STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING

RICK SNYDER
GOVERNOR

DAN WYANT
DIRECTOR

June 1, 2012

Mr. Steven C. Lucas
Senior Remediation Leader
The Dow Chemical Company
1790 Building, Washington Street
Midland, Michigan 48674

Dear Mr. Lucas:

SUBJECT: Approval of Interim Response Activity Plan Designed to Meet Criteria (IRDC) for Midland Area Soils (Work Plan); The Dow Chemical Company (Dow), Michigan Operations, Midland Plant; Midland, Michigan; MID 000 724 724

The Department of Environmental Quality (DEQ), Resource Management Division (RMD), has completed a review of the Work Plan. The Work Plan was submitted by Dow on March 7, 2012, and was most recently revised on May 25, 2012, in response to review comments from the DEQ. The Work Plan was submitted as part of corrective action work required under Condition XI.G. of the Hazardous Waste Management Facility Operating License (License) issued to Dow by the DEQ in 2003 pursuant to Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), and the federal Resource Conservation and Recovery Act of 1976.

This Midland Area Soils IRDC was designed to be an important and major part of final remedial action intended to represent the response action for direct contact to soils for Dow's off-site corrective action obligations under Conditions XI.B. and XI.J. of the License. Therefore, the DEQ conducted public participation pursuant to Condition XI.J.2. of the License and R 299.9511 of the Part 111 administrative rules, including a public comment period held from March 11, 2012, to April 25, 2012, and a public hearing held on April 17, 2012. The enclosed Notice of Final Decision and Responsiveness Summary responds to significant comments submitted during the public comment period, describes the significant changes made to the draft Work Plan, and provides the basis of the DEQ's decision on the site-specific residential direct contact cleanup criterion for Midland Area Soils. The DEQ will be sending notice of this decision to all persons on the facility mailing list and to the appropriate units of state and local government.

Based on the DEQ's review of the revised Work Plan submitted on May 25, 2012, and review of the public comment obtained during the public comment period, the revised Work Plan is hereby approved. In accordance with Condition XI.G.2. of the License, the approved Work Plan becomes an enforceable condition of the License. This approval constitutes a CA400 Remedy Selection Determination for Midland Area Soils.

The DEQ reserves its rights in regard to hazardous substances, as defined in Section 20101 of Part 201, Environmental Remediation, of Act 451, beyond those identified and addressed as a part of the revised Work Plan. This approval does not convey any rights regarding unknown environmental conditions or compliance with other environmental laws and regulations.

Should you have any questions regarding this approval, please contact Ms. DeLores Montgomery, Chief, Hazardous Waste Section (HWS), RMD, at 517-373-7973 or montgomeryd1@michigan.gov; or Mr. Al Taylor, HWS, RMD, at 517-335-4799 or taylora@michigan.gov; or you may contact them at DEQ, P.O. Box 30241, Lansing, Michigan 48909-7741; or you may contact me.

Sincerely,

Liane J. Shekter Smith, P.E., Chief
Resource Management Division
517-373-9523

Enclosures
cc: Mr. Jose Cisneros, U.S. Environmental Protection Agency
Mr. Brian Rudolph, DEQ
Mr. David Slayton, DEQ
cc/enc: Mr. Greg Rudloff/Dr. Mario Mangino, U.S. Environmental Protection Agency
Mr. Jim Sygo, DEQ Deputy Director
Ms. DeLores Montgomery, DEQ
Mr. Jon Bloemker/Ms. Trisha Confer, DEQ
Ms. Cheryl Howe, DEQ
Dr. Deb MacKenzie-Taylor, DEQ
Mr. Al Taylor, DEQ
Operating License File

NOTICE OF FINAL DECISION
AND
RESPONSIVENESS SUMMARY

Midland Area Soils Off-Site Corrective Action Under the Hazardous Waste Management Facility Operating License Issued to
The Dow Chemical Company
Midland, Michigan

Michigan Operations, Midland Plant
MID 000 724 724

June 1, 2012

Michigan Department of Environmental Quality
Resource Management Division

On April 17, 2012, the Michigan Department of Environmental Quality (DEQ), Resource Management Division (RMD), held a public hearing to receive comments on the Interim Response Activity Plan Designed to Meet Criteria for Midland Area Soils (Work Plan) submitted by The Dow Chemical Company (Dow), Michigan Operations, Midland Plant, located at 1790 Building, Midland, Michigan 48674, on March 7, 2012, as part of corrective action work required under the Hazardous Waste Management Facility Operating License (License) issued to Dow by the DEQ in 2003 pursuant to Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), and the federal Resource Conservation and Recovery Act of 1976 (RCRA). The DEQ and Dow reached conceptual agreement on the proposed Midland cleanup plan that was introduced at a public information meeting on March 1, 2012. In response to review comments from the DEQ after the public hearing, Dow revised the Work Plan on May 25, 2012. The DEQ approved the revised Work Plan on June 1, 2012.

The public hearing and public comment period on the draft Work Plan were announced in the Midland Daily News on March 11, 2012. Three informal public availability sessions were also announced in the public notice and held on March 19, 2012, March 28, 2012, and March 29, 2012. The public comment period extended from March 11, 2012, to April 25, 2012. On March 26, 2012, and April 9, 2012, notices regarding the public hearing and public availability sessions on the proposed Work Plan also appeared in the DEQ Environmental Calendar, which is published every two weeks to provide public notice of pending public hearings, DEQ decisions, etc.

In accordance with Condition XI.J.2. of the License and R 299.9511 of the Part 111 administrative rules, the DEQ has prepared a Responsiveness Summary to respond to significant comments submitted during the public comment period and to describe any significant changes made to the draft Work Plan. Oral comments were received from three individuals during the public hearing. Written comments were received from approximately 10 individuals during the public hearing and public comment period. The DEQ required Dow to make some modifications to the draft Work Plan as a result of certain comments that were received. A summary of the comments received and the DEQ responses are presented in Attachment 1, Summary of Comments. Most of these responses have also been incorporated into a consolidated DEQ Question and Answer Document on the Cleanup of Midland Area Soils found at www.michigan.gov/deqdioxin under “Midland Area Soil Cleanup”. The notation (Q&A #) after each comment indicates the corresponding question and answer in the consolidated DEQ Question and Answer Document on the Cleanup of Midland Area Soils.

Significant changes that were made to the draft Work Plan by Dow in response to review comments by the DEQ prior to approval are summarized in Attachment 2, Summary of Changes.

Attachment 3, the DEQ Basis of Decision and Response for a Site-Specific Residential Direct Contact Cleanup Criterion (SSRDCC) for Dioxins/Furans (D/F) Toxic Equivalents (TEQ) for Midland Area Soils, provides the DEQ’s basis for the approval of the site-specific 250 parts per trillion (ppt) action level for dioxins and furans contamination in Midland Area Soils.

The approved Work Plan along with the Notice of Final Decision and Responsiveness Summary may be reviewed at Reference Desk of the Grace A. Dow Memorial Library, 1710 West St. Andrews Street, Midland, Michigan, and the DEQ, Saginaw Bay District Office, 401 Ketchum Street, Suite B, Bay City, Michigan (contact Ms. Trisha Confer at 989-894-6296). The Work Plan and related materials are also available at the DEQ, RMD, Constitution Hall, Atrium North,

525 West Allegan Street, Lansing, Michigan (contact Mr. Al Taylor at 517-335-4799) and at http://www.michigan.gov/deqdioxin under “Midland Area Soil Cleanup”. Copies of the documents may be obtained for the cost of reproduction by sending your request to Mr. Al Taylor, DEQ, RMD, P.O. Box 30241, Lansing, Michigan 48909 7741 or taylora@michigan.gov. Depending upon the items requested, there may be a charge for reproduction and mailing costs. The Notice of Final Decision and Responsiveness Summary is being sent, at no charge, to the individuals who made oral comments at the public hearing or who submitted written comments during the public comment period.

NOTE: To have your name added to receive mailings such as this or removed from the DEQ’s Dow facility mailing list, please contact Ms. Lindacarol Leiter at leiterl@michigan.gov or at 517-373-9875.

ATTACHMENT 1
Summary of Comments

COMMENT 1 (Q&A 4): When specifically did the Dow incinerator stop releasing elevated levels of dioxins?

DEQ RESPONSE: Dow's incineration history is described in Section 2.0 of the Work Plan. To summarize, Dow began burning liquid organic tar wastes on-site as early as the 1930s in tar burners that vented directly to the atmosphere. Some tars were also burned periodically for energy recovery in Dow's previously-operated on-site coal-fired power plant for a time until the 1980s. Solid wastes were burned without any pollution controls prior to 1948 when a rotary kiln incinerator was placed into service. Improvements to air pollution controls on the tar burners and rotary kiln incinerator were made over several decades to reduce emissions, but it was not until the 1988-1990 time period that Dow's modernized 703 and 830 Incinerators demonstrated the achievement of four to five nines (i.e., 99.99 to 99.999 percent) destruction efficiency. It was at this time that the DEQ had reliable data that indicated that elevated levels of dioxins were no longer being released from on-site incineration.

The 703 and 830 Incinerators were replaced by Dow's 32 Incinerator in 2003, further reducing dioxin emissions from incineration. The 32 Incinerator was designed to comply with the federal Hazardous Waste Combustor Maximum Achievable Control Technology (MACT) rule that was issued in 2005. These requirements stemmed from a 1999 federal joint Clean Air Act/RCRA rule that promulgated more stringent hazardous waste combustor emissions standards using a MACT approach for dioxins, furans, mercury, cadmium, lead, particulate matter, hydrogen chloride, chlorine gas, hydrocarbons, carbon monoxide, and several low-volatile metals.

There is extensive ongoing monitoring to ensure that unacceptable levels of dioxins and other pollutants are not being released through the 32 Incinerator stack. As part of this monitoring, comprehensive performance testing must be conducted roughly every five years. Testing in 2003 and 2009 demonstrated that dioxin and furan emissions were substantially below federal and state emission requirements.

Another environmental monitoring program that is being done under Dow's License requires the sampling of soil boxes that ring the site every six months for dioxins and furans. From this monitoring, we are able to get a trend analysis of the dioxin levels from air releases due to burning and production processes on the plant site, as well as trackout from the facility. There are much higher levels of dioxins and furans on the plant site than are present outside the plant site and we do not want those getting off-site either. If a high level of dioxins or furans is seen in the soil box monitoring, that triggers a process where an investigation occurs on-site and practices are changed to prevent the additional release of dioxin above acceptable levels.

COMMENT 2 (Q&A 5): A commenter stated that it was mentioned during the public hearing presentation that the incineration is at five nines and that that it has been a while since they worked on incinerator issues, but they recalled that the goal was to achieve six nines efficiency. The commenter stated that it was the first they had heard that five nines is acceptable rather than six nines.

DEQ RESPONSE: State and federal combustion regulations require six nines (99.9999 percent) destruction for incineration of a number of dioxin-contaminated wastes from specific manufacturing processes (hazardous waste numbers F020, F021, F022, F023, F026, and F027, commonly referred to as F020-series wastes). Rather than incinerating certain F020-series wastes in its on-site 32 Incinerator, Dow sends such wastes off-site for management. Although

Dow does incinerate other dioxin-contaminated wastes on-site, they do not fall under the F020-series hazardous waste classifications so they are allowed to be incinerated at five nines (99.999 percent) efficiency pursuant to Dow's Renewable Operating Permit (ROP) Permit Number MI-ROP-A4033-2011a issued under state law by the DEQ, Air Quality Division, on April 11, 2011, and revised April 12, 2012. Incineration of F020-series wastes in Dow's 32 Incinerator is prohibited under the ROP and License.

COMMENT 3 (Q&A 18): A commenter heard that there were high levels of dioxin found at the Eastlawn School in the 1970s or 1980s. Is this true? What will be done to address this along with other schools and playgrounds?

DEQ RESPONSE: The only sample data the DEQ is aware of at Eastlawn School was a single sample taken in 1996 that shows the concentration was 100 ppt of dioxin. All schools, playgrounds, gardens, and other properties in the Resolution Area where children are present, or areas where people engage in activities like those at residential properties, will be tested and cleaned up if they exceed the proposed residential action level of 250 ppt. As remediation design sampling is conducted, if soil concentrations are exceeding the 250 ppt action level at properties in the initial Resolution Area directly south of Eastlawn School, then the school property will also be included in the design sampling area to determine if cleanup is necessary.

COMMENT 4 (Q&A 21): A few people raised concerns for sample design and concentrations close to the 250 ppt action level, including whether they could request resampling.

DEQ RESPONSE: Properties where data show dioxin concentrations of 250 ppt or less are not considered contaminated and do not need to be cleaned up by Dow. The Work Plan is designed to assure that the data from soil samples will conservatively represent the conditions at each property and that measured concentrations of 250 ppt or less are safe. The action level itself is based on protective assumptions about exposure – it is designed to protect the most exposed and most sensitive people, including children. The soil sampling process is designed to best represent the conditions on each property by combining samples from multiple locations on the property. In addition, three combined samples will be taken from each property as part of the sampling design. If the first sample that is tested is in a range between 220 and 280 ppt, additional samples will be analyzed to give a high degree of confidence (95 percent) that soil concentrations above 250 ppt will be identified and cleaned up.

COMMENT 5 (Q&A 22): Can a property owner decline to allow sampling if they have knowledge that the area has been disrupted by water/sewer line installation, etc. and they believe this has altered the location of contamination?

DEQ RESPONSE: The DEQ encourages every property owner in the Resolution Area to participate in the sampling and, if necessary, the cleanup process. However, it is up to the property owner to decide whether to allow sampling and/or cleanup to occur on his or her property. Water or sewer line installation is likely to have affected only a small portion of a property. Testing of the entire property will provide the best information to determine if the action level is exceeded and cleanup for the whole property is necessary.

COMMENT 6 (Q&A 23): Several houses in a commenter's neighborhood were moved from locations closer to Dow during times when chemical emission releases were regularly occurring. Can considerations be made to adjust testing on those properties to include those specific houses as well?

DEQ RESPONSE: Soil sampling for properties that had houses moved onto them will be the same as those with houses that were built in place. Although the DEQ does not have details of when and where this occurred, the anecdotes that have been relayed indicate this occurred more than 40 years ago and, therefore, any dust in the house should be related to the soil at the current location of the houses. The Work Plan was revised to address the potential for cleaning of duct work in houses where appropriate. At this time, the DEQ does not anticipate that testing will need to be adjusted for relocated houses.

COMMENT 7 (Q&A 25): Where did the 250 ppt come from? How did the DEQ decide that 250 ppt dioxin was the appropriate action level? Where can the Midland-specific data and information that was used to establish the 250 ppt action level be reviewed?

DEQ RESPONSE: The basis for the DEQ's determination that 250 ppt dioxin is an acceptable action level is contained in Attachment 3, DEQ Basis of Decision and Response for a Site-Specific Residential Direct Contact Cleanup Criterion (SSRDCC) for Dioxins/Furans (D/F) Toxic Equivalents (TEQ) for Midland Area Soils. As detailed in the attachment, the DEQ conducted extensive reviews of available scientific information about the risks posed by dioxins and also carefully reviewed site-specific information provided by Dow to determine that 250 ppt action level for dioxin would protect the public according to the requirements of state law. This information includes a large body of data in the scientific literature, assessments conducted by national and international public health organizations, and documentation of studies conducted by Dow to determine how dioxin that is present in soil in Midland is expected to be absorbed into the bodies of people who are exposed. The June 1, 2012 document, a Midland Action Level Fact Sheet, and other information about Midland Area Soils cleanup is available at: http://www.michigan.gov/deq/0,4561,7-135-3307_29693_21234-271213--,00.html.

COMMENT 8 (Q&A 26): The 250 ppt was based on site-specific criteria involving the analysis of Midland soils – are Midland soils that much different than soils in other communities in Michigan?

DEQ RESPONSE:
Michigan's environmental cleanup law requires the DEQ to establish cleanup criteria for residential and nonresidential land use throughout Michigan using standard assumptions. These assumptions include things such as frequency and duration of exposures, the toxic properties of hazardous substances, and the level of risk that is deemed, by law, to be acceptable. Criteria developed with the standard assumptions are called "generic" criteria for use across the entire state.

The law also allows for site-specific criteria, which are essentially a refinement of the generic criteria, because they use site-specific exposure information instead of some of the standard assumptions.

In the case of Midland soils, the data that Dow developed show that some of the standard assumptions are more conservative than what actually occurs in Midland. For example, studies of Midland soil have been done to evaluate the absorption of dioxin by animals that are exposed in their feed and that is used to determine human absorption of dioxin. Taking this data into account is not less protective, it is simply a more thorough and site-specific approach to developing the action level/criterion.

Some of the Midland soils site-specific considerations that were approved by the DEQ actually are more conservative than the standard assumptions that are made to address conditions across the entire state. An example of a factor that was used for the site-specific Midland calculation (that is more conservative than the standard assumption) is the number of days without frozen soils or snow cover in Midland.

Refer to the Attachment 3 for the details of the DEQ's review and the final inputs that were used to calculate the 250 ppt dioxin action level.

COMMENT 9 (Q&A 36): The contamination, which contains many chemicals, but is characterized by dioxin-like compounds, threatens not only the health of residents, but also the food web. The cleanup number in Midland is based on the presumption that no one in Midland will ever raise chickens or other animals for food within the city limits. A commenter stated that they think that this indefinite limit on future uses in the community is unwise and potentially unsafe.

DEQ RESPONSE: Neither the generic residential cleanup criteria for all chemicals nor the Midland site-specific residential cleanup criterion consider food-chain exposures. Typical residential use does not include raising animals for food, although that can be considered under the cleanup law, as appropriate. A recent proposal to change a city of Midland ordinance to allow residents to raise chickens was defeated. The ordinance that prevents the raising of chickens (and other animals products for human consumption) will need to be part of the overall remedy implemented by Dow. The current ordinance, or a modification if one is necessary, will be reviewed by the DEQ before it is approved to make sure it is enforceable, that it is clear to readers of the ordinance and future officials that it is necessary as an exposure control due to releases of dioxin, and that it includes a provision to notify the DEQ prior to any changes to the ordinance.

COMMENT 10 (Q&A 29): The cleanup number proposed is also based on the presumption that all soils in the area share common characteristics that make dioxin less of a concern for people. A commenter stated that they believe that this assertion has not been demonstrated to be true in all cases.

DEQ RESPONSE: The DEQ has determined that the Midland Area Soils are sufficiently similar to the Midland soil tested for bioavailability to make remedial decisions. Dow collected 337 soil samples that were distributed around Midland in 2006. These samples were analyzed for physical and chemical properties including grain size distribution and total organic carbon. These soil characteristics were compared to those of the Midland soil used for the bioavailability study. A comparison table is provided below.

- The total organic carbon of the Midland bioavailability study soil (3.14 percent) is very close to the mean (3.4 percent) and median (3.16 percent) of the 2006 samples. It is expected that higher total organic carbon would result in lower bioavailability.
- For the grain size distribution, the Midland bioavailability study soil has more sand (~10 percent) and less silt (~4 percent) and clay (~5.5 percent) than the 2006 study mean and median. It is expected that the coarser grained soils (i.e., those with more sand) would have higher bioavailability.

The bioavailability values used for calculating the Midland site-specific cleanup level are likely to represent the average or slightly above average bioavailability for Midland soils. These bioavailability values are combined with other average and high-end exposure parameters to represent a reasonable maximum exposure.

		Bioavailability Study Soil Dow Corporate Center, CC-S-27 7/8/2004	Summary Statistics for 2006 Soil Sampling Study to Support a Bioavailability Study			
Soil Parameters	Units		Mean Concentration	Median Concentration	Standard Deviation	# of Detects/ Samples
Total Organic Carbon	%	3.14	3.4	3.16	1.5	337/337
Grain Size						
Sand	%	87.4	77.36	78	10.47	337/337
Silt	%	12.1	16.47	16	7.14	337/337
Clay	%	0.5	6.17	6	4.73	337/337

COMMENT 11 (Q&A 27): The cleanup number proposed is based on a cancer potency value that is half as protective as the number used at the national level. A commenter stated that they believe Midland should be protected at the same level as others across the country.

DEQ RESPONSE: This commenter is referencing a 156,000 $(mg/kg\text{-}day)^{-1}$ cancer slope factor developed by the U.S. Environmental Protection Agency (EPA) in 1984 based on a study of toxicity in rats (Kociba et al, 1978). The DEQ used a 75,000 $(mg/kg\text{-}day)^{-1}$ cancer toxicity value for both the generic cleanup criteria for dioxin and the Midland SSRDCC calculation. This cancer slope factor was developed for an EPA Great Lakes Water Quality Guidance (GLWQG) document in 1995. This was based on a 1991 reevaluation of the pathology slides by an independent Pathology Working Group from the same rat study (Kociba et al, 1978) and is considered to represent the best available information. A copy of the 1995 EPA GLWQG document is found at: http://www.michigan.gov/documents/deq/deq-whm-hwp-dow-EPA-820-B-95-006_251912_7.pdf

COMMENT 12 (Q&A 28): On February 17, 2012, one day after the 250 ppt was announced for soils in Midland, the EPA released the noncancer portion of the dioxin reassessment. For the first time ever, the Agency established a reference dose (RfD) for dioxin. This RfD translates to a soil concentration of approximately 50 ppt.

DEQ RESPONSE: The DEQ used the new EPA RfD announced February 17, 2012, to evaluate the proposed Midland Action Level to make sure that the value developed based on cancer risk would also be protective for noncancer risk (See Attachment 3).

COMMENT 13 (Q&A 38): A commenter wanted to know if in addition to bioavailability studies in rats and young pigs, have there been laboratory tests in people or tests of people in the vicinity where release of elevated levels of dioxin were present? Was a study done on their blood to see if it affected them health wise?

DEQ RESPONSE:

- A study on human bioavailability of dioxin in corn oil showed that it was very similar to the bioavailability of dioxin in corn oil from rat studies. Based on this information, rats are a good surrogate for dioxin bioavailability in humans.
- There has been an exposure study by the University of Michigan looking at the blood levels for the general population in the Midland/Saginaw area and compared them to the general population in the Jackson/Calhoun area. This study included 48 participants in the Midland Plume, 37 of which had soil and dust concentration information. This study did not look at health effects. There have also been studies of other groups of people as described further below.
- Under the authority of Part 111 of Act 451, the DEQ is responsible for ensuring that Dow properly manages hazardous waste it generates and ensuring that Dow is responsible for cleaning up any on-site or off-site releases of contaminants. The Michigan Department of Community Health can conduct public health assessments and consultations at sites of environmental contamination through a grant funded by the Agency for Toxic Substances and Disease Registry, the federal agency that conducts these evaluations.

COMMENT 14 (Q&A 39): How is human testing done – by fat testing vs. blood testing or bone marrow?

DEQ RESPONSE: Blood or serum testing is currently used to measure dioxin levels in people. In the past, human testing was done using fat samples since dioxins are concentrated in that tissue. As analytical capabilities improved, blood testing became available. A fairly large volume of blood is necessary to measure typical dioxin levels in most people. A fact sheet on blood testing is available from the Michigan Department of Community Health at: http://www.michigan.gov/documents/Blood_Testing_for_Dioxins_119419_7.pdf

COMMENT 15 (Q&A 40): Are there any studies on dioxin levels in hot spots on dioxins found in human and animals, generation after generation?

DEQ RESPONSE: There have been studies of exposure to different dioxin levels in both humans and animals. Studies in humans have included groups of people with occupational exposures, accidental or intentional poisoning, exposures in areas where there have been known releases, and typical general population exposures of other groups of people in various areas of the world. These different human and animal studies have shown that humans will accumulate higher levels of dioxins than most laboratory animals with the same exposure per body weight.

Some of these studies have evaluated health effects in both humans and animals. These studies have shown that there are similar health effects in both humans and animals. Recent human studies have provided very valuable information on both long-term cancer effects and noncancer effects related to elevated exposure to dioxin. This includes studies of groups of people in Seveso, Italy who were exposed to dioxin after an explosion at a chemical plant in 1976. The exposed people included adults and children whose health has been followed since the accident, including some studies of their children born about 20 years later. Some of these studies were used by the EPA to develop the recently released reference dose.

COMMENT 16 (Q&A 41): Can houses (wood, cement, plastic, etc.) be tested? Why test dirt rather than plants, animals, and humans?

DEQ RESPONSE: Testing is focused on soil because skin contact with soil and accidentally swallowing soil are the main ways that people are exposed to dioxin in the environment. Contamination that is present on concrete or wood surfaces is believed to present less potential for exposure and, in any case, is not likely to be greater than the concentrations found in soil. The purpose of the testing that will be done by Dow under their Work Plan is to determine where it is necessary to clean up contaminated soil. Testing of plants, animals, or humans does not provide information that can be used to design the cleanup. By removing contaminated soil, the primary exposure is reduced or eliminated, making residential properties safe for unrestricted use.

COMMENT 17 (Q&A 42): Why is dirt and plant testing done vs. animal and human testing?

DEQ RESPONSE: Different types of testing are done for different reasons. There have been a lot of studies looking at plants and uptake from contaminated soils that show little uptake into the plant. There may be some soil adhered to the outside of the plant, but the dioxins do not move into the plant. If a resident has a garden and wants to eat their vegetables, wash them off. When using vegetables such as carrots and potatoes that grow below the ground surface, peel them and wash them. Dioxins are not taken up into the vegetable itself, so washing and/or peeling will prevent exposure to dioxin in the soil that adhered to the vegetable.

Animal testing can be done to evaluate risks from consumption of the animal products by people. This can include testing of fish, wild game, and livestock, especially in areas with known contamination. We do know there are elevated levels of dioxin in wild game (e.g., turkey, deer liver) from the Tittabawassee River floodplain. We have also seen elevated levels of dioxin in chicken eggs when chickens were allowed to forage in areas with contaminated soils in the floodplain. This shows that dioxin is taken up by animals that are eating crops or foraging where they can pick up contaminated soil. Animal testing can also be done to evaluate ecological risks.

Human testing is conducted to see what kind of levels there are in humans. This has included people with past occupational exposures, people who live in areas near accidents or other known releases, and other groups of people to see what type of blood levels they have. See the response to Comment 15 for more about this.

COMMENT 18 (Q&A 43): **The Work Plan is based on an action level of 250 ppt. If that action level is later determined to be too high (not protective), will the Work Plan change for properties where design sampling results are below 250 ppt?**

DEQ RESPONSE: The action level is based on the best scientific information available to the DEQ. It takes into account the most recent information about health risks posed by dioxin and also Midland-specific information about climate, exposure to soil, and the potential for dioxin in soil to be absorbed into the bodies of people who are exposed. If scientific information about the risks posed by dioxin changes in the future, the DEQ will consider whether it is necessary to revisit the cleanup that is being done under the Work Plan. Dow is required, as a condition of its License, to provide for corrective action that is protective.

COMMENT 19 (Q&A 44): The proposed cleanup number is based on human health concerns and is not designed to be protective of ecosystems. This is inconsistent with the requirement of the RCRA corrective action and permit programs that require adverse risks to the environment evaluated and controlled.

DEQ RESPONSE: The proposed Midland Action Level is intended to be protective of human health at residential properties. It was not developed to be protective of all ecosystems in the Midland area. An evaluation of ecological risk for the various ecosystems in the Midland area will be conducted to determine if further actions are necessary to address ecological risks (e.g., for more sensitive ecosystems). If necessary, these actions may be a part of the Natural Resource Damage restoration process. Further corrective action on residential properties that have received a cleanup is not expected to be necessary, since the post cleanup soil concentrations are expected to be very low.

COMMENT 20 (Q&A 45): The cleanup number is not fully protective of health and the environment.

DEQ RESPONSE: The cleanup of residential soils to address direct contact is only one component of the corrective action for Midland Area Soils. Additional components include an extensive evaluation of other chemicals and exposure pathways, plus an evaluation of ecological risk to determine if additional actions will be required. Additional corrective action may include local zoning ordinances and/or deed restrictions to control exposure at nonresidential properties and to address food chain pathways (e.g., a prohibition on raising chickens in the city of Midland).

COMMENT 21 (Q&A 46): Dow is not doing enough for home owners affected by the situation.

DEQ RESPONSE: The DEQ has authority under the law and Dow's License to require management of wastes in a manner to prevent current and future releases of contaminants and require cleanup of contaminated media from past, current, and future releases. As part of that authority, the DEQ has worked with Dow to develop this Work Plan for cleanup of the contaminated soils in Midland and will ensure that Dow addresses all of its corrective action obligations. Some issues, such as concerns about past health impacts or property values, are not intended to be addressed as part of the cleanup process.

COMMENT 22 (Q&A 47): A Tittabawassee River resident expressed concern that the proposed Midland site-specific action levels of 250 ppt for soil and the soil sampling design plan for affected properties will be used as a pilot program to address all properties owners affected by dioxin contamination including those along the river(s).

DEQ RESPONSE: The site-specific action level of 250 ppt was developed for soils in the city of Midland. Some of the site-specific information, such as the bioavailability values and the soil/dust ratio, is not appropriate for the Tittabawassee River floodplain because it does not reflect conditions there. The EPA does recommend the use of incremental composite sampling designs for evaluation of dioxin contaminated soils (see Web link below). The Work Plan that Dow submitted addresses incremental composite sampling that follows these EPA recommendations and also considers the results of a pilot study that is specific to Midland. Since the source, distribution, and type of deposition of the dioxin contamination in the Tittabawassee River and on the floodplain is different, the type of sampling and/or decision unit for the river may be different from that used in Midland.

http://epa.gov/superfund/health/contaminants/dioxin/pdfs/Dioxin%20UFP%20QAPP%20UserGuide.pdf

COMMENT 23 (Q&A 60): If a land owner agrees to allow soil removal, can they decline to have the cleanup done in wooded areas on their property, even though they border another's property? In this example, neighborhood children play in the wooded area.

DEQ RESPONSE:
Yes, a property owner can decline to have sampling and/or cleanup done in wooded sections of his or her property. Cleanup work can only be done by Dow with the property owner's permission. Property owners should be aware that if design sampling shows that a property, or portion of a property, has dioxin concentrations that exceed 250 ppt, they will have "Due Care" obligations for that property, including the obligation to prevent unacceptable exposure for people who use their property. Property owners are also precluded from doing anything that will make it more expensive or more difficult for Dow to clean up the contamination at a later date, or that will cause the contamination to migrate off the property. Due Care obligations also require property owners to provide reasonable cooperation to someone who is conducting cleanup work and comply with and not impede any use restrictions that are put in place to address contamination.

Parents and caregivers who are concerned about exposure that may result from children playing on property that is not cleaned up should consider taking steps to minimize that exposure. This may include encouraging children not to play in these areas and/or taking other steps such as hand washing. Information about ways to minimize exposure can be found at: http://www.michigan.gov/documents/deq/deq-whm-hwp-dow-Reducing-Exposure-Home_251917_7.pdf.

COMMENT 24 (Q&A 61): Will Dow be required to clean the interior of homes where design sampling shows that dioxin levels exceed the 250 ppt action level (e.g., carpets, walls, and heating ducts) as was done previously with houses and day cares close to the plant?

DEQ RESPONSE: Although interior cleaning was not included in the proposed Work Plan, Dow and the DEQ have further considered potential circumstances where the soil concentrations may be high enough to result in indoor dust concentrations that could pose unacceptable risk. In the approved Work Plan, a property-by-property evaluation will be conducted that considers the soil concentration prior to cleanup and how much of the property has clean soil. This information will be used to calculate if the indoor dust could result in unacceptable risk. If so, interior duct cleaning will be offered to the property owners.

COMMENT 25 (Q&A 62): A few commenters were concerned that the cleanup process would increase exposure to dioxin by disturbing the contaminated soil. They wanted to know what steps will be taken to reduce the release of dioxin during the cleanup process.

DEQ RESPONSE: Dioxin is not volatile (i.e., it does not become a gas when exposed to air or disturbed by activities such as digging). Because dioxin remains tightly bound to the soil particles, with adequate control of dust and trackout, the excavation and disposal or safe reuse of soil will remove dioxin from the affected properties without creating exposure in other ways such as inhalation. Dow will be required, with DEQ oversight, to control dust, trackout, and

other conditions that could redistribute contamination in the neighborhoods where work will be done.

COMMENT 26 (Q&A 85): How should home owners with pets manage their pets during the cleanup time (e.g., fenced yard and two dogs)? What can home owners do during excavation and while grass is being established?

DEQ RESPONSE: Residents with pets may need to take some precautions to protect their pets during the cleanup process. They will want to discuss these precautions with Dow and their contractors as part of the sampling and cleanup planning processes. Considerations may include walking pets on a leash or keeping pets inside the house or otherwise contained during sampling and cleanup activities. Dow is planning to reestablish lawns with sod, so this should allow residents and their pets to enjoy the use of their yards again as soon as possible.

COMMENT 27 (Q&A 69): A commenter stated that their yard's soil is much different than a block away – will soil replaced match organic matter level, percolation rate, pH, nutrients, etc.?

DEQ RESPONSE: Dow will be responsible for working directly with property owners to determine the details of how the work will be accomplished and what restoration work will be done at each property. A cleanup plan specific to each property will be developed and reviewed with the property owner. The replacement soil will be tested prior to use to demonstrate that it is not contaminated and that it has appropriate topsoil characteristics. Dow has committed to restore all properties to the same or better condition where it conducts cleanups.

COMMENT 28 (Q&A 70): Where will replacement dirt come from?

DEQ RESPONSE: New topsoil and backfill will be imported from a location that is outside the area possibly impacted by releases from Dow. To ensure that backfill and topsoil are suitable for use, they will be tested to make sure that both are uncontaminated and that the topsoil has appropriate soil characteristics to assure topsoil quality. The top four to six inches will be topsoil.

COMMENT 29 (Q&A 72): If the License requires on- and off-site cleanup, how can contaminated soils removed from yards in the city be used for fill inside the plant (Dow being right along the river)? What happened to soil and dioxins during floods (regarding soil moved onto Dow property)?

DEQ RESPONSE: The soils on industrial properties can have higher concentrations without posing a risk to public health because exposures on those properties are different than at residential properties (e.g., children are not typically present; see also the response to Comment 34). As a result, the nonresidential direct contract criterion for dioxin is 990 ppt. Under Michigan law, it is permissible to relocate soils from the residential setting to an industrial setting where the exposure is different as long as the soil concentrations do not exceed the nonresidential criterion. The residential soils in Midland are much lower in concentration than many places on the Dow Midland plant site. These less contaminated soils will be used to cover much higher soil concentrations to decrease the exposure to the Dow plant workers and decrease the levels that may be eroding or emitted as fugitive dust. The soil would need to be placed on the plant site in a way that prevents runoff to the river, including during flooding events. In addition, Dow captures site groundwater and surface water (runoff) to treat it before

discharge to the Tittabawassee River as part of the on-site corrective action program to contain plant site contamination.

COMMENT 30 (Q&A 106): What if Dow exits Midland (such as what happened when Velsicol left St. Louis)?

DEQ RESPONSE: Dow's corrective action obligations under state and federal law are ongoing, regardless of whether Dow has a continued presence in Midland. Dow, as a corporation, has to maintain their corrective action obligations for the Midland plant site. If Dow ceased to be viable and could not meet their corrective action obligations then the Midland plant site could become a Superfund site. However, under the Work Plan, a trust fund provides financial assurance to complete the work related to Midland soils in the event that Dow cannot meet its corrective action obligations.

COMMENT 31 (Q&A 107): A Tittabawassee River property owner asked if residents are considered collateral damage and expendable in the eyes of the DEQ and EPA? What value do the agencies place on a human life?

DEQ RESPONSE: The DEQ and EPA are working within the state and federal laws that provide these agencies authority to require cleanup of contamination for the protection of human health. Starting in 2005, the DEQ required Dow to offer interim measures to minimize exposure to soils at properties presumed to have the contamination based on limited data until a final cleanup was completed both in Midland and along the Tittabawassee River. Currently, the DEQ is requiring Dow to clean up residential properties in Midland to protect human health. The EPA has also required Dow to offer further early actions based on additional sampling data that showed where higher concentrations are on residential properties along the Tittabawassee River. These early actions by the EPA on residential properties started in 2008 and are ongoing in a prioritized manner. Higher concentration properties are being addressed earlier than those with lower concentrations of dioxin, to the extent possible.

Cleanup actions to address environmental contamination can take a long time, especially when the affected areas are large, such as the soils in Midland and the Tittabawassee River and its floodplain. It takes time to determine where the contamination is located and how best to clean it up. Since there are large areas impacted in Midland, the cleanup work will take several years and must be prioritized first for areas that are most likely to have the highest contamination. In addition, the EPA, in consultation with the DEQ, has approved a process to complete remediation by working in an upstream-to-downstream manner along the Tittabawassee River in order to minimize recontamination once an area is cleaned up.

COMMENT 32 (Q&A 108): A Tittabawassee River property owner expressed puzzlement as to why they were receiving the public notice pertaining to Midland Area Soils when they are not directly affected.

DEQ RESPONSE: The commenter received a copy of the public notice pertaining to Midland Area Soils because their name is on the Dow facility mailing list maintained by the DEQ, RMD. Individuals on the mailing list receive public notices pertaining to all licensing and corrective action matters. Anyone can be removed or added to the Dow facility mailing list by contacting Ms. Lindacarol Leiter at leiterl@michigan.gov or at 517-373-9875.

COMMENT 33 (Q&A 109): A commenter stated that they believe this historic cleanup should be done once, and done right, so that this issue can finally be resolved for the community for a safe and protective cleanup.

DEQ RESPONSE: The DEQ agrees that this cleanup should be done once and done right, but should also not be delayed. If there is new information that requires a reevaluation of the work after it is completed, Dow will continue to have corrective action obligations under state and federal law.

COMMENT 34 (Q&A 111): With respect to the generic criterion of 990 ppt for nonresidential property, what does the term "generic" refer to? Is it specifically in reference to the generically acceptable levels of dioxin levels on commercial/industrial properties?

DEQ RESPONSE: Michigan has generic (i.e., statewide) cleanup levels for residential and nonresidential use. These cleanup levels are intended to be protective of individuals with reasonably high exposures for each of the land uses. The exposure includes small amounts of soil that are accidently swallowed during hand-to-mouth activities, soil stuck onto food items, and swallowing dust that gets into the nose, mouth, or throat, plus soil that comes in contact with skin. As an example of the assumptions that are made for nonresidential criteria, the exposure values include working at the same place for 21 years, soil exposure for 245 days per year for accidental swallowing, and 160 days per year for skin contact. Significant amounts of soil are assumed to stick to the skin (based on measurements that have been made of actual soil exposures experienced by construction/utility workers).

COMMENT 35 (Q&A 112): During the public hearing, it was stated that the data shows that nonresidential property levels are all below the 990 ppt, which was then contradicted by a statement that there is "a small area near former railroad track" that requires additional evaluation because levels above the 990 ppt were identified. Have all property owners in those areas already been contacted? If a property owner has not been contacted, are they to assume that their property has been tested and the levels are below the 990 ppt? If the property has been tested, will the test results be shared with the property owner? If the property has not been tested, what level of assurance does Dow have that the actual levels are below 990 ppt?

DEQ RESPONSE: There are several sources of data that indicate that nonresidential property levels are likely to be below 990 ppt. Sampling conducted in 2006 (at many properties in the Resolution Area) included both residential and nonresidential properties in Midland where the property owners consented to the sampling. The maximum concentration from this sampling effort was a location with 950 ppt on Dow-owned property located due east of the plant. Sampling conducted in 2010 and 2011 in 12 areas around the northern and eastern boundaries of the plant, but on Dow-owned property in close proximity to the fence line, also demonstrated levels below 990 ppt. This was based on average concentrations per area with many sampling locations per area. To the DEQ's knowledge, there has not been any sampling on residential or nonresidential private property other than samples collected as part of the 2006 study mentioned above. Property owners included in the 2006 study were given an opportunity to receive the results for their property or block of properties.

There is an area on Dow-owned property south of Austin Road where levels were found that exceed the nonresidential cleanup criterion of 990 ppt. The chemical makeup of the dioxins found in that area has a different "fingerprint" that is an indication that the contamination there

comes from a different source than the soil contamination in Midland. Dow will be required to do additional sampling along the railroad tracks north of Austin Road and properties next to the tracks to determine the extent of contamination associated with this alternate source of contamination.

Additional sampling in nonresidential areas that are not in close proximity to residential areas will be necessary to determine the extent of contamination. This sampling will be used to confirm that nonresidential properties are below 990 ppt and to determine where institutional controls will be necessary to assure that the property will remain in industrial/commercial use.

COMMENT 36 (Q&A 113): Could the DEQ more clearly define what is meant by "appropriate institutional controls" of nonresidential properties? Does "future residential use" equate to single family dwellings only? Will there be additional regulatory controls placed on these privately owned properties that will limit the types of business activities that can be conducted on the site?

DEQ RESPONSE: Different mechanisms can be used to reliably restrict the future land use so that residential or residential-like uses do not occur on property that is currently nonresidential unless additional evaluation (sampling and/or cleanup, as necessary) is done to assure that such a proposed use is safe. The most common form of this type of control is a restrictive covenant on the property deed. This type of restriction is under the direct control of the property owner. When a large number of properties need reliable restrictions, local ordinances, such as a zoning ordinance, could be considered. There are specific requirements related to enforceability and notification if local ordinances are used to achieve land use controls. The restriction would include any form of dwelling and any use that would have soil-related activities that could be similar to residential use (e.g., daycare centers). In some cases, where nonresidential property is in an area that is zoned to allow residential use, it could be addressed by the trust fund being set up by Dow for future sampling and cleanup, as necessary, when the land use changes to residential or residential-like.

COMMENT 37 (Q&A 114): It was implied that there is only a requirement of disclosure IF the property owner has knowledge -- therefore, if the property owner has no knowledge of the actual dioxin/furan levels on their properties, they have no legal obligation to disclose. What impact are actions taken today going to have on the future transfer/sale of the properties in this area? What action(s) is Dow taking to assure nonresidential property owners within the Resolution Area that current and future environmental issues related to dioxins/furans will be Dow's responsibility?

DEQ RESPONSE: The DEQ cannot speculate about how these actions may affect future transfer or sale of properties in the area. The DEQ's focus is on providing people with information about the current requirements for disclosure. Dow will continue to have corrective action obligations for any contamination, including contamination of nonresidential properties that is related to releases from Dow (past, current, or future) that require cleanup under state or federal law.

COMMENT 38 (Q&A 115): A commenter noted that there was some discussion of the containment precautions that will be required for the process of removing the top 12 inches of contaminated soils in identified properties. How will those types of environmental concerns impact property owners in the area if in the future they need to apply for permit(s) to make renovations/maintenance that requires digging/concrete removal (e.g., replacement of an existing parking lot)? Who would be responsible for the

additional costs? Or would this be covered by the "don't know, don't ask, don't tell" approach?

DEQ RESPONSE: If a property is cleaned up by Dow under the approved Work Plan or determined by design sampling not to require cleanup, there would not be any restrictions on future relocation of soil from that property. Keep in mind that property owners may still need to get permits that are unrelated to the presence of contamination (e.g., for digging in a wetland). If owners have nonresidential property in the Resolution Area with dioxin concentrations above 250 ppt, Michigan law imposes restrictions on the relocation of contaminated soil. Information about soil relocation restrictions is available at http://www.michigan.gov/documents/deq/deq-whm-hwp-dow-TR-Advisory-dioxin-Color-Final_251808_7.pdf. DEQ staff can also answer questions about those restrictions and how they will affect work done on such property. In general, soil can only be relocated on property that is similarly contaminated. Use restrictions and/or exposure barriers would be required at the new location. Deed restrictions or zoning ordinances that are developed as part of the overall remedial action in Midland will have to address the applicability of soil relocation restrictions. With respect to the issue of additional costs, a property owner has the right to recover from the liable party costs associated with contamination that is not caused by the property owner.

COMMENT 39 (Q&A 116): A commenter noted that it was implied that the DEQ and Dow have determined, based on the nonresidential status of a site, that there are no human health safety issues related to dioxins/furans that a business and property owner need to be concerned about. Is it appropriate to share the informational materials (Health Questions and Reducing Exposure at Home) provided at the public hearing with employees working at a nonresidential property in the Resolution Area? Are any additional actions required or recommended?

DEQ RESPONSE: The informational materials that this commenter refers to would be appropriate for most worker situations related to dioxin contaminated soils. These materials have been used for communicating hazards for construction/utility activities in areas along the Tittabawassee River that exceed the nonresidential cleanup level. The DEQ encourages other business owners to be proactive in sharing this information with their employees.

COMMENT 40: Some commenters expressed support for allowing the Work Plan to proceed.

DEQ RESPONSE: The DEQ acknowledges these comments.

ATTACHMENT 2
Summary of Changes

The attached summary table entitled “Responses to Interim Response Activity Plan Designed to Meet Criteria dated March 6, 2012” that was submitted by Dow and reviewed by the DEQ summarizes the significant changes that were made to the draft Work Plan in response to comments made by the DEQ. All of the summarized revisions to the draft Work Plan were reviewed by the DEQ prior to approval of the final Work Plan.

Revisions to
Interim Response Activity Plan
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Revision No.	Original Page	Original Section	Comment	Change Description
Response to MDEQ Comments Dated April 19, 2012				
General Comments				
1	--	--	Indoor Dust	An evaluation of exposure to indoor dust to determine whether a remedy is necessary to address dust accumulated in ducts for properties identified for soil remedy has been added to the Work Plan. The following sections of the Work Plan were updated with indoor dust discussion: - Section 7.4 - Response Actions to Address Residential Use - Section 7.4.7 - Completion of Presumptive Remedy - Section 7.4.7.1 - Construction Quality Assurance - Section 7.6.3 - Monitoring
2	--	--	Extensive Landscaping	A discussion was added to the Work Plan to address properties where the property owner provides information establishing that the existing lawn has been significantly landscaped or fill was placed across much of the property. The following sections of the Work Plan were updated with this discussion: - Section 7.4.3.1 - Sample Collection - Section 7.4.4 - Decision Rules - New Figure 7-7 - Decision Rules for Extensively Landscaped Properties
3	--	--	Evaluation of Non-Residential Land Use	Text was added to the Work Plan to present the approximate schedule for verifying that the land use on non-residential properties is consistent with the initial determination. The following sections of the Work Plan were updated with this discussion: - Section 7.5 - Response Actions to Address Non-Residential Land Use - Section 7.6.3 - Monitoring - New Figure 7-8 - Schedule for Review of Areas Designated as Non-Residential

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Revision No.	Original Page	Original Section	Comment	Change Description
4	--	--	Northeast Midland Resolution Area Boundary	Discussion of two additional outliers located near the northeast boundary of the Midland Resolution Area was added to the Work Plan. This discussion includes consideration of confirming the northeast boundary of the Midland Resolution Area. The following sections of the Work Plan were updated with this discussion: - Section 4.2.3 - Outliers - Section 7.2 - Outliers (Response Actions) - Section 7.7 - Final Delineation of Midland Resolution Area Boundary - Section 9.3 - Midland Resolution Area Boundary
Specific Comments				
1	iv	Executive Summary	This should include a bullet that describes the process for properties that choose not to participate at this time (Trust Fund).	Added a bullet documenting that the work plan proposed the establishment of a trust fund for properties where owners do not wish to participate at this time.
2	iv	Executive Summary	Should include a bullet on documenting completion of the work with respect to Dow related contamination.	Revised bullet to document that the report provides a schedule of completing activities and all Midland Area Soils Corrective Action related to the historic airborne release from The Dow Chemical Company.
3	iv	Executive Summary	[Original comment made in Attachment A] This should be revised to indicate that the Work Plan contains a waiver request of the FS requirement.	Text revised to indicate that the Work Plan contains a waiver request of the FS requirements.
4	1	1.0 Introduction	General description of how this will be wrapped up into the final corrective measures for the Midland Area Soils.	Added text describing this IRDC and the overall completion of corrective action for the Midland Area Soils project.
5	2	1.2 License Procedure	General agreement; however, 'no further action' has specific definition that might not apply here.	Modified text to indicate 'no further remedial actions', it is understood that additional measures will be necessary to address all pathways.
6	2	1.2 License Procedure	[Original comment made in Attachment A] This should be revised to indicate that the Work Plan contains a waiver request of the FS requirement.	Text revised to present a waiver request of the FS requirements.
7	4	2.3.1 Process Emissions	May want to recognize more stringent environmental regulations.	Added text acknowledging more stringent environmental regulations as a contributor.
8	4	2.3.1 Process Emissions	Waste products were also sometimes burned for BTU value with the coal.	Added text describing that specific waste streams were burned in addition to coal in some historic power plants.

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9	8	2.3.3 Combustion of Solid Wastes	Need to add a sentence here that indicates that emissions are monitored on a routine basis by AQD. Also note the perimeter soil box monitoring program.	Added text indicating the incinerator testing frequency is required and notes the regulatory mechanisms. Added text with respect to fugitive dust control program and the soil box monitoring programs. Updates were also made to Sections 2.3.4 and Section 3.
10	11	3.0 Summary of Investigations and Studies	The EPA did not indicate that no risk was presented in 1984. This section is missing the study where EPA indicates the need for additional sampling and risk assessment related to dioxins and furans.	Added text discussing EPA 1988 'Risk Management Recommendations for Dioxin Contamination at Midland, MI Final Report', as well as a brief summary of how those recommendations were or are being satisfied.
11	12	3.0 Summary of Investigations and Studies	1998 Dow study needs fact checking. Some of the samples at the NE perimeter were at or near 1,000 ppt TEQ.	[No change necessary]. Statement has been verified. The statement refers to off-site results only. Sample NEP-S-11 was 1,070 ppt TEQ with a few additional results near 900 ppt; however these samples are within the facility boundary, perimeter fence, and have had clean fill placed over them in 2002. All corporate center samples were within the range specified in the existing text.
12	13	3.0 Summary of Investigations and Studies	The 2006 CH2M Hill Study section needs to be clarified that only a subset of the samples were collected for analysis in the 1-6" depths - the two rings of samples closest to the plant site.	Revised text to indicate that 30% of the samples were tested for SCOIs and dioxins/furans in the 1-6" depth. This corresponds to the two rings of samples closest to the plant site.
13	13	3.0 Summary of Investigations and Studies	Text describing "unblinding" is not accurate, needs clarification of what was specifically done.	Revised existing text to indicate that a centroid was established for the sampling area and that TEQ values were released to Dow and MDEQ for that sampling area for decision-making purposes, provided all properties were not owned by a single entity.
14	15	4.1.2 Climate and Meteorology	Include description of the newer NCDC and MAWN climate data used for site-specific criteria.	Text revised to incorporate more recent climate and meteorology information. Section 11 References updated with the following website for the Michigan State Climatologist's Office : http://climate.geo.msu.edu/Stations/5434/.
15	17	4.1.4 Geomorphology and Geology	Permeability in glacial till is typically low also because of the high degree of compaction.	Sentence revised indicate that the high degree of compaction also impacts permeability of glacial till.
16	17	4.1.4 Geomorphology and Geology	Clarification is necessary to indicate that sandy regional aquifer is not present everywhere in study area - sometimes pinches out against bedrock valley walls.	Revised text to clarify that the R.A. underlies 'much' of the area, and is largely located within bedrock valleys.

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Revision No.	Original Page	Original Section	Comment	Change Description
17	18	4.1.5 Hydrogeology	Glacial till sands are used for domestic water supply in some areas adjacent to Midland. Note groundwater is not used for drinking water in the Resolution Zone.	Added text to indicate that within Midland County till sands are a source of drinking water. Also noted that groundwater is not used for drinking water in the Midland Resolution Area.
18	19	4.2 Midland Land Use	[Other factors, such as development age may be considered as well] - paraphrased from verbal conversation.	Added text to indicate that the physical features of the area would also be considered.
19	20	4.2.2 Residential Land Use	[Possible generic description of Residential Land Use or Residential-Like Land use].	Added an additional sentence to clarify what constitutes a 'residential-like' property.
20	20	4.2.2 Residential Land Use	Day shelters need more consideration including known or likely soil concentraions (related to track in) and outdoor activities.	Text changed to clarify the facilities serve adults.
21	20-21	4.2.3 Outlier Area(s)	Need a description of how other outlier areas may be identified and addressed in the work plan.	Refer to response to General Comment on Northeast Midland Resolution Area Boundary.
22	21	4.2.3.1 Zoning	Will need to acquire definitions of the zoning categories for future use for the Institutional Controls.	Noted. No text change necessary.
23	22	4.2.3.1 Zoning	Need a record of the Midland zoning map and the zoning plan at this point in time so DEQ knows what was considered to make this decision.	The Midland zoning map and plan will be provided to DEQ as a CD attachment - new Attachment K.
24	22	4.3.1 Conceptual Site Model	Pathways are not incomplete. They were evaluated to determine that they do not exceed criteria and therefore do not require further evaluation.	Sentence revised to document that pathways were evaluated to determine if COC concentrations exceed pathway criteria and do not require further evaluation.
25	22	4.3.1 Conceptual Site Model	Other pathways and/or COCs will be addressed if necessary prior to completion of the IRDC.	Added sentence to note that if determined to be necessary based on on-going evaluations, other pathways and/or COCs will be addressed according to the proposed schedule presented in Section 10.2.
26	24	4.3.1.2 Fate and Transport Mechanisms	There is evidence of Toluene in soil - this should be a more general statement, such as 'typically'.	Inserted the word, 'typically'.
27	24	4.3.1.2 Fate and Transport Mechanisms	This section should indication that dioxins and furans are considered very persistent.	Added sentence to note that dioxins and furans are persistent.
28	24	4.3.1.2 Fate and Transport Mechanisms	DEQ recognizes the potential for this surface transport pathway to have an effect on adjacent residential properties and will be addressed under this work plan.	To address this comment, additional text was added to the text revisions completed in Section 7.5 addressing the verification of non-residential land use.

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29	25	4.3.2 Exposure Pathways	Add a concluding paragraph to draw together - will be required to prepare a report that documents whether additional response activities are necessary to address other hazardous substances or pathways (if required Dow will submit a work plan including a schedule).	Added a conclusion paragraph that documents that evaluation is ongoing to determine if additional efforts are necessary to address other pathways and/or COCs. The findings of this evaluation will be completed and documented in accordance with the schedule presented in Section 10.2.
30	26	5.1 Purpose	Replace "separate" CA with "additional" CA. Other pathways and hazardous substances may be required.	Text revised to state 'an additional corrective action…'.
31	28	5.2.3.2 Background	Call this a regional background and also make the adjustment to Table 5-1.	Text updated to replace "Modified Urban Background" with "regional background". Table 5-1 and Section 5.3.1 text also updated with this edit.
32	30	5.3.1 Screening Categories	Category D4 was evaluated spatially, include in the list. Compounds in group E2 are pending, so they 'May' be removed.	Added D4 to the list. Revised text to indicate compounds in this category 'may' be eliminated.
33	31	5.3.1 Screening Categories	Background concentrations were obtained from "State of Michigan background information for metals (when available)"	Revised text to indicate primary and supplemental sources for background data.
34	33	5.5.1 Determination of Depth of Dioxin and Furan Impacts	Incorrect reference to Figure x, should be Figure 5-5.	Figure reference was corrected.
35	36	6.0 Summary of the Basis for the Residential Site-Specific Action Level	[Add a reference to the use of the 2005 WHO TEFs] - paraphrased from verbal conversation	References were added to the 2005 WHO TEFs in Section 6. Additional references were added in the following locations: - Section 3.0 - Section 5.2.2 - Section 5.5
36	41	7.1 Midland Resolution Area	Recommend avoiding use of the terminology "full corrective action" in this context as there are other components of the corrective action process that will not be complete until the DEQ approves the Corrective Measures Implementation Report.	Sentence revised to replace "full corrective action" with "all field activities".
37	43	7.2 Outlier Area	Need to reflect the evaluation of other relevant information as well (ages of houses, etc.) The trigger for this is not just based on the "three property" buffer.	Revised the text to indicate that sampling will be completed when the available information shows that the areas are less than 250 ppt or they have been bounded. Physical features of each area will also be part of the decision.
38	43	7.3 Current Land Use	Need a way for property currently identified as non-residential to be reevaluated for residential-like. It may be appropriate to have some decision rules that allows both current and future evalautions (if land use change) to be consistent.	See General Comments for text revisions addressing this topic.

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39	44	7.4 Response Action Addressing Residential Land Use	Based on existing data, 6-12 inch depth contains a significant number of locations over 250 ppt. Eliminate "greater" from this sentence and reword "…to a depth below where SSAL exceedances area expected…"	Sentence reworded to state that presumptive remedy 'removes soil to a depth where SSAL exceedances could occur…'.
40	46	7.4.3.1 Sample Collection	Additional guidelines should be indicated for offsets from sample grid points.	Additional interferences noted, and a generic statement included for items not yet addressed.
41	52	7.4.7 Completion of the Presumptive Remedy	Add language to minimize diesel emissions, to the extent practicable.	Text added to Section 7.4.7 to indicate that when using heavy equipment during excavation and/or construction, diesel emissions will be minimized, to the extent practicable. Reference to Attachment L provided. Attachment L was added to provide information on Green Remediation Project Guidelines.
42	52	7.4.7 Completion of the Presumptive Remedy	Revise to indicate that clean up will occur, as necessary, under porches/decks etc that that are reasonably accessible to humans (i.e. raised decks).	Revised text to indicate that new cover and/or barriers could be used in those cases where the existing decks are elevated to a degree that would allow reasonable access for use beneath it.
43	53	7.4.7 Completion of the Presumptive Remedy	Should reference Health and Safety Plan.	Project Health and Safety Plan included for reference as Attachment J.
44	52	7.4.7 Completion of the Presumptive Remedy	--	Inserted reference to Project Soil Erosion and Sedimentation Control plan for reference as Attachment I.
45	54	7.4.7.1 Construction Quality Assurance	Add text to indicate the plan to revisit undisturbed limited use wooded areas during Adaptive Management.	Text added in Section 7.6.1 (Trust Fund) to address this comment and indicate that heavily wooded lots that have not been sampled or where remedy was declined or deferred and are zoned to allow residential-like use will be included in the Trust.
46	54	7.4.7.2 Post Remedy Care and Maintenance	Clarify that plants will be replaced, and will not have to be negotiated on a case-by-case basis.	Text clarified to indicate that plants will be replaced if they don't survive after the first growing season and that this will be spelled out in the site-specific remediation plan for their property.
47	55	7.5 Response Actions Addressing Non-Residential Land Use	Some non-Residential sampling may be done to better define the Midland Resolution Area Boundary.	Revised text to include possible sampling to better define Midland Resolution Area Boundary.
48	55	7.5 Response Actions Addressing Non-Residential Land Use	Site F1 - Should we do some incremental sampling to confirm this, as this site is not restricted like Site 1?	Added the results of the 95% UCL evaluation of the data for Site 1.
49	56	7.5.1 Decision Rules for Non-Residential Property	Consider referencing building codes in Section 7.4.1.	Reference to building codes added to text.

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50	57	7.6.1 Trust Fund	Clarify that residentially zoned woodlots will be included as appropriate.	Text clarified to indicate that residentially zoned woodlots will be included as appropriate.
51	57	7.6.2 institutional Controls	The IRDC is not final until all other components of project are completed.	Revised sentence to remove "final" and just state "The remedy is designed…."
52	58	7.6.2 institutional Controls	Existing zoning ordinance that prohibits residential use (e.g., industrial) will still need to be reviewed and likely revised for consideration as reliable exposure control.	Noted. No text change necessary.
53	58	7.6.3 Monitoring	Need to work out how and when all non-residential properties will be evaluated, including those outside residential areas included in scheduled work.	See General Comments for text revisions addressing this topic.
54	58	7.6.3 Monitoring	Does monitoring during the project include an evaluation for determining what is/is not residential or residential-like.	Added discussion of review of non-residential land-use in Section 7.5 and updated text in 7.6.3 to indicate that this monitoring would be compelted in conjunction with that evaluation.
55	59	7.7 Final Delineation of Midland Resolution Area	Additional flexibility needs to be added to this section to account for other possible influential factors than just concentration.	Text revised to indicate that other factors will be included in the evaluation and stated the overall goal of the boundary, consistent with the evaluation.
56	61	8.1 Sampling Plans	Clarify language to specify that residential lots don't need to be larger than 7200 square feet.	Re-ordered sentence to clarify this.
57	61	8.1.4 Non-Residential DUs	Clarify that these properties will be monitored.	Revised text to indicate that the properties identified in this section will be subject to monitoring.
58	63	9.0 Adaptive Management	Clarification - A number of aspects of work that may be proposed for change subject to approval.	Text modified to indicate that the items listed that may be recommended for change and submitted to MDEQ for approval.
59	64	9.1 Rationale for Changes	Also need to evaluate 'wooded' vs. 'non-wooded' concentrations.	Noted. Text is currently not intended to identify every item that will be considered for evaluation. No text was modified in response to this comment.
60	65	9.3 Midland Resolution Area Boundary	Need a mechanism to evaluate boundary in those areas where sampling is not currently proposed to be conducted - especially where pre-existing discrete data shows concentrations could exceed 250 ppt TEQ.	Revised text to make boundary discussion consistent with revisions to Section 7.7 and included a discussion referencing Section 7.7 discussion of the northeast boundary.
61	66	10.1 Reporting	Need to identify minimum frequency of updating and have some periodic submittal of information to satisfy potential FOIA requests.	Text was modified to discuss that a project progress tracking log that is routinely updated will be made available to MDEQ on a continual basis during the project implementation and is provided in lieu of a monthly written progress report.

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Attachment A				
1	2	General Text	Add Footnote "2": This discussion is based on Dow's License issued June 12, 2003, and the relevant provisions of Part 201 and the Part 201 administrative rules in effect on that date (License Condition XI.G).	Footnote added as requested.
2	2	General Text	Monthly/quarterly download of information from Sharepoint?	Text was modified to discuss that a project progress tracking log that is routinely updated will be made available to MDEQ on a continual basis during the project implementation.
3	3	License Requirement: Submit IRA Report within 60 days after completion of IRA	Need to also reference the final completion report noted later in the table.	Text added to reference the final completion report.
4	3	License Requirement: Monthly Reports	Can monthly/quarterly or some other frequency "download" of the Sharepoint information be provided?	Text was modified to reference a project progress tracking log that is routinely updated will be made available to MDEQ on a continual basis during the project implementation.
5	6	License Requirement: Legal description of the specific parcel of property addressed by the response activity	Maps, addresses, and a list of the parcel numbers are adequate for the legal description of the individual properties addressed by the response activity. For properties where only a portion has been sampled and/or remediated, Dow can provide the map with GPS coordinates of the corners of the unsampled/unremediated area(s).	Text updated to document that for parcels where only a portion of the property is addressed, Dow will provide a map and GPS coordinates delineating the unsampled / unremediated areas.
6	6	License Requirement: If the interim response activity is a subset of a remedial action that is being planned, then provide a description of the relationship of the interim response to the remedial action	Describe how this fits in with the other hazardous substances and exposure pathways for the IRDC and the overall RAP or corrective measure implementation - the "paperwork" and the ongoing monitoring that will be necessary, groundwater leach tests, any necessary waivers, etc.	Text was added to document how the IRDC fits into the overall RAP and corrective measure implementation process for the Midland Area Soils project. Additional miscellaneous text changes were made to make the attachment text consistent based on this comment.
7	7	License Requirement: Submit a written RI Work Plan.	The Department has determined that the Midland Area Soils Work Plan will provided sufficient data for remedial decision making for MAS dioxins and furans. The revised RIWP will address other remaining pathways and hazardous substances, if any.	Text was added to document that the IRDC address dioxins and furans in soil for the direct contact pathway; and the revised RIWP will further evaluate COCs/exposure pathways not addressed in this work plan.
8	7	License Requirement: Develop and Implement a Feasibility Study (FS) to evaluate response activity alternatives (may be waived by MDEQ). License, XI.I	This should be revised to indicate that the Work Plan contains a waiver request of the FS requirement.	Text revised to indicate that the Work Plan contains a waiver request of the FS requirements. Executive Summary updated to indicate that Work Plan contains a waiver request and Section 1.2 presents the request.
Attachment B				
--	--	--	No comments.	No changes warranted.

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Revision No.	Original Page	Original Section	Comment	Change Description
Attachment C				
--	--	--	No comments.	No changes warranted.
Attachment D				
1	All	Agreement Forms	Box indicating that educational materials provided. Do you intend to distribute educational materials at the meeting with property owner or should this be removed?	The educational materials have already been distributed at public meetings and the box on the form was removed.
Attachment E				
1	All	Example Letter Templates	Should MDEQ contact information be provided on these letters?	MDEQ contact information was added to each letter.
Attachment F				
--	--	--	No comments.	No changes warranted.
Attachment G				
--	--	--	No comments.	No changes warranted.
Attachment H				
1	--	General	Consider adjusting Decision Units to address potential alternative source and possible exposure to adjacent properties.	Modified sampling plan Decision Units to include a DU along the rail line and DUs for adjacent property to evaluate backfill along the tracks as a potential alternative source other than historical aerial deposition, as well as possible exposure for adjacent properties.
Attachment I				
1	--	--	per Revision 44, Specific Comments	Added Attachment I Project Soil Erosion and Sedimentation Control Plan.
Attachment J				
1	--	--	per Revision 43, Specific Comments	Added Attachment J Project Health and Safety Plan.
Attachment K				
1	--	--	per Revision 23, Specific Comments	Added Attachment K Electronic Copy of City of Midland Zoning Map.
Attachment L				
1	--	--	per Revision 41, Specific Comments	Added Attachment L Green Remediation Project Guidelines.
Response to MDEQ Comments Dated May 18, 2012				
Specific Comments				
1	16	4.1.2 Climate and Meteorology	There needs to be a reference to the frozen soil/soil temperature work that was done by Michigan State in 2010.	Reference added.
2	21	4.2.2 Residential Land Use	Add "e.g." to parentheses and remove "less than 6 yrs old".	Completed text revision as requested.

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Revision No.	Original Page	Original Section	Comment	Change Description
3	21	4.2.2 Residential Land Use	For property uses where it is not clear if it is "residential" or "residential-like" use, the work plan should state that the exposure at the property will be compared to the residential and non-residential exposure assumptions under Part 201 to determine how they should be managed under the IRDC.	Added a sentence that reads: "When considering a property to determine if the use is residential-like, the actual land use will be evaluated against the residential and non-residential exposure assumptions of Part 201."
4	44	7.2 Outlier Areas	It appears that the reference to Section 7.3.2.1 should be to Section 7.4.4 - please verify.	Verified and change made.
5	45	7.2 Outlier Areas	Add "age of property development" concept into the evaluation process.	Completed text revision as requested.
6	46	7.4 Response Action Addressing Residential Land Use	It appears that the reference to Section 7.4.6 should be to Section 7.4.7.1 - Please verify.	Verified and change made.
7	49	7.4.3.1 Sample Collection	Possible addition of a bullet point to address short term Midland property access issue - although it appears to be covered under the last bullet.	Added the following bullet: "Increment locations will be offset from area where access has not been granted."
8	49	7.4.3.1 Sample Collection	Replace the reference to "whole property" with "a large portion" or similar.	Revised text to replace reference to "whole property" with "much of the property."
9	53	7.4.4 Decision Rules for Residential Land Use	Replace the reference to "whole property" with "a large portion" or similar.	Revised text to replace reference to "whole property" with "much of the property."
10	53	7.4.4 Decision Rules for Residential Land Use	Suggest addition of sentence "If concentrations at the DU exceed the SSAL, further evaluation will be conducted as specified in Section 7.4.7.1" or similar.	Added the following sentence: "If the detected concentration at the DU is greater than the SSAL, further evalaution exposure to dust accumulated in the dwelling(s) duct work will be performed as per Section 7.4.7.1."
11	56	7.4.7 Completion of Presumptive Remedy	Remove phrase "(e.g., adjoin an upper level of the home)" or reword to capture the concept that an exposure barrier will be placed to reduce contact with existing soils under structures that are/could be accessed routinely.	Text revised to remove phrase "(e.g., adjoin an upper level of the home)".
12	59	7.4.7.1 Construction Quality Assurance	With respect to the concentration of dioxins and furans in the unsampled wooded reas where the presumption will be that the unsampled wooded area concentrations are the same as the sampled area concentrations, the DEQ wants to capture the concept that this assumption may be revisited under the adaptive management process as additional wooded area data is collected and evaluated. Recommend that this be done by addition of a new bullet in Section 9 "Management and monitoring of undisturbed limited use wooded areas," or similar.	Added bullet to Section 9 that reads "Monitoring and management of undisturbed limited use woodland properties."

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Revision No.	Original Page	Original Section	Comment	Change Description
13	61	7.5.1 Decision Rules for Non-Residential Property	It appears that the reference to Section 7.4.1 should be to 7.4.3.1 - please verify.	Verified and change made.
14	69	9.0 Adaptive Management	See comment #12.	Added bullet to Section 9 that reads "Monitoring and management of undisturbed limited use woodland properties."
15	71	9.3 Midland Resolution Area Boundary	Add "and physical features" into the phrase ("taking age of property development and physical features into account)." Check for use of consistent languge in other portions of the work plan (e.g., Comment 5 above).	Text revised as requested and other references to this statement have been made consistent throughout the document.
Attachment A				
1	1	Title	The Table of Contents lists "Attachments." The document is titled "Appendix A". Please revise as appropriate.	Title corrected to "Attachment A".
2	6	Item (b)	As discussed, the lists of properties will also need to include parcel and/or property numbers as well as the current address.	Edited text now reads: "Maps of the areas subject to the response action are included in Figures in the Work Plan. Further, lists, by address and parcel number, of properties that have been addressed in a given year will be provided in each annual summary report. for parcels where only a portion of the property is addressed, Dow will provide a map with parcel number and GPS coordinates delineating the unsampled / unremediated areas.
Attachment C				
1	19	4.4.7 Split Sampling Procedures	The QAPP specifies a specific procedure for MDEQ split sampling. This will need to be revised. Discussion of this topic is scheduled for our call on Tuesday, May 22, 2012.	As per this comment and the discussion during the call on May 22, 2012, the text was revised to read as follows: "Michigan Department of Environmental Quality (DEQ) staff will periodically split some samples as part of their oversight of this project. Data generated from DEQ split samples will be used to monitor the overall quality of project analytical work. The laboratories used during this project will use different analytical methods, and some differences are anticipated. A comparability study between Dow analyzed samples and agency analyzed samples is being conducted prior to the start of this project."

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Revision No.	Original Page	Original Section	Comment	Change Description
Attachment H				
1	7	Scope of Work	As discussed, please revise this language to indicate that "If any of the four DUs exceed 990 ppt TEQ, Dow will submit a plan for further evaluation of the offsite area for DEQ review and approval within 30 days of that determination," or similar - rather than the process currently identified in the work plan.	The text was revised to read as follows: "If results of sampling on any of the four (4) DUs listed above indicate the soils exceed 990 ppt TEQ, Dow will submit a plan for further evaluation of the offsite area to MDEQ for review and approval within 30 days of determination."
Attachment I				
1	All	Soil Erosion and Sedimentation Control Plan	Discussion of this topic is scheduled for our call Tuesday, May 22, 2012, after Dow has had an oportunity to review WRD's proposed revisions.	The SE/SC was revised in response to the WRD's comments as discussed during the May 22, 2012 call.
Attachment J				
1	--	Job Safety Analyses	As discussed, please include "Ask and be aware of children," in each of the work activities identified in the MAS Job Safety Analysis	The JSAs were revised as requested.

Attachment 3

DEQ Basis of Decision and Response for a Site-Specific Residential Direct Contact Cleanup Criterion (SSRDCC) for Dioxins/Furans (D/F) Toxic Equivalents (TEQ) for Midland Area Soils

Revised June 1, 2012

This document describes the Michigan Department of Environmental Quality's (DEQ) analysis and decision regarding the SSRDCC for Midland Area Soils. The preliminary development of the SSRDCC was reviewed and coordinated with The Dow Chemical Company (Dow) and the U.S. Environmental Protection Agency (EPA) in conversations that lead up to Dow submitting its work plan for corrective action to address dioxin in the city of Midland. These discussions were undertaken to allow for development of the work plan on the basis of an agreed-upon action level.

This revised document includes discussion and analysis of additional information provided by the EPA during the work plan review process. This information did not result in a change of DEQ's approval of the Midland Action Level.

The DEQ has approved the 250 parts per trillion (ppt) TEQ Midland Action Level as part of the approval of the work plan. The basis of that approval is provided in the Summary section of the attached revised DEQ staff recommendation document.

Executive Summary

Cleanup criteria calculations include both exposure assumptions and toxicity values. Exposure assumptions describe how much contact a person has with contaminated media (e.g., soil, drinking water, sediments, food). Exposures vary from person to person, depending on their habits and activities. The exposure assumptions used for calculation of cleanup criteria are chosen to protect what is referred to as the "reasonable maximum exposure" in order to be protective of susceptible individuals including children. Exposure assumptions can have state-wide application (generic), be chemical specific, and/or site-specific.

Toxicity values are chemical or chemical class-specific and based on human and/or animal data that identify how much chemical causes a health-related effect. The DEQ is required by state law to consider both cancer and noncancer toxicity values. Cleanup criteria are determined on the basis of the effect (cancer or noncancer) that is most sensitive. Typically, human toxicity data are preferred over animal toxicity data.

The cancer toxicity value the DEQ considered for the Midland Area Soils SSRDCC was developed for the 1995 EPA Great Lakes Water Quality Guidance (1995 GLWQG) based on animal data.

The noncancer toxicity value considered for the Midland Area Soils SSRDCC is the 2012 EPA reference dose (RfD) based on thyroid hormone function and male reproductive function in humans exposed before and after birth.

In addition to applying the generic exposure assumptions used for other chemicals, the DEQ has considered exposure assumption changes proposed by Dow for a SSRDCC for D/F TEQ for Midland Area Soils. Although not all of the specific values proposed by Dow were accepted, the DEQ recommends changes to the following exposure assumptions:

- Soil oral bioavailability (i.e., the amount of D/F TEQ that gets into body tissues from material that is swallowed) based on the average of site-specific data in rats and young pigs;
- Soil exposure frequency (i.e., the number of days of exposure to soil) based on site-specific climate data;
- Separate soil and dust exposure with dust concentrations as a fraction of the soil concentration based on site-specific data;
- Soil dermal bioavailability (i.e., the amount of dioxin absorbed through the skin) based on average values from the published literature;
- Relative source contribution (i.e., the relative amount of exposure from soil considering exposure from other major sources such as diet) based on the most recent dietary and background exposure information and the information available for the toxicity studies.

See Tables 1 and 2 (attached) for the specific values used and the attached DEQ staff recommendations for the basis of each value.

The DEQ did not agree to the child soil ingestion rate proposed by Dow. There is no site-specific information available to support this change, and the DEQ had recently reviewed and retained the current value of 200 milligrams per day for state-wide application.

Since the noncancer RfD is based on early life exposure, a child receptor was used to calculate the noncancer cleanup value.

Based on the use of the modified exposure and toxicity values described above, the calculated cancer cleanup value is 260 ppt and the noncancer cleanup value is 260 ppt.

A recalculation of the noncancer cleanup value based on the clarification of bioavailability assumed in the development of the 2012 EPA RfD results in values of 220-230 ppt. However, the DEQ has determined that the additional conservatism of the RfD does not warrant modification of the proposed action level (since the RfD does not account for non-2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) dioxin-like chemical (DLC) exposure in the participants of the studies upon which it is based).

These calculations and the additional information provided in the attached revised DEQ staff recommendation document support a 250 ppt Midland Action Level.

The DEQ has determined, after consideration of Dow's proposal and EPA's clarification, that 250 ppt Midland Action Level is appropriate. The presumptive remedy that is approved for Midland Area Soils is based on three primary steps as laid out in the approved work plan: (1) identification of properties likely to have dioxin concentrations greater than the Midland Action Level of 250 ppt TEQ; (2) confirmation through a design sampling process whether individual residential or residential-like properties exceed the Midland Action Level; and (3) remediation, contingent on property owners' consent, through removal of the top 12 inches of soil, where practical, when the design sampling shows a property exceeds the Midland Action Level.

DEQ Staff Recommendations for a
Site-Specific Residential Direct Contact Cleanup Criterion (SSRDCC) for
Dioxins/Furans Toxic Equivalents (TEQ) for Midland Area Soils

Revised June 1, 2012

A SSRDCC for polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (D/F) has been requested by The Dow Chemical Company (Dow) for Midland Area Soils (Dow, 2010) as allowed by Condition XI.B.3.(b)(iv) of their hazardous waste management facility operating license. This document conveys staff's recommendations to DEQ management about an acceptable SSRDCC. Developing a soil direct contact criterion involves the use of both toxicity values and exposure assumptions. Toxicity values are specific to the chemical or class of chemicals and may include cancer slope factors (CSFs) or noncancer reference doses (RfD). Exposure assumptions may include generic exposure assumptions that are used for state-wide application, chemical specific, and/or site-specific assumptions. Dow has proposed some exposure assumptions changes to be considered for a site-specific criterion.

The DEQ is required, when information is available, to evaluate both cancer and noncancer risk in developing cleanup criteria for a hazardous substance. An oral CSF and a noncancer RfD value have been considered for calculating a SSRDCC for dioxin in Midland Area Soils.

Dioxin can refer to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD), dioxins and furans, or include other dioxin-like chemicals (DLCs). Four terms are used in this document:

- **Dioxin** is used as a general or umbrella term;
- **D/F**(s) refers to dioxins and furans only;
- **DLC** includes D/F and other dioxin-like chemicals such as coplanar polychlorinated biphenyls (PCBs); and
- **TCDD** refers specifically to 2,3,7,8-tetrachlorodibenzo-p-dioxin.

D/Fs and DLCs are found in mixtures and many of these chemicals act through a common mechanism(s) with both demonstrated and assumed additive toxicity. As a result a TEQ approach is used in accordance with Michigan regulations, the U.S. Environmental Protection Agency (EPA), and World Health Organization (WHO) guidance. The DEQ, Dow, and EPA have agreed with the proposal to compare the D/F TEQ (i.e., measured soil concentration) to the proposed action level. Use of the D/F TEQ is based on sampling conducted in 2010 that measured D/F and dioxin-like PCBs. That sampling found that the PCBs contributed negligibly to the TEQ (typically <2% of D/F+PCB TEQ, range 0.01-6.7%).

Toxicity Values

Cancer Slope Factor

The DEQ has used an oral CSF of 75,000 per milligram per kilogram per day (mg/kg-day^{-1}) for TCDD since 1995 for developing Part 201 cleanup criteria. This CSF was developed for 1995 EPA Great Lakes water quality guidance (GLWQG) and is based on the Kociba et al, 1978 rat study and a 1990 reevaluation of the female liver tumor classification from this study by an independent panel of pathologists. The DEQ has determined that this CSF is best available information for a SSRDCC for Midland Area Soils. The DEQ will reassess the dioxin CSF when the EPA provides a new final CSF as part of the ongoing EPA dioxin reassessment/reanalysis. The EPA has provided a draft CSF of 1,000,000 mg/kg-day^{-1} as part of the Draft EPA's Reanalysis of Key Issues Related to Dioxin Toxicity and Response to National Academy of Sciences (NAS) Comments (EPA 2010 Reanalysis). On August 26, 2011, the EPA's Science Advisory Board (SAB) completed a review of this document and indicated that they had significant comments that still need to be addressed by the EPA regarding the proposed CSF. On August 29, 2011, the EPA announced that it will address the SAB comments and complete the cancer portions of the reanalysis after completing the noncancer portion, but that will take some time.

NonCancer RfD or Other Equivalent Value

When information is available for multiple adverse effects of a hazardous substance, an evaluation of both cancer and noncancer adverse health effects is necessary to determine the most sensitive effect for developing cleanup criteria (§324.20120a(4)). As part of the development of the current Part 201 cleanup criteria, noncancer effects were informally evaluated to determine if they would require a cleanup criterion more restrictive than that based on the CSF. At that time, different noncancer criteria were calculated and all were less restrictive than the cancer-based criterion.

New information regarding prenatal and postnatal human effects and changes in risk assessment practices have resulted in the necessity to more closely consider the noncancer adverse effects in developing Part 201 site-specific criteria requiring the use of best available information. Based on this new information, the EPA developed a new oral RfD that was released on February 17, 2012 and posted the final noncancer assessment to the Integrated Risk Information System (IRIS). The associated toxicity assessment released at the same time is the final version of the noncancer portion of the EPA's Reanalysis of Key Issues Related to Dioxin Toxicity and Response to National Academy of Sciences (NAS) Comments, Volume 1 (EPA, 2012). The 2012 EPA RfD is the best available information for assessment of noncancer endpoints. In addition, when the adverse effects are related to early-life exposures, the appropriate sensitive receptor is a child. Therefore, a child receptor is used to develop the noncancer direct contact criterion based on the 2012 EPA RfD.

The noncancer value is the 2012 EPA RfD of 7.0×10^{-10} mg/kg-day from the EPA 2012 reanalysis based on two human studies demonstrating altered thyroid function

(Baccarelli et al, 2008) and impaired adult male reproductive function (Mocarelli, et al, 2008) associated with prenatal and postnatal exposure to TCDD.

The 2012 EPA RfD is based on co-critical studies in humans, Baccarelli et al, 2008 and Mocarelli et al, 2008. The Baccarelli study evaluated serum thyroid stimulating hormone (TSH) levels in neonates born to mothers who were exposed to TCDD 17-29 years prior to pregnancy during the 1976 explosion in Seveso, Italy. The adverse effect was identified as an increase in TSH levels above the WHO standard of 5 µ-units TSH per mL of serum indicating dysregulation of thyroid hormone metabolism. The Mocarelli et al study reported decreased adult sperm concentrations and decreased motile sperm counts in men who were 1-9 years old in 1976 at the time of initial exposure to TCDD from the Seveso accident.

The 2012 EPA RfD uses intake rates derived using the Emond et al human physiologically-based pharmacokinetic (PBPK) model from serum concentrations reported in the studies. For the Baccarelli et al study, the EPA used the study's regression model to estimate a maternal plasma TCDD concentration at the neonatal TSH level of concern and the Emond human PBPK model under the gestational scenario to determine the maternal intake rate lowest-observed-adverse-effect level (LOAEL) of 2.4 $x10^{-8}$ mg/kg-day. For the Mocarelli et al study, since it was not clear whether the effects were related to the peak exposure or to the average exposure, the EPA used the average of the estimated intake rates for both to derive an intake rate LOAEL of 2.0 x 10^{-8} mg/kg-day. The RfD also includes a 30x uncertainty factor, 10 for the LOAEL and 3 for within human variability.

The DEQ evaluated noncancer risk using the 2012 EPA RfD, although Dow did not include an evaluation of noncancer risk in their work plan.

Exposure Assumptions

Oral Bioavailability or Ingestion Absorption Efficiency (Ae_i)
Oral bioavailability is the proportion of an ingested chemical that is absorbed from the gastrointestinal tract into the bloodstream and tissues. Dow has proposed to use an oral relative bioavailability value of 0.26 or 26% based on swine data from a pilot bioavailability study conducted on a single sample to represent Midland Area Soils (Dow, 2010).

Dow proposed, and the DEQ has agreed, to consider the data from a pilot bioavailability study (Dow, 2005) in lieu of Dow conducting a full bioavailability study. This decision was made after review of the data from the pilot studies because the difference in bioavailability values did not appear to be worth the time and cost required to complete a full study.

The pilot study was designed to evaluate two animal models, Sprague-Dawley rats and juvenile swine, for measuring the bioavailability of five important D/F congeners for the

Midland Area Soils and Tittabawassee River floodplain soils to inform the design of a full study. The pilot study was to compare liver and adipose tissue D/F congener levels from soil-fed animals and control animals. The control animals had matched doses of the same congeners in either feed or corn oil vehicle. The results estimate the relative bioavailability between the soil and the vehicle dosing. Objectives were to evaluate the feasibility to detect the D/Fs in the liver and adipose tissue of both animals and evaluate the study designs including the number of animals per dose group. One soil sample each from the two areas of interest was administered for 30 days, in a soil/feed mixture for rats and in soil wrapped in a dough ball for swine. The dosing for control rats included both a feed and corn oil vehicle. The control swine were dosed with an oil vehicle in a gelatin capsule, wrapped in a dough ball.

The results of the pilot study indicated that both animal models had drawbacks. For swine, there was trouble detecting the congener concentrations for the Midland Area Soil, probably due to the rapid growth of the animals during the 30-day study period. The swine study also resulted in fairly large coefficients of variation for the bioavailability values.

The control rats also demonstrated differentially elevated enzyme activity typically induced by dioxin exposure. The studies included measurement of 7-ethoxyresorufin-O-deethylase (EROD) and methoxyresorufin-O-deethylase (MROD) associated with cytochrome P450 enzyme activity to evaluate whether or not differential enzyme induction was occurring between soil-fed and control groups. The soil-fed rats did not eat as much as expected, resulting in a lower D/F dose than the control rats. The control groups had higher EROD activity related to their higher doses than the soil-fed rats. The higher EROD induction in the controls led to speculation that the relative bioavailability estimates may be elevated since the increased metabolic activity could reflect increased elimination of the D/F congeners in the control rats. A follow-up study in rats with the Tittabawassee River floodplain soil and several dose-matched corn oil controls was designed to evaluate whether the increased EROD activity was influencing the bioavailability values (Dow, 2006). This follow-up study demonstrated that when controls with similar dose and EROD activity were used to estimate relative bioavailability, the relative bioavailability was not different from those of the pilot study for 4 of the 5 congeners. The only congener that appeared to be significantly elevated in the pilot study was 2,3,7,8-tetrachlorodibenzofuran (TCDF). TCDF has a much shorter half-life than other D/F congeners with toxic equivalency factors (TEFs), so is more likely to have increased elimination. The TCDF congener contributes an average of only 2.3% to the TEQ for 2006 Midland Area Soil samples. Since TCDF is not an important congener for the Midland area, it was not one of the congeners used in the pilot study to represent dioxin bioavailability for the Midland soil. TCDF is an important congener for the Tittabawassee River floodplain soil.

The conclusion of the follow-up study was that there appeared to be a true difference in bioavailability between the rat and swine studies. It is not clear whether the difference was due to species absorption differences or the soil dosing differences (soil within

normal feed, intermittent intake in rats, or soil within dough balls dosed twice daily, bolus intake in swine).

It is not clear which animal model, swine or rats, best represents the oral bioavailability of dioxin in soil for humans. The DEQ considers an average of the two species oral bioavailability values to be appropriate. Dow argues that the swine are a better model for human gastrointestinal function and only the swine values are appropriate.

A recent EPA report (EPA, 2010b) reviews the available information on the bioavailability of dioxins in soil. This review included the Dow rat and swine pilot and follow-up studies (Budinsky et al, 2008). The EPA's conclusions are that there is not sufficient information to determine a preferred animal model or bioassay protocol for predicting soil relative bioavailability in humans. Part of this determination is based on conflicting results between animals with increasing levels of dioxin chlorination. Rodents appear to have lower bioavailability with increasing chlorination, as would be expected. The swine appear to have higher bioavailability with increasing dioxin chlorination based on the limited swine studies available.

The stated primary purpose of the EPA, 2010b report was to evaluate whether an adjustment is necessary to account for differences in the bioavailability of dioxins in soil and the absorption of the contaminant in the test medium (ABS_{GI}) used in the critical study(s) on which the CSF and/or RfD were based (e.g., dietary exposure vs. exposure to soil). The conclusion was that this type of adjustment was appropriate, but there was not sufficient information available to establish a nationwide default value. Since the bioavailability must be evaluated relative to the test medium for the critical toxicity study, the appropriate value to use for Midland Area Soils is relative to the feed control in the rats and the dough-ball control in the swine for the current cancer slope factor.

For the 2012 EPA RfD, an absolute oral bioavailability value was used by the DEQ to calculate a Midland site-specific noncancer criterion to evaluate the Midland Action Level proposed by Dow based on calculation of a cancer criterion. In April 2012, the EPA clarified to the DEQ that the RfD was adjusted by incorporating into the physiologically-based pharmacokinetic (PBPK) model an input of 87% as the ABS_{GI} based on uptake of TCDD from corn oil measured as part of a human study (Poiger and Schlatter, 1986). The calculation for noncancer adverse effects did not include consideration of this adjustment, but assumed there was no adjustment (i.e., 100% ABS_{GI}). Further discussion of this decision is in the Summary section of this document.

One of the considerations for the bioavailability values is how to address different congeners that are contributing to the TEQ. Dow proposed to use a TEQ-weighted average from the five congeners evaluated in the bioavailability study to represent the total TEQ bioavailability. The five congener distribution of the single test soil is provided in Table 3 (attached) and compared to the average congener distribution of samples collected in 2006 for Midland Area Soils. The 2006 soil sampling was conducted to represent soil concentrations and characteristics for the design of a full bioavailability study. The five congeners in the test soil contributed 88% of the TEQ for that soil. The

congener distribution of the single test soil is not the same as the average of the 2006 soil samples. The five congeners tested for bioavailability only represent 78% of the average TEQ for the 2006 soil samples. The test soil also has a higher contribution from TCDD and 1,2,3,7,8-pentachlorodibenzo-p-dioxin (PeCDD) to the TEQ with the higher chlorinated dioxins underrepresented as compared to the average of the 2006 samples. In developing a fast analytical technique for further sampling in Midland Area Soils, Dow has determined, and DEQ concurs, that 13 of the 17 TEF congeners must be included to adequately represent the TEQ. Therefore, 22% of the TEQ typical for Midland Area Soils is not adequately represented by the bioavailability value obtained from the pilot study.

As a result of these considerations, the DEQ has adjusted the pilot bioavailability values using the following averages in sequence:

- Average of TEQ weighting from the congener distributions between the test soil and the average 2006 soil samples for both the rat relative to feed and swine relative to dough-ball control,
- Average of the reported swine values at both ½ the detection level and the detection level, and
- Average of the rat and swine averages.

The above values are displayed in Table 3. The calculations have resulted in an average TEQ weighted relative to feed bioavailability value of 0.38 or 38%. This is the recommended value for the use with the toxicity values where the test medium was feed, i.e., 1995 GLWQG oral SF. The value recommended for Midland Area Soils as best available information for oral absorption efficiency is 0.38 relative bioavailability for use with the 1995 GLWQG oral SF.

For the 2012 EPA RfD, which is based on human studies where intake doses were estimated from blood levels, the assumed test medium for the PBPK model was corn oil in humans. An absolute bioavailability value of 0.26 or 26% (Table 4) for both the rats and swine with the same considerations as above was used to evaluate the proposed Midland Action Level. Further discussion of the clarification by EPA on the human bioavailability assumption of 87% used for the PBPK model in developing the RfD is provided in the Summary section of this document.

Dermal Bioavailability or Dermal Absorption Efficiency (Ae_d)

Dermal bioavailability is the amount of chemical that enters the body when applied to skin. As with oral bioavailability, this value can be an absolute bioavailability value or a value relative to the vehicle used for the toxicity study that serves as the basis of a toxicity value. The generic dioxin dermal absorption efficiency in the current Part 201 rules is 0.03 or 3%. The DEQ agreed to a value of 0.0175 or 1.75% as the appropriate value for typical Michigan soils during discussions with Dow. This value was developed for soils with an f_{oc} of 0.45% (consistent with soils in Michigan) based on adjusted human AE_d values for TCDD reported as 0.0095 (0.95%) and 0.025 (2.5%) (EPA, 1991). These values were calculated from mean percents absorbed for four or five test animals or excised skin samples and, therefore, represent average values. Human *in*

vitro data from excised skin samples were adjusted using the ratio of animal *in vivo*/animal *in vitro* to derive the estimated human *in vivo* value of 0.0095 (0.95%). Animal *in vivo* data were adjusted using the ratio of human *in vitro*/animal *in vitro* to derive the estimated human *in vivo* value of 0.025 (2.5%). Both approaches are equally valid and provide estimates of average human dermal absorption efficiency for TCDD. Therefore, the DEQ suggests a midpoint value of 0.0175 (1.75%) for the dermal bioavailability (AE_d) to calculate soil direct contact criteria.

The values reported above are absolute percutaneous absorption values. As described above for the oral bioavailability, a percutaneous absorption value must be adjusted for the absorption of the contaminant from the test medium (ABS_{GI}) used in the toxicity study that serves as the basis of the oral toxicity value. This adjustment is of even greater importance for dermal absorption (EPA, 2004). The rat feed results from the pilot study were used assuming 80% absorption for the corn oil gavage to calculate an absolute bioavailability value for the feed of 0.55 (55%) as the ABS_{GI} value from the EPA dermal guidance.

The soil dermal absorption rate of 0.0175 divided by the feed absolute bioavailability value (ABS_{GI}) of 0.55 resulting in a relative bioavailability value of 0.032 (3.2%) is recommended as best available information applied to the 1995 GLWQG CSF based calculation.

The dermal absorption efficiency of 0.0175 for soil was applied to the 2012 EPA RfD based calculation. A discussion of the decision to use this soil dermal absorption rate for criterion calculations with the 2012 EPA RfD is provided in the Summary section of this document.

Exposure Frequency

Dow proposed using local climate data to adjust outdoor soil exposure frequency to only those days above freezing air temperature with no significant precipitation. The DEQ reviewed the original basis for the statewide default value and the available local climate data. The DEQ and EPA have typically based outdoor vs. indoor exposure on days with snow cover (e.g., >1 inch) and/or frozen soil (e.g., maximum soil temp <32° F). The DEQ accepts that these conditions define the number of days with only indoor dust exposure. The available local climate data (NOAA, 2010 and MSU, 2010) for 2005-2009 indicates the number of days with either snow cover or frozen soils (≤32°F) is 90 days (88.8-91.8 days potential range for days with missing data) resulting in 275 days when the soil is not frozen or there is less than an inch of snow cover. The default value for residential exposure is 350 days per year (accounting for 15 days per year the receptor is assumed to be away from home). The outdoor exposure for the SSRDCC would be 260 days (275-15 days spent away from home). This site-specific exposure frequency value is greater than the default value of 245 days.

Dow proposed to split the soil ingestion between outdoor soil exposure and indoor dust exposure. The soil-to-dust ratio proposed is based on a linear regression model from the University of Michigan, Dioxin Exposure Study (UMDES). The DEQ does not agree

to use the linear regression as proposed by Dow. The DEQ has previously determined that the model is confounded with collinear parameters and sampling weights, and thus would only be willing to accept the paired data without the model influences. Dow has not provided any other representation of the paired dust/soil data to the DEQ, only the model predictions. Based on the unpaired data and the model prediction, the soil-to-dust contribution appears to be in the range of 35% (model predicted) to 50% (fractional TEQ concentrations 0.30-0.54 from unpaired summary statistics). The median value (~50%) is preferred as most representative without paired soil-to-dust data. The DEQ remains willing to reconsider this prorated house dust concentration based on paired soil and dust data for the Midland Area Soils.

The DEQ considers a split between soil and dust exposure to be appropriate for both soil ingestion and dermal contact with similar adjustments to the dermal exposure frequency. Dow proposed a fifty-fifty split between soil and dust exposure that was included in the calculations for outdoor days with all of the exposure for indoor days coming from dust.

Consequently, the values recommended as best available information for Midland Area Soils are:

- Site-specific 260 outdoor exposure days per year for soil,
- 350 days per year for dust,
- half of average daily ingestion rate each for soil and dust, and
- 0.5 fractional dust concentration from soil, unless paired soil-to-dust data is provided by Dow to revise this value.

Soil Ingestion Rate for Children

Dow proposed to change the soil ingestion rate for children from 200 mg/day to 100 mg/day described as a central tendency in the 2008 EPA Exposure Factors Handbook (EFH) for children without pica or geophagy behavior. The DEQ Toxics Steering Group (TSG), Children's Environmental Health Subcommittee had recently reviewed the 200 mg/day children's soil ingestion rate for DEQ, Remediation Division (RD), and recommended retaining the 200 mg/day value. An upper bound on the central tendency for children's soil ingestion is 200-270 mg/day according to Ms. Jackie Moya, the primary author of the 2008 EPA EFH. The EPA regional screening levels continue to use 200 mg/day for the children's soil ingestion rate (<http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm>). Based on this information the RD determined that the 200 mg/day value for children under the age of 6 is the best available information.

Calculation of recommended values for a Midland Area Soils SSRDCC uses the 200 mg/day soil ingestion rate value for children.

Relative Source Contribution (RSC)

Section 20120(a)(4) states: "For the noncarcinogenic effects of a hazardous substance present in soils, the intake shall be assumed to be 100% of the protective level, unless compound and site-specific data are available to demonstrate that a different source

contribution is appropriate." Part 201 provides for the application of a factor to account for "source contributions" other than the pathway under consideration in the development of soil cleanup criteria. Part 201 specifies a default value of one (100%) unless data are available to justify a chemical-specific value. Consideration of source contribution for carcinogenic effects is not provided for under Part 201.

The DEQ applies exposure data where available and of sufficient quality to choose an appropriate RSC. Data are available for DLCs primarily due to the highly toxic nature of these chemicals and public concerns related to their health effects.

The available data indicate that TCDD and related compounds are ubiquitous in the diet of U.S. residents. There are numerous studies of DLCs in dietary items including studies conducted by the U.S. Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), and Health Canada (HC) on dietary items, although many only included D/Fs, without dioxin-like PCBs. The FDA has used Total Diet Study (TDS) data from 2001-2004 to estimate average per capita dietary intakes of D/Fs for various age groups (FDA, 2007). Lorber et al, 2009 and Lorber et al, 2010 provided an analysis of USDA beef, pork, and poultry data and National Health and Nutrition Examination Survey (NHANES) 2001/2002 blood data for adults to evaluate trends. Although the interpretation of the trend data was difficult due to differences in methods, analytes, and detection limits between studies at different time periods, there does appear to be a downward trend in exposure levels for most DLCs and TEQ. Lorber et al, 2010 has used the most recent FDA, USDA, and HC data to update adult intake estimates to determine an average intake of 33.5 pg TEQ/day for D/Fs and PCBs for adults in the U.S. This evaluation indicates that the average dietary intake of DLCs has decreased.

<u>RSC with respect to the 2012 EPA RfD</u>
Staff recommends that it is not appropriate to use an RSC of less than one in the calculation of a criterion using the 2012 EPA RfD for the reasons described below. The 2012 EPA RfD is based on exposure to TCDD alone, since the Seveso explosion was a release of TCDD and reference toxicity values have typically been developed for TCDD. However, the available information indicates that the study populations that serve as the basis of this RfD had typical exposures to other DLCs at the time of their measured TCDD exposure.

Baccarelli et al, 2008 reported a mean maternal D/F and coplanar PCB (DFcP) TEQ of 44.8 ppt for plasma samples collected between 1992 and 1998 for a subset of the exposed mothers from Seveso. The calculated mean DFcP TEQ without TCDD is 25.9 ppt for this co-critical study. For comparison to U.S. adults in the mid 1990s and 2001/2002, Lorber et al, 2009 reported mean serum DFcP TEQ of 17.2-22.9 ppt and calculated DFcP TEQ without TCDD of 16.5-20.7 ppt. Patterson et al, 2008 reported 90^{th} and 95^{th} percentiles for U.S. women from the 2001-2002 NHANES data. The 90^{th} and 95^{th} percentile DFcP concentrations for women aged 20-39 years were 23.1 ppt and 26.4 ppt, respectively, and for women aged 40-59 years were 33.5 ppt and 46.9 ppt, respectively. From available data in Michigan, the mean and 95^{th} percentile

values for DFcP TEQ (without TCDD) are 6.2 (5.3) ppt and 9.1 (8.0) ppt, respectively for adults from the Midland Plume,18-29 years old(n=3); 12.8 (11.5) ppt and 17.3 (15.1) ppt, respectively, for adults from the Midland Plume, 30-44 years old (N=9); 7.3 (6.6) ppt and 10.4 (7.3) ppt for adults in the Jackson/Calhoun reference area, 18-29 years old (n=16); and 13.8 (12.8) ppt and 23.3 (21.4) ppt, respectively, from the Jackson/Calhoun reference area for adults, 30-44 years old (n=66)(UMDES, 2008).

The Mocarelli et al study had only TCDD data available for their subjects due to sample volume for the individual samples. The only data for other DLCs from the appropriate time frame (soon after the 1976 explosion) are from pooled serum samples from female residents of the reference area outside the area impacted by TCDD that were analyzed for DFcP TEQ (Eskenazi et al, 2004). Two pooled serum samples were analyzed for the 0-12 year age group. The reported concentrations were 119.5 ppt and 113.6 ppt for serum DFcP TEQ and calculated DFcP TEQ without TCDD are 71.9 ppt and 80.2 ppt for this age group. These concentrations were reported as within the range of levels typical for persons tested in Europe around the same time period. Representative data for U.S. or Michigan populations were not available for comparison purposes for the age groups of interest. Based on decreases in adult serum concentrations since that time frame in the U.S. and child serum concentrations reported from elsewhere (Burns et al, 2009; Link et al, 2005; and Tohyama et al, 2011), the late 1970s Seveso reported concentrations are well above those expected for children in Midland today.

From the available data, it appears that the subjects of both the Mocarelli et al and Baccarelli et al studies had exposure to background concentrations of non-TCDD TEQ that were above, or well above, current measured or expected levels. This evaluation is supported by other data that show decreasing exposures to D/F TEQ since the 1970s. The 2012 EPA RfD is based only on TCDD exposure and did not take into account other DLC exposure in the study groups that serve as the basis for the RfD. Therefore, calculating a criterion using a RSC less than one for this RfD is not appropriate based on the information currently available and the basis of this RfD.

Summary

The DEQ is required, when information is available, to evaluate both cancer and noncancer risk in developing cleanup criteria for a hazardous substance. An oral CSF and a noncancer RfD value have been considered for calculating a SSRDCC for dioxin in Midland Area Soils.

The toxicity values and exposure assumptions used in the residential direct contact criteria calculations are presented in Table 1 for the cancer calculation and Table 2 for the noncancer calculation.

The SSRDCC uses the algorithm and, except for those identified as site-specific below, the exposure assumptions for the generic residential criteria for other chemicals pursuant to R 299.5720. Site-specific information is considered for some of the exposure assumptions in the calculation for a SSRDCC for dioxin in Midland Area Soils.

After evaluation of proposed changes to exposure assumptions for a dioxin SSRDCC, the following values are recommended as being best available information for the purpose of calculating a SSRDCC for Midland Area Soils:

- Soil oral bioavailability of 0.38 relative bioavailability and 0.26 absolute bioavailability based on site-specific information;
- Soil exposure frequency (incidental ingestion and dermal contact) of 260 outdoor days/year and dust exposure frequency of 350 days/year based on site-specific information (incidental ingestion and dermal contact for both soil and dust);
- Soil and dust each contribute half of the soil/dust exposure for the 260 outdoor days, the other 90 days are 100% dust exposure;
- Fractional concentration of TEQ for dust from soil of 0.5;
- Child soil ingestion rate of 200 mg/day based on a recent reevaluation of this generic assumption by DEQ, no change from previous generic assumption;
- Soil dermal bioavailability of 0.032 relative bioavailability and 0.0175 absolute bioavailability; and
- Relative source contribution for soil exposure to TEQ of 1 is appropriate for the 2012 EPA RfD.

In addition, a child only receptor was used to calculate the noncancer cleanup value, since the noncancer RfD is based on prenatal and postnatal early life exposures.

These recommended exposure assumptions result in a cancer value of 260 parts per trillion (ppt). The noncancer value based on human data from the 2012 EPA RfD and the recommended assumptions is 260 ppt.

As stated above in the Oral Bioavailability or Ingestion Absorption Efficiency (Ae_i) and Dermal Bioavailability or Dermal Absorption Efficiency (Ae_i) sections, EPA provided the DEQ a clarification that the 2012 EPA RfD did include an assumption of 87% oral bioavailability as part of the PBPK model. The DEQ has evaluated this information with the following considerations:

The Midland site specific noncancer criterion could be recalculated to account for this adjustment within the development of the RfD. Two approaches could be considered for this adjustment:

1. Adjust the absolute bioavailabilities (both oral and dermal) previously used for the calculation by dividing the values by the fractional absorption used in the PBPK model. This would result in a cleanup criterion of 230 ppt.
2. Use the Dow, 2005, pilot study bioavailability value relative to corn oil for the rat and the dough ball for the swine in the calculation of the noncancer oral bioavailability value. The dermal bioavailability value would be adjusted by dividing the absolute percutaneous absorption value by the fraction absorption used in the PBPK model. This would result in a cleanup criterion of 220 ppt.

The Midland Site Specific Action Level could remain as proposed based on the following considerations:

- EPA guidance recommends not making these adjustments unless the ABS_{GI} from the critical toxicity study is significantly less than 100%. Their recommended cutoff is 50%. The 87% ABS_{GI} included in the PBPK model for the 2012 EPA RfD is close to 100%, although we did adjust the bioavailability relative to feed (at 55%) for the cancer slope factor since it was close to the 50% recommended cutoff.
- The RfD is based on the exposure to TCDD alone. The study groups that are the basis of the RfD were also exposed to other DLCs. The study groups exposure to other DLCs was greater, even much greater, than has been observed or would be expected for background exposures in Midland as described in the Relative Source Contribution section of this document resulting in additional conservatism in the calculated cleanup criterion.

Based on the above considerations, the DEQ has concluded it is appropriate to approve the site-specific Midland Action Level of 250 ppt TEQ.

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Table 1. Assumptions for cancer residential direct contact criterion (DCC)

Assumptions for Cancer Risk Criteria Calculations	**Current Residential DCC (90 ppt)**	**Current Default Assumptions for Other Chemicals**	**Recommended Assumptions for SSRDCC with 1995 EPA GLWQG CSF**
Toxicity Assumptions			
Oral Cancer Slope Factor $(mg/kg\text{-}day)^{-1}$	75,000	NA – chemical specific	75,000
Target risk level	$1x10^{-5}$	$1x10^{-5}$	$1x10^{-5}$
Exposure Assumptions			
Averaging Time (years)	70	70	70
Exposure Duration (years)	30 6 (0-6 child) 24 (>6-adult)	30 6 (0-6 child) 24 (>6-adult)	30 6 (0-6 child) 24 (>6-adult)
Body Weight (kg)	15 (0-6 child) 70 (>6-adult)	15 (0-6 child) 70 (>6-adult)	15 (0-6 child) 70 (>6-adult)
Ingestion Exposure Frequency – Soil (days/year)	350*	350*	**260**
Ingestion Exposure Frequency – Dust (days/year)	NA(350)*	NA(350)*	**350**
Soil Ingestion Rate (mg/day)	200 (0-6 child) 100 (>6-adult)	200 (0-6 child) 100 (>6-adult)	200 (0-6 child) 100 (>6-adult)
Oral Bioavailability – Ingestion Absorption Efficiency (fraction)	0.5	NA – chemical specific	**0.38**[@]
Dermal Exposure Frequency – Soil (days/year)	245*	245*	**260**
Dermal Exposure Frequency – Dust (days/year)	NA(245)*	NA(245)*	**350**
Skin Surface Area (cm^2)	1820 (0-6 child) 5000 (>6-adult)	2670 (0-6 child) 5800 (>6-adult)	2670 (0-6 child) 5800 (>6-adult)
Adherence Factor (mg/cm^2)	1.0 (0-6 child) 1.0 (>6-adult)	0.2 (0-6 child) 0.07 (>6-adult)	0.2 (0-6 child) 0.07 (>6-adult)
Dermal Bioavailability – Dermal Absorption Efficiency (fraction)	0.03	NA – chemical specific	0.32 =0.0175*0.55[@]
Dust/Soil Concentration Ratio	NA(1)*	NA(1)*	**0.5**
Proportion of Outdoor Days Attributable to Dust and Soil	NA(1)*	NA(1)*	**0.5**

Bold values are based on site-specific information.

*Soil and dust exposure are not evaluated separately for generic criteria.

[@]Soil bioavailability is relative to toxicity study exposure medium (e.g., animal feed) bioavailability.

Table 2. Assumptions for noncancer residential direct contact criterion

Assumptions for NonCancer Risk Criteria Calculations	**Current Generic Assumptions for Other Chemicals**	**Recommended Assumptions for SSRDCC with 2010 Draft EPA RfD**
Toxicity Assumptions		
Oral Reference Dose (RfD - mg/kg-day)	NA – chemical specific	0.0000000007
Uncertainty Factors	NA – chemical specific	30
Exposure Assumptions		
Averaging Time (years)	30	6
Exposure Duration (years)	30 6 (0-6 child) 24 (>6-adult)	6 6 (0-6 child)
Body Weight (kg)	15 (0-6 child) 70 (>6-adult)	15 (0-6 child)
Relative Source Contribution (fraction)	NA – chemical specific (Rule 752 =0.2)	1[+]
Ingestion Exposure Frequency – Soil (days/year)	350*	**260**
Ingestion Exposure Frequency – Dust (days/year)	NA(350)*	**350**
Soil Ingestion Rate (mg/day)	200 (0-6 child) 100 (>6-adult)	200 (0-6 child)
Oral Bioavailability – Ingestion Absorption Efficiency (fraction)	NA – chemical specific	**0.26**[^]
Dermal Exposure Frequency – Soil (days/year)	245*	**260**
Dermal Exposure Frequency – Dust (days/year)	NA(245)*	**350**
Skin Surface Area (cm^2)	2670 (0-6 child) 5800 (>6-adult)	2670 (0-6 child)
Dermal Adherence Factor (mg/ cm^2)	0.2 (0-6 child) 0.07 (>6-adult)	0.2 (0-6 child)
Dermal Bioavailability – Dermal Absorption Efficiency (fraction)	NA – chemical specific (Rule 752 =0.03)	0.0175[^]
Dust/Soil Concentration Ratio	NA(1)*	**0.5**
Proportion of outdoor days attributable to Dust and Soil	NA(1)*	**0.5**

Bold values are based on site-specific information.

*Soil and dust exposure are not evaluated separately for generic criteria.

[^]Absolute bioavailability value.

[+]See text for explanation.

Table 3. Relative Bioavailability for Midland Test Soil and Animal Feed Intake

Congeners Tested	Congener Distributions (CD)		Bioavailability Values					
	Pilot Study Test Soil, CC-S-27S (n=1) % Soil TEQ	Average 2006 Soil Samples (n=72) % Soil TEQ	Rat		Swine			
			Soil vs. Ref. Feed		½ D.L.		D.L.	
			Liver + Adipose	C.V.	Liver + Adipose	C.V.	Liver + Adipose	C.V.
2,3,7,8-TCDD	49	40	43	16	18	43	22	20
1,2,3,7,8-PeCDD	25	20	55	13	24	41	34	20
1,2,3,6,7,8-HxCDD	2.7	4.6	64	11	38	55	45	32
1,2,3,4,6,7,8-HpCDD	4.3	8.3	58	10	55	32	55	32
2,3,4,7,8-PeCDF	6.7	5	50	10	32	31	41	19
Test Congeners % of Soil TEQ	88	78						
TEQ-Weighted Relative Bioavailability as % (Pilot Soil CD/ Avg. 2006 CD)			48/49		23/26		29/31	
Average Species Relative Bioavailability as %			49		27			
Average Overall Relative Bioavailability as %			38					
Average Overall Relative Bioavailability as Fraction			0.38					

Table 4. Absolute Bioavailability for Midland Test Soil

Congeners Tested	Congener Distributions (CD)		Bioavailability Values		
	Pilot Study Test Soil, CC-S-27S (n=1) % Soil TEQ	Average 2006 Soil Samples (n=72) % Soil TEQ	Rat	Swine	
			Soil vs. Ref. Feed	½ D.L.	D.L.
			Liver + Adipose	Liver + Adipose	Liver + Adipose
2,3,7,8-TCDD	49	40	28	15	18
1,2,3,7,8-PeCDD	25	20	32	19	27
1,2,3,6,7,8-HxCDD	2.7	4.6	37	31	36
1,2,3,4,6,7,8-HpCDD	4.3	8.3	27	44	44
2,3,4,7,8-PeCDF	6.7	5	32	25	33
Test Congeners % of Soil TEQ	88	78			
TEQ-Weighted Absolute Bioavailability as % (Pilot Soil CD/ Avg. 2006 CD)			30/30	19/21	24/25
Average Species Absolute Bioavailability as %			30	22	
Average Overall Absolute Bioavailability as %			26		
Average Overall Absolute Bioavailability as Fraction			0.26		