



STATE OF MICHIGAN
DEPARTMENT OF ENVIRONMENTAL QUALITY
LANSING



JENNIFER M. GRANHOLM
GOVERNOR

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February 1, 2008

Via E-Mail and U.S. Mail

Mr. Greg Cochran, Director
Michigan Dioxin Initiative
Michigan Operations
The Dow Chemical Company
1790 Building
Washington Street
Midland, Michigan 48674

Dear Mr. Cochran:

SUBJECT: Approval with Modifications; Remedial Investigation Scope of Work for the Saginaw River and Floodplain and Saginaw Bay, Michigan; The Dow Chemical Company, Michigan Operations (Dow); MID 000 724 724

The Michigan Department of Environmental Quality (MDEQ), Waste and Hazardous Materials Division (WHMD), has reviewed the Revised Scope of Work for the Saginaw River and Floodplain and Saginaw Bay, Michigan (SRB SOW), submitted by Dow to the MDEQ on October 15, 2007, as required in Dow's Hazardous Waste Management Facility Operating License (License). The MDEQ review of the revised submittal indicates that several critical points raised in our initial review of the SRB SOW were not addressed in Dow's revisions. Therefore, in accordance with Condition XI.B.4. of the License, the MDEQ is exercising its authority to modify and approve the SRB SOW as provided in the enclosure to this letter.

The MDEQ is approving the SOW with modifications in order to avoid delay in the preparation of the Remedial Investigation Work Plan (RIWP). As you may recall, the SOW approval process significantly delayed the development of the Tittabawassee River RIWP and investigation work on the Tittabawassee River. This approval of the SRB SOW with modifications allows Dow and the MDEQ to focus resources on the more substantive RIWP tasks and proceeding with approved work on the Saginaw River and Saginaw Bay during the upcoming field season.

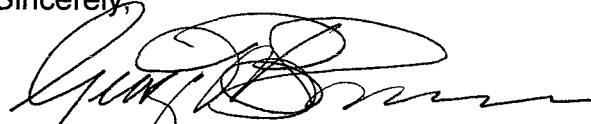
Additionally, to the extent that the Natural Resource Damage Assessment Trustees' comments were not addressed in the revised SRB SOW, the MDEQ has incorporated those comments into the Approval with Modifications. The MDEQ remains committed to coordinating, to the extent practicable, the corrective action investigation and remediation of the Saginaw River and Floodplain and Saginaw Bay with the investigation and restoration efforts of the Trustees.

As part of this Approval with Modifications, the MDEQ has created an Interim Response Activities/Pilot Corrective Action Plan (IRA/PCAP) Decision Tree for the Saginaw River and Floodplain and Saginaw Bay by modifying the existing April 30, 2007, IRA/PCAP Decision Tree for the Tittabawassee River and the existing undated IRA/PCAP Step-Out Sampling Plan and attaching these documents to the SRB SOW.

Upon this approval, the approved SRB SOW becomes an enforceable condition of the License. Dow is required to incorporate these modifications into the development of the RIWP for the Saginaw River and Floodplain and Saginaw Bay, which is due within 60 days of receipt of this Approval with Modifications on April 1, 2008.

Should you have questions regarding this Approval with Modifications, please contact Mr. Arthur Ostaszewski, Hazardous Waste Section, WHMD, at 517-335-1119 or by e-mail at ostaszea@michigan.gov; or you may contact Mr. Allan Taylor, Hazardous Waste Section, WHMD, at 517-335-4799 or by e-mail at taylorab@michigan.gov; or you may contact me.

Sincerely,



George W. Bruchmann, Chief
Waste and Hazardous Materials Division
517-373-9523

Enclosures

cc/enc: Mr. Ben Baker, Dow
Mr. David Gustafson, Dow
Mr. Peter Wright, Dow
Mr. Jack Bails, Public Sector Consultants
Mr. Ralph Dollhopf, U.S. Environmental Protection Agency, Region 5
Mr. Greg Rudloff, U.S. Environmental Protection Agency, Region 5
Mr. John Steketee, U.S. Environmental Protection Agency, Region 5
Dr. Lisa Williams, U.S. Fish and Wildlife Service
Mr. Jim Sygo, Deputy Director, MDEQ
Mr. Frank Ruswick, Jr., Senior Policy Advisor, MDEQ
Ms. Liane Shekter Smith, MDEQ
Ms. DeLores Montgomery, MDEQ
Mr. Steve Buda, MDEQ
Ms. Judith Gapp, MDEQ
Ms. Virginia Himich, MDEQ
Ms. Cheryl Howe, MDEQ
Dr. Deborah MacKenzie-Taylor, MDEQ
Mr. Arthur Ostaszewski, MDEQ
Mr. Allan Taylor, MDEQ

MODIFICATIONS FOR APPROVAL

The Dow Chemical Company
Midland, Michigan
MID 000 724 724

Remedial Investigation Scope of Work Saginaw River and Floodplain and Saginaw Bay, Michigan February 1, 2008

The Revised Scope of Work for the Saginaw River and Floodplain and Saginaw Bay, Michigan (SRB SOW), dated October 15, 2007, is approved with the following modifications:

General Modifications

1. **Status of Previous Dow Submittal**

The Dow Chemical Company (Dow) submitted "The Conceptual *GeoMorph*TM Scoping Study, Upper Saginaw River, Saginaw, Michigan" prepared by Ann Arbor Technical Services (ATS) to the Michigan Department of Environmental Quality (MDEQ) in April 2006. The MDEQ and Dow agreed to defer implementation of the Upper Saginaw River (USR) Scoping Study until the *GeoMorph*TM Pilot for the Upper Tittabawassee River was complete and approved.

The MDEQ hereby considers the ATS USR Scoping Study document to be withdrawn and superseded by the ENVIRON Revised SRB SOW and associated proposed RIWP. However, it would be acceptable for Dow to repropose the *GeoMorph*TM process for the Upper Saginaw River as opposed to the geostatistical model proposed in the SRB SOW. It is not clear why Dow is changing investigation strategies for the Saginaw River system.

[RATIONALE: This modification is necessary because the MDEQ has received two separate submittals to cover investigation of the Upper Saginaw River and Dow did not specifically state that the earlier submittal was superseded or withdrawn. In addition, application of the GeoMorph process to the Tittabawassee River appears to be successfully defining the extent of contamination for remedial and risk management purposes.]

2. **Adequate Time for MDEQ Review and Approval**

The SRB SOW is modified to provide 45 calendar days for MDEQ review and approval of the Remedial Investigation Work Plan (RIWP) and all subsequent work plans. The time frame for MDEQ review and approval starts upon the receipt of a signed hard copy and unprotected electronic submittal. No work is to commence without MDEQ approval of the Current Conditions Report, the RIWP, work plans, or components of the work plans that have not been specifically approved by the MDEQ.

[RATIONALE: The Dow hazardous waste management facility operating license (License) specifically requires review and approval of the RIWP and work plans by the Chief of the MDEQ, Waste and Hazardous Materials Division.]

3. **Interim Response Activity/Presumptive Remedy**

The MDEQ has created an Interim Response Activities/Pilot Corrective Action Plan (IRA/PCAP) Decision Tree for the Saginaw River and Floodplain and Saginaw Bay by modifying the existing April 30, 2007, IRA/PCAP Decision Tree for the Tittabawassee River and has modified the existing undated IRA/PCAP Step-Out Sampling Plan to be applicable to the Saginaw River and Saginaw Bay (copies enclosed). The SRB SOW is modified to incorporate these documents. Dow, working with the MDEQ, U.S. Environmental Protection Agency (U.S. EPA), and the U.S. Army Corps of Engineers, must be prepared to provide for assessment and action when these triggers are exceeded in the Saginaw River and Saginaw Bay. Based on current conditions, surficial bedload sediments already exceed the triggers. The RIWP and initial Phase I work plans shall assess the scope and extent of sediment bedload contamination in the Saginaw River and Saginaw Bay and propose IRAs to be implemented in 2008 to reduce the movement of dioxins and furans along the Saginaw River and into the Saginaw Bay.

It is noted that the SRB SOW mentions "Considerations could include expansion of current sediment trap pilot program" [reference Table 1-1, License Condition XI.B.3.(a)]. As noted above, these actions must be significantly accelerated in the Saginaw River to limit further contamination of Saginaw Bay with dioxins and furans and other potential constituents of interest (PCOIs) related to Dow's Midland operations. Ideally, a sediment trap upstream of the navigational portion of the river would be used to prevent further migration of contaminants downstream. In addition, maintenance dredging of the navigation channel should be increased to prevent further migration of contaminants into Saginaw Bay being accelerated by shipping traffic (e.g., churning of sediments by freighters).

The SRB SOW is modified to clarify that IRAs may be required at any point in the corrective action process, including any point in advance of or during the remedial investigation.

[RATIONALE: *The IRA/PCAP Decision Tree and IRA/PCAP Step-Out Sampling Plan were modified to be applicable to the Saginaw River and Floodplain and Saginaw Bay and to clarify the information that is required to be reported to the MDEQ and the process and time lines to be followed when triggering concentrations are exceeded during investigation work.*

Adequate information exists on bedload transport of contaminants to support sediment traps and maintenance dredging as IRAs/presumptive remedies to help reduce the loading of dioxins and furans to the Saginaw Bay. Surficial concentrations of dioxins and furans in excess of the 10,000 parts per trillion in-channel trigger level have been identified in bedload samples from the Sixth Street Turning Basin area.]

4. **Compliance with R 299.5528**

The SRB SOW is modified to indicate that the proposed RIWP will provide a clear description of the overall remedial investigation/corrective action strategy being proposed by Dow. Pursuant to R 299.5528(2) of the administrative rules promulgated pursuant to Part 201, Environmental Remediation, of the Natural

Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 201 Rules), the MDEQ shall approve RIWPs or reports for work done in phases if all of the following conditions are satisfied:

- (a) Anticipated subsequent phases of investigation are described in sufficient detail so that the MDEQ can determine that the phase being proposed or reported on is appropriately defined.
- (b) The RI described in the work plan or report complies with the requirements of this rule for the scope it is intended to address.
- (c) If conducting the RI in phases will not prevent the RI from being completed in a timely fashion.

With respect to R 299.5528(2)(a), the SRB SOW is modified to indicate that the RIWP will clearly identify the remedial alternatives that are under consideration by Dow and will describe how the proposed investigation approach(es) will support the evaluation of potential remedial alternatives and/or the implementation of presumptive remedies. Sufficient clarity shall be provided in the RIWP to show that the proposed work and/or the proposed phasing of work are adequate and appropriate in the context of the overall corrective action process.

Table 1-1 and the revised SRB SOW do not adequately address R 299.5528(3). Therefore, the SRB SOW is modified to indicate that the RIWP will be developed to comply with the applicable requirements of R 299.5528(3). The MDEQ has determined that all of the requirements of R 299.5528(3) are potentially applicable to this very large scale remedial investigation. The RIWP shall include tables that describe how each individual requirement of R 299.5528(3) will be addressed during the implementation of the proposed RIWP. If Dow believes that a specific requirement of R 299.5528(3) is not applicable, then the RIWP shall provide the technical justification for that position.

[RATIONALE: *The License specifically requires that the RIWP must meet the requirements of R 299.5528. The SRB SOW has been modified to clarify Dow's obligation under the License to conduct a remedial investigation that meets the R 299.5528 requirements and the scope identified in the License.*]

5. **Conceptual Site Model**

The SRB SOW defers the Conceptual Site Model and listing of specific exposure pathways to the RIWP and work plan process. The RIWP shall identify all of the known and suspected exposure pathways and identify a process in the proposed work plans that provides for the collection of information necessary to evaluate these pathways during the implementation of the work plans.

[RATIONALE: *This information is necessary to develop final cleanup criteria and must be included in Phase I as this information was not included in the SRB SOW as required by Condition XI.B.3. of the License.*]

6. **Direct Investigation of High Concern Properties**

The RIWP and Phase I work plans shall identify a process that provides for the direct investigation of residential and agricultural properties that are of highest concern – those that have been flooded repeatedly in the last 100 years.

[RATIONALE: *This modification is necessary to ensure that the work is phased and prioritized based on consideration of potential risks to human health and the environment as required by Condition XI.B.3. of the License.*]

7. **Include Mass Balance/Loadings by Reach**

The SRB SOW is modified to indicate that the RIWP and work plans shall include a strong emphasis on the mass balance and movement of contaminant mass through the upper, middle, and lower compartments of the Saginaw River into the Saginaw Bay.

The RIWP and work plans shall propose a process that will provide sufficient spatial sampling detail to allow the MDEQ, U.S. EPA, and Trustees the ability to determine the nature and extent of dioxins and furans and other PCOI concentrations in sediment, floodplain soils, and biota in the following reaches:

USR – Upper Saginaw River: Confluence to (not including) Sixth Street Turning Basin (SSTB)

MSR – Middle Saginaw River: SSTB to (not including) Airport Turning Basin

LSR – Lower Saginaw River: Airport Turning Basin to Mouth (River Mile Zero)

SAGB-IE, IW – Saginaw Bay Inner (East of Navigation [Nav.] Channel, West of Nav. Channel)

SAGB-OE, OW – Saginaw Bay Outer (East of Nav. Channel, West of Nav. Channel)

[RATIONALE: *This modification is necessary to provide an understanding of the contaminant mass that is entering each Saginaw River/Bay compartment, how much is exiting, how much is being stored in each compartment, and what factors are influencing the transport or retention of contaminants in and between these compartments.*]

8. **Development of Time Lines for Recovery Based on Multiple Response Actions**

The SRB SOW is modified to incorporate an additional objective of projecting concentration trends (time lines) for dioxins/furans and other PCOIs in sediments, biota, and related ecological and human health risk reduction for the Saginaw River compartments and Saginaw Bay, using a matrix of remedial responses as part of the RIWP.

The RIWP and work plans shall address this additional objective.

[RATIONALE: *This information is necessary for Dow and the MDEQ to evaluate remedial alternatives for the Saginaw River and Saginaw Bay.*]

9. **Topographic, Bathymetric, and Geophysical Surveys**

The SRB SOW is modified to indicate that sediment cores and borings shall be integrated into the geophysical surveys to calibrate the geophysics and to “ground

truth" the results. The SRB SOW is modified to indicate that surveys shall be conducted by Dow as necessary to develop the information necessary to identify the nature and extent of contamination in Saginaw Bay as required by Condition XI.B.6. of the License.

[RATIONALE: *As noted above, in addition, this information is necessary for compliance with Condition XI.B.6. of the License.*]

10. The SOW is modified and clarified to indicate that the RIWP shall include assessment of all aspects of sediment resuspension, deposition and influences on contaminant availability, including but not limited to: natural and human activity resuspension, bioaccumulation, bioturbation, burial, and natural attenuation.

Hydrodynamic event characterization in the RIWP shall include adequate scales of time and event intensity, including investigations on a watershed scale that have or may have influence on the Saginaw River and Saginaw Bay in the future.

The RIWPs shall also provide for the assessment of the frequency, magnitude, and impacts of Saginaw River flow reversals.

[RATIONALE: *This information is necessary to understand the fate, nature, and extent of contamination related to Dow in accordance with the conditions of the License.*]

Specific Modifications

11. **Title Page**

Pursuant to Condition XI.B.6. of the License, the title for the SRB SOW is revised to read: Remedial Investigation Scope of Work for the Saginaw River *and Floodplain* [emphasis added] and Saginaw Bay, Michigan.

[RATIONALE: *This modification is necessary for consistency with Condition XI.B.6. of the License, which identifies the Saginaw River floodplain as an area specifically requiring investigation as part of the RIWP.*]

12. **Section 1.2.1 - Objectives**

In addition to the objectives proposed in the text of Section 1.2.1, the SRB SOW is modified to indicate that the RIWP will specifically propose work to address and answer the following issues and questions:

- How the location and depth of historical sediment and floodplain deposits will be determined (i.e., geophysics followed by coring and chemical analysis).
- River morphological characteristics, such as channel slope, width to depth ratio, entrenchment, and sinuosity.
- The depth at which the navigation channel needs to be maintained to prevent remobilization of sediments.

- How the bedload and suspended solids contamination load will be determined.
- The human health and ecological exposure pathways that are present and significant for PCOIs released from Dow in and along the Saginaw River and Saginaw Bay.
- The information necessary to support the development of cleanup criteria for floodplain soils and sediments in and along the Saginaw River and Saginaw Bay.
- The nature, extent, distribution, and environmental fate of PCOIs that were released from Dow and are present in media in and along the Saginaw River and Saginaw Bay.
- The mass of contamination related to historic Dow releases that is moving into the Saginaw River from the Tittabawassee River.
- The mass of contamination related to historic Dow releases that is moving from the Saginaw River into the Saginaw Bay.
- The effect of river barge and freighter traffic on contaminants in the navigational channel of the Saginaw River and Saginaw Bay.
- Additional IRAs that are necessary to limit human exposure to PCOIs.
- IRAs that are necessary to limit or minimize the spread of contamination into the Saginaw Bay.

[RATIONALE: *These modifications are necessary to ensure that key components of the remedial investigation required by the License and R 299.5528 are included in the RIWP. The MDEQ is specifically identifying these objectives to clarify agency expectations for the RIWP and to help Dow focus on issues that the MDEQ has identified as important and requiring further investigation as part of the RIWP.]*

13. **Section 1.2.1. - Objectives, Continued**

The first sentence of paragraph 4 on page 6 of the SRB SOW is modified as follows: The word "consistent" is changed to "in compliance." This sentence now reads: With respect to the first three objectives above, work will be performed that is *in compliance* with Michigan and federal guidance and regulations that apply to the remedial investigation / feasibility study (RIFS) process.

The last phrase in the second sentence of paragraph 4 on page 6 of the SRB SOW is modified by the addition of the following words shown in italics: *and in compliance with Michigan's Part 111 and Part 201, Rule 730 regulations and other applicable state and federal laws and regulations.*

The last phrase in the first sentence of paragraph 5 on page 6 of the SRB SOW is modified as follows: the words "for example" are deleted. The phrase now reads: *and include but are not limited to the following.*

[RATIONALE: *These modifications are necessary to clarify that the SRB SOW and the RIWP are required to be developed in compliance with the License and applicable state rules and regulations. The words "for example" were replaced with "including but not limited to" for clarity as the items that Dow listed as "examples" do need to specifically addressed as part of the RIWP. The phrase "and other applicable state and federal laws and regulations" was added to clarify that the RIWP would be developed to comprehensively address the RIWP requirements under state and federal law.]*

14. **Section 1.2.2 - Implementation of the Work**

The following modifications are made to this section of the SRB SOW with respect to field investigation activities:

- The SRB SOW is modified to indicate that data collection in the Saginaw Bay shall be comprehensive enough to define the nature and extent of contamination related to Dow operations, make remedial decisions, support the natural resource damage assessment, and ensure protection of human health and the environment.

[RATIONALE: *This modification is necessary to ensure that key components of the remedial investigation required by the License and R 299.5528 are included in the RIWP.]*

- Consistent with Condition XI.B.6. of the License, the SRB SOW is modified to indicate that the extent of the Saginaw Bay study area shall include "areas impacted by off-site migration or transportation of contaminants from the Dow facility."

[RATIONALE: *As stated above.]*

- The third sentence of paragraph 2 on page 8 of the SRB SOW is modified read: The draft *Current Conditions Report* will be reviewed and approved or approved with modifications as part of the RIWP review process. Data gaps identified during the review will be addressed in subsequent phases of the RIWP.

[RATIONALE: *This modification is necessary to clarify the review and approval status of the draft *Current Conditions Report* (draft CCR). Upon resolution of "current conditions," the RIWP can be structured to address data gaps. Initial review of the draft CCR indicates that the report may not be complete. For example, the draft CCR does not appear to document or acknowledge the very high bedload TEQ concentrations that were found during the turning basin pilot studies in 2006 and 2007.]*

- The last sentence of paragraph 2 on page 8 of the SRB SOW that reads as follows is deleted: Based on the existing information and interpretation of current environmental conditions reported in the available studies and technical reports, some aspects of the river and bay are well understood and require little, if any, further investigation and characterization.

[RATIONALE: *This modification is necessary because it is not known at this time if there is sufficient information to limit further characterization under the RIWP. This determination will be made after a comprehensive review of existing information has been completed. The MDEQ does agree that existing information will be used to the extent practicable to limit the need for additional investigation.]*

- The second sentence in paragraph 4 on page 8 that begins “The data developed from this work will form the basis for future investigation and data evaluation . . .” is deleted.

[RATIONALE: *This modification is necessary because it is not known yet if the data from the pre-RI work, that was completed “at risk” by Dow, will be adequate to form the basis for future investigation and data evaluation. The MDEQ will review this data, as well as the information contained in the Current Conditions Report, during the review of the RIWP. The MDEQ does agree that existing information will be used to the extent practicable to limit the need for additional investigation.]*

- The SRB SOW is modified to require that Phase 1 of the RIWP shall include additional sampling as necessary to determine the nature and extent of contamination related to the Dow Midland facility.

[RATIONALE: *This modification is necessary to specify that the determination of nature and extent of contamination will be completed early in the RIWP process.]*

- The SRB SOW is modified to require that Phase 1 of the RIWP shall include baseline sampling of key fish species from the Saginaw Bay, and possibly further sampling of fish from the Saginaw River, for dioxins, furans, and other PCOIs necessary for human health risk assessment (HHRA) and public health evaluation purposes. This activity is to be conducted in coordination with the Trustees, to the extent practicable.

[RATIONALE: *This requirement is necessary to ensure that the work is phased and prioritized based on consideration of potential risks to human health and the environment as required by Condition XI.B.3. of the License. Fish consumption has been identified as a key exposure pathway in the Saginaw River and Saginaw Bay system by the MDEQ and the Michigan Department of Community Health.]*

- The SRB SOW is modified to require that Phase 1 of the RIWP shall include monitoring of a flood event(s) in spring 2008, capturing data related to flow, sediment resuspension, and contaminant transport during this event through reaches of the Saginaw River and out into the Saginaw Bay as identified below:

USR – Upper Saginaw River: Confluence to (including) SSTB

MSR – Middle Saginaw River: S STB to (including) Airport Turning Basin

LSR – Lower Saginaw River: Airport Turning Basin to Mouth (River Mile Zero)

SAGB-IE, IW – Saginaw Bay Inner (East of Nav. Channel, West of Nav. Channel)

SAGB-OE, OW – Saginaw Bay Outer (East of Nav. Channel, West of Nav. Channel)

[RATIONALE: *This modification is necessary to ensure that key contaminant fate and transport data is developed early in the RIWP process.*]

- The SRB SOW is modified to require that Phase 1 of the RIWP shall include the collection and testing of representative Saginaw River and Saginaw Bay sediments for aquatic toxicity for the purpose of meeting the conditions of MDEQ-Remediation and Redevelopment Division Operational Memorandum #4, Attachment 3 – Sediment, and allowing the MDEQ to adequately calculate site-specific sediment criteria for the Saginaw River and Saginaw Bay.

[RATIONALE: *This modification is necessary to ensure that the information necessary to calculate sediment cleanup criteria pursuant to R 299.5730 is developed under the RIWP.*]

- Paragraph e on page 9, "Implementation of field sampling and survey activities specified in the RIWP," is modified to read as follows:

Field investigation activities described in the RIWP will focus on the Saginaw River (beginning at the confluence with the Tittabawassee and Shiawassee Rivers and extending to Saginaw Bay) and Saginaw Bay. Saginaw River studies will include, but not be limited to, hydrodynamic conditions, river bottom and bank sediments, sediment transport within the river, floodplain soils including floodplain areas immediately adjacent to the river, biological and ecological conditions, surface water conditions, and human and ecologic exposures to dioxins, furans, and other PCOIs from Dow. Saginaw Bay studies will focus on bay sediments and biota including, but not be limited to, chemical characterization of sediments, beaches, and biota for dioxins, furans, and other PCOIs, hydrodynamics, sediment transport within the bay, bay sediments, biological and ecological conditions, and human and ecological exposure to dioxins and other PCOIs from Dow.

[RATIONALE: *This paragraph was modified to clarify the scope of the RIWP and to make it consistent with the requirements of the License.*]

- Paragraph f on pages 9 and 10, "Preparation of work summary reports and the overall final Saginaw River / Bay RIWP report and submittal to MDEQ," is modified and clarified to indicate that Dow shall submit environmental data associated with the implementation of the RIWP in compliance with the conditions of the License (within 60 days of the end of the calendar quarter in which the sample[s] were collected).

[RATIONALE: *As noted above.*]

15. **Section 2 - Scope of Work**

The SRB SOW is modified to clarify that the primary purpose of the work summarized in the SRB SOW is to characterize the *extent of contamination*

[emphasis added] and the fate and transport of substances originating from the Dow Midland Plant and other work, as necessary, to address the requirements of Dow's License and the associated regulatory requirements.

[RATIONALE: *As noted above.*]

16. **Section 2.1 - Definition of Study Area**

This section of the SRB SOW is modified as follows:

- The last sentence of the first paragraph of Section 2.1 that begins "In Saginaw Bay, at this point in time and subject to data to be obtained . . ." is deleted.

[RATIONALE: *The Saginaw Bay Study Area is defined in the License as an off-site area that exceeds the environmental protection standards pursuant to Sections 20120a(1)(a) and (17) of Part 201 and is further defined as an area impacted by off-site migration or transportation of contaminants. For clarity, Saginaw Bay is defined in the SRB SOW as the area from the Saginaw River mouth to U.S. EPA Lake Huron Station HU 95b (reference Figure 2-2, enclosed).]*

- The SRB SOW is modified and clarified to indicate that the RIWP and work plans will include defining the extent of contamination from Dow-related dioxins, furans, and other PCOIs in the Saginaw River and Saginaw Bay sediments and floodplain.

[RATIONALE: *This modification is necessary to ensure that key components of the remedial investigation required by the License and R 299.5528 are included in the RIWP.]*

- The last sentence in Section 2.1 is modified to read as follows: The RIWP may propose work that involves a tiered approach using the progressive collection of data, geostatistics, modeling, and other investigation and assessment tools to identify and evaluate conditions in the river and the bay. An additional sentence is added as follows: Modeled results and statistical projections will be verified by field measurements and analytical data.

[RATIONALE: *This modification is necessary to clarify the MDEQ's requirement and expectation that modeled results must be verified with actual environmental data. The level of confirmation/verification sampling will be based, in large part, on reasonable predictions of future land use and the level of certainty required for remedial decision-making.]*

17. **Section 2.2 - Investigation Activities, Phase I Activity (Saginaw River Sediment and Soil Chemical Characterization)**

The SRB SOW is modified to indicate that the following information shall be clearly included in the RIWP and work plans for MDEQ review and approval:

- The statistical basis for the sampling grid and/or pattern (the point to area spatial representation) and a clear basis for proposing the sample population(s) for the study areas. The RIWP shall demonstrate that the proposed grid intervals are

appropriate for their intended purposes. Any references and calculations must be provided in the proposal.

- The processes and equations upon which the geostatistical model identified in Section 2.2, Phase 1 Activity, and other areas of the SRB SOW, is based. A report documenting the development and application of the model shall be presented for review. The proposal shall identify what type and amount of data are to be used in developing and calibrating the model and the plan for using results of all pertinent model simulations. This information must be included in text, table, and/or figure format.
- The process by which the model will be calibrated to the "n" samples. Geostatistical model calibration consists of changing values of model input parameters, within a reasonable range, in an attempt to match observed concentrations. Calibration simulations shall be provided to narrow the range of variability in model input data since there may be numerous choices of model input data values that may result in similar model solutions. At a minimum, model calibration must include comparisons between model-simulated conditions and field conditions for the "n" samples.
- Dow shall evaluate the predictive capabilities and accuracy of the geostatistical model by selecting locations to collect new samples and comparing the modeled results to the actual concentrations in the samples. The MDEQ and U.S. EPA have the option of collecting, or requiring the collection and analysis of, additional audit and confirmation samples to verify the results of the model.

[RATIONALE: *These modifications are necessary to clarify the MDEQ's requirements and expectations for the use of models and to specify the level and types of information that Dow will be required to provide in the RIWP to support the use of proposed models and to receive regulatory approval for model use.*]

18. **Section 2.2 - Investigation Activities, Phase 1 Activity**

The SRB SOW is modified to include the following elements in the first phase of work:

- Evaluation of IRAs to limit migration of Dow-related contamination within the Saginaw River and Bay system.
- The additional Phase 1 activity modifications that are identified elsewhere in this document are incorporated into this section.

[RATIONALE: *This requirement is necessary to ensure that the work is phased and prioritized based on consideration of potential risks to human health and the environment as required by Condition XI.B.3. of the License and that key RIWP work is conducted early in the investigation process.*]

19. **Section 2.2 - Investigation Activities, Phase 2 Activity**

The SRB SOW is modified to include the following elements in the second phase of work:

- Evaluation of IRAs to limit migration of Dow-related contamination within the Saginaw River and Bay system.

[RATIONALE: *This modification is necessary to clarify that IRAs will be continuously evaluated and implemented as necessary during the RIWP process to prevent limit migration of Dow-related contaminants down river and into Saginaw Bay.*]

- Conduct additional sampling and analysis as necessary to fill data gaps identified during review of the Current Conditions Report and the pre-RI work that Dow conducted "at risk" to complete the nature and extent component of the remedial investigation.

[RATIONALE: *As stated above.*]

- Develop a plan and conduct baseline sampling of the Saginaw River and Saginaw Bay for any monitored natural recovery components of proposed remedial actions.

[RATIONALE: *This modification is necessary as the MDEQ anticipates that Dow will propose monitored natural recovery as a component of the final remedial action for the Saginaw River and Saginaw Bay. Baseline information on the level of Dow-related contamination present in the Saginaw River and Saginaw Bay is necessary to track the effectiveness of any monitored natural attenuation components of a remedial action into the future.*]

- Continued identification and implementation of any IRAs and/or presumptive remedies to control human exposure and limit spread of existing contamination (e.g., sediment traps, navigational dredging, etc.).

[RATIONALE: *As stated above.*]

20. **Section 2.2 - Proposed Investigation Activities, Phase 3 Activity**

The SRB SOW is modified to include the following elements in the third phase of work:

- Evaluation of IRAs to limit migration of Dow-related contamination within the Saginaw River and Saginaw Bay system.

[RATIONALE: *This modification is necessary to clarify that IRAs will be continuously evaluated and implemented as necessary during the RIWP process to minimize further migration of Dow-related contaminants down river and into Saginaw Bay.*]

- A comprehensive HHRA, including all applicable pathways (e.g., fish consumption). The HHRA shall include identification and consideration of key receptor populations, including subsistence anglers.

[RATIONALE: *This modification is necessary to clarify the MDEQ's expectations with respect to the HHRA, especially with respect to key receptor populations such as high-end Saginaw Bay watershed fish consumers.]*

- Identification of remedial alternatives for the Saginaw River and Saginaw Bay, including but not limited to, dredging, capping, and monitored natural recovery.

[RATIONALE: *This modification is necessary to ensure that the RIWP develops the information necessary to evaluate remedial alternatives.]*

21. **Section 2.7 - Floodplain Soil**

The last sentence of this section is modified to read: Characterization of floodplain soils will be conducted as needed.

[RATIONALE: *This modification is necessary to determine the nature and extent of contamination in this key area identified in the License.]*

- The SRB SOW is modified to provide for the collection of floodplain soils in areas of high concern – repeatedly flooded residential and agricultural properties and high use recreation areas, and near the confluence of the Tittabawassee and Shiawassee Rivers. This shall be identified in the RIWP and reflected in the Phase I work plan.

[RATIONALE: *This requirement is necessary to ensure that the work is phased and prioritized based on consideration of potential risks to human health and the environment as required by Condition XI.B.3. of the License.]*

22. **Section 2.8 - Saginaw River Sediment**

The SRB SOW is modified to indicate that the RIWP shall propose bedload/surficial sediment sampling for dioxins/furans and other PCOIs. The RIWP shall propose bedload sampling throughout the Saginaw River and Saginaw Bay, at various times of the year, as part of the remedial investigation and the results shall be used for mass balance evaluations, concentration range determinations, and to predict and gauge effectiveness of remedial actions, including natural attenuation.

- The SRB SOW is modified to indicate that sediment and floodplain sampling shall be conducted to verify the results of any geostatistical analysis.
- Under the RIWP and work plans, the Saginaw River mouth shall be identified as a station location for determining the mass loading of contaminants to the Saginaw Bay.
- The second sentence of the first paragraph of Section 2.8 is modified to begin as follows: At least two types of sediment data will be collected
- The third sentence of the second paragraph of Section 2.8 that begins "The hydrologic modeling and geostatistical analysis will identify areas of the river that do not require further characterization . . ." is deleted.

[RATIONALE: *These modifications are necessary to ensure that adequate characterization data are collected to determine the nature and extent of the contamination.]*

23. **2.9 - Saginaw Bay Sediment**

The SRB SOW is modified as follows:

The second sentence of Section 2.9 is modified to begin as follows: At least two types of sediment data will be collected – static measurements at depth

The fifth sentence of Section 2.9 that begins “The hydrologic modeling and geostatistical analysis will identify areas of the bay that do not require further characterization . . .” is deleted.

[RATIONALE: *These modifications are necessary to ensure that adequate characterization data are collected to determine the nature and extent of the contamination.]*

24. **Section 2.12 - Human Health and Ecological Risk Assessment**

The SRB SOW is modified to clarify that Dow is required to conduct comprehensive human health and ecological risk assessments (ERAs), using appropriate MDEQ and U.S. EPA guidance documents, for the Saginaw River and Saginaw Bay and to include all PCOIs associated with releases from Dow, including PCOI toxicological interactions pursuant to R 299.5734, unless specifically excluded with the approval of the MDEQ.

[RATIONALE: *This modification is necessary to clarify the MDEQ’s expectations with respect to the HHRA and the ERA.]*

25. **Section 3 - Schedule and Deliverables**

The schedule for the SRB SOW, RIWP, and work plans is modified to include the date of approval of the SRB SOW by the MDEQ in Table 3-1. The schedule is also modified to require the submission, review, revision (if necessary), and final MDEQ approval of the Current Conditions Report in advance of submission of the Phase 1 work plan. Further, pursuant to Conditions XI.B.8. and XI.B.3.(b) of the License, the SRB SOW is modified to require that the schedule for corrective action for off-site areas identified in the table in Condition XI.B.6. of the License shall be incorporated into the detailed Compliance Schedule (Attachment 28) for the Dow facility as required under Condition XII.A. of the License.

[RATIONALE: *This modification is necessary to add key missing activities and deliverables into the schedule and to incorporate the schedule into the Compliance Schedule License attachment.]*

26. **Section 4 - References**

The SRB SOW is modified to incorporate the following references:

Michigan Department of Environmental Quality. 2002. Sampling Strategies and Statistics Training Materials for Part 201 Cleanup Criteria.

Michigan Department of Environmental Quality. 2006. Remediation and Redevelopment Division Operational Memorandum #4 Attachment 3 – Contaminated Sediments.

Shen, L., et. al. 2006. PCDD/Fs, Dioxin-like PCBs, and PBDEs in Sediment of Lake Huron and Its Tributaries. Ontario Ministry of the Environment. State of Lake Huron Poster.

The Dow Chemical Company. 2007. Tittabawassee River Remedial Investigation Work Plan (TR-RIWP). Appendix K – Interim Response Activities/Pilot Corrective Action Plan - Decision Tree.

[RATIONALE: *This modification is necessary to add key missing references into the SRB SOW to ensure that pertinent information contained in these references is considered during the development of the RIWP.*]

27. **Table 1-1**

The Note at the end of Table 1-1 is modified by the addition of the following sentence: As noted in the e-mail cover note from George Bruchmann, the MDEQ's statements are not intended to be a comprehensive list, but rather general guidance as to the MDEQ's expectations.

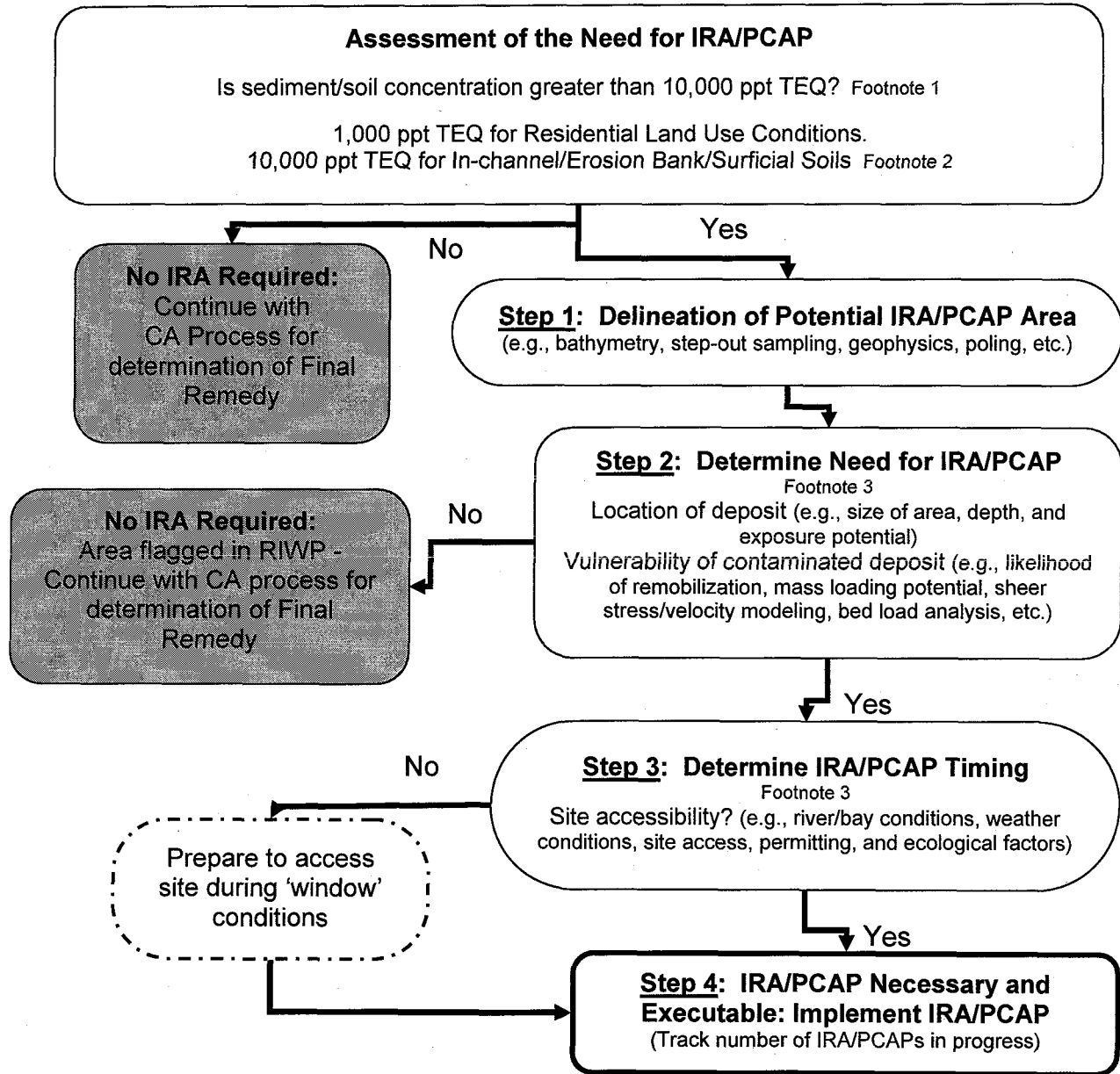
While it is recognized that the MDEQ-specified modifications are not fully addressed in Table 1-1, there is no need to modify the table, particularly the "Comments / Where Addressed in SOW" column. However, the RIWP shall be developed to address these modifications.

[RATIONALE: *This modification is necessary for clarification of the Note and to notify Dow that modification of the table is unnecessary based on this approval with modifications .]*

IRA/PCAP Implementation Decision Tree for Saginaw River and Floodplain and Saginaw Bay

2/1/08

Objective: To define a process that consistently addresses future sampling results for determining when the IRA/PCAP response needs to be judiciously initiated. Any identified IRA/PCAP work is performed to reduce human exposure for the short term and is separate from the ongoing requirement to complete the Corrective Action (CA) process for selecting, designing, and implementing the final corrective measures/remedial action plan, which will address long-term human health and ecological issues (which may incorporate IRA/PCAP work into the final CA measure).



Footnote 1: This decision tree currently applies only to dioxins and furans. This IRA/PCAP decision process will need to be reviewed and revised based on continued RIWP findings (e.g., other PCOs, other factors affecting IRA/PCAP process).

Footnote 2: Evaluation of 'surficial soils' is to include intervals up to and including one foot in depth. For eroding bank samples, interval is within one foot of bank surface.

Footnote 3: Step 2 and Step 3, if necessary, will be completed and submitted to the MDEQ for review and approval within 60 days of the identification of a triggering concentration, as defined in Step 1.

Attachment B
IRA/PCAP Step-Out Sampling Plan
Modified by the MDEQ 2/1/08

A procedure has been established to initiate step-out sampling based on the thresholds identified in the IRA/PCAP Decision Tree. For sampling locations with reported concentrations that exceed the IRA/PCAP Decision Tree thresholds, step-out sampling to bound the lateral extent of the area will be initiated within 10 calendar days (Step 1, Delineation of Potential IRA/PCAP Area). Electronic notifications will be posted to eProject, with such notifications sent to the Michigan Department of Environmental Quality (MDEQ) within 3 calendar days of receiving data that indicates a sampling location exceeds the IRA/PCAP Decision Tree threshold levels. The electronic notification will include the following information:

- a. Sample identification and concentration that exceeds the IRA/PCAP Implementation Decision Tree trigger criteria.
- b. Confirmation that the appropriate step-out sampling will be initiated within 10 calendar days and cores/samples/analyses will be processed on a Priority 1 basis.
- c. Sample identification and proposed step-out sampling locations (both map location[s] and coordinates) for each IRA trigger location.
- d. E-TEQ or TEQ concentration in parts per trillion (ppt) and values for the 5 E-TEQ congeners or 17 TEQ congeners (to two significant figures).
- e. Geomorphic setting.
- f. Sample collection date and date that analytical results were received by Dow.
- g. For overbank or upland samples: property owner, property address, property tax identification number, access status, and current land use as indicated by zoning authority.

In-Channel Step-Out Sampling: Samples >10,000 ppt TEQ, Any Depth

In-channel step-out sampling locations will be initiated with approximate 50-foot spacing around the location that exceeded the IRA/PCAP Decision Tree thresholds.

Overbank Step-Out Sampling: Samples >10,000 ppt TEQ, Any Land Use Designation

Overbank step-out sampling locations will be initiated with approximate 100-foot spacing around the location that exceeded the IRA/PCAP Decision Tree thresholds.

Overbank Step-Out Sampling: Samples >1,000 ppt TEQ, Residential Land Use Designation

Where appropriate based on geomorphic surface development, step-out sampling locations will be initiated with approximate 100-foot spacing around the location that

exceeded the IRA/PCAP Decision Tree thresholds. The final spacing will be adjusted to be representative of the geomorphic surface type(s) present when they contain sample(s) that exceeded the IRA/PCAP Decision Tree threshold. The final selection of step-out sampling locations on residential properties will take into account important geomorphic surfaces factors including aggradation/degradation pattern (deposition/erosion), surface elevation, channel gradient, channel configuration, causation and streamline factors, and thalweg position.

Erosion Scar Step-Out Sampling: Samples >10,000 ppt TEQ, Any Land Use Designation

Erosion scar step-out sampling locations will be initiated approximate 50 feet upstream and downstream around the location that exceeded the IRA/PCAP Decision Tree thresholds.

Step-Out Delineation

Appropriate hot spot characterization is necessary so that a thorough evaluation of interim response options can be conducted. Factors to be considered include, but are not limited to, the location of the hot spot in the watershed, land use, sediment stability, and exposure potential. After step-out sampling has been triggered at a hot spot, at a minimum, the area(s) will be delineated to identify contamination that is greater than 1,000 ppt TEQ. If Dow proposes an IRA for consideration as a component of the final remedy and until final pathway criteria are developed (e.g., human health risk assessment and ecological risk assessment), delineation will be conducted down to 90 ppt TEQ at all depths for property in residential use and 50 ppt for in-channel sediment or eroding bank soils. These criteria are subject to revision by the MDEQ.

Laboratory results of the initial step-out sampling will be evaluated through the IRA/PCAP Decision Tree process. Step-out locations with concentrations that exceed the IRA/PCAP Decision Tree thresholds will result in additional step-out sampling to further bound the lateral extent of the area. As appropriate, additional step-out sampling will be initiated within 10 calendar days. Laboratory results generated through this process will be included in the monthly Site Investigation update.

Once the area that exceeds the IRA/PCAP trigger level has been delineated, the next steps of the IRA/PCAP Implementation Decision Tree (Step 2, Determine Need for IRA/PCAP, and Step 3, Determine IRA/PCAP Timing) will be implemented.

Implementation of additional IRA/PCAP Implementation Decision Tree steps is dependent upon the results of the evaluation completed in Steps 2 and 3. Within 60 days of the initial notification, Dow will complete the work and submit a written evaluation of the need for and timing of additional IRA/PCAP work to the MDEQ's Waste and Hazardous Materials Division Chief. Based on review of the information provided by Dow and any other relevant information, the MDEQ will determine if the implementation of additional interim response activities is necessary and the schedule for the implementation and anticipated completion of those activities pursuant to Step 3, Determine IRA/PCAP Timing, and Step 4, IRA/PCAP Necessary and Executable: Implement IRA/PCAP.

**Figure 2-2. Modified Extent of Saginaw Bay Scope of Work-
Saginaw River Mouth to USEPA Lake Huron Station HU 95B.**

USEPA Lake Huron Summer Sampling Stations

