown in the risk assessment, regular consumption of even relatively small amounts of these fish over the long term may pose substantial risks of cancer. Also, long-term consumption or, in certain circumstances, short-term consumption of these fish may pose significant risks of adverse impacts other than cancer. The current Michigan fish consumption advisory for catfish and carp is fully supported by U.S. EPA studies.

The risk assessment also highlights possibly significant risks from consumption of game or sports fish (e.g., walleye, northern pike, smallmouth bass, and white bass). These risks may be associated with both short-term and long-term consumption.

The MDPH has been conducting a creel survey to better define fish consumption patterns for Tittabawassee River fishermen and their families. The MDPH also has been actively participating in ongoing discussions with the other Great Lakes states, the U.S. EPA, and the Food and Drug Administration, seeking a uniform basis for fish

consumption advisories. The MDPH will consider the risk assessment findings along with any new data on fish contaminant levels and local consumption rates when it reviews the fish consumption advisory for the Tittabawassee River.

Individuals who choose to consume any fish caught in the Tittabawassee River should clean them in accordance with MDPH recommendations. Fillets should be skinned, with all visible traces of surface fat removed. All belly fat from the fillet should be removed, as well as dark tissue along the lateral line on each fillet. Cooking methods which allow fats and juices to drain from the fish may reduce contaminant levels in the cooked fish.

CITY OF MIDLAND SURFACE SOILS

The overall estimated cancer and non-cancer risks from exposures to surface soils in Midland are not considered to be significant except possibly for children with pica. Parents of toddlers and children with pica should encourage their children to keep dirt or soil out of their mouths.

Other commonsense measures such as thoroughly washing hands after exposure to outdoor soils; washing or peeling home-grown vegetables prior to eating; and regular house-cleaning to remove dusts are also encouraged.

OPPORTUNITIES FOR PUBLIC INVOLVEMENT

PUBLIC INFORMATION REPOSITORIES

For more information about U.S. EPA's dioxin studies in the Midland area, please consult the information contained in repositories at the following locations. Complete copies of the risk assessment and proposed risk management reports are available for review at:

Grace A. Dow Memorial Public Library
Emilia Parker
1710 West St. Andrews Drive
Midland, MI 48640
(517) 835-7157

Midland Health Department
Dr. Winifred Oyen, Director
125 West Main Street
Midland, MI 48640
(517) 832-6655

Ingersoll Township Hall
Kurt Shaffner, Supervisor
4400 Brooks Road
Midland, MI 48640
(517) 835-5289

FOR ADDITIONAL INFORMATION

Please contact:

John Perrecone
Community Relations Coordinator
U.S. EPA Region 5
230 South Dearborn Street
Chicago, IL 60604
(312) 886-6685
1-800-621-8431 (TOLL FREE,
8:30 a.m. - 4:30 p.m., Central Time)

Gary Amendola
U.S. EPA Project Manager
Michigan Dioxin Studies
U.S. EPA Eastern District Office
25089 Center Ridge Road
Westlake, OH 44145
(216) 835-5200

PUBLIC MEETING

The U.S. EPA is holding a public meeting to discuss the risk assessment and risk management reports, and accept comments on these studies. U.S. EPA personnel will be available to answer questions the public may have about dioxin, health risks, and other topics.

DATE: April 28, 1988

TIME: 7 p.m.

PLACE: Northeast Intermediate School, the Little Theater
1305 E. Sugnet, Midland, Michigan

PUBLIC COMMENT PERIOD

There will be a 30-day comment period to receive input from interested citizens about the risk assessment and proposed risk management actions. The comment period will begin April 25, 1988. Comments must be postmarked by June 3, 1988 and mailed to:

John Perrecone, 5PA-14
Office of Public Affairs
U.S. EPA Region 5
230 South Dearborn Street
Chicago, IL 60604



U. S. Environmental Protection Agency
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Office of Public Affairs
230 South Dearborn Street
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