DEPARTMENT OF ENVIRONMENTAL QUALITY
Dioxin Contamination in the Midland Area
July 2, 2004

Dioxin defined: The word "dioxin" is generally used to describe a group of 210 dioxin and furan compounds that have similar structures and chemical properties. Dioxins in the environment are usually a mixture of these chemicals. There are 17 dioxins and furans that are considered toxic. The most toxic chemical in the group is 2,3,7,8-tetrachlorodibenzo-para-dioxin (2,3,7,8-TCDD). Because it is the most toxic, 2,3,7,8-TCDD is the standard to which the other 16 toxic dioxins and furans are compared. The total toxicity of this group of 17 dioxin and furan compounds is called the toxic equivalent concentration (TEQ). This TEQ value is the number that is reported for comparison to cleanup criteria and is what is meant when the word "dioxin" is used in this document. Prior to 1989, the concentration of 2,3,7,8-TCDD (only) was typically reported. In many cases, including the Midland and Tittabawassee River, reporting only 2,3,7,8-TCDD significantly underestimates the total dioxin toxicity.

1. Misperception: The Department of Environmental Quality (DEQ) is not using "sound science" in evaluating dioxin contamination in the Midland area.

Cleanup criteria for environmental contamination are determined under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451). The soil generic residential direct contact criterion (DCC) for dioxin is 90 parts per trillion (ppt). That criterion was developed in 1995 using the best information available at that time. The scientific information that has developed since 1995 indicates that dioxin poses even more of a risk than considered in 1995. Recent work conducted by the World Health Organization (WHO), the United Nations Food and Agriculture Organization, the European Commission Scientific Committee on Food, and in the United States Environmental Protection Agency's (EPA's) draft dioxin reassessment supports standards even lower than those in effect in Michigan. The United States Department of Health and Human Services, the National Institute for Occupational Safety and Health and the WHO's International Agency for Research on Cancer, as well as the EPA, have concluded, based on literally hundreds of animal and human studies, that 2,3,7,8-TCDD is a potent human carcinogen.

2. Misperception: Dioxin is being held to a different standard than every other chemical that DEQ regulates. (See The Science Behind Michigan's 90 ppt Dioxin Cleanup Criterion.)

The Part 201 DCC of 90 ppt for dioxin is based on exposure assumptions and toxicity information available in 1995. The toxicity of dioxin is currently being re-evaluated in a

major reassessment done by the EPA, including review by the National Academy of Sciences. When promulgating the Part 201 cleanup criteria rules in 2002, the DEQ determined that it was more scientifically defensible to continue to apply the 1995 DCC of 90 ppt than to update the criterion before the results of the federal dioxin reassessment are available. It is anticipated that revision of the dioxin DCC to reflect current science and risk assessment would result in a generic residential soil DCC in the range of 10 to 70 ppt. An update of the soil DCC for dioxin would require:

- A re-evaluation of the cancer potency value.
- An evaluation of noncancer toxicity.
- An appropriate animal-dose to human-dose conversion to account for differences between species.
- Selection of the most sensitive toxicity endpoint.
- Identification of an appropriate relative source contribution factor (which accounts for the fact that a significant source of dioxin exposure is from the diet).
- Incorporation of the updated generic exposure assumptions (i.e., the exposure assumptions used in the Part 201 Administrative Rules).

3. Misperception: The DEQ is looking at dioxin contamination in Midland and the Tittabawassee River when the EPA indicated no risk was presented in 1984?

The EPA did not indicate that no risk was presented in 1984.

In 1988, the EPA released a Risk Assessment and a Risk Management Report that summarized EPA's recommendations for dioxin contamination in Midland and in the Tittabawassee River based on data collected by the EPA and The Dow Chemical Company (Dow). The 1988 Risk Management Report integrated the data collected by Dow and the EPA that was reported in 1983, 1984, and 1985. These reports do not indicate that there is no risk related to dioxin contamination in Midland or the Tittabawassee River floodplain. In fact, the Risk Management Report included specific follow up recommendations to further characterize risk and to manage the risks that were identified at that time based on existing data.

This report included recommendations for additional soil and house dust sampling in Midland; sampling of river sediments and flood plain soils; food chain sampling; ecologic risk assessment; minimizing consumption of fish from the Tittabawassee River; and the minimization of contact with contaminated soils - with special emphasis on the approximately 1 out of every 200 children who intentionally eat soil.

These recommendations are incorporated into the federal permit issued by the EPA in 1988. This permit contained specific conditions to follow up on dioxin contamination in Midland and in the Tittabawassee River. Because of staff turnover and extensive cleanup activities on the Dow plant site, the EPA conducted very limited follow up on the Midland and Tittabawassee off-site dioxin contamination issues. In 1996, the EPA

authorized the DEQ to oversee the implementation of Dow's corrective action responsibilities.

The DEQ recognized that the EPA's 1988 Risk Management Report and federal permit were based on limited data. The 1988 Risk Management Report recommendations were generally based upon data for one dioxin congener, 2,3,7,8-TCDD, and did not use the complete toxic equivalent (TEQ) approach which takes into account the total toxicity of the 17 different dioxins and furans that are known to be toxic. The more complete analyses are reported as concentration in TEQ (e.g., 90 ppt TEQ). We now know, based on studies conducted by the DEQ in 1996 and 2001, and by Dow in 1998, that the data used in the 1988 Risk Management Report represents only about 1/3 of the total dioxin toxicity of Midland soils and about 1/20 of the total dioxin toxicity of the Tittabawassee River sediments and floodplain soils.

In 2003, the DEQ issued Dow a Part 111 Operating License to replace the federal permit. This license follows up on and directly correlates with the 1988 Risk Management Report and the 1988 federal permit. Dow's operating license also incorporates data from soil sampling in Midland in 1996, 1998, and from 2000-2004 sampling of the Tittabawassee River sediments and floodplain. The federal permit included mechanisms to collect this additional data. However, agreement was not reached with Dow to do this sampling, so it was done by the DEQ in preparation for the issuance of the operating license.

- In the very limited 1980s studies 2,3,7,8-TCDD was not detected in river sediments or floodplain soils (9 sediment and 3 floodplain soil samples). However, additional extensive sampling and characterization was recommended. This work was done in part by the DEQ in 2000, 2001, and 2002 and identified high levels of dioxins and furans in sediments and floodplain soils.

    - Less than 10 ppt TEQ was found upstream of Dow and up to 7,000 ppt TEQ in soils and 2,100 ppt TEQ in sediments were found downstream of Dow. Approximately 70 sediment samples and over 400 floodplain soil samples have been collected by the DEQ during the period from 2000 to 2004.

- When total toxicity is estimated from the 1980s Midland data, TEQ concentrations in the range of 1,000 ppt (as high as 1,400 ppt in the limited data available) may be present in neighborhoods that are close to and downwind of Dow. The 1988 Risk Management Report was based on approximately 35 off-site soil samples that were analyzed only for 2,3,7,8-TCDD. Since 1988, more than 100 additional off-site samples have been collected and analyzed for all 17 congeners (TEQ).

The 1988 Risk Management Report also indicated that a dioxin reassessment was necessary and was expected within months. This reassessment still has not been completed and has been delayed until at least 2006.

The 1988 Risk Management Report indicated that the conclusions of the report could change if there was a large change in the cancer potency of 2,3,7,8-TCDD and suggested that this was unlikely. However, the most recent draft of the EPA's dioxin reassessment indicates that 2,3,7,8-TCDD is significantly more potent than previously believed (5-6 times).

The 1988 Risk Management Report also recognized that human epidemiologic studies (e.g., health studies) are only capable of detecting relatively large increases in adverse effects and that negative results from such studies cannot prove the absence of effects.

4. Why does the DEQ require cleanup to 90 ppt when the Agency for Toxic Substances and Disease Registry (ATSDR) uses 1000 ppt?

The soil level of 1,000 ppt established by the ATSDR is a public health action level, not a cleanup criterion that is protective for long-term exposure. This action level was presented in an interim policy guideline for dioxin and dioxin-like compounds in soil that the ATSDR issued in 1997. The action level was originally established years before (during the Times Beach, Missouri situation) and appears to have been strongly influenced by the limits of laboratory analytical techniques during the time that the action level was evaluated by Dr. Renate Kimbrough, et al. (1984). Three dioxin levels are discussed in ATSDR's 1997 interim guidance: a screening level of 50 ppt, an evaluation range of 50 to 1,000 ppt, and an action level of 1,000 ppt.

- Concentrations less than 50 ppt are considered safe for exposure without further evaluation or action.
- Soil concentrations between 50 and 1,000 ppt warrant a site-specific evaluation.
- Concentrations above 1,000 ppt warrant consideration of action to interrupt ongoing exposures and prevent future exposures from occurring.

When presented in the proper context, the ATDSR's 1,000 ppt value is not sufficiently protective to adopt as a cleanup criterion. The level of cancer risk associated with 1,000 ppt of dioxin in soil is, as calculated by EPA, 2.5 in a population of 10,000. This is 25 times the risk to public health that is allowed under Michigan law for any other contaminant.

5. Why does the DEQ require cleanup to 90 ppt when the EPA allows 1000 ppt?

A memorandum issued by the EPA uses 1,000 ppt of dioxin as a screening level for dioxin in soil. This memorandum was issued in 1998 and was explicitly described as temporary pending completion of the EPA's reassessment of the health effects of dioxin. When issuing the 1998 dioxin guidance, the EPA calculated the risk posed by that value, using the same equation and much the same exposure assumptions as Michigan has in developing the 90 ppt DCC. EPA stated in the 1998 dioxin memorandum that the 1,000 ppt level presented an increased cancer risk of 2.5 in a

population of 10,000. As noted above, this is 25 times the risk to public health that is allowed under Michigan law for any contaminant, including dioxin. Importantly, EPA does not consider 1,000 ppt of dioxin as a final, safe level. The 1998 dioxin memorandum provides that once the dioxin reassessment is complete, the EPA will review and determine the need for further corrective action at sites that used the 1,000 ppt standard.

Importantly, EPA also states in the 1998 dioxin memorandum that if a more stringent state criterion is applicable, as it is in Michigan, then that criterion should be applied.

6. Misperception: The DEQ uses unreasonable assumptions in setting cleanup criteria.

Cleanup criteria are established based upon the calculated risk posed by a given contaminant. Risk to human health is calculated based upon the potential of the contaminant to cause health problems—as measured in studies of animals and, if possible, humans—and assumptions, such as duration and frequency, related to exposure to the contaminant. The exposure assumptions used by the DEQ in deriving Part 201 cleanup criteria are in line with, and in some cases less conservative than, assumptions used by other regulatory agencies, including the EPA, for such purposes. These assumptions are frequently simplifications of widely varying exposures and are intended to represent someone with a reasonable maximum exposure in order to protect most people. These assumptions are not intended to represent the average person.

7. Misperception: Michigan requires cleanup at much lower levels than other states.

Michigan's current standard is actually toward the high end of similar standards used throughout the country. Of the other states that have derived safe levels for dioxin in soil, seven are lower than Michigan, and only two are higher. Oregon, Massachusetts, West Virginia, Washington, and Florida all have standards lower than 10 ppt. Iowa and Arizona are at 14 and 38 ppt, respectively. Only Pennsylvania at 120 ppt and Minnesota at 200 ppt are higher.

8. What health effects occur from exposure to dioxin?

As with most chemicals, the type of toxicity depends on:

1) How people are exposed (air, food, soil, water),
2) How much of the chemical (concentration/dose) they are exposed to,
3) How long they are exposed (days, months, years), and
4) The susceptibility of the person being exposed (age, genetics).

Higher exposures to dioxins in human populations have been linked with many adverse effects including chloracne, increased incidence of cancer, cardiovascular disease, diabetes, birth defects, and blood disease (porphyria). Fetuses, infants, and children may be especially sensitive to dioxin exposure because of their rapid growth and development. Low-level exposures to dioxins in human populations have been linked to more subtle effects on developing fetuses including alterations in thyroid function, immune function, learning abilities, behavior, and effects on tooth enamel. The same adverse effects noted above and other biological responses to dioxins have also been observed in animal studies with controlled exposures to dioxin. It's important to note that some effects of dioxins, such as chloracne in humans and wasting disease/death in some rodents, have only been observed in a few species that appear more sensitive to that particular effect.

Other effects of dioxins, including changes in liver enzymes, hormonal effects, and effects on the developing nervous system, appear to occur in many or most species, including humans. Based on the available information, dioxins are believed to have the potential to cause a wide range of adverse effects in humans. The EPA has characterized the mixture or group of dioxins to which people are usually exposed as "likely human carcinogens." The EPA has also characterized 2,3,7,8-TCDD-- the most toxic chemical in the dioxin group -- as a "human carcinogen." In addition, the U.S. Department of Health and Human Services, National Toxicology Program 9th Report on Carcinogens (January 2001) lists 2,3,7,8-TCDD as a substance "known to be a human carcinogen." The DEQ has evaluated the data on dioxin exposures in humans, animals, and what is known about how dioxins affect cell and tissue functions. These data indicate that humans are susceptible to various adverse effects of dioxins. This DEQ conclusion is consistent with the WHO, the International Agency for Research on Cancer (IARC), U.S. Centers for Disease Control and Prevention and its ATSDR, and the EPA. It is not yet known if people exposed to the elevated levels of dioxins found in soils in the Midland area and in downriver floodplains have or will experience any of these adverse effects.

9. Misperception: Dioxin ranks 72nd on the ATSDR/EPA National Priority List (NPL), which means there are 71 chemicals felt to be more toxic.

The 2003 CERCLA Priority List of Hazardous Substances on the ATSDR website, under the heading "What is the CERCLA List," states that **"It should be noted that this priority list is not a list of the "most toxic" substances, but rather a prioritization of substances based on a combination of their frequency, toxicity, and potential for human exposure at NPL sites.**"

Consequently, with this ranking system, many chemicals which are much less toxic than dioxin are ranked higher than dioxin simply because they are more frequently encountered at NPL sites.

The Support Document for the list ranks each chemical by:

(1) Frequency based on number of sites compared to the maximum number of sites (max = 600 pts; TCDD = 63),
(2) Toxicity based on the Reportable Quantity (RQ), and the exposure potential by concentrations in air, water, and soil (max = 600 pts; TCDD = 600), and
(3) Potential for human exposure based on relative source contribution portion based on concentrations found in air, water, and soil (max = 300 pts; TCDD = 68) and an exposure portion based on number of sites with known or potential exposures to the contaminant (max = 300 pts; TCDD = 207 pts)

This ranking system is very simplified. For example, for the RQ rank, both TCDD and Arsenic have a RQ of 1 (i.e., are equivalently toxic). However, other evaluations of toxicity (Reference Dose [or RfD] equivalent and oral cancer slope factor [or oCSF]) indicate TCDD is at least 50,000 to 230,000 times more potent than Arsenic. (EPA Integrated Risk Information System [IRIS] reported RfD and oCSF for Arsenic and EPA Great Lakes Water Quality Agreement values for TCDD). These are without adjustment of TCDD toxicity for body burden differences.

In addition, for the relative source contribution, the ranking is based on concentration with no correction for relative potency. So the concentrations of TCDD are very low compared to other chemicals ranked similarly or higher.

10. Misperception: Dow's studies of its workers show no increase health effects compared to other workers.

Although Dow has not published some findings, they reported to the DEQ and the EPA in 1998 significant increases in prostate cancer deaths, stomach cancer deaths and all causes of death from 1940-1994 related to increases in TCDD exposure as compared to other workers at the Midland plant that were considered "unexposed." A 2003 publication by Dow (Bodner, et al) that reported mortality of TCDD exposed workers during the same years, barely mentions prostate and stomach cancer rates, and does not indicate the mortality rates for these cancers was significantly increased with increasing cumulative exposure to TCDD.

11. Why is dioxin a concern when Midland citizens show no increased health concerns over other Michigan citizens?

To determine if effects of chemical exposure are occurring, a comparison must be made of groups separated into differing exposure levels. Most of the comparisons made to date have only used health statistics for all of Midland County. The people in Midland County have varying exposures. Most are expected to have exposures similar to the rest of the state and country, predominantly from dietary sources. Some people in Midland County may have elevated exposures due to occupational exposure, eating

some locally caught fish, or being exposed for a long time to elevated concentrations in the soil. To evaluate risk from dioxin, the people would need to be grouped by their known or likely exposure level and comparisons made between different exposure levels.

A few health statistics have been evaluated for cancer incidence and birth defects in the Midland community. A higher-than-expected number of all cancers combined was observed in the city of Midland zip code 48640 as compared with Midland County, Bay County, and the entire state of Michigan for each year and the entire period of 1994 through 1998. These analyses are difficult to interpret. County-wide evaluation of cancer incidence rates for years 1994 through 1998 did not indicate an increased incidence for Midland County as compared to Oakland County and the entire state of Michigan. An evaluation of birth defects for the years 1992-1996 identified no consistent pattern of excess in any particular category of birth defects and no excesses were observed for anencephaly, spina bifida or cleft palate (related to dioxin exposure). For more details of these health studies, please refer to the ATSDR Health Consultation or contact the Michigan Department of Community Health or the Midland County Health Department. In addition, the Midland County Health Department has reported that there was elevated diabetes related mortalities for years 1994 to 2002 (Krecek, 2004).

Cancer health statistics are reported as cancer incidence, which is typically the number of new cases diagnosed per year per 10,000 people. The estimated annual cancer risk at 1,000 ppt soil concentration for a reasonably high residential exposure equates to 0.036 cases per year per 10,000 people (2.5 in 10,000 over 70 years per the EPA). The most recent cancer incidence rate reported for Michigan residents is 50.9 per 10,000 people. Even if everyone in Midland and along the River had reasonably high residential exposures, a measurable increase in cancer incidence would not be expected. In other words, a health study based on cancer incidence is not expected to show an increase above background due to dioxin soil exposure, even including exposed people in the downriver tri-county area.

The other more sensitive health effects associated with dioxin exposure are predominantly developmental effects observed from fetal, infant, and childhood exposures, including reproductive effects, effects on learning and memory, effects on behavior, and effects on the immune system (ability to fight communicable diseases). These types of effects are not gross malformations, such as those included in a birth defects registry and are not routinely tracked. In addition, effects of this nature (e.g., decreases in fertility or changes in reproductive function later in life, delays in reaching developmental milestones, and increased susceptibility to infectious diseases) are not easy to measure and may not manifest themselves for several years or decades after the critical exposure.

12. Misperception: There is no reason to take any steps to address dioxin until there has been a health study of Midland area residents.

The DEQ administers environmental protection programs that are focused on preventing exposures that could cause adverse human health effects to occur. Therefore, the DEQ programs are primarily focused on prevention. This means that acceptable concentration standards are generally set at levels below which adverse health effects are expected to occur.

Although an exposure investigation and health study may provide very useful information about public health and allow individuals to make informed personal decisions, it is unlikely to provide the type of information necessary to develop cleanup criteria for dioxin. The regulations require that cleanup criteria be developed to protect the public health, safety, welfare, and the environment. This includes protecting for the most sensitive toxic effect from reasonable maximum exposure conditions. Although an exposure study may help identify some critical exposure pathways and exposure ranges for the individuals that are included in the study, it will not provide sufficient information on reasonable maximum exposures. The regulations also require that criteria for substances that pose a carcinogenic risk be developed using the 95 percent upper bound on a calculated cancer risk of 1 additional cancer above the background cancer rate per 100,000 individuals. A health study, even if it included several hundred exposed individuals, could not detect that level of cancer risk. In addition, the most sensitive noncancer effects of dioxin appear to occur during early childhood development and are effects that are not frequently measured (reproductive organ effects) or are difficult to measure (learning, behavior, immune system effects). It is unlikely that even a very well conducted exposure and health study will provide adequate information to protect for these sensitive effects.

13. Why is the DEQ declaring residential properties as "hazardous waste facilities?"

The DEQ does not "designate" a property as a facility. Rather, a property becomes a facility (or part of a larger facility) by virtue of the presence of contamination above defined levels. In addition, the properties in question here would not be considered "hazardous waste facilities." A hazardous waste facility is the term used to describe a business that treats, stores, or disposes of hazardous waste. For example, Dow Chemical is a "hazardous waste facility."

Under Part 201, any area or place, or property where Dow's releases of a "hazardous substance" have caused that hazardous substance to be present in excess of the generic residential cleanup criteria is part of a "facility" as defined in Part 201. Dioxin is a "hazardous substance" under Part 201.

Dow is required to take corrective action at any property that is part of the facility it has created by the release of dioxin. Action must be taken whether the property is owned by Dow or someone else.

A person who did not cause contamination, but nevertheless owns property that is part of a facility, must: (1) not "exacerbate" the contamination (i.e., make it worse), and (2) notify a potential purchaser of the presence of contamination similar to the disclosures that are required under state law if you are selling a house with lead-based paint or problems with asbestos or radon.

A property remains part of the facility until dioxin is removed to levels below the generic residential cleanup criteria (in this case, 90 ppt).

14. Misperception: The DEQ is being prescriptive and inflexible in requiring Dow to undertake cleanup activities.

Consistent with federal and state law, Dow must undertake four basic actions to address dioxin contamination: First, take immediate steps to reduce the highest risks where, for example, children—the most susceptible segment of the population—have the greatest chance of being exposed to the highest levels of dioxin contamination. Second, help people living in the Midland area understand what steps they can take to reduce the risk of dioxin exposure. Third, map where dioxin contamination exists in the area and at what levels. Finally, based on the studies and evaluations that will certainly take a year or more, to develop and conduct a long-term plan to address dioxin contamination above levels considered safe. The DEQ and Dow are currently engaged in productive discussions on each of these objectives.

Within these broad outlines, Dow has a fair amount of flexibility. For example, with respect to immediate steps to reduce exposure, Dow could test the soil to determine whether dioxin exists at safe levels, provide an exposure barrier (e.g., soil and grass cover), remove contaminated soil, or change the use of the land (i.e., purchase the property and not use it for residential purposes).

15. Misperception: The DEQ is requiring people's yards to be dug up.

The DEQ is not requiring Dow to dig up and remove soil from people's yards. Scraping off and removing soil is only one of a variety of options available to Dow as a means of achieving the required objective of reducing exposure to impermissible levels of dioxin contamination. Dow must consult with individual property owners when evaluating these options.

16. Misperception: The DEQ views the situation as an "emergency" and is rushing to action.

The DEQ is taking a phased, priority-based approach to addressing dioxin contamination in the Midland and Tittabawassee River areas. The EPA began work on determining the presence of dioxin contamination in these areas in the early 1980s. Since then, several studies have been conducted to further refine our understanding of the issue. These studies include:

- **1996 DEQ (Waste and Hazardous Materials Division [WHMD]) Soil and Sediment Screening Study**
  Objective: Screening level evaluation of dioxin levels in soil and limited sediment levels in the Midland community and on the Dow Plant Site for comparison to EPA 1980s dioxin levels. More complete analyses (all 17 TEQ congeners, not just 2,3,7,8-TCDD) than previously available.
  Findings: Generally, dioxin levels were found to be higher than state cleanup criteria close to and downwind of Dow and on the Dow Plant Site.

- **1996-1999 DEQ (WHMD) Michigan Soil Background Study**
  Objective: Determination of Michigan-specific background levels of dioxins in urban and rural areas and other locations close to suspected sources of dioxin.
  Findings: State-wide dioxin background levels average about 6 ppt and range from nondetectable to 35 ppt. Findings are consistent with national background studies.

- **1999 Dow Soil Sampling Summary Report on 1998 Dow Corporate Center and Plant Site Sampling**
  Objective: Follow-up to 1996 DEQ screening study by collecting limited statistically representative samples and to validate individual grab samples collected during 1996. This sampling was conducted under the federal permit, with oversight by DEQ on EPA's behalf. The Dow Corporate Center was sampled as a surrogate for the previously sampled locations in the Midland community because access to residential and public properties was not agreed to by the city of Midland.
  Findings: Generally, the results validated the 1996 DEQ screening study and reinforced the conclusion that concentrations of dioxins and furans are present at levels that exceed the residential soil cleanup criteria in the downwind area of investigation. Elevated levels were also found on and at the northeast perimeter of the Dow Plant Site and along haul routes to the off-site landfill.

- **2001 DEQ (Remediation and Redevelopment Division [RRD]) Phase I Final Report for Sampling of Tittabawassee River Floodplain Soils in December 2000-July 2001**
  Objective: To confirm or refute the presence of elevated dioxin soil levels identified (25 times higher than state residential direct contact cleanup criteria)

during a wetland mitigation project in a farm field near the confluence of the Tittabawassee and Saginaw Rivers.
Findings: The elevated levels of dioxin were confirmed by this study. Dioxin levels in 34 surface and below-ground level soil samples from five locations within a two-mile stretch of the Tittabawassee River floodplain between Center Road and the Saginaw River confluence ranged up to 80 times higher than the state cleanup criteria (from 35-7,400 ppt). Residential, agricultural, and public park properties were located within the study area. Phase II sampling to further evaluate the extent of contamination upstream was recommended.

- **2002 DEQ (WHMD) Baseline Characterization of Saginaw Bay Watershed Sediment Study Report for 2001 Sampling**
  Objective: Determination of baseline levels of contaminants, including dioxins and furans, in Tittabawassee River sediments and floodplain soils upstream and downstream of Midland.
  Findings: Dioxin sediment and floodplain soil levels upstream of Midland in the Tittabawassee, Chippewa, and Pine Rivers were found to be consistent with state-wide background levels. Downstream of Midland, sediment dioxin levels were found to be pervasively elevated (ranging up to 2,100 ppt). In addition, all downstream floodplain soil levels exceeded the state cleanup criteria (ranging from 300-1,500 ppt).

- **2003 DEQ (RRD) Phase II Final Report for Sampling of Tittabawassee River Floodplain Soils in May 2002-December 2002**
  Objective: In follow up to Phase I sampling and the 2002 sediment study, further evaluation was conducted on floodplain soil dioxin levels upstream of Midland and along the Tittabawassee River downstream of Midland to the beginning of the Saginaw River.
  Findings: Dioxin floodplain soil levels upstream of Midland in the Tittabawassee, Chippewa, and Pine Rivers, and outside of the 100-year floodplain downstream of Midland, were found to be consistent with state-wide background levels. Downstream of Midland, floodplain soil dioxin levels at the surface and below ground level were found to be pervasively elevated (ranging up to 3,400 ppt). Most of the samples collected within the floodplain exceeded the state cleanup criteria. Drinking water well sample results were below applicable regulatory criteria. Dioxin levels in eggs from chickens that free ranged on floodplain soils were found to be elevated.

- **2002-2003 DEQ (RRD) Tittabawassee River Aquatic Ecological Risk Assessment Sampling of Water Fowl Eggs and Four Species of Fish**
  Objective: Obtain risk assessment data to assist the DEQ in determining the impacts and risks to wildlife posed by dioxin and furan contamination in the Tittabawassee River and further downstream in the Saginaw River and Bay and the appropriate response activities needed to reduce those risks.
  Findings: DEQ-contracted 2003 Aquatic Ecological Risk Assessment Report indicates that dioxin and furan contaminated sediments in the Tittabawassee

River downstream of Midland pose significant reproductive, embryo, and early life-stage mortality risk to fish-eating birds and mammals in the Tittabawassee River and downstream.

- **2003-2004 DEQ (RRD) Sampling of Tittabawassee River Floodplain Soil in Support of Department of Community Health (DCH) Pilot Exposure Investigation**
  Objective: Further determination of the nature and extent of dioxin levels at 22 residential properties in support of efforts by the DCH to evaluate human health concerns related to dioxin contamination in the area.
  Findings: Dioxin levels are consistent with the results of prior floodplain surface and below ground soil samples previously collected by the DEQ. Soil located within portions of property downstream of Midland and subject to frequent flooding by the Tittabawassee River is contaminated with elevated levels of dioxin ranging up to 5,660 ppt.

Based on these studies, the DEQ concluded that dioxin contamination exists in the Midland and Tittabawassee River areas above permissible levels as defined by Part 201 and that Dow was responsible for this contamination. As a result, the DEQ developed a hazardous waste operating license for Dow that established a framework for Dow to address the dioxin contamination. That license was issued in June 2003 after several years of negotiation with Dow and public comment. Since then, the DEQ has been working with Dow to specify the details of Dow's activities. These activities are to occur in a phased, priority-based approach. This approach properly and necessarily involves addressing the highest priority sites first. These sites are the areas known to have the highest levels of contamination and potential for exposure by the most sensitive individuals. Subsequent actions include studies to map the extent of contamination and, based on those findings, developing a long term plan to reduce dioxin contamination throughout the affected area to permissible levels.

17. Misperception: The DEQ is preventing Dow from responding to the dioxin contamination.

The DEQ is not preventing Dow from responding to dioxin contamination. To the contrary, the DEQ has always encouraged Dow to take short-term actions to immediately limit the communities' exposure to dioxin contamination. Such short-term actions must be distinguished, however, from the necessarily systematic approach to mapping the extent of contamination and developing a long-term response. Under the hazardous waste operating license, Dow's proposed actions in responding to contamination are to be described in documents entitled "Scopes of Work" (SOWs). The SOWs Dow initially submitted were substantially inadequate. Rather than merely provide comments that would require a third round of submissions from Dow and review by the DEQ, which would surely delay implementation, the DEQ chose to rebuild Dow's submission into approved SOWs. The DEQ is developing those documents. It is important to note, however, that even though the SOWs have not been finalized, Dow

has always been able, and can still take steps to reduce the communities' exposure to dioxin contamination. With very limited exceptions, Dow has chosen not to do so to date.

18. Why is additional sampling needed in Midland and along the Tittabawassee River?

Additional sampling is needed for the following:

- To determine locations of Tittabawassee River and floodplain contamination for implementation of interim response activities or other measures.

- To determine contaminant concentrations in neighborhoods of highest concern in Midland in order to evaluate the need for interim response activities or other measures.

- As part of the pilot exposure investigation to relate blood dioxin levels to dioxin concentrations in soil.
- To determine where contaminated soils are so they are not relocated into clean areas.

- Dow has proposed to conduct a bioavailability study to develop site-specific criteria for Midland and the Tittabawassee River floodplain soils. As part of conducting this study, Dow will need to collect soil samples that represent the soil types and contamination levels for the entire study area.

- Determine nature and extent of contamination in accordance with applicable laws and regulations (i.e., Parts 111 and 201).

- Determine if there are other contaminants present besides dioxin that require remediation.

19. Misperception: Dioxin is everywhere. Why is the DEQ worried about the Midland and Tittabawassee River levels?

The majority of dioxin in the environment and the food chain (meat, dairy, fish, and shellfish) is <u>not</u> naturally occurring. The major sources of dioxins found in the environment today are the result of past industrial practices including chemical and pesticide manufacturing, bleaching of pulp and paper, and burning of waste materials. Many of these sources of dioxins are controlled today through environmental regulations. There are also naturally occurring sources like forest fires, but these contribute little to the current dioxin levels in the environment. Since past major sources of dioxins are now controlled by regulation, sources that are most significant now are

locally elevated levels in soils and sediments from previous inadequately controlled sources, such as the Dow plant site.

In the Tittabawassee River sediments and floodplain soils, the high levels of dioxin contamination -- up to 7,400 ppt toxic equivalent (TEQ) -- are related to releases from Dow in Midland. These sediments and soils are a reservoir of contamination that continues to be a source as it migrates. These levels of dioxins are much higher than "background" levels found in a survey of soils in urban and rural areas across Michigan (Michigan Soil Background Study). This survey identified dioxin levels up to 35 ppt TEQ in Michigan soils, with the average level about 6 ppt TEQ. The highest levels of dioxins are usually found in contaminated soils and sediment and in animal fat. People who eat lots of fish, fatty meats, or high fat dairy products may be exposed to higher levels of dioxins. Dioxins are in the food we eat because it is in our environment. Beginning to remove dioxins from the environment, or eliminating exposure to these sources, will help to remove them from our diet.

People who live near or work at contaminated sites containing dioxins, waste incinerators, or manufacturing facilities that historically produced dioxins as a by-product may also have additional dioxin exposures beyond their diet from direct contact with waste materials, or with contaminated soils and sediments and other pathways.