UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
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CHICAGO, IL 60604-3590

EPA Region 5 Records Ctr.
249650

MEMORANDUM JUL 12 2007 REPLY TO THE ATTENTION OF

SUBJECT: **ENFORCEMENT ACTION MEMORANDUM:** Determination of an Imminent and Substantial Threat to Public Health and the Environment at the Reach D Area of the Tittabawassee River Dioxin Spill Site, Midland County, Michigan (Site ID #B5KF)

FROM: James E. Augustyn, On-Scene Coordinator
Emergency Response Branch 1 – Removal Section 1

TO: Richard C. Karl, Director
Superfund Division

THRU: William J. Bolen, Chief
Emergency Response Branch 1

I. PURPOSE

The purpose of this Action Memorandum is to document the determination of an imminent and substantial threat to public health and the environment at the "Reach D," area of contamination within the Tittabawassee River Dioxin Spill Site, (also referred to as the "Site" or the "Tittabawassee River Site"). The Site, which is located in Midland County, Michigan, was contaminated with dioxin and furans, primarily as the result of historic wastewater discharge practices associated with The Dow Chemical Company (Dow) Plant.

The Site is located within The Dow Chemical Company Midland Plant property with a common address of 1000 East Main Street, 1790 Building, Midland, Michigan, 48667 (the "Midland Plant"). The Site is the location where the facility owns and operates a chemical manufacturing plant and is the location where the facility has historically disposed of hazardous substances, pollutants, or contaminants. The geographical coordinates for Reach D are longitude 84° 14' 19.336" West and latitude 43° 36' 4.389" North.

The response actions proposed in this Action Memorandum will mitigate threats to public health, welfare, and the environment presented by the presence of an uncontrolled release of dioxin and furans, hazardous substances, into the food chain of the Tittabawassee River from in-stream sediments located within the Reach D Area. Due to the contaminated nature of the sediment, the continuing release of

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contamination into the food chain, and potential exposure to the public, this removal action will be classified as time-critical. The proposed response actions include dredging and/or excavation and containment of contaminated sediments and bottom deposits, air monitoring, water treatment, stabilization and on-site disposal. The response activities will require approximately 120 on-site working days to complete, and will result in the removal of approximately 14,000 cubic yards of waste material.

The potentially responsible party (PRP) for the Site, The Dow Chemical Company, is prepared to conduct the time-critical removal action described in this Action Memorandum.

There are no nationally significant or precedent-setting issues associated with the Site and the Site is not on the National Priorities List (NPL).

II. SITE CONDITIONS AND BACKGROUND

CERCLIS ID #MID 980 994 354

A. Physical Location and Description

The Site covers the area in the vicinity of, an historic, 1,200 foot-long, water discharge flume containing approximately 14,000 cubic yards of dioxin-contaminated sediment and bottom deposits and is generally bounded by the Dow Revetment Groundwater Interception System (RGIS) sheet piling along the northeast bank of the Tittabawassee River and a line of old sheet piling constructed in the 1930s-1940s and varying from 5 to 40 feet distant from the northeast bank, as well as contamination that may have migrated immediately beyond the RGIS system and beyond the historic sheet piling along the upstream and downstream portions of Reach D, all located approximately 1,200 feet upstream of the Dow Dam. The historic water discharge flume was, at one time, connected to an outfall at the Midland Plant.

The Midland Plant began operations in 1897. The Midland Plant covers approximately 1,900 acres. The majority of the Midland Plant is located on the east side of the Tittabawassee River and south of the City of Midland. Over the time of its operation, the Midland Plant has produced over 1,000 different organic and inorganic chemicals. These chemicals include the manufacture of 24 chlorophenolic compounds since the 1930s.

The Tittabawassee River is a tributary to the Saginaw River, draining approximately 2,600 square miles of land in the Saginaw River watershed. The Tittabawassee River flows south and east for a distance of approximately 80 miles to its confluence with the Shiawassee River, approximately 22 miles southeast of Midland. Up stream of the Midland Plant, the Tittabawassee River's flow is regulated by the Secord, Smallwood, Edenville, and Sanford Dams. The current operation of the hydroelectric station at Sanford results in water releases from Sanford Dam during peak electricity usage

periods to provide peaking power to Consumer's Energy. Sanford Lake has limited flood storage capacity due to a narrow range of permitted lake levels. The Dow Dam is located adjacent to the Dow Plant. Below the Dow Dam, the River is free flowing to its confluence with the Shiawassee and Saginaw Rivers. The Tittabawassee River's flow and water level fluctuate daily in response to releases from the Sanford Dam. The average and 100-year flood discharge for the Tittabawassee River based on data from 1937 to 1984 are approximately 1,700 cubic feet per second ("cfs") and 45,000 cfs, respectively. The relatively large ratio between the 100-year flood discharge and the long-term average discharge (26.5) indicates that the river is "flashy," or has a flow regime that is characterized by highly variable flows with a rapid rate of change.

Portions of the Tittabawassee River floodplain are periodically inundated by floodwaters. Sheet piling has been used to stabilize the banks of the Tittabawassee River along numerous stretches within the Midland Plant area and in several downstream locations. This type of bank stabilization increases channel velocity in the immediate area during flood stages by restricting the cross-sectional area of the River and, depending on the local cross-section, may increase downstream flood elevations and erosive forces by increasing the flows and velocities of water that can no longer be stored on the over-bank above stabilized areas.

Site topography is influenced largely by past glacial activity. The area is relatively flat with gentle rolling plains. In general, the land surface slopes gently eastward toward Lake Huron. Terminal moraines, eskers, and drumlins provide the only significant relief over the region. Low elevation areas are typically wetlands.

In the very early history of the Midland Plant, wastes were discharged directly into the Tittabawassee River and, sometime later, wastes were stored and treated in ponds on the facility. Other wastes were disposed of at the Midland Plant either on land or by burning. Over time, changes in waste management practices included installation and operation of a modern wastewater treatment plant. Changes in the wastewater treatment plant and subsequent incorporation of pollution controls have reduced or eliminated releases from the Midland Plant.

Elevated dioxin and furan levels in and along the Tittabawassee River appear to be primarily attributable to early brine electrolysis for chlorine manufacturing, and associated waste management practices of the period at the Midland Plant. Prior to the construction of wastewater storage ponds in the 1920s, wastes from manufacturing processes were discharged directly to the Tittabawassee River. Historic flooding of the Midland Plant property resulted in discharges to the Tittabawassee River of stored brines and untreated or partially treated process wastewaters. The primary source of furans and dioxins from the Midland Plant to the Tittabawassee River is believed to be historic releases of aqueous wastes. The original chlorine manufacturing process is the likely source of comparatively high furan toxicity equivalents (TEQ) readings in and along the Tittabawassee River. These dioxins and furans would have been discharged

directly to the Tittabawassee River. Dioxins and furans found in more recent sediments are also believed to be related to chlorophenol production that began in the mid-1930s.

Although the Site is within the Midland Plant property boundary, access to the Site is unrestricted to Midland Plant workers and is unrestricted to people approaching the Site on the Tittabawassee River. Wildlife in the area also has unrestricted access. The Site may also be subject to flooding and stream bank erosion. This is particularly true during high stream flow events. This may result in the potential spread of dioxin contamination to other locations within the flood plain of the River, as well as to downstream locations. This may also result in further contamination of fish and invertebrates within the River watershed.

Dioxins and furans are listed as a hazardous substance in the Resource Conservation and Recovery Act (RCRA) Appendix VIII to 40 CFR 261; and Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, Michigan Compiled Laws (MCL) 324.101 et seq. (NREPA).

B. Environmental Justice Analysis

To meet Region 5's Environmental Justice (EJ) concern criteria, the area within 1 mile of a Site must have a population that is at least twice the state's average low-income percentage and/or twice the state minority percentage. Among all Michigan residents, the low-income percentage is 29% and the minority percentage is 21%. To meet EJ concern criteria, the area must be at least 58% low-income and/or 42% minority. U.S. EPA's EJ analysis of the population within 1 mile of the Reach D area determined that the low-income percentage is 34% and the minority percentage is 5%. Therefore, the Reach D area does not meet the Region's EJ criteria based on demographics, as identified in "Region 5 Interim Guidelines for Identifying and Addressing a Potential EJ Case, June 1998."

C. Site Assessments

The Administrative Record for the Tittabawassee River Site contains numerous reports which summarize the investigations conducted to date. Detailed information from the reports most relevant to this time-critical removal action is set forth here:

1. In October 2003, MDEQ completed its "Tittabawassee River Aquatic Ecological Risk Assessment."

In the "Tittabawassee River Aquatic Ecological Risk Assessment," risks to birds and mammals from consuming fish from the Tittabawassee River below Midland were evaluated using a streamlined approach that included site-specific contaminant data and modeling related to TCDD (fish tissue and bird egg concentrations) and data from the scientific literature. Regarding fish, the results of this analysis show that:

Fish prey of piscivorous (i.e., fish-eating) birds and mammals in the Tittabawassee River below the City of Midland are contaminated with polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs).

The concentrations of PCDDs and PCDFs in at least four species of fish in the Tittabawassee River (i.e., carp, catfish, shad and smallmouth bass) are sufficiently high as to pose serious risks of reproductive impairment to piscivorous birds and mammals.

The concentrations of PCDDs and PCDFs in carp, catfish, shad and smallmouth bass exceed levels that are protective of reproductive success in piscivorous birds by factors of up to and exceeding 200.

The concentrations of PCDDs and PCDFs in carp, catfish, shad and smallmouth bass exceed levels that are protective of reproductive success in piscivorous mammals by factors of up to 60.

Carp is the most contaminated fish collected from the Tittabawassee River. The concentrations of PCDDs and PCDFs in carp exceed levels that are protective of reproductive success in piscivorous birds by factors of up to over 445.

The concentrations of PCDDs and PCDFs in carp from the Tittabawassee River exceed levels that are protective of reproductive success in piscivorous mammals by factors of up to 128.

The concentrations of PCDDs and PCDFs in carp, catfish, shad and smallmouth bass from the Tittabawassee River are sufficiently high to pose risks of reproductive impairment to bird species that are comparatively insensitive, as well as more sensitive species.

Specific ecological risks posed by the PCDD and PCDF contamination in carp, catfish, shad and smallmouth bass from the Tittabawassee River comprise those of reduced fertility (mink and river otter), and embryo and other early life stage mortality (birds, mink, and river otter).

To eliminate unacceptable levels of risk, the diets of mink in the Tittabawassee River and its floodplain would have to comprise less than 2% of fish from the River. Consequently, mink living in the Tittabawassee River floodplain would have to acquire more than 98% of their prey from uncontaminated food sources. This would require the animals to feed mainly outside the floodplain.

A sensitivity analysis demonstrates that even if carp, catfish, bass and shad comprised a relatively minor fraction of the diet of piscivorous birds, and their other fish prey from the Tittabawassee River had only half the contamination levels of these four species, risks of reproductive impairment would still be high. This confirms the robustness of the risk estimations in this ERA.

The risk levels identified by this aquatic ecological risk assessment are probably sufficiently high to result in population effects in exposed avian and mammalian piscivores.

The main contributors to risk in piscivores through contamination of Tittabawassee River carp, catfish, shad and smallmouth bass are 2,3,4,7,8-pentachlorodibenzofuran (2,3,4,7,8-PeCDF), 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD), and 2,3,7,8-tetrachlorodibenzofuran (2,3,7,8-TCDF), in that descending order.

As part of the "Tittabawassee River Aquatic Ecological Risk Assessment," in 2003, eggs of wood ducks and hooded mergansers nesting in the Shiawassee National Wildlife Refuge and from reference areas were collected and analyzed for PCDDs and PCDFs. These data showed that:

The wood duck eggs from the Shiawassee National Wildlife Refuge had TCDD-EQ concentrations that were, on average, 2.7 times higher than those in the reference eggs. The hooded merganser eggs from the Shiawassee National Wildlife Refuge had TCDD-EQ concentrations that were, on average, 24.4 times higher than those from the reference areas.

The TCDD-Equivalents (TCDD-EQ) in the eggs of wood ducks and hooded mergansers from the Shiawassee National Wildlife Refuge exceeded by factors of up to 49 and 122, respectively, levels that would be protective of the more sensitive bird species and by factors of up to 2.4 and 6.1, respectively, levels that would be protective of comparatively insensitive bird species. These empirical and Site-specific data support the conclusions of risk to avian piscivores that were obtained in the ecological risk assessment.

Congener data from wood duck and hooded merganser eggs from the Shiawassee National Wildlife Refuge, and the eggs of ground-foraging chickens from nearby Riverside Drive showed that 2,3,7,8-TCDF persists during food chain transfer.

The results of the "Tittabawassee River Aquatic Ecological Risk Assessment" were used to identify sediment threshold concentrations (STCs) of TCDD-EQ that would be protective of avian and mammalian piscivores. This showed that:

The TCDD-EQ STCs for the three avian TRV categories (most, less, and least sensitive) were 10, 100, and 211 pg/g, respectively.

The TCDD-EQ STC for mink is 12 pg/g, and for river otter is 9 pg/g.

Sediments in the Tittabawassee River from the City of Midland downstream exceeded the STCs for birds and mammals by factors of up to more than 100.

TCDD-EQ concentrations in 9 sediment samples from Saginaw Bay and 25 sediment samples from Saginaw River equaled or exceeded one or more of the avian and mammalian STCs, indicating that the risk posed by PCDDs and PCDFs extend downriver beyond the Tittabawassee River.

The main conclusion of the "Tittabawassee River Aquatic Ecological Risk Assessment" is that the possibility of unacceptable risks to aquatic receptors, as well as avian and mammalian piscivores in the Tittabawassee River floodplain, due to sediment contamination by dioxin cannot reasonably be discounted.

2. In April 2004, MDEQ completed its "Tittabawassee River Floodplain Screening-level Ecological Risk Assessment."

In the "Tittabawassee River Floodplain Screening-level Ecological Risk Assessment" risks to six species of birds and mammals from consuming soils and invertebrate, mammalian, and avian prey from the floodplain of the Tittabawassee River downriver of Midland were evaluated using a screening level ecological risk assessment. This analysis was based on empirical soil PCDD/PCDF concentrations and bioaccumulation, toxicological, and ecological data from the scientific literature. The question addressed by this ecological risk assessment was whether an unacceptable risk to ecological receptors in the Tittabawassee River floodplain could be reasonably discounted. The results of this analysis show that:

Using empirical soil PCDD/PCDF data and assuming soil-organism uptake factors from the scientific literature, TCDD-EQ concentrations in invertebrates, small mammals and birds in the Tittabawassee River floodplain downriver of Midland are predicted to average 393, 12,048, and 6,038 pg/g TCDD-EQ, respectively (using WHO avian TEFs), and 124, 5,083, and 2,552 pg/g (using WHO mammalian TEFs). These organisms are assumed to be the prey of the six receptor species.

The majority of the TCDD-EQ in the invertebrates, small mammals and birds is predicted to be contributed by two congeners, 2,3,7,8-TCDF and 2,3,4,7,8-PCDF.

Food chain models predict that the daily TCDD-EQ intake rates for the six receptor species are:

Red fox	1,732,613 pg

Short-tailed shrew	1,049 pg
Red-tailed hawk	1,586,547 pg
American kestrel	318,013 pg
American woodcock	90,586 pg
American robin	46,879 pg

Protective toxicity reference values (daily TCDD-EQ doses) for the six receptor species were established as:

Red fox	2,050 pg
Short-tailed shrew	38 pg
Red-tailed hawk	17,136 pg
American kestrel	1,820 pg
American woodcock	3,080 pg
American robin	1,134 pg

Combining the TCDD-EQ intake rates with the toxicity reference values resulted in the following hazard indices:

Red fox	845
Short-tailed shrew	28
Red-tailed hawk	93
American kestrel	174
American woodcock	29
American robin	41

All of these hazard indices (based on soil mean PCDD/PCDF concentrations) represent unacceptable risk to the receptor species

Hazard indices were also calculated based on soil median, maximum and upper 95% confidence limits of the mean. All of these also showed unacceptable risk to each of the receptors and ranged up to 6,636 for the most at-risk species (red fox) and 220 for the least at-risk species (short-tailed shrew).

The main conclusion of the "Tittabawassee River Floodplain Screening-level Ecological Risk Assessment" is that the possibility of unacceptable risks to terrestrial receptors in the Tittabawassee River floodplain due to soil contamination by dioxins cannot reasonably be discounted. The relatively high HI values obtained may be an indication that it may be more likely than not that risk actually pertains in the assessment area. Further Site-specific studies are needed before any such risks can be confirmed or rejected.

3. PRP-conducted Supplemental Assessment Work.

The MDEQ issued Dow its current RCRA Hazardous Waste Management Facility Operating license for the Midland Plant, with an effective date of June 12, 2003, and an expiration date of June 12, 2013 (the License). Under its License, the company has been conducting corrective action work.

As part of the RCRA corrective action work, Dow prepared and submitted a Remedial Investigation (RI) Work Plan (RIWP) for the area consisting of river channels and floodplains within the Tittabawassee River. On July 7, 2006, Dow submitted a GeoMorph Sampling and Analysis Plan for the Upper Tittabawassee River (UTR SAP). On July 12, 2006, MDEQ approved, on a pilot basis, the UTR SAP for the upper 6.5 miles of the Tittabawassee River. On February 1, 2007, Dow submitted the UTR Pilot Site Characterization Report. On May 3, 2007, the MDEQ approved the UTR Pilot Site Characterization Report with conditions and removed pilot Site status from the GeoMorph process. Once approved and implemented, the RIWP will meet the requirements of Michigan's Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451 [Act 451], as amended, Parts 111 (Hazardous Waste Management) and 201 (Environmental Remediation), and RCRA regulations and standards of practice.

Sampling was conducted under the pilot GeoMorph UTR SAP as part of the remedial investigation process. The sampling was conducted to identify areas potentially contaminated with dioxins and furans. Sampling within Reach D established dioxin sediment contamination levels of up to 69,000 parts per trillion (ppt) TEQ.

Sampling conducted as part of the RIWP strongly suggests that the dioxin/furan contamination at the Site and in the Tittabawassee River adjacent to and downstream of Dow is associated with the Dow Midland plant. Soil samples collected upstream of Midland did not contain elevated levels of dioxins or furans. Dioxin and furan concentrations from up stream locations are consistent with statewide background concentrations. Additional sediment sampling within tributaries of the Tittabawassee River has failed to identify any significant sources of dioxins or furans. Dioxin/furan congener profile charts for Tittabawassee River sediments and floodplain soils down stream of the Dow Midland facility are similar amongst themselves and very different from sample locations upstream of the Dow Midland facility.

D. Risk Assessments

Human Health Risk Assessments.

On July 30, 2004, U.S. EPA issued its "(1) Health Risk Analysis of Tittabawassee Fish with Dioxin and (2) Recommendations for Risk Evaluation."

In the "(1) Health Risk Analysis of Tittabawassee Fish with Dioxin and (2) Recommendations for Risk Evaluation," U.S. EPA evaluated the risks to humans from consuming fish from the Tittabawassee River. Tittabawassee River fish data collected

by MDEQ in 2003 and made available to U.S. EPA in June 2004 was analyzed to assess risks to fish consumers. The conclusion was that dioxins in River fish present unacceptable risks to public health. Cancer risks to a frequent (high-end) fish consumer are as great as one in a 1,000 exceeding U.S. EPA cancer risk management guidelines of one in 10,000 to one in 1,000,000. Non-cancer risks (e.g., reproductive and congenital defects) are up to 10 times acceptable exposure values for adults and 25 times above safe levels for children. There is particular concern of risks to women of childbearing age and to the developing fetus. The "(1) Health Risk Analysis of Tittabawassee Fish with Dioxin and (2) Recommendations for Risk Evaluation" also identified unacceptable risks to wildlife (Tittabawassee Ecological Assessment Report, MDEQ, Galbraith Environmental Services, 2003). The assessment concluded that dioxin and dibenzofurans are at levels posing "serious" reproductive impairment to fish, fish eating birds and mammals. Furthermore, dioxin levels are elevated in area turkey, deer and other game (Dow Chemical, July 2004) indicating terrestrial food chain contamination due to contamination of flood plain soils, posing potential public health risks. Dioxin contamination of sediments and flood plain soils appears to extend over 50 miles, into Saginaw Bay (MDEQ November, 2003 update). The Site has similar characteristics regarding levels of risk and area affected as the Kalamazoo and Fox Rivers, which are currently a focus of U.S. EPA remediation plans.

On September 14, 2004, the Michigan Department of Natural Resources (MDNR) issued a public Health Advisory for Consuming Wild Game from the Tittabawassee River Flood Plain due to excessive dioxin contamination. The advisory remains in place today, and warns against consuming wild game from the flood plain area.

III. THREATS TO PUBLIC HEALTH OR WELFARE OR THE ENVIRONMENT, AND STATUTORY AND REGULATORY AUTHORITIES

Conditions present at the Reach D Area of the Tittabawassee River Dioxin Spill Site constitute a threat to public health, welfare or the environment based upon the factors set forth in 40 C.F.R. § 300.415(b)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). These include, but may not be limited to, the following:

- Actual or potential exposure to nearby populations, animals, or the food chain from hazardous substances or pollutants or contaminants.

Dioxins and furans are listed as a "hazardous substance" as defined by Section 101(14) of CERCLA, 42 U.S.C. § 9601(14). They are also listed in the Resource Conservation and Recovery Act (RCRA) Appendix VIII to 40 CFR 261; and Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, Michigan Compiled Laws (MCL) 324.101 et seq. (NREPA).

This factor is present at the Site due to the presence of dioxin-contaminated bottom deposits and sediments at or near the surface, as well as at depth at the Site. Although the Site is within the Midland Plant property boundary, access to the Site is unrestricted to humans approaching the Site from the Tittabawassee River. People may have direct contact with dioxin-contaminated bottom deposits and sediments. Wildlife in the area also has unrestricted access. The Site is subject to periodic flooding and erosion. This may result in the spread of dioxin contamination to other locations within the flood plain, as well as to down-stream locations where humans and wildlife may come into direct contact with the dioxin contamination. This may also result in further contamination of fish and invertebrates within the River. Finally, human consumption of fish taken from the River and contaminated with dioxin from the Site may pose an additional exposure route to humans. These chemicals have the potential to biomagnify, which means that they have the potential to increase in concentration as they are transferred from one link in the food chain to another.

Sampling within the Site establishes dioxin contamination levels of up to 69,000 parts per trillion (ppt) dioxin for in-stream sediments. The ongoing, uncontrolled migration of sediments is a significant source of dioxin loading to the Tittabawassee River. In-stream sediments and bottom deposits are primary sources of an ongoing release of dioxin into the waters of the Tittabawassee River.

September 14, 2004, the MDNR issued a public Health Advisory for Consuming Wild Game from the Tittabawassee River Flood Plain, the game consumption advisory is simply that – advisory. In addition to the game consumption advisory, there is a fish consumption advisory for the Tittabawassee River. The River still continues to be a popular fishery.

The most significant outcome of the ecological and human health risk assessments is the conclusion that fish consumption is the primary exposure pathway for receptors that may be at risk from dioxin within the Tittabawassee River. Therefore, the key to reducing exposure and potential risks to important receptors (e.g. fish-eating birds, fish-eating wildlife, and humans) is to reduce dioxin concentrations in the fish tissue consumed by these receptors. The greatest factor controlling dioxin levels in fish is the bioavailability of dioxin in sediments and the water column where fish and their prey come in contact with or ingest dioxin.

- High levels of hazardous substances or pollutants or contaminants in bottom deposits and sediments largely at or near the surface, that may migrate;

This factor is present at the Site due to the existence of dioxin-contaminated bottom deposits and sediments at or near the surface, as well as at depth existing at the Site. The Site is subject to periodic flooding and erosion. This may result in the spread of dioxin contamination to other locations within the flood plain, as well as to downstream locations.

- Actual or potential contamination of sensitive ecosystems;

This factor is present at the Site due to the existence of dioxin-contaminated bottom deposits and sediments at or near the surface, as well as at depth at the Site. The Site is subject to periodic flooding and erosion. This may result in the spread of dioxin contamination to downstream locations and the contamination of the water in the Tittabawassee River, the Saginaw River, and ultimately Lake Huron.

- Weather conditions that may cause hazardous substances or pollutants or contaminants to migrate or be released;

The Tittabawassee River is often subjected to extreme weather conditions in the winter and spring, which enhance the threat of a release of dioxins and furans. The breakup of ice in the late winter, and the movement of ice floes downstream, causes scouring of the banks and River bottom. Likewise, heavy spring rains and/or summer storms increase stream volume and current velocity, which lead to increased scouring of the River bottom and banks. All of these forces cause an increase in the volume and extent of dioxin and furan contamination in the Tittabawassee River and the Saginaw River.

IV. ENDANGERMENT DETERMINATION

Given the conditions at the Reach D Area, the nature of the hazardous substance there, and the potential exposure pathways described above, the actual or threatened release of dioxin from Reach D, if not addressed by implementing the response actions selected in this Action Memorandum, may present an imminent and substantial endangerment to public health, or welfare, or the environment.

V. PROPOSED ACTIONS

A. Description of the Proposed Action

The preferred response action to mitigate threats associated with dioxin-contaminated sediments in the Reach D Area consists of removing contaminated sediments. The AOC will specify all required response actions, which will include, but may not be limited to, the following tasks:

1) Respondent shall perform, at a minimum, all actions necessary to implement the approved Removal Work Plan. The actions to be implemented generally include, but are not limited to, the following:

a. Develop for review and approval by U.S. EPA a Removal Work Plan describing in detail the Performance Based removal activities to be taken at the Site. Upon approval, implement the Removal Work Plan. The Removal Work Plan shall include a comprehensive description of the project tasks, procedures to accomplish

them, quality assurance/quality control systems, project documentation, and project schedule. The removal activities described in the Removal Work Plan shall be performed in accordance with the criteria in Paragraphs 15.b. through 15.h. A Site-specific Health and Safety Plan shall be prepared pursuant to Paragraph 17;

b. The Removal Work Plan shall include, for review and approval by U.S. EPA, a Field Sampling Plan describing the sampling and data collection methods. The Field Sampling Plan shall take into consideration the sampling needed to determine disposal requirements for dredged or excavated bottom deposits and sediments, and post-Performance Based removal action work sampling to delineate contamination remaining at the Site after the completion of the Performance Based removal action work within the area of the Performance Based work;

c. Post-Performance Based removal action work sampling and chemical analysis shall take place within the area of the Performance Based work as the Performance Based removal work action progresses. Samples shall be collected in accordance with the sampling and statistical analysis plans contained in the Removal Work Plan. A record of sample locations and results must be maintained and submitted to U.S. EPA. All sampling shall be completed in accordance with the deadlines established in the Field Sampling Plan. All Post-Performance Based removal action work sampling and chemical analysis shall be completed by December 15, 2007, and a complete report detailing the sample locations and results shall be completed and submitted to U.S. EPA by December 31, 2007;

d. Excavation and/or dredging of bottom deposits and sediments in the Tittabawassee River within Reach D in accordance with the Performance Based removal action Work and at the locations specified in the Removal Work Plan;

e. Disposal of all dioxin-contaminated bottom deposits and sediments specified in the Removal Work Plan into existing landfills;

(1) Dioxin-contaminated sediments removed from the work areas at the Site must be properly characterized for disposal as authorized by this Settlement Agreement or as otherwise allowed under applicable law. Characteristic waste and contaminants may be present in the bottom deposits and sediments and sampling shall be conducted to determine the presence of other contaminants. Depending on the manner of disposal, along with testing for dioxin and listed hazardous wastes, the excavated bottom deposits and sediments shall be tested using the Toxic Characteristic Leaching Procedure (TCLP) to determine if the excavated bottom deposits and sediments are characteristic of hazardous waste as provided at 40 C.F.R. Part 261, Subpart C. Based upon the results, treatment may be required prior to disposal and disposal options will be based upon the analytical results as provided at 40 C.F.R. Part 268;

(2) Sediments removed from the Site contaminated with dioxins shall be transported off-site for proper disposal at a landfill approved to accept dioxin remediation waste. Waste must be disposed of in compliance with the EPA Off-Site Disposal Rule (Section 300.440 of the NCP and 58 Fed. Reg. 49200). Air monitoring for contaminants of concern must be conducted during the removal action required under this Settlement Agreement in accordance with the approved Removal Work Plan.

f. All contaminated water generated as part of the removal action under this Settlement Agreement must be characterized, treated and disposed of in a wastewater treatment plant (WTP) or Temporary WTP as authorized by the State and or as otherwise approved by U.S. EPA. For purposes of this removal action only, and for purposes of treating and discharging waste water generated as part of the contaminated sediment de-watering process only, Respondents existing Midland Plant WTP is determined to be on-site and, accordingly, modification of Respondent's Midland Plant WTP National Pollution Discharge Elimination System permit to allow treatment and discharge of waste water generated as part of the contaminated sediment de-watering process is not necessary;

g. Stabilization of the area within which the Performance Based removal action Work is conducted, which may include backfilling/grading and erosion control;

h. In no event shall field work begin later than August 15, 2007.

2). Work Plan and Implementation.

a. Within 7 calendar days after the Effective Date, Respondent shall submit to U.S. EPA for approval a draft Removal Work Plan for performing the removal action generally described in Paragraph 15.a. through 15.h., above. The draft Removal Work Plan shall provide a description of, and an expeditious schedule for, the actions required by the Work described in Paragraph 15.a. through 15.h., above, and in this Settlement Agreement.

b. U.S. EPA may approve, disapprove, require revisions to, or modify the draft Removal Work Plan in whole or in part. To the extent practicable, and only to the extent consistent with the NCP, EPA shall first provide Respondent one request for modification and an opportunity to cure all noticed deficiencies within 5 calendar days before EPA modifies the draft Removal Work Plan. If U.S. EPA requires revisions, Respondent shall submit a revised draft Removal Work Plan within 5 calendar days of receipt of U.S. EPA's notification of the required revisions. Respondent shall implement the Removal Work Plan as approved in writing by U.S. EPA in accordance with the schedule approved by U.S. EPA. Once approved, or approved with modifications, the Removal Work Plan, the schedule, and any subsequent modifications shall be incorporated into and become fully enforceable under this Settlement Agreement.

c. Except as previously authorized and/or directed by MDEQ, or as provided by this Settlement Agreement or as directed by U.S. EPA's letter to Respondent dated June 27, 2007, Respondent shall not commence any Work except in conformance with the terms of this Settlement Agreement, or commence implementation of the Removal Work Plan developed hereunder until receiving written U.S. EPA approval pursuant to Paragraph 16(b). U.S. EPA acknowledges that Respondent has commenced mobilization, Site preparation, sheet pile work, and related activities prior to the Effective Date of this Settlement Agreement.

3) Health and Safety Plan. Within 7 calendar days after the Effective Date, Respondent shall submit for U.S. EPA review and comment a plan that ensures the protection of the public health and safety during performance of on-site work under this Settlement Agreement. This plan shall be prepared consistent with U.S. EPA's Standard Operating Safety Guide (PUB 9285.1-03, PB 92-963414, June 1992). In addition, the plan shall comply with all currently applicable Occupational Safety and Health Administration (OSHA) regulations found at 29 C.F.R. Part 1910. If U.S. EPA determines that it is appropriate, the plan shall also include contingency planning. Respondent shall incorporate all changes to the plan recommended by U.S. EPA and shall implement the plan during the pendency of the removal action.

4) Quality Assurance and Sampling.

a. Within 7 calendar days of the Effective Date, Respondent shall submit to U.S. EPA for approval, a Quality Assurance Project Plan (QAPP). Respondent shall use quality assurance, quality control, and chain of custody procedures for all treatability, design, compliance and monitoring samples in accordance with "EPA Requirements for Quality Assurance Project Plans for Environmental Data Operation," (EPA QA/R5) (EPA/240/B-01/003, March 2001); "Guidance for Quality Assurance Project Plans (QA/G5)" (EPA/600/R-98/018, February 1998), and subsequent amendments to such guidelines upon notification by U.S. EPA to Respondent of such amendment. Amended guidelines shall apply only to procedures conducted after such notification. All sampling and analyses performed pursuant to this Settlement Agreement shall conform to U.S. EPA direction, approval, and guidance regarding sampling, quality assurance/quality control (QA/QC), data validation, and chain of custody procedures. Consistent with the foregoing, the methods and procedures contained in Respondent's existing QAPP covering the RCRA corrective actions associated with the Midland Plant shall be used as much as possible. Respondent shall ensure that the laboratory used to perform the analyses participates in a QA/QC program that complies with the appropriate U.S. EPA guidance. Respondent shall follow, as appropriate, "EPA Guidance for Quality Assurance Project Plans," EPA/QA/G-5, EPA/600/R-02/009 (December 2002), "EPA Requirements for Quality Assurance Project Plans," EPA/QA/R-5, EPA/240/B-01/003 (March 2001) and "Instructions on the Preparation of a Superfund Division Quality Assurance Project Plan," EPA Region 5, based on EPA QA/R-5, Revision 0 (June 2000),"Quality

Assurance/Quality Control Guidance for Removal Activities: Sampling QA/QC Plan and Data Validation Procedures" (OSWER Directive No. 9360.4-01, April 1, 1990), as guidance for QA/QC and sampling. Respondent shall only use laboratories that have a documented Quality System that complies with ANSI/ASQC E-4 1994, "Specifications and Guidelines for Quality Systems for Environmental Data Collection and Environmental Technology Programs" (American National Standard, January 5, 1995), and "EPA Requirements for Quality Management Plans (QA/R-2) (EPA/240/B-01/002, March 2001)," or equivalent documentation as determined by U.S. EPA. U.S. EPA may consider laboratories accredited under the National Environmental Laboratory Accreditation Program (NELAP) as meeting the Quality System requirements.

b. Upon request by U.S. EPA or the State, Respondent shall have such a laboratory analyze samples submitted by U.S. EPA or the State for QA monitoring. Respondent shall provide to U.S. EPA and the State the QA/QC procedures followed by all sampling teams and laboratories performing data collection and/or analysis.

c. Upon request by U.S. EPA or the State, Respondent shall allow U.S. EPA, the State or their authorized representatives to take split and/or duplicate samples of any samples collected by Respondent or its contractors or agents while performing the Work. Respondent shall notify U.S. EPA and the State not less than 3 business days in advance of any sample collection activity, unless shorter notice is agreed to by U.S. EPA and the State. U.S. EPA and the State shall have the right to take any additional samples that U.S. EPA or the State deems necessary. Upon request, U.S. EPA and the State shall allow Respondent or its contractors to take split or duplicate samples of any samples taken as part of their oversight of Respondent' implementation of the Work.

5) Post-Removal Site Control. In accordance with the Removal Work Plan schedule, or as otherwise directed by U.S. EPA after consultation with the State, Respondent shall submit a proposal for post-removal Site control consistent with Section 300.415(l) of the NCP and OSWER Directive No. 9360.2-02. Upon approval by U.S. EPA, after a reasonable opportunity for review and comment by the State, of the proposal for post-removal Site control, Respondent shall implement such controls and shall provide U.S. EPA and the State with annual documentation of all post-removal Site control arrangements.

6) Reporting.

a. Respondent shall submit a monthly written progress report to U.S. EPA and to the State concerning actions undertaken pursuant to this Settlement Agreement, beginning 30 days after the Effective Date until EPA's approval of the Final Report under Section XXVI, unless otherwise directed in writing by the OSC. These reports shall thereafter be due by the 15th day of each succeeding month and shall describe all significant developments during the preceding month, including the Work performed and

any problems encountered, validated final analytical data received during the reporting period and developments anticipated during the next reporting period, including a schedule of work to be performed, anticipated problems and planned resolutions of past or anticipated problems.

b. Respondent shall submit to U.S. EPA and to the State three copies of all plans, reports or other submissions required by this Settlement Agreement or the approved Removal Work Plan. Upon written request by U.S. EPA or the State, Respondent shall submit such documents in electronic form.

c. If the Respondent owns real property at the Site where work related to this Settlement Agreement will be performed, such Respondent shall, at least 30 days prior to the conveyance of any interest in such property, give written notice to the transferee that the property is subject to this Settlement Agreement, and written notice to U.S. EPA and the State of the proposed conveyance, including the name and address of the transferee. Respondent also agrees to require that its successors provide the same notice to U.S. EPA, the State, and to any subsequent transferee that is required of Respondent in the immediately preceding sentence. Respondent further agrees to require its successors to comply with Sections IX (Site Access) and X (Access to Information).

7) Final Report. Within 90 calendar days after receipt of all manifests, validated final analytical and QA/QC data and completion of all work required by Section VIII of this Settlement Agreement, except for any continuing obligations required by this Settlement Agreement (e.g., monitoring, record retention and payment of Future Response Costs), Respondent shall submit for U.S. EPA review and approval, in consultation with the State, a final report summarizing the actions taken to comply with this Settlement Agreement. The final report shall conform, at a minimum, with the requirements set forth in Section 300.165 of the NCP, 40 C.F.R. '300.165 entitled "OSC Reports" and with the guidance set forth in "Superfund Removal Procedures: Removal Response Reporting – POLREPS and OSC Reports" (OSWER Directive No. 9360.3-03, June 1, 1994). The final report shall include: 1) a good faith estimate of total costs or a statement of actual costs incurred in complying with this Settlement Agreement; 2) a listing of quantities and types of materials removed off-site or handled on-site; 3) a listing of the ultimate destination(s) of those materials; 4) a presentation of the final validated analytical results of all sampling and analyses performed; 5) and accompanying appendices containing all relevant documentation generated during the removal action (e.g., manifests, invoices, bills, contracts, and permits). The final report shall also include the following certification signed by a person who supervised or directed the preparation of the final report:

"Under penalty of law, I certify that to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of the report, the information submitted is true, accurate, and complete. I am aware that there are significant

penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

8) Off-Site Shipments.

a. Respondent shall, prior to any off-site shipment of Waste Material from the Site to an out-of-state waste management facility, provide written notification of such shipment and of any contemplated additional shipments of Waste Material to the appropriate state environmental official in the receiving facility's state and to the OSC. However, this notification requirement shall not apply to any off-Site shipments when the total volume of all such shipments will not exceed 10 cubic yards.

b. Respondent shall include in the written notification the following information: 1) the name and location of the facility to which the Waste Material is to be shipped; 2) the type and quantity of the Waste Material to be shipped; 3) the expected schedule for the shipment of the Waste Material; and 4) the method of transportation. Respondent shall notify the state in which the planned receiving facility is located of major changes in the shipment plan, such as a decision to ship the Waste Material to another facility within the same state, or to a facility in another state.

c. Before shipping any hazardous substances, pollutants, or contaminants from the Site to an off-Site location, Respondent shall obtain U.S. EPA's certification that the proposed receiving facility is operating in compliance with the requirements of CERCLA Section 121(d)(3), 42 U.S.C. § 9621(d)(3), and 40 C.F.R. § 300.440. Respondent shall only send hazardous substances, pollutants, or contaminants from the Site to an off-Site facility that complies with the requirements of the statutory provision and regulation cited in the preceding sentence.

The response action will be conducted in a manner not inconsistent with the NCP. The OSC has initiated planning for provision of post-removal Site control consistent with the provisions of Section 300.415(l) of the NCP.

The response actions described in this memorandum directly address actual or threatened releases of hazardous substances, pollutants, or contaminants at the Reach D Area which may pose an imminent and substantial endangerment to public health, welfare and the environment. These response actions do not impose a burden on the affected property disproportionate to the extent to which that property contributes to the conditions being addressed.

These activities will require an estimated 120 on-site working days to complete.

B. Applicable or Relevant and Appropriate Requirements

All applicable or relevant and appropriate requirements (ARARs) of federal and state

law will be complied with to the extent practicable. By letter dated June 28, 2007, Region 5 requested that MDEQ identify potential state ARARs for this response action. Any state ARARs identified in a timely manner for this removal action will be complied with to the extent practicable.

VI. EXPECTED CHANGE IN THE SITUATION SHOULD ACTION BE DELAYED OR NOT TAKEN

Continued risk to public health and the environment will result if response action is delayed or not taken. Delayed action increases the likelihood that human and/or wildlife populations with access to the area will come into direct contact with dioxin-contaminated sediments and floodplain soils.

VII. OUTSTANDING POLICY ISSUES

No outstanding policy issues have been identified in relation to the Reach D Area of the Tittabawassee River Dioxin Spill Site.

VIII. ENFORCEMENT

For administrative purposes, information concerning the enforcement strategy associated with this removal action is contained in a confidential Enforcement Addendum.

IX. RECOMMENDATION

This decision document represents the selected response action for the Reach D Area of the Tittabawassee River Dioxin Spill Site. It was developed in accordance with CERCLA as amended, and is not inconsistent with the NCP. This decision is based upon the Administrative Record for the removal action, an index of which is attached to this Action Memorandum.

Conditions at the Reach D Area meet the criteria of Section 300.415(b)(2) of the NCP for a removal action, and I recommend your approval of the proposed removal action. Region 5 expects that the potentially responsible party will perform all removal actions under the oversight of the OSC. You may indicate your decision by signing below.

APPROVE: _____ DATE: 7/12/07

for Richard C. Karl, Director
Superfund Division

DISAPPROVE:_____ DATE:_____

Richard C. Karl, Director
Superfund Division

Attachments:

Enforcement Addendum
Environmental Justice Analysis
Attachment 1: Administrative Record Index

cc: D. Chung, U.S. EPA, 5203-G
M. Chezik, U.S. DOI, w/o Enf. Addendum
Steven E. Chester, Director, Michigan DEQ, w/o Enf. Addendum
Michael Cox, Michigan Attorney General, w/o Enf. Addendum

BCC PAGE

HAS BEEN REDACTED

NOT RELEVANT TO THE SELECTION OF THE REMOVAL ACTION

ATTACHMENT 1

ADMINISTRATIVE RECORD INDEX
TITTABAWASSEE RIVER DIOXIN SPILL SITE
MIDLAND, MIDLAND COUNTY, MICHIGAN
JULY 2007

ORIGINAL
JULY 12, 2007

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	3/04/02	MI Dept. of Community Health/ ATSDR	U.S. EPA	Petitioned Health Consultation: Dow Chemical Company Michigan Division Dioxin Contamination in Soil in Midland, Midland County, Michigan	113
2	10/02	ACOE	File	Sampling Data for Saginaw River Dioxins	7
3	11/02	MDEQ	File	Tittabawassee River Flood Plain Soil Sampling	167
4	02/20/07	MDEQ/ USACE	Dow Chemical Company/ Ann Arbor Technical Services,	Joint Permit Application to Remove Contaminated Deposits from the Tittabawassee River/Flume Along NE Bank, 1200 ft. Upstream of Dow Dam w/Attachments	44
5	03/30/07	MDEQ/ USACE	Dow Chemical Company/ Ann Arbor Technical Services, Inc.	Joint Permit Application to Remove Contaminated Deposits from the Tittabawassee River/SW Side of Saginaw Road, 1 Mile SE of Baily Bridge Road w/Attachments	27
6	06/03	State of Michigan	Public	Soil Movement Advisory for Private, Public, and Commercial Projects for the Tittabawassee River Furan and Dioxin Flood Plain Soil Soil and Sediment Contamination	2
7	07/02/07	Dow	U.S. EPA	Agency Presentation Slides for the Tittabawassee River Reach D Remediation Project Approach (ID&D w/Geotubes)	28
8	07/05	MDEQ	Public	Revised Supplemental Advisory: FAQs for Owners of Property Affected by Mi-	4

				grating Dioxin Contamination	
9	01/21/07	Dow	MDEQ	Progress Report, January 21, 2007 for the Dow Tittabawassee River PCAPs	5
10	06/07/07	Guerriero, M., U.S. EPA	Bruchmann, G., MDEQ	Letter re: EPA Comments on the Revised RI Work Plans Submitted by Dow Chemical Company on December 1, 2006 in Response to March and April Notices of Deficiency	2
11	10/14/04	MDEQ	MDEQ	MDEQ Analysis of Wild Game from the Tittabawassee River Flood Plain	2
12	07/04	Dow Chemical Company	MDEQ	Dow Chemical Wild Game Study – Deer Liver	1
13	07/04	Dow Chemical Company	MDEQ	Dow Chemical Wild Game Study – Deer Muscle	1
14	07/04	Dow Chemical Company	MDEQ	Dow Chemical Wild Game Study – Turkey	1
15	07/04	Dow Chemical Company	MDEQ	Dow Chemical Wild Game Study – Squirrel	1
16	03/04/02	U.S. Dept. of Health and Human Services/ ARSDR	U.S. EPA	Petitioned Health Consultation: Public Comment Release, Dioxin Contamination in Soil, Dow Chemical Company Michigan Division Midland Location, Midland County, Michigan	75
17	03/15/02	U.S. Dept. of Health and Human Services/ ARSDR	U.S. EPA	Petitioned Health Consultation: Public Comment Release, Dioxin Contamination in Soil in the Tittabawassee River Floodplain South of Midland, Michigan	79
18	08/29/02	MDEQ	Office of the Great Lakes, MDEQ	Baseline Chemical Characterization of Saginaw Bay Watershed Sediments	163
19	04/02-03	MDEQ	U.S. EPA	Fish Sampling Data from Smiths Crossing Road at the Tittabawassee River April 6, 1995-April 2, 2003	16

20	05/18/04	Smith, H., State of Delaware	Van Dam, T., Dow Chemical Company	Restated Certificate of Incorporation of the Dow Chemical Company	10
21	06/00/03	MDEQ	U.S. EPA	Final Report – Phase II Tittabawassee/Saginaw River Dioxin Flood Plain Sampling Study	49
22	06/04/03	MDEQ	File	Data Sampling: Sediment Results from the Tittabawassee and Saginaw Rivers	7
23	06/12/03	MDEQ	Dow Chemical Company	Hazardous Waste Management Facility Operating License Amendment 3	90
24	08/27/03	Dow Chemical Company	File	Dow Chemical Michigan Operations Compliance Activity Schedule (Duration in Work Days)	6
25	10/00/03	Galbraith Environmental Services, LLC	MDEQ	Tittabawassee River Aquatic Ecological Risk Assessment/Polychlorinated Dibenzo-P-Dioxins, Polychlorinated Dibenzofurans	63
26	10/00/03	Galbraith, H., Galbraith Environmental Sciences	MDEQ	Presentation Slides: Tittabawassee River Aquatic Ecological Risk Assessment-Results	58
27	10/21/03	Taylor, A., MDEQ	Carrington, S., Dow Chemical Company	Letter re: Work Scope for the Inierim Response Activity of Evaluating Wild Game from the Tittabawassee River Floodplain for Human Consumption w/Attachment	5
28	10/23/03	Galbraith, H., Galbraith Environmental Sciences	Brouillet, A., MDEQ	Memorandum re: Ecological Impacts due to PCDD/PCDF Contamination Along Tittabawassee River	2
29	11/20/03	MDEQ	U.S. EPA	Figure: Tittabawassee and Saginaw Rivers, and Saginaw Bay Sediment and Floodplain Soil Data in ppt TEQ Figure 1 – WHO Mammalian	1
30	00/00/04	MDEQ	File	Sampling Data from the Shiawassee and Saginaw River/Bay – Detects Only	1
31	04/00/04	Galbraith	MDEQ	Tittabawassee River Flood-	57

		Environmental Sciences, LLC		plain Screening Level Ecological Risk Assessment PCD-*P*-Ds and PCDFs	
32	04/14/04	Galbraith, H., Galbraith Environmental Sciences	Brouillet, A., S. Kaelber-Matlock, MDEQ	Memorandum re: Review of Recently Published Studies on Effects of Dioxin-like Contaminants on Tree Swallows and Mink	5
33	07/16/04	Galbraith, H., Galbraith Environmental Sciences	Brouillet, A., S. Kaelber-Matlock & B. Brouillet, MDEQ	Memorandum re: GES Comments on Entrix (2004) Wild Game Study Report	6
34	07/22/04	Galbraith, H., Galbraith Environmental Sciences	Brouillet, A., S. Kaelber-Matlock & B. Brouillet, MDEQ	Memorandum re: GES Analysis of Data in Entrix (2004) Wild Game Study Report	5
35	07/30/04	Clark, M., U.S. EPA	File	Health Risk Analysis of Tittabawassee Fish with Dioxin and Recommendations for Risk Evaluation	8
36	06/00/04	ENTRIX, Inc.	Dow Chemical Company	Evaluation of PCDDs and PCDFs in Wild Game Taken From the Floodplain Along the Tittabawassee River	425
37	07/00/04	Dow Chemical Company	U.S. EPA	A Preliminary Evaluation of Dioxins (Polychlorodibenzodioxins and Polychlorodibenzofurans) in Wild Game Taken from the Floodplain Along the Tittabawassee River	14
38	02/28/05	Galbraith, H., Galbraith Environmental Sciences	Brouillet, A., B. Brouillet & S. Kaelber-Matlock, MDEQ	Memorandum re: Contamination of the Tittabawassee River Watershed by Dioxins and Furans	9
39	03/22/05	Pepin, R., U.S. EPA	Clark, M., U.S. EPA	Memorandum re: Dioxin and Congener Levels in the Tittabawassee Watershed w/Attachment	18
40	07/27/05	U.S. Dept. of Health and Human Services/ ARSDR	U.S. EPA	Health Consultation: Tittabawassee River Fish Consumption Health Consultation	41
41	02/09/06	MDEQ	U.S. EPA	Presentation Slides: MDEQ *Dioxin Data Overview* –	10

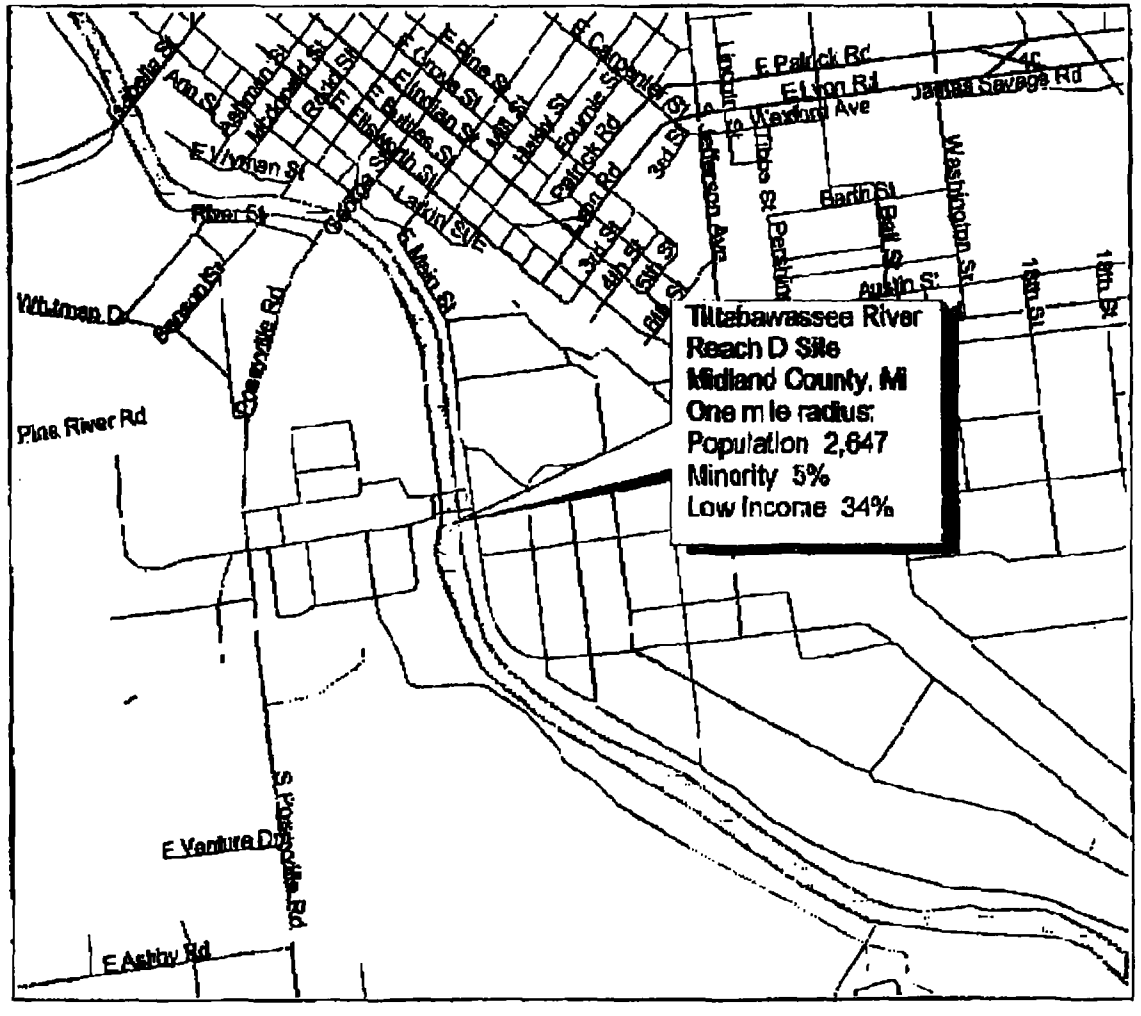
				Shiawassee and Saginaw River Watersheds	
42	05/02/06	MDEQ	U.S. EPA	Final Report: Dioxin-Like Toxicity in the Saginaw Bay Watershed and PBDE Distribution in the Saginaw Bay Watershed	77
43	06/07/07	U.S. EPA	MDEQ	U.S. EPA Comments on Responses to MDEQ's March 2 and April 13, 2006 Notices of Deficiency Submitted to MDEQ by Dow Chemical Company	44
44	06/29/06	Brouillet, A., MDEQ	Distribution List	Memorandum re: Interim Response Action Decision Process; Sediment Probable Effects Concentrations in the Tittabawassee River	29
45	12/01/06	Ann Arbor Technical Services	Dow Chemical Company	Remedial Investigation Work Plan for the Tittabawassee River and Upper Saginaw River Floodplain Soils Vol. 1	1233
46	12/01/06	Ann Arbor Technical Services	Dow Chemical Company	Remedial Investigation Work Plan for the Tittabawassee River and Upper Saginaw River Floodplain Soils Vol. 2	1810
47	12/18/06	Simon, P. & P. Simon, Ann Arbor Technical Services, Inc.	Taylor, A., MDEQ	Memorandum re: Reach O 322+50 In-Channel Deposit for the Upper Tittabawassee River w/Attachments	18
48	12/20/06	Baker, B., Dow Chemical Company	Bruchmann, G., MDEQ	Reach O Plan and Pilot Corrective Action Plan w/Cover Letter	29
49	12/20/06	Simon, P. & P. Simon, Ann Arbor Technical Services, Inc.	Taylor, A., MDEQ	Letter re: Pilot Corrective Actions at the Upper Tittabawassee River w/Attachments	
50	12/20/06	Sygo, J., MDEQ	Guerriero, M., U.S. EPA	Letter re: Dow Chemical Company Tittabawassee River Interim Response Activities and Pilot Corrective Action Plans	3

51	12/21/06	Bruchmann, G., MDEQ	Cochran, G., Dow Chemical Company	Letter re: the Dow Chemical Company, Tittabawassee River Interim Response Activities for Reach O Plan and Pilot Action plan	4
52	04/07	Michigan Dept. of Community Health	Public	2007 Michigan Family Fish Consumption Guide	31
53	02/01/07	Ann Arbor Technical Services	Dow Chemical Services	GeoMorph Pilot Site Characterization Report for the Upper Tittabawassee River and Floodplain Soils	1233
54	02/20/07	Baker, B., Dow Chemical Company	Bruchmann, G., MDEQ	PCAP Progress Reports/ Work Plans for Reaches D, O, J/K w/Cover Letter	22
55	03/00/07	Ann Arbor Technical Services	File	Sampling Data for Reach D of the Tittabawassee River Site	2
56	03/08/07	MDEQ	Dow Chemical Company	MDEQ Conditional Permit w/Attachment	14
57	03/20/07	Baker, B., Dow Chemical Company	Bruchmann, G., MDEQ	March 20, 2007 Status Reports for Tittabawassee River Reach o and J-K PCAP w/Cover Letter	17
58	03/25/07	Ann Arbor Technical Services, Inc.	Dow Chemical Company	Organic Analysis Data Summary Sheet for Reach D PCAP	32
59	03/30/07	Simon, P., Ann Arbor Technical Services, Inc.	Haas, J., MDEQ	Joint Permit Application and Application Fee for Pilot Corrective Actions in Reach O of the Upper Tittabawassee River w/ Cover Letter	55
60	04/19/07	Dow Chemical Company	U.S. EPA	Reach Project Sediment Removal Transportation and Disposal Work Plan	10
61	04/19/07	Dow Chemical Company	U.S. EPA	Reach D Project Sediment Dewatering Containment Facility Work Plan	7
62	04/19/07	Dow Chemical Company	U.S. EPA	Reach D Project Permanent Sheet Piling Wall Work Plan	4

63	04/20/07	Baker, B., Dow Chemical Company	Howe, C., MDEQ	Submittal of Reach J-K and Reach O PCAP April 2007 Progress Report w/Cover Letter	17
64	04/20/07	Cochran, G., Dow Chemical Company	Bruchmann, G., MDEQ	Letter re: April 2007 Progress Report for the Reach D PCAP Project w/Attachment	8
65	05/20/07	Cochran, G., Dow Chemical Company	Bruchmann, G., MDEQ	Letter re: May 2007 Progress Report for the Reach D PCAP Project and the Geophysical Summary Report, Final Geotube Containment Facility Design Drawings and SPMD Study Summary w/Attachments	118
66	05/20/07	Cochran, G., Dow Chemical Company	Bruchmann, G., MDEQ	May 2007 Reach D Progress Report for the Upper Tittabawassee River May 2007 w/Cover Letter	6
67	05/21/07	Baker, B., Dow Chemical Company	Howe, C., MDEQ	Submittal of Reach J-K, UTR Bank Stability and Reach O PCAP May 2007 Progress Report w/Cover Letter	46
68	06/29/07	Baker, B., Dow Chemical Company	Howe, C., MDEQ	Submittal of Reach J-K, UTR Bank Stability and Reach O PCAP June 2007 Progress Report W/Cover Letter	13
69	12/00/07	Ann Arbor Technical Service	U.S. EPA	UTR Pilot Corrective Action Plan Timeline (December 2006-December 2007)	2

Region 5 Superfund EJ Analysis

Tittabawassee River Reach D Site Midland, MI


Tittabawassee River
Reach D Site
Midland County, MI
One mile radius:
Population 2,647
Minority 5%
Low Income 34%
E Patrick Rd
E Ivon Rd
James Savage Rd
Waxford Ave
Washington St
Barlin St
Austin St
E Main St
E Ellsworth St
E Cross St
E Pine St
E Wyman St
River St
Whitman Dr
Pine River Rd
E Ashby Rd
E Venture Dr
S Poseyville Rd
Poseyville Rd
Jefferson Ave
Lincoln St
Perkins St
Ball St
Lakint St
Ann St
Ashmun St
McDonald St
Rand St
Hadley St
Eastlake St
Eastlake St
Eastlake

ENFORCEMENT ADDENDUM

TITTABAWASSEE RIVER DIOXIN SPILL SITE
MIDLAND, MIDLAND COUNTY, MICHIGAN
JULY 2007
2 PAGES

HAS BEEN REDACTED

ENFORCEMENT CONFIDENTIAL
NOT SUBJECT TO DISCOVERY