



Memorandum

July 15, 2019

To: Zachary Sasnow (USEPA)

Ref. No.: 058502

From: John-Eric Pardys/kf/40

Tel: 519-340-4316

CC: Dave Favero (RACER)

**Subject: Response to U.S. EPA comments dated June 4, 2019
Saginaw Nodular Industrial Land – Saginaw, Michigan**

This letter presents responses to USEPA comments provided on June 4, 2019 via email regarding USEPA's review of GHD's memorandum titled, "Response to USEPA comments from April 4, 2019 Site meeting" (May 29, 2019), GHD's memorandum titled, "North Ditch – Ecological Screening Assessment" (March 14, 2019), and GHD's memorandum titled, "Ecological Screening Assessment for Isolated Wetlands Recently Formed in IU G" (January 4, 2019). For ease of review we have provided USEPA's comment in *italics* followed by the response.

The following attachments are provided in support of the responses:

Attachment A – Supporting Files for Response 1

Attachment B – Supporting Files for Response 3

General Comments

USEPA Comment 1:

Before EPA would approve abandonment of wells MW-6, MW-8, and the 13 wells located near the southern boundary of IU I, I would like to know for what purpose these wells were installed given the lack of analytical data. I would assume they were monitored at some point or another if they were installed by GM; does RACER have the boring logs for these or at a minimum a date when they were installed?

Response 1:

Monitoring wells MW-6 and MW-7 are associated with the General Motors (GM) Landfill. GM has indicated that they do not require these monitoring wells for the on-going operation/maintenance/monitoring of the GM landfill. GHD was unable to locate monitoring well logs for MW-6 and MW-7, however, there is analytical data associated with these wells from 1984 until 1992 as presented in Attachment A.1. Please note that a landfill permit was obtained from the MDNR in December 1992 (Attachment A.2). The permit did not include sampling of MW-6 and MW-7. Therefore, since GM no longer requires the use of monitoring wells MW-6, and MW-7 RACER is requesting approval to abandon monitoring wells MW-6 and MW-7.



Three of the 13 monitoring wells located near the southern boundary of IUI are associated with a Hydrogeological Investigation for Solid Waste Residue Disposal Study (1975) completed on behalf of GM. Monitoring wells MW-37, MW-40, and MW-42 were installed on behalf of GM as background monitoring points to check water quality as disposal activities progressed. The area of the three wells is underlain by extensive clay and/or clay till formations (with a minimum thickness of 68 feet) which afford excellent protection of the underlying sand-stone aquifer. GHD was unable to locate analytical data associated with these wells.

The other ten monitoring wells were installed in response to allegations from the neighboring Fairchild property that GM activities were adversely impacting the property. A chronology of events relating to the litigation are provided below:

Prior to 1982	Fairchild held in contempt of court on at least two occasions and jailed for refusing to obey Saginaw Circuit Court order prohibiting him from dumping refuse on his property.
Early 1982	Fairchild sues GM for \$10 million in damages for GM dumping practices which were allegedly contaminating his land rendering his 13 acres virtually useless.
May 1984	Court order to allow access for groundwater investigation on Fairchild property
June 1984	GM conducted groundwater sampling event the results of which are provided in Attachment A.3. Sample results were submitted for analysis of pH, BOD5, COD, TOC, Nitrite, Nitrate, ammonia, organic nitrogen, dissolved iron, phenol, total cyanide, chloride, sulfate, total dissolved solids, dissolved cadmium, dissolved chromium, dissolved copper, dissolved nickel, dissolved lead, dissolved zinc, and dissolved arsenic. Chloride, sulfate, total dissolved solids, and various metals reported levels above the December 2013 Part 201 Residential Drinking Water Criteria. In general impacts were identified on the Fairchild property and immediately downgradient of the Fairchild property.
July 1984	GM identified interest in purchasing the Fairchild property
May 1985	Expert witness testifies on behalf of Fairchild.
Sept. 1985	Partial response by defendant General Motors
1986	Various attempts were made to reschedule the trial without success. There is no further documentation in our file on the legal proceedings.
May 1987	Department of Natural resources executed a search of Fairchild's facility, and among other discoveries, identified a floor drain discharge from a maintenance garage which outlet onto the ground at the southwest corner of the building. A large area of stained soil was observed and the flow direction toward GM property. A water sample was collected of the discharge and submitted for analysis which reported 3,000 parts per million (ppm) (oil and grease) 7,300 ppm (COD) 1,700 ppm (TOC). A soil sample was collected of the stained area and submitted for analysis which reported 270 ppm (total chromium), 37 ppm (copper), 29 ppm



(nickel), 49 ppm (lead), 430 ppm (zinc) and 13,000 ppm (oil and grease). A copy of the results of the search are provided in Attachment A.4

Therefore, given that GM performed minimal operations in this area, pending the analysis proposed in response to comment 4, RACER will propose abandoning the monitoring wells.

USEPA Comment 2:

Given the upcoming work plan for black carbon sampling at the North Ditch, and EPA's request for additional investigatory work in this email, an update to the QA documentation for the site is warranted. I am not aware of a QAPP for the ongoing EI monitoring, nor did the Draft IM PCB work plan refer to any governing quality documents. Going forward, RACER should either prepare an updated QAPP for the whole project, or subsequent work plans should include all the relevant QAPP information as listed in EPA's QA-R5 document that RACER should be familiar with from other sites. A standalone QAPP is not necessary if each work plan addresses all those requirements.

Response 2:

Since 2011 (RACER) and since CRA's (now GHD) involvement (2000) in the project, the approach and intent was to collect high quality sample results. Samples were collected and submitted to certified laboratories and methods used to analyze the samples were USEPA approved where possible. Third party validation was completed on the data collected and we are not aware of any issues with the data collected.

It is our understanding that USEPA is not requesting a full QAPP, however, based on GHD's review of USEPA's QA-R5 document identified above, in order to meet the requirements included in the QA-R5 document, it seems a full QAPP would be necessary. Instead of preparing a full-QAPP, GHD proposes to provide the following information to meet USEPA's request for QA documentation:

- Brief summary of Scope of Work
- Scoping table identifying media, parameters, number of samples, methods
- Table identifying reporting limits for methods identified in scoping table
- Table with accuracy and precision limits for each of the methods
- Attachment with field SOPs and laboratory SOPs.

We request USEPA's concurrence the information GHD is proposing to provide for QA documentation or as an alternative we would appreciate an example of the QA information that USEPA requires and/or further clarification.

USEPA Comment 3:

It is EPA's position that further monitoring the ammonia contamination and high pH spanning the RACER property, or simply addressing it with institutional controls, is not sufficient given the pH is significantly above criteria, there is sufficient access to the plumes for more active treatment (as mentioned in the 1994 evaluation from Attachment A), and the contamination is close to the Saginaw River. Anticipating the revised CMP, RACER should investigate potential active treatment methods to



stabilize the pH and reduce ammonia concentrations on-site. Once RACER has had time to come up with some tentative strategies we can have a call to discuss.

Response 3:

The conclusions of the Supplemental RCRA Facility Investigation (RFI) Report (CRA, 2012) indicate that,

- Current health and safety practices on-Site prevent the exposure of a construction worker to ammonia and pH in groundwater; furthermore, proper health and safety procedures and groundwater and land use restrictions to be placed on the property will prevent future exposure scenarios.
- The potential exposures to routine workers, maintenance workers, trespassers, and off-facility residents are not significant.
- Risk of adverse ecological effects is low to negligible from exposure to Facility-related constituents.

Environmental Indicator (EI) reports (ENVIRON, 2003) were also submitted for the Site (CA750 – Migration of Contaminated Groundwater Under Control and CA725 – Current Human Health Exposures Under Control) which were approved by USEPA on September 29, 2004 and August 25, 2004, respectively. In accordance with the USEPA Environmental Indicator guidance document dated February 1999, the maximum detected concentration of ammonia was compared to 10 times the Criteria Maximum Concentration and Chronic Criterion Magnitude. The results included in the USEPA approved EI report identified that the detected concentrations of ammonia were less than 10 times the Criteria Maximum Concentration and Chronic Criterion Magnitude, and therefore, the discharge of groundwater containing total ammonia at this concentration are expected to be insignificant.

As an outcome of the EI report, a groundwater monitoring program was initiated to confirm that the existing areas of groundwater contamination at the Site remain stable. Monitoring completed as part of the EI monitoring program indicates that the extent of impacts are consistent or less than the concentrations evaluated in the EIs.

In 2009 GM submitted a mixing zone determination request (MZDR) to address venting of groundwater with elevated ammonia at two locations (one of which [Part 2] is associated with the RACER Site). In response to the MZDR MDEQ indicated that “mixing” of venting groundwater to be such that “chronic” impacts are not likely, and that venting in excess of concentrations protective of acute impacts (420 micrograms per liter [ug/L] unionized ammonia) would be a condition requiring response activity to ensure adequate resource protection. However, the ammonia plume venting from the RACER property was actually considered to be so limited as to not even pose a potential for exceeding either acute or chronic water quality standards.

In April 2015, CRA completed an ammonia in groundwater evaluation that was submitted to USEPA and MDEQ for review (Attachment B). To date, no responses have been received from USEPA or MDEQ on the evaluation. The evaluation was completed to evaluate the necessity for conducting further activities associated with ammonia in groundwater above MDEQ Groundwater Surface Water Interface (GSI) criteria in monitoring wells next to the Saginaw River. The evaluation was completed in general accordance with the MDEQ’s document titled, “Groundwater/Surface Water Interface Pathway Compliance Options” (June 2014). The evaluation summarized the sampling and analysis completed to date including the RFI, EIs, and MZDR.



The evaluation concluded that further activities to address ammonia above GSI criteria in monitoring wells next to the Saginaw River at the Site are not necessary beyond continued monitoring. A recommendation was made to adjust the reporting of ammonia associated with the EI monitoring. Up until 2015, ammonia was reported as total ammonia, however, the toxic fraction of ammonia is unionized ammonia which is based on the temperature and pH of the receiving waters. Since 2015, the reporting for the annual EI letters has been adjusted to report unionized ammonia. To date, there has been no exceedances of GSI criteria at the wells along the Saginaw River.

Given there is no unacceptable risk related to ammonia and any potential significant risks from high pH can be readily addressed with institutional controls and proper due care, no further effort beyond limited continued monitoring and recording applicable deed restrictions are recommended. It is not expected that active remedies would be necessary or appropriate even if they were developed and evaluated as part of a CMS.

USEPA Comment 4:

EPA agrees with the plan to take additional samples of the slag material found south of the clay pile area. Slag should be tested for metals at a minimum.

Response 4:

A scope of work will be prepared and submitted to USEPA including necessary QA/QC requirements.

USEPA-Specific Comments

USEPA Comment 5:

North Ditch ERA Table 2: Please revise the screening for Fe to include the Region 4 ESV (iron is not non-toxic under all ecological scenarios). I don't believe there were exceedances of the ESV but that should be shown in the report.

Response 5:

Per your request, screening Fe to the Region 4 Ecological Screening Values (ESV) was completed, and the results show that one out of seven samples exceeds the Severe Effect Level (SEL). This maximum concentration drives the average concentration; thus, the average also, barely by 6 percent, exceeds the ESV. However, the frequency of exceedance is below the *de minimis* level of 20 percent.

In addition, there are concerns in the ecological risk assessment community about the validity of all SEL values as ecological screening values. In fact, GHD is not aware of any information that indicates that Fe is toxic to benthic invertebrates at environmentally relevant concentrations.

USEPA Comment 6:

In addition the units for the Probable Effects Concentration (PEC) for PCBs should be in mg/kg (the risk calculations in the table are correct however and don't need revision).



Response 6:

Agreed and noted.

USEPA Comment 7:

EPA agrees with the proposed additional sampling for black carbon in North Ditch sediments.

Response 7:

A scope of work to collect sediment samples from the North Ditch will be prepared and submitted to USEPA which will include necessary QA/QC requirements. Once USEPA provides approval, samples will be collected and analyzed for black carbon, after which the North Ditch Ecological Screening evaluation will be updated and revised.

USEPA Comment 8:

EPA agrees that surface water poses low potential adverse risk to ecological receptors.

Response 8:

No response required.

USEPA Comment 9:

EPA does not agree with the conclusion that there are no ecological significant risks posed by the PCB contamination in the North Ditch and Isolated Wetlands sediments. For the Isolated Wetlands, the fact that the high PCB contamination is confined to a 'hot spot' suggests that it would be relatively simple to include that hot spot in the planned PCB dredging in the Secondary Ponds, and would eliminate most of the ecological risk posed by PCBs in that area.

Response 9:

In the ecological screening assessment of the Isolated Wetland (GHD 2018), the PCB hot spot is limited to a small number of samples in a small area that, at worst using highly conservative assumptions, represents a *de minimis* area (less than half an acre) and *de minimis* risk. The highest PCB result (8 milligrams per kilogram [mg/kg]) in shallow soil (0-2 feet below ground surface [ft bgs]), which was found at the isolated wetland area in 2001, could not be repeated in confirmation sampling events (and step outs) completed in 2015. In contrast to 2001 samples, all 2015 sample results on and immediately around the 2001 hot spot were less than 1 mg/kg. This suggests that the 2001 samples are not representative of current conditions. Several other shallow soil samples were taken farther from the hot spot, and all the 2015 samples were also below 1 mg/kg. If the risk assessment only included more recent data collected in 2015, maximum PCB concentrations and maximum risks are reduced by an order of magnitude; the average PCB concentrations and average risks are reduced by half. Therefore since risk is *de minimis*, no further activity is proposed for the isolated wetland area except for a deed notification and restricting use to low occupancy as a conservative, protective measure. It is not expected that active remedies would be necessary or appropriate even if they were developed and evaluated as part of a CMS.



USEPA Comment 10:

In addition, the North Ditch PCB hazard quotients being significantly above 1.0 using the PEC (given that the PEC is itself a less conservative criterion than ESVs) indicate a non-negligible risk posed by those sediments. Pending the results from the black carbon sampling, RACER should include the area of high PCBs HQ (which seems from this ERA to be confined to the area around H7) in the ditch in the Secondary Pond dredging plans.

Response 10:

If the PEC for PCBs is used to assess risks then the appropriate comparison is when the PEC and the PCBs results are normalized to the same concentration of organic carbon. This standardization accounts for the well known reduction of PCB bioavailability at higher organic carbon concentrations. The PEC was developed based on the geometric mean of 5 other numbers (including the SEL), three of which assumed 1% organic carbon. Therefore, PCB results should be normalized to 1 percent total carbon in order to compare the sample results to the PEC for PCBs. That comparison was presented in the North Ditch Ecological Screening Assessment (GHD, 2019). That comparison showed that PECs are not exceeded, even for the maximum concentration of PCBs normalized to 1 percent organic carbon. That is, observed PCB concentrations were divided by the average total organic carbon concentration of approximately 5 percent. In addition, the six sediment samples collected between 1998 and 2005 reported PCBs ranging from 0.3 mg/kg to 3.39 mg/kg. The seven sediment samples collected in 2013 reported PCBs at non-detect (less than 1 mg/kg), except for one location which reported PCBs at an estimated value of 0.11 mg/kg. Therefore, no further activity is proposed for the North Ditch with the exception of conducting black carbon sampling and re-evaluating the North Ditch Ecological Screening evaluation, as well as, a deed notification and restricting use to low occupancy as a conservative, protective measure. It is not expected that active remedies would be necessary or appropriate even if they were developed and evaluated as part of a CMS.

If based on your review, you think it would be beneficial to setup a meeting with the ecological risk assessors, please let us know when you are available and we will schedule a call.

Attachment A

**Landfill Groundwater Data
1984**

SAMPLE DATE 10/31/84
 Hydro Number 85100

GENERAL MOTORS CORP.
 CENTRAL FOUNDRY DIVISION
 NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

MONITOR WELL NO. MW 6

<u>CHEMICAL</u>	<u>TEST RESULTS</u>	<u>DRINKING WATER STANDARDS</u>
ARSENIC, Dis., mg/l	0.006	0.05
BARIUM, Dis., mg/l	0.8	1
CHLORIDE, mg/l	1150	250
COD, mg/l	610	--
COPPER, Dis., mg/l	0.04	1
CYANIDE (TOTAL), mg/l	<0.02	--
IRON, Dis., mg/l	10	0.3
FLUORIDE, mg/l	0.38	1.4-2.4
CADMIUM, Dis., mg/l	0.03	0.01
PCB, ug/l	(see below)*	--
CHROMIUM (TOTAL), Dis., mg/l	0.05	0.05
TIN, Dis., mg/l	<0.5	--
ALUMINUM, Dis., mg/l	<0.5	--
NITROGEN (TKN), mg/l	66	--
LEAD, Dis., mg/l	<0.05	0.05
MANGANESE, Dis., mg/l	0.14	0.05
MERCURY, Dis., mg/l	0.0006	0.002
PH	6.7	6.5-8.5
PHENOLS, mg/l	0.002	.001
SELENIUM, Dis., mg/l	<0.005	0.01
SILVER, Dis., mg/l	<0.02	0.05
PHOSPHOROUS (TOTAL), mg/l	0.12	--
HARDNESS, mg/l	1400	--
SODIUM, Dis., mg/l	940	--
SPECIFIC CONDUCTANCE	6800	--
SULFATE, mg/l	4	250
ZINC, Dis., mg/l	54	5
TOC, mg/l	210	--
STATIC WATER LEVEL	1.50'	--
MAGNESIUM, Dis., mg/l	230	--
GROUND WATER ELEVATIONS	N/A	--

*PCB, ug/l
 Aroclor 1242 <0.05
 Aroclor 1254 --
 Aroclor 1260 <0.05

Note: Analyses were performed on the supernatant liquid.
 All samples for metals analysis were filtered.

SAMPLE DATE 11/1/84
 Hydro Number 85161

GENERAL MOTORS CORP.
 CENTRAL FOUNDRY DIVISION
 NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

MONITOR WELL NO. MW 7

<u>CHEMICAL</u>	<u>TEST RESULTS</u>	<u>DRINKING WATER STANDARDS</u>
ARSENIC, Dis., mg/l	<0.005	0.05
BARIUM, Dis., mg/l	0.2	1
CHLORIDE, mg/l	350	250
COD, mg/l	310	--
COPPER, Dis., mg/l	<0.02	1
CYANIDE (TOTAL), mg/l	<0.02	--
IRON, Dis., mg/l	<0.02	0.3
FLUORIDE, mg/l	0.91	1.4-2.4
CADMIUM, Dis., mg/l	<0.01	0.01
PCB, ug/l	(see below)*	--
CHROMIUM (TOTAL), Dis., mg/l	<0.02	0.05
TIN, Dis., mg/l	<0.5	--
ALUMINUM, Dis., mg/l	0.5	--
NITROGEN (TKN), mg/l	19	--
LEAD, Dis., mg/l	<0.05	0.05
MANGANESE, Dis., mg/l	<0.02	0.05
MERCURY, Dis., mg/l	<0.0005	0.002
PH	9.1	6.5-8.5
PHENOLS, mg/l	0.014	.001
SELENIUM, Dis., mg/l	<0.005	0.01
SILVER, Dis., mg/l	<0.02	0.05
PHOSPHOROUS (TOTAL), mg/l	0.14	--
HARDNESS, mg/l	200	--
SODIUM, Dis., mg/l	370	--
SPECIFIC CONDUCTANCE	1900	--
SULFATE, mg/l	69	250
ZINC, Dis., mg/l	0.49	5
TOC, mg/l	110	--
STATIC WATER LEVEL	3.37'	--
MAGNESIUM, Dis., mg/l	33	--
GROUND WATER ELEVATIONS	N/A	--

*PCB, ug/l
 Aroclor 1242 <0.4
 Aroclor 1254 --
 Aroclor 1260 <0.4

Note: Analyses were performed on the supernatant liquid.
 All samples for metals analysis were filtered.

**Landfill Groundwater Data
1985**



HYDRO RESEARCH SERVICES
Water Management Division
Clow Corporation

408 Auburn Avenue
Pontiac, MI 48058

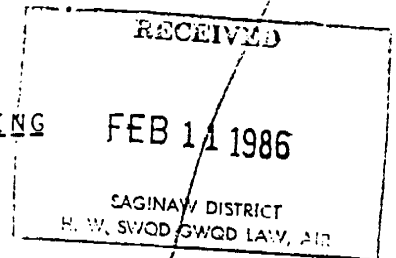
313 334-1630
313 334-4747

Sample Date: 11-15-85

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
MODULAR IRON PLANT

PARAMETERS -- GROUNDWATER MONITORING

CROW ISLAND LANDFILL



Hydro Number: 1077

Monitor Well Number: MW-7

Chemical	Test Results **	Drinking Water Standards
Arsenic, mg/l	<0.01	0.05
Barium, mg/l	<0.1	1
Chloride, mg/l	260	250
COD, mg/l	120	--
Copper, mg/l	<0.02	1
Cyanide (Total), mg/l	<0.02	--
Iron	<0.02	0.3
Fluoride, mg/l	1.0	1.4-2.4
Cadmium, mg/l	<0.01	0.01
Chromium (Total), mg/l	<0.02	0.05
Tin, mg/l	<0.5	--
Aluminum, mg/l	<0.1	--
Nitrogen (TKN), mg/l	8.8	--
Lead, mg/l	<0.05	0.05
Manganese, mg/l	<0.02	0.05
Mercury, mg/l	<0.0005	0.002
pH (on site)	8.7	6.5-8.5
Phenols, mg/l	0.091	0.001
Selenium, mg/l	<0.01	0.01
Silver, mg/l	<0.02	0.05
Phosphorous (Total), mg/l	0.06	--
Hardness, mg/l	160	--
Sodium, mg/l	150	--
Specific Conductance, umhos/cm	1200	--
Sulfate, mg/l	97	250
Zinc, mg/l	0.20	5
TOC, mg/l	52	--
Static Water Level, feet	2.6	--
Magnesium, mg/l	27	--
Ground Water Elevations		--
PCB's ug/l		
Aroclor 1242	<0.05	
Aroclor 1254	--	
Aroclor 1260	<0.05	

** Analyses were performed on the supernatant. Metals were filtered upon arrival in the lab.



HYDRO RESEARCH SERVICES
Water Management Division
Clow Corporation

408 Auburn Avenue
Pontiac, MI 48058

313 334-1630
313 334-4747

Sample Date: 11-15-85

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS -- GROUNDWATER MONITORING

CROW ISLAND LANDFILL

Hydro Number: 1081

Monitor Well Number: MW-6

<u>Chemical</u>	<u>Test Results **</u>	<u>Drinking Water Standards</u>
Arsenic, mg/l	<0.01	0.05
Barium, mg/l	0.8	1
Chloride, mg/l	1200	250
COD, mg/l	820	--
Copper, mg/l	<0.02	1
Cyanide (Total), mg/l	<0.02	--
Iron	1.5	0.3
Fluoride, mg/l	0.40	1.4-2.4
Cadmium, mg/l	<0.01	0.01
Chromium (Total), mg/l	<0.02	0.05
Tin, mg/l	<0.5	--
Aluminum, mg/l	<0.1	--
Nitrogen (TKN), mg/l	59	--
Lead, mg/l	<0.05	0.05
Manganese, mg/l	0.09	0.05
Mercury, mg/l	<0.0005	0.002
pH (on site)	6.6	6.5-8.5
Phenols, mg/l	0.025	0.001
Selenium, mg/l	<0.01	0.01
Silver, mg/l	<0.02	0.05
Phosphorous (Total), mg/l	0.23	--
Hardness, mg/l	1680	--
Sodium, mg/l	610	--
Specific Conductance, umhos/cm	5400	--
Sulfate, mg/l	3	250
Zinc, mg/l	30	5
TOC, mg/l	370	--
Static Water Level, feet	4.6	--
Magnesium, mg/l	230	--
Ground Water Elevations		--
PCB's ug/l		
Aroclor 1242	--	
Aroclor 1254	--	
Aroclor 1260	--	

* Analyses were performed on the supernatant. Metals were filtered upon arrival in the lab.

SAMPLE DATE 8-23-85
 Hydro Number 96678 **

GENERAL MOTORS CORP.
 CENTRAL FOUNDRY DIVISION
 MODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

MONITOR WELL NO. 6

<u>CHEMICAL</u>	<u>TEST RESULTS</u>	<u>DRINKING WATER STANDARDS</u>
ARSENIC, Dis., mg/l	0.010	0.05
BARIUM, Dis., mg/l	<0.1	1
CHLORIDE, mg/l	1.020	250
COD, mg/l	620	--
COPPER, Dis., mg/l	<0.02	1
CYANIDE (TOTAL), mg/l	<0.02	--
IRON, Dis., mg/l	0.19	0.3
FLUORIDE, mg/l	0.35	1.4-2.4
CADMIUM, Dis., mg/l	<0.01	0.01
PCB, ug/l	(see below)*	--
CHROMIUM (TOTAL), Dis., mg/l	<0.02	0.05
TIN, Dis., mg/l	<1	--
ALUMINUM, Dis., mg/l	<0.1	--
NITROGEN (TKN), mg/l	68	--
LEAD, Dis., mg/l	<0.05	0.05
MANGANESE, Dis., mg/l	0.06	0.05
MERCURY, Dis., mg/l	<0.0005	0.002
PH	6.9	6.5-8.5
PHENOLS, mg/l	0.093	.001
SELENIUM, Dis., mg/l	<0.005	0.01
SILVER, Dis., mg/l	<0.02	0.05
PHOSPHOROUS (TOTAL), mg/l	0.11	--
HARDNESS, mg/l	1,590	--
SODIUM, Dis., mg/l	500	--
SPECIFIC CONDUCTANCE	5,500	--
SULFATE, mg/l	2	250
ZINC, Dis., mg/l	29	5
TOC, mg/l	230	--
STATIC WATER LEVEL	2.4	--
MAGNESIUM, Dis., mg/l	210	--
GROUND WATER ELEVATIONS		--

*PCB, ug/l

Aroclor 1242 <0.05
 Aroclor 1254 ---
 Aroclor 1260 <0.05

Clow Corporation
 Hydro Research Services

Note: Analyses were performed on the supernatant liquid.
 All samples for metals analysis were filtered.

** : Some samples limited or unavailable.

SAMPLE DATE 8-23-85

Hydro Number 96679

GENERAL MOTORS CORP.
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

MONITOR WELL NO. 7

<u>CHEMICAL</u>	<u>TEST RESULTS</u>	<u>DRINKING WATER STANDARDS</u>
ARSENIC, Dis., mg/l	<0.005	0.05
BARIUM, Dis., mg/l	<0.1	1
CHLORIDE, mg/l	250	250
COD, mg/l	110	--
COPPER, Dis., mg/l	<0.02	1
CYANIDE (TOTAL), mg/l	<0.02	--
IRON, Dis., mg/l	0.04	0.3
FLUORIDE, mg/l	0.88	1.4-2.4
CADMIUM, Dis., mg/l	<0.01	0.01
PCB, ug/l	(see below)*	--
CHROMIUM (TOTAL), Dis., mg/l	<0.02	0.05
TIN, Dis., mg/l	<1	--
ALUMINUM, Dis., mg/l	<0.1	--
NITROGEN (TKN), mg/l	10	--
LEAD, Dis., mg/l	<0.05	0.05
MANGANESE, Dis., mg/l	<0.02	0.05
MERCURY, Dis., mg/l	<0.0005	0.002
PH	8.8	6.5-8.5
PHENOLS, mg/l	0.013	.001
SELENIUM, Dis., mg/l	<0.005	0.01
SILVER, Dis., mg/l	<0.02	0.05
PHOSPHOROUS (TOTAL), mg/l	0.06	--
HARDNESS, mg/l	190	--
SODIUM, Dis., mg/l	120	--
SPECIFIC CONDUCTANCE	1,200	--
SULFATE, mg/l	97	250
ZINC, Dis., mg/l	0.49	5
TOC, mg/l	43	--
STATIC WATER LEVEL	5.20	--
MAGNESIUM, Dis., mg/l	29	--
GROUND WATER ELEVATIONS		--

*PCB, ug/l

Aroclor 1242

<0.05

Aroclor 1254

Aroclor 1260

<0.05

Clow Corporation

Hydro Research Services

Note: Analyses were performed on the supernatant liquid.
All samples for metals analysis were filtered.



HYDRO RESEARCH SERVICES
Water Management Division
Clow Corporation

408 Auburn Avenue
Pontiac, MI 48058

313 334-1630
313 334-4747

SAMPLE DATE June 3, 1985

GENERAL MOTORS CORP.
CENTRAL FOUNDRY DIVISION
MODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

Hydro Number: 93321

MONITOR WELL NO. MW-6

CHEMICAL	TEST RESULTS	DRINKING WATER STANDARDS
	mg/l	mg/l
ARSENIC dissolved	<0.005	0.05
BARIUM	0.6	1.0
CHLORIDE	220	
COD	590	
COPPER	<0.02	
CYANIDE (TOTAL)	<0.02	
IRON	0.20	
FLUORIDE	0.62	1.4 - 2.4
CADMIUM	<0.01	0.01
PCB		
CHROMIUM (TOTAL)	<0.02	0.05
TIN	<0.5	
ALUMINUM	<0.5	
NITROGEN (TKN)	50	
LEAD	<0.05	0.05
MANGANESE	0.07	
MERCURY	<0.0005	0.002
PH	7.1	
PHENOLS	0.028	
SELENIUM	<0.005	0.01
SILVER	<0.02	0.05
PHOSPHOROUS (TOTAL)	0.08	
HARDNESS	1750	
SODIUM	1680	
SPECIFIC CONDUCTANCE	umhos/cm 5600	
SULFATE dissolved, feet	2.8	
ZINC	30	
TOC	220	
STATIC WATER LEVEL	1.83'	
MAGNESIUM dissolved	220	
GROUND WATER ELEVATIONS		
PBC's, ug/l		
Aroclor 1242	<0.05	
Aroclor 1254	--	
Aroclor 1260	<0.05	



HYDRO RESEARCH SERVICES
Water Management Division
Clow Corporation

408 Auburn Avenue
Pontiac, MI 48058

313 334-1630
313 334-4747

SAMPLE DATE June 3, 1985

GENERAL MOTORS CORP.
CENTRAL FOUNDRY DIVISION
MODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

Hydro Number: 93318

MONITOR WELL NO. MW-7 6/3/85

CHEMICAL	TEST RESULTS	DRINKING WATER STANDARDS
	mg/l	mg/l
ARSENIC dissolved	<0.005	0.05
BARIUM	<0.1	1.0
CHLORIDE	150	
COD	170	
COPPER	<0.02	
CYANIDE (TOTAL)	<0.02	
IRON	0.05	
FLUORIDE	1.4	1.4 - 2.4
CADMIUM	<0.01	0.01
PCB		
CHROMIUM (TOTAL)	<0.02	0.05
TIN	<0.5	
ALUMINUM	<0.5	
NITROGEN (TKN)	14	
LEAD	<0.05	0.05
MANGANESE	<0.02	
MERCURY	<0.0005	0.0002
PH (on site)	9.1	
PHENOLS dissolved	0.005	
SELENIUM	<0.005	0.01
SILVER	<0.02	0.05
PHOSPHOROUS (TOTAL)	0.09	
HARDNESS	180	
SODIUM	235	
SPECIFIC CONDUCTANCE, umhos/cm	1200	
SULFATE dissolved	94	
ZINC	3.5	
TOC	40	
STATIC WATER LEVEL feet	5.00'	
MAGNESIUM Dissolved	30	
GROUND WATER ELEVATIONS	--	
PCB's ug/l		
Aroclor 1242	<0.05	
Aroclor 1254	--	
Aroclor 1260	<0.05	

**Landfill Groundwater Data
1986**



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, MI 48058
313/334-4747

Sample Date: 8-8-86

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING

CROW ISLAND LANDFILL

Sample Number: 11558

Monitor Well Number: SNI-MW-6

<u>Chemical</u>	<u>Test Results</u>	<u>Drinking Water Standards</u>
Arsenic, mg/l	<0.005	0.05
Barium, mg/l	<0.1	1
Chloride, mg/l	1200	250
COD, mg/l	930	--
Copper, mg/l	<0.02	1
Cyanide (Total), mg/l	<0.02	--
Iron	0.15	0.3
Fluoride, mg/l	0.52	1.4-2.4
Cadmium, mg/l	<0.01	0.01
Chromium (Total), mg/l	<0.02	0.05
Tin, mg/l	<1.0	--
Aluminum, mg/l	<0.5	--
Nitrogen (TKN), mg/l	68	--
Lead, mg/l	<0.05	0.05
Manganese, mg/l	0.05	0.05
Mercury, mg/l	<0.0005	0.002
pH (on site)	6.9	6.5-8.5
Phenols, mg/l	0.005	0.001
Selenium, mg/l	<0.005	0.01
Silver, mg/l	<0.02	0.05
Phosphorous (Total), mg/l	0.21	--
Hardness, mg/l	2200	--
Sodium, mg/l	760	--
Specific Conductance, umhos/cm	7300	--
Sulfate, mg/l	7	250
Zinc, mg/l	24	5
TOC, mg/l	250	--
Static Water Level, feet	2.3	--
Magnesium, mg/l	220	--
PCB's ug/l		
Aroclor 1242	<0.05	
Aroclor 1254	--	
Aroclor 1260	<0.05	

Samples for metals analysis were filtered in the lab and reported as dissolved.



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, MI 48058
313/334-4747

Sample Date: 8-8-86

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING

CROW ISLAND LANDFILL

Sample Number: 11559

Monitor Well Number: SN1-MW-7

<u>Chemical</u>	<u>Test Results</u>	<u>Drinking Water Standards</u>
Arsenic, mg/l	<0.005	0.05
Barium, mg/l	<0.1	1
Chloride, mg/l	370	250
COD, mg/l	130	--
Copper, mg/l	<0.02	1
Cyanide (Total), mg/l	<0.02	--
Iron	<0.02	0.3
Fluoride, mg/l	0.79	1.4-2.4
Cadmium, mg/l	<0.01	0.01
Chromium (Total), mg/l	<0.02	0.05
Tin, mg/l	<1.0	--
Aluminum, mg/l	<0.5	--
Nitrogen (TKN), mg/l	9.8	--
Lead, mg/l	<0.05	0.05
Manganese, mg/l	<0.02	0.05
Mercury, mg/l	<0.0005	0.002
pH (on site)	8.5	6.5-8.5
Phenols, mg/l	0.008	0.001
Selenium, mg/l	<0.005	0.01
Silver, mg/l	<0.02	0.05
Phosphorous (Total), mg/l	0.20	--
Hardness, mg/l	190	--
Sodium, mg/l	170	--
Specific Conductance, umhos/cm	1400	--
Sulfate, mg/l	150	250
Zinc, mg/l	0.10	5
TOC, mg/l	26	--
Static Water Level, feet	4.5	--
Magnesium, mg/l	27	--
PCB's ug/l		
Aroclor 1242	<0.05	
Aroclor 1254	--	
Aroclor 1260	<0.05	

Samples for metals analysis were filtered in the lab and reported as dissolved.



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, MI 48058
313/334-4747

Sample Date: 5-15-86

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS -- GROUNDWATER MONITORING

CROW ISLAND LANDFILL

Sample Number: 8059

Monitor Well Number: SNI-MW-6

<u>Chemical</u>	<u>Test Results</u>	<u>Drinking Water Standards</u>
Arsenic, mg/l	<0.005	0.05
Barium, mg/l	1.0	1
Chloride, mg/l	1100	250
COD, mg/l	230	--
Copper, mg/l	<0.02	1
Cyanide (Total), mg/l	0.03	--
Iron	0.16	0.3
Fluoride, mg/l	0.68	1.4-2.4
Cadmium, mg/l	<0.01	0.01
Chromium (Total), mg/l	<0.02	0.05
Tin, mg/l	<5.0	--
Aluminum, mg/l	<0.5	--
Nitrogen (TKN), mg/l	66	--
Lead, mg/l	<0.05	0.05
Manganese, mg/l	0.08	0.05
Mercury, mg/l	<0.0005	0.002
pH (on site)	7.0	6.5-8.5
Phenols, mg/l	0.029	0.001
Selenium, mg/l	<0.005	0.01
Silver, mg/l	<0.02	0.05
Phosphorous (Total), mg/l	0.19	--
Hardness, mg/l	1750	--
Sodium, mg/l	720	--
Specific Conductance, umhos/cm	5600	--
Sulfate, mg/l	2	250
Zinc, mg/l	39	5
TOD, mg/l	250	--
Static Water Level, feet	2.2	--
Magnesium, mg/l	210	--
PCB's ug/l		
Aroclor 1242	<0.05	
Aroclor 1254	ND	
Aroclor 1260	<0.05	

Samples for metals analysis were filtered in the lab and reported as dissolved.

ND - Not detected
P/3c

**Landfill Groundwater Data
1987**



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, MI 48058
313/334-4747

Sample Date: 8-6-87

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

Sample Number: 25330

Monitoring Well Number: MW-6

	Test <u>Results</u>	Drinking Water <u>Standards</u>
Arsenic, As, mg/l	<0.005	0.05
Barium, Ba, mg/l	1.3	1
Chloride, Cl, mg/l	1400	250
Chemical Oxygen Demand, mg/l	1	--
Copper, Cu, mg/l	<0.02	1
Cyanide, CN, mg/l	<0.02	--
Iron, Fe, mg/l	0.16	0.3
Fluoride, F, mg/l	0.55	1.4-2.4
Cadmium, Cd, mg/l	<0.01	0.01
Chromium, Cr, mg/l	<0.02	0.05
Tin, Sn, mg/l	<1.0	--
Aluminum, Al, mg/l	0.07	--
Kjeldahl Nitrogen, N, mg/l	110	--
Lead, Pb, mg/l	<0.05	0.05
Manganese, Mn, mg/l	0.04	0.05
Mercury, Hg, mg/l	<0.0005	0.002
pH (on site)	7.03	6.5-8.5
Phenolics, mg/l	0.012	0.001
Selenium, Se, mg/l	<0.005	0.01
Silver, Ag, mg/l	<0.02	0.05
Phosphorus, P, mg/l	0.44	--
Total Hardness, mg/l	1500	--
Sodium, Na, mg/l	930	--
Specific Conductivity (on site), uhmos/cm	6490	--
Sulfate, SO ₄ , mg/l	1	250
Zinc, Zn, mg/l	17	5
Total Organic Carbon, mg/l	255	--
Static Water Level, Feet	2.15	--
Magnesium, Mg, mg/l	210	--
PCB's, ug/l		
Aroclor 1242	<0.05	--
Aroclor 1254	--	--
Aroclor 1260	<0.05	--

Samples for metals analysis were filtered in the lab and reported as dissolved.

CI/1r



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, MI 48058
313/334-4747

Sample Date: 8-6-87

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

Sample Number: 25331

Monitoring Well Number: MW-7

	Test Results	Drinking Water Standards
Arsenic, As, mg/l	0.005	0.05
Barium, Ba, mg/l	0.10	1
Chloride, Cl, mg/l	230	250
Chemical Oxygen Demand, mg/l	59	--
Copper, Cu, mg/l	<0.02	1
Cyanide, CN, mg/l	<0.02	--
Iron, Fe, mg/l	<0.02	0.3
Fluoride, F, mg/l	0.83	1.4-2.4
Cadmium, Cd, mg/l	<0.01	0.01
Chromium, Cr, mg/l	<0.02	0.05
Tin, Sn, mg/l	<1.0	--
Aluminum, Al, mg/l	<0.05	--
Kjeldahl Nitrogen, N, mg/l	5.7	--
Lead, Pb, mg/l	<0.05	0.05
Manganese, Mn, mg/l	<0.02	0.05
Mercury, Hg, mg/l	<0.0005	0.002
pH (on site)	8.12	6.5-8.5
Phenolics, mg/l	0.007	0.001
Selenium, Se, mg/l	<0.005	0.01
Silver, Ag, mg/l	<0.02	0.05
Phosphorus, P, mg/l	<0.02	--
Total Hardness, mg/l	310	--
Sodium, Na, mg/l	160	--
Specific Conductivity (on site), uhmos/cm	1200	--
Sulfate, SO ₄ , mg/l	100	250
Zinc, Zn, mg/l	0.40	5
Total Organic Carbon, mg/l	22	--
Static Water Level, Feet	4.65	--
Magnesium, Mg, mg/l	40	--
PCB's, ug/l		
Aroclor 1242	<0.05	--
Aroclor 1254	--	--
Aroclor 1260	<0.05	--

Samples for metals analysis were filtered in the lab and reported as dissolved.

CT/2r



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, MI 48058
313/334-4747

Sample Date: 5-15-87

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING

CROW ISLAND LANDFILL

Sample Number: 21846

Monitor Well Number: MW #6

<u>Chemical</u>	<u>Test Results</u>	<u>Drinking Water Standards</u>
Arsenic, mg/l	<0.005	0.05
Barium, mg/l	1.3	1
Chloride, mg/l	1300	250
COD, mg/l	720	--
Copper, mg/l	<0.02	1
Cyanide (Total), mg/l	<0.02	--
Iron, mg/l	0.24	0.3
Fluoride, mg/l	0.52	1.4-2.4
Cadmium, mg/l	<0.01	0.01
Chromium (Total), mg/l	<0.02	0.05
Tin, mg/l	1.9	--
Aluminum, mg/l	0.05	--
Nitrogen (TKN), mg/l	100	--
Lead, mg/l	<0.05	0.05
Manganese, mg/l	0.05	0.05
Mercury, mg/l	0.0007	0.002
pH (on site)	6.75	6.5-8.5
Phenols, mg/l	0.022	0.001
Selenium, mg/l	<0.005	0.01
Silver, mg/l	<0.02	0.05
Phosphorous (Total), mg/l	0.05	--
Hardness, mg/l	1900	--
Sodium, mg/l	790	--
Specific Conductance, umhos/cm	6400	--
Sulfate, mg/l	16	250
Zinc, mg/l	27	5
TOC, mg/l	125	--
Static Water Level, feet	2.1	--
Magnesium, mg/l	250	--
PCB's ug/l		
Aroclor 1242	<0.05	
Aroclor 1254	--	
Aroclor 1260	<0.05	

Samples for metals analysis were filtered in the lab and reported as dissolved.



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, MI 48058
313/334-4747

Sample Date: 5-15-87

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
NODULAR IRON PLANT

PARAMETERS - GROUNDWATER MONITORING

CROW ISLAND LANDELL

Sample Number: 21847

Monitor Well Number: MW #7

<u>Chemical</u>	<u>Test Results</u>	<u>Drinking Water Standards</u>
Arsenic, mg/l	<0.005	0.05
Barium, mg/l	0.07	1
Chloride, mg/l	310	250
COD, mg/l	170	--
Copper, mg/l	<0.02	1
Cyanide (Total), mg/l	<0.02	--
Iron, mg/l	<0.02	0.3
Fluoride, mg/l	0.76	1.4-2.4
Cadmium, mg/l	<0.01	0.01
Chromium (Total), mg/l	<0.02	0.05
Tin, mg/l	1.3	--
Aluminum, mg/l	<0.05	--
Nitrogen (TKN), mg/l	10	--
Lead, mg/l	<0.05	0.05
Manganese, mg/l	<0.02	0.05
Mercury, mg/l	0.0006	0.002
pH (on site)	7.99	6.5-8.5
Phenols, mg/l	0.003	0.001
Selenium, mg/l	<0.005	0.01
Silver, mg/l	<0.02	0.05
Phosphorous (Total), mg/l	0.05	--
Hardness, mg/l	380	--
Sodium, mg/l	190	--
Specific Conductance, umhos/cm	1600	--
Sulfate, mg/l	100	250
Zinc, mg/l	0.71	5
TOC, mg/l	45	--
Static Water Level, feet	4.1	--
Magnesium, mg/l	45	--
PCB's ug/l		
Aroclor 1242	<0.05	
Aroclor 1254	--	
Aroclor 1260	<0.05	

Samples for metals analysis were filtered in the lab and reported as dissolved.

**Monitoring Well Data
Fourth Quarter
1987**



Burmah Technical Services, Inc
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, Michigan 48058

313-334-4747

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
MODULAR IRON PLANT
PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

Sample Number: 29821

Monitoring Well Number: MW-7

Sample Date: 11-5-87

	Test <u>Results</u>	Drinking Water <u>Standards</u>
Arsenic, As, mg/l	<0.005	0.05
Barium, Ba, mg/l	0.07	1
Chloride, Cl, mg/l	270	250
Chemical Oxygen Demand, mg/l	130	--
Copper, Cu, mg/l	<0.02	1
Cyanide, CN, mg/l	<0.02	--
Iron, Fe, mg/l	0.04	0.3
Fluoride, F, mg/l	0.86	1.4-2.4
Cadmium, Cd, mg/l	<0.01	0.01
Chromium, Cr, mg/l	<0.02	0.05
Tin, Sn, mg/l	<1.0	--
Aluminum, Al, mg/l	0.16	--
Kjeldahl Nitrogen, N, mg/l	6.6	--
Lead, Pb, mg/l	<0.05	0.05
Manganese, Mn, mg/l	<0.02	0.05
Mercury, Hg, mg/l	<0.0005	0.002
pH (on site)	8.50	6.5-8.5
Phenolics, mg/l	0.002	0.001
Selenium, Se, mg/l	<0.005	0.01
Silver, Ag, mg/l	<0.02	0.05
Total Phosphorus, P, mg/l	0.06	--
Total Hardness, mg/l	290	--
Sodium, Na, mg/l	170	--
Specific Conductivity (on site), uhms/cm	1500	--
Sulfate, SO ₄ , mg/l	130	250
Zinc, Zn, mg/l	0.50	5
Total Organic Carbon, mg/l	31	--
Static Water Level, Feet	3.10	--
Magnesium, Mg, mg/l	35	--
PCB's, ug/l		
Aroclor 1242	<0.05	--
Aroclor 1254	--	--
Aroclor 1260	0.38	--

Samples for metals analyses were filtered in the lab and reported as dissolved.

CI/6r

814832



Burmah Technical Services, Inc
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, Michigan 48058

313-334-4747

GENERAL MOTORS CORPORATION
CENTRAL FOUNDRY DIVISION
MODULAR IRON PLANT
PARAMETERS - GROUNDWATER MONITORING
CROW ISLAND LANDFILL

Sample Number: 29819

Monitoring Well Number: MW-6

Sample Date: 11-5-87

	Test Results	Drinking Water Standards
Arsenic, As, mg/l	<0.005	0.05
Barium, Ba, mg/l	1.2	1
Chloride, Cl, mg/l	2100	250
Chemical Oxygen Demand, mg/l	380	--
Copper, Cu, mg/l	<0.02	1
Cyanide, CN, mg/l	0.02	--
Iron, Fe, mg/l	0.34	0.3
Fluoride, F, mg/l	0.53	1.4-2.4
Cadmium, Cd, mg/l	<0.01	0.01
Chromium, Cr, mg/l	<0.02	0.05
Tin, Sn, mg/l	<1.0	--
Aluminum, Al, mg/l	<0.05	--
Kjeldahl Nitrogen, N, mg/l	130	--
Lead, Pb, mg/l	<0.05	0.05
Manganese, Mn, mg/l	0.05	0.05
Mercury, Hg, mg/l	<0.0005	0.002
pH (on site)	7.00	6.5-8.5
Phenolics, mg/l	0.013	0.001
Selenium, Se, mg/l	<0.005	0.01
Silver, Ag, mg/l	<0.02	0.05
Total Phosphorus, P, mg/l	0.23	--
Total Hardness, mg/l	2400	--
Sodium, Na, mg/l	700	--
Specific Conductivity (on site), uhms/cm	7000	--
Sulfate, SO ₄ , mg/l	9	250
Zinc, Zn, mg/l	23	5
Total Organic Carbon, mg/l	310	--
Static Water Level, Feet	1.85	--
Magnesium, Mg, mg/l	200	--
PCB's, ug/l		
Aroclor 1242	<0.05	--
Aroclor 1254	--	--
Aroclor 1260	<0.05	--

Samples for metals analyses were filtered in the lab and reported as dissolved.

**Landfill Groundwater Data
1988**

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL LABORATORY

REPORT Waste Management Division
TO Ottawa Building
Lansing, MI 48909

ATTEN KIP COSAN

LABORATORY WORK ORDER # 88-11-059
WORK ID 6M MODULAR
P.O. # 68424 COST \$ 2885.00
RECEIVED 11/09/88 CLIENT WM
REPORTED _____ NUMBER OF SAMPLES 6
LAB CONTACT RW KA BN MATRIX WATER

*non Annual
Spec 15*

TEST	UNITS	MW-HH	EQUIP BLANK	MW-EE	MW-6
Aluminium in Water	ug/l	220	K 50	23600	7170
Alkalinity of Water	mg CaCO3/l	363	K 10		2270
Carbonate Alkalinity	mg CaCO3/l	K 5	K 5		K 5
Bicarbonate Alkalinity	mg CaCO3/l	363	K 10		2270
Arsenic in Water	ug/l	K 2.0	K 2.0	15.5	2.9
Barium in Water	ug/l	46	K 10	181	1840
Beryllium in Water	ug/l	K 1.0	K 1.0	K 1.0	K 1.0
Calcium in Water	ug/l	102	K 1	234	257
Cadmium in Water	ug/l	K 20	K 20	K 20	K 20
Chloride in Water	ug/l	131	K 1		1500
Cobalt in Water	ug/l	K 50	K 50	K 50	K 50
COD	ug/l	13	3		880
Conductivity of Water	uaho/cm	1414	1.0		6760
Chromium in Water	ug/l	K 50	K 50	K 50	K 50
Hex Chromium in Water	ug/l	K 5	K 5		K 5
Copper in Water	ug/l	K 20	K 20	30	45
Iron in Water	ug/l	450	K 100	27000	25000
Mercury in Water	ug/l	K 0.5	K 0.5	K 0.5	K 0.5
Potassium in Water	ug/l	2.52	K .1	3.08	81

RECEIVED

DEC 15 1988

Waste Management
Division

TEST	UNITS	MW-HH	EQUIP BLANK	MW-EE	MW-6
Aluminum in Water	ug/l	K 20	K 20	60	85
Magnesium in Water	ug/l	60	K 1	86	247
Manganese in Water	ug/l	460	K 20	510	230
Molybdenum in Water	ug/l	K 25	K 25	29	K 25
Sodium in Water	ug/l	122	K 1	94.4	921
Nickel in Water	ug/l	K 50	K 50	K 50	80
Nitrate + Nitrite	ug N/l	.01	K .01		K .5 DS
Ammonia	ug N/l	.42	K .01		170.
Kjeldahl Nitrogen	ug N/l	.62	.07		200
Lead in Water	ug/l	K 50	K 50	K 50	180
pH of Water	pH	7.97	INT		7.51
Total Phosphorus	ug P/l	.01	K .01		.20 DS
Iron in Water	ug/l	1.4	K 1.0	K 1.0	1.4
Selenium in Water	ug/l	1.0	1.2	K 1.0	K 1.0
Sulfate in Water	ug/l	235	K 2		34
Titanium in Water	ug/l	K 15	K 15	199	131
TOC	ug/l	2.2	.3		270
Vanadium in Water	ug/l	K 10	K 10	44	20
Zinc in Water	ug/l	K 50	K 50	5500	29000

TEST	UNITS	MW5	MW-4
Aluminum in Water	ug/l	257	156
Alkalinity of Water	ug CaCO3/l	320	249
Carbonate Alkalinity	ug CaCO3/l	K 5	K 5
Bicarbonate Alkalinity	ug CaCO3/l	320	249

**Monitoring Well Data
Third Quarter
1988**

RMT Inc.
LABORATORY REPORT

CLIENT: BMC-CFD Saginaw Grey Iron
PROJECT #: 1030.20
LOCATION: Saginaw, MI

SAMPLE DATE: 09/05/88
REPORT DATE: 10/05/88
TOTAL # PAGES: 2
FILE NAME: SG1001GM
SAMPLE COLLECTOR: JAN

GROUND WATER
MONITORING RESULTS

PARAMETERS	UNITS	LOCATION								
		Sample #'s	33370	33371	33372	33373	33374	33375	33376	33377
			MW-3	MW-4	MW-5	MW-6	MW-7	MW-EE	MW-M1	MW-M2
Alkalinity-Bicarbonate	mg/l		110	270	440	2200	220	300	300	230
Ammonia, Nitrogen	mg/l as N		0.41	0.67	0.70	100	5.4	0.22	0.50	0.48
Cadmium, Dissolved	mg/l		< 0.0002	0.0004	0.0005	0.0021	0.0003	< 0.0002	0.0009	0.0003
Calcium, Dissolved	mg/l		53	120	190	270	72	71	110	140
Chloride	mg/l		120	170	180	1500	270	21	160	360
Chromium, Total Dissolved	mg/l		< 0.001	< 0.001	< 0.001	0.007	< 0.001	< 0.001	< 0.001	< 0.001
COD	mg/l		17	20	31	910	100	31	< 20	42
Iron, Dissolved	mg/l		0.05	0.24	0.56	0.1	< 0.04	0.09	< 0.04	< 0.04
Lead, Dissolved	mg/l		< 0.003	0.004	< 0.003	0.006	< 0.003	< 0.003	< 0.003	< 0.003
Magnesium, Dissolved	mg/l		25	57	82	270	45	45	57	100
Nitrate, Nitrogen	mg/l as N		< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.17	0.11	< 0.05
Phenols	mg/l		< 0.005	< 0.005	< 0.005	0.010	< 0.010	< 0.005	< 0.005	< 0.005
Sodium, Dissolved	mg/l		120	130	85	870	150	89	130	150
Sulfate	mg/l		200	280	300	< 20	140	210	280	390
Total Organic Carbon	mg/l		6.2	4.3	6.6	270	25	5.3	3.4	4.8
pH	pH Units		8.3	7.6	7.1	6.9	8.0	7.6	7.6	7.8
Conductivity	microhos/cm @ 25C		910	1400	1650	7980	1400	880	1340	1830

807069

RMI Inc.
LABORATORY REPORT

CLIENT: GMC-CFD Saginaw Grey Iron
PROJECT #: 1030.20
LOCATION: Saginaw, MI

SAMPLE DATE: 09/05/88
REPORT DATE: 10/05/88
TOTAL # PAGES: 2
FILE NAME: SG10016M
SAMPLE COLLECTOR: JAN

GROUND WATER
MONITORING RESULTS

Sample #'s		33370	33371	33372	LOCATION		33373	33374	33375	33376	33377
PARAMETERS	UNITS	NW-3	NW-4	NW-5	NW-6	NW-7	NW-EE	NW-IH	NW-MH		
Odor		NO	NO	YES	YES	NO	NO	NO	NO		
Color		NO	NO	NO	YES	NO	NO	NO	NO		
Turbidity		YES	NO	NO	YES	YES	YES	YES	YES		
Water Elevation	Feet/MSL	--	--	--	--	--	--	--	--		
	</										


Laboratory Director

**Monitoring Well Data
Fourth Quarter
1988**



General Motors Corporation
Central Foundry Division
Saginaw Grey Iron Plant
1629 N. Washington Ave.
Saginaw, MI 48605-5073
Attn: June Foulds

January 3, 1989

PROGRAM: QUARTERLY GROUNDWATER MONITORING - CROW ISLAND LANDFILL

Date Received: 11/8-18/88

ALD Number:

Client I.D.:

48662	47915	47916	48663	48154
MW-3	MW-4	MW-5	MW-6	MW-7
11-18-88	11-8-88	11-8-88	11-18-88	11-11-88

Specific Conductivity,

(on site), umhos/cm	820	1400	1500	4600	1200
Bicarbonate Alkalinity, as HCO ₃ , mg/l	130	330	370	2800	220
Chloride, mg/l	120	240	260	1400	240
Sulfate, SO ₄ , mg/l	210	310	270	1	110
Calcium, Ca, Diss., mg/l	✓ 28	110	130	200	50
Iron, Fe, Diss., mg/l	✓ <0.02	0.05	0.04	2.7	0.07
Magnesium, Mg, Diss., mg/l	✓ 14	58	62	190	37
Sodium, Na, Diss., mg/l	✓ 80	130	120	850	160
Total Organic Carbon, mg/l	18	15	21	410	35
Static Water Level, feet	8.40	6.20	9.00	2.10	2.25

cc: Bob Offenborn ✓

Annual 1/r

501208



General Motors Corporation
Central Foundry Division
Saginaw Grey Iron Plant
Attn: June Foulds

January 3, 1989

PROGRAM: QUARTERLY GROUNDWATER MONITORING - CROW ISLAND LANDFILL

Date Received: 11/8-18/88

ALD Number:	48662	47915	47916	48663	48154
Client I.D.:	MW-3 11-18-88	MW-4 11-8-88	MW-5 11-8-88	MW-6 11-18-88	MW-7 11-11-88

PCB, ug/l

Aroclor 1242	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	--	--	--	--	--
Aroclor 1260	<0.05	<0.05	<0.05	<0.05	<0.05

Q/3r

807107



General Motors Corporation
Central Foundry Division
Saginaw Grey Iron Plant
1629 N. Washington Ave.
Saginaw, MI 48605-5073
Attn: June Foulds

January 24, 1989

Follow-up Report

PROGRAM: QUARTERLY GROUNDWATER MONITORING - CROW ISLAND LANDFILL

Date Received: 11/8-18/88

ALD Number:

Client I.D.:

48662	47915	47916	48663	48154
MW-3	MW-4	MW-5	MW-6	MW-7
11-18-88	11-8-88	11-8-88	11-18-88	11-11-88
10:00 am	3:15 pm	3:00 pm	11:00 am	10:45 am

Specific Conductivity,

(on site), umhos/cm	820	1400	1500	4600	1200
Bicarbonate Alkalinity, as HCO ₃ , mg/l	130	330	370	2800	220
Chloride, mg/l	120	240	260	1400	240
Sulfate, SO ₄ , mg/l	210	310	270	1	110
Calcium, Ca, Diss., mg/l	28	110	130	200	50
Iron, Fe, Diss., mg/l	<0.02	0.05	0.04	2.	0.07
Magnesium, Mg, Diss., mg/l	14	58	62	190	37
Sodium, Na, Diss., mg/l	80	130	120	850	160
Total Organic Carbon, mg/l	18	15	21	410	35
Static Water Level, feet	8.40	6.20	9.00	2.10	2.25

cc: Bob Offenborn✓

Annual 1/r



General Motors Corporation
Central Foundry Division
Saginaw Grey Iron Plant
Attn: June Foulds

January 24, 1989

PROGRAM: QUARTERLY GROUNDWATER MONITORING - CROW ISLAND LANDFILL

Date Received: 11/8-18/88

ALD Number:	48662	47915	47916	48663	48154
Client I.D.:	MW-3	MW-4	MW-5	MW-6	MW-7
	11-18-88	11-8-88	11-8-88	11-18-88	11-11-88
	10:00 am	3:15 pm	3:00 pm	11:00 am	10:45 am

PCB, ug/l

Aroclor 1242	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	--	--	--	--	--
Aroclor 1260	<0.05	<0.05	<0.05	<0.05	<0.05

Q/3r

660408

**Landfill Groundwater Data
1989**

SAMPLE ID MW6 FRACTION 01A TEST CODE SC 1 NAME Scan 1 Water
Date & Time Collected 08/11/89 10:05:00 Category _____

ANALYST WILFORD
ANALYZED 08/21/89
DILUTION 2

UNITS ug/L ppb

CAS#	COMPOUND	RESULT	REMARK	DETECTION LIMIT
75-01-4	Vinyl chloride	59		10
74-83-9	*Bromomethane	ND		10
75-00-3	*Chloroethane	ND		10
75-69-4	*Trichlorofluoromethane	ND		10
75-35-4	1,1-Dichloroethene	ND		2.0
75-09-2	Methylene chloride	ND		10
156-60-5	trans-1,2-Dichloroethene	ND		2.0
75-34-3	1,1-Dichloroethane	ND		2.0
156-59-2	cis-1,2-Dichloroethene	ND		2.0
67-66-3	Chloroform	ND		2.0
71-55-6	1,1,1-Trichloroethane	ND		2.0
56-23-5	Carbon tetrachloride	ND		2.0
107-06-2	1,2-Dichloroethane	ND		2.0
79-01-6	Trichloroethene	ND		2.0
78-87-5	1,2-Dichloropropane	ND		2.0
75-27-4	Bromodichloromethane	ND		2.0
10061-01-5	cis-1,3-Dichloropropene	ND		2.0
10061-02-6	trans-1,3-Dichloropropene	ND		2.0
79-00-5	1,1,2-Trichloroethane	ND		2.0
127-18-4	Tetrachloroethene	ND		2.0
124-48-1	Dibromochloromethane	ND		2.0
108-90-7	Chlorobenzene	ND		2.0
75-25-2	Bromoform	ND		2.0
79-34-5	1,1,2,2-Tetrachloroethane	ND		2.0

COMMENTS UnID PEAK

ND = not detected at the specified detection limit.
* Compound identity not confirmed by second independent technique.

Page 3
Received: 08/11/89

DNR Labora. REPORT
Results by Sample

Work Order # J8-112

SAMPLE ID MW6 FRACTION Q1B TEST CODE SC 2 NAME Scan 2 Water
Date & Time Collected 08/11/89 10:05:00 Category _____

ANALYST WILFORD
ANALYZED 08/21/89
DILUTION 2

UNITS ug/L ppb

<u>CAS#</u>	<u>COMPOUND</u>	<u>RESULT</u>	<u>REMARK</u>	<u>DETECTION LIMIT</u>
71-43-2	Benzene	<u>ND</u>	<u> </u>	<u>2.0</u>
108-88-3	Toluene	<u>ND</u>	<u> </u>	<u>2.0</u>
100-41-4	Ethylbenzene	<u>ND</u>	<u> </u>	<u>2.0</u>
108-38-3	Xylene isomers	<u>ND</u>	<u> </u>	<u>2.0</u>

COMMENTS _____

ND = not detected at the specified detection limit.

SAMPLE ID MW7 FRACTION 02A TEST CODE SC 1 NAME Scan 1 Water
Date & Time Collected 08/11/89 10:13:00 Category

ANALYST WILFORD
ANALYZED 08/22/89
DILUTION 5

		UNITS <u>ug/L ppb</u>		DETECTION
<u>CAS#</u>	<u>COMPOUND</u>	<u>RESULT</u>	<u>REMARK</u>	<u>LIMIT</u>
75-01-4	Vinyl chloride	ND		25
74-83-9	†Bromoethane	ND		25
75-00-3	†Chloroethane	ND		25
75-69-4	†Trichlorofluoroethane	ND		25
75-35-4	1,1-Dichloroethene	ND		5.0
75-09-2	Methylene chloride	ND		25
156-60-5	trans-1,2-Dichloroethene	ND		5.0
75-34-3	1,1-Dichloroethane	ND		5.0
156-59-2	cis-1,2-Dichloroethene	ND		5.0
67-66-3	Chloroform	ND		5.0
71-55-6	1,1,1-Trichloroethane	ND		5.0
56-23-5	Carbon tetrachloride	ND		5.0
107-06-2	1,2-Dichloroethane	ND		5.0
79-01-6	Trichloroethene	ND		5.0
78-87-5	1,2-Dichloropropane	ND		5.0
75-27-4	Bromodichloroethane	ND		5.0
10061-01-5	cis-1,3-Dichloropropene	ND		5.0
10061-02-6	trans-1,3-Dichloropropene	ND		5.0
79-00-5	1,1,2-Trichloroethane	ND		5.0
127-18-4	Tetrachloroethene	ND		5.0
124-48-1	Dibromochloromethane	ND		5.0
108-90-7	Chlorobenzene	ND		5.0
75-25-2	Bromoform	ND		5.0
79-34-5	1,1,2,2-Tetrachloroethane	ND		5.0

COMMENTS FOAMY SAMPLE

ND = not detected at the specified detection limit.
† Compound identity not confirmed by second independent technique.

Page 5
Received: 08/11/89

DNR Labora. ,
Results by Sample

REPORT

Work Order # 08-112

SAMPLE ID MW7 FRACTION 028 TEST CODE SC 2 NAME Scan 2 Water
Date & Time Collected 08/11/89 10:13:00 Category

ANALYST WILFORD
ANALYZED 08/22/89
DILUTION 5

UNITS ug/L ppb

<u>CAS#</u>	<u>COMPOUND</u>	<u>RESULT</u>	<u>REMARK</u>	<u>DETECTION</u> <u>LIMIT</u>
71-43-2	Benzene	ND		5.0
108-88-3	Toluene	ND		5.0
100-41-4	Ethylbenzene	ND		5.0
108-38-3	Xylene isomers	ND		5.0

COMMENTS FOAMY SAMPLE

ND = not detected at the specified detection limit.

**Monitoring Well Data
First Quarter
1989**



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, MI 48058

313 334-1630
313 334-4747

General Motors Corporation
Central Foundry Division
Saginaw Grey Iron Plant
1629 N. Washington Ave.
Saginaw, MI 48605-5073
Attn: Bob Offenborn

October 4, 1988

PROGRAM: ANNUAL GROUNDWATER MONITORING - CROW ISLAND LANDFILL

Date Received: 8-19-88

ALD Number:

Client I.D.:

43066	43067	43068	43069	43070
MW-3	MW-4	MW-5	MW-6	MW-7
8-19-88	8-19-88	8-19-88	8-19-88	8-19-88

pH (on site)	6.84	7.09	7.14	7.02	7.01
Specific Conductivity, (on site), umhos/cm	920	1400	1700	7900	1600
Bicarbonate Alkalinity, as HCO ₃ , mg/l	220	290	450	2900	440
Chemical Oxygen Demand, mg/l	14	11	16	830	86
Chloride, mg/l	120	190	200	1500	360
Sulfate, SO ₄ , mg/l	230	250	220	3	120
Phenolics, (4AAP), mg/l	<0.002	0.003	0.004	0.025	0.004
Nitrate Nitrogen, as N, mg/l	<0.02	<0.02	<0.02	<0.02	<0.02
Ammonia Nitrogen, as N, mg/l	0.62	0.76	0.94	170	8.1
Calcium, Ca, Diss., mg/l	44	93	160	240	63
Cadmium, Cd, Diss., mg/l	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium, Cr, Diss., mg/l	<0.02	<0.02	<0.02	<0.02	<0.02
Iron, Fe, Diss., mg/l	<0.02	<0.02	<0.02	0.22	<0.02
Lead, Pb, Diss., mg/l	<0.05	0.05	<0.05	0.05	<0.05
Magnesium, Mg, Diss., mg/l	24	44	68	230	43
Sodium, Na, Diss., mg/l	110	130	100	800	170
Total Organic Carbon, mg/l	5	4	6	310	50
Static Water Level, feet	8.40	6.10	6.40	3.80	6.00

Annual/1r

Susan K Scott
Laboratory Supervisor

**Monitoring Well Data
Second Quarter
1989**



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, Michigan 48058

313/334-4747

JUN 12 '89 12:43

General Motors Corporation
Central Foundry Division
Saginaw Grey Iron Plant
1629 N. Washington Ave.
Saginaw, MI 48605-5073
Attn: June Foulds

June 12, 1989

PROGRAM: QUARTERLY GROUNDWATER MONITORING - CROW ISLAND LANDFILL

Date Received: 5-16-89

ALD Number:

Client I.D.:

56716	56717	56718	56719	56720
MW-3	MW-4	MW-5	MW-6	MW-7
5-16-89	5-16-89	5-16-89	5-16-89	5-16-89
12:10 pm	1:45 pm	2:00 pm	1:15 pm	1:30 pm

pH (on site)	8.05	7.80	7.61	6.84	7.96
Specific Conductivity, (on site), umhos/cm	820	1300	1300	7600*	1400
Bicarbonate Alkalinity, as HCO ₃ , mg/l	100	170	180	2700	320
Chloride, mg/l	110	210	240	1400	310
Sulfate, SO ₄ , mg/l	220	320	280	3	140
Calcium, Ca, Diss., mg/l	41	79	87	210	63
Iron, Fe, Diss., mg/l	0.04	0.04	0.03	0.41	0.05
Magnesium, Mg, Diss., mg/l	26	54	51	240	51
Sodium, Na, Diss., mg/l	100	150	130	790	170
Total Organic Carbon, mg/l	7	21	6	290	41
Static Water Level, feet	6.50	6.50	9.75	1.00	1.00

Reported to the Laboratory

COPIES OF REPORT

Annual/1r

807047

PHSE.002



Burmah Technical Services, Inc.
Analytical Laboratories Division

408 Auburn Avenue
Pontiac, Michigan 48058

313/334-4747

General Motors Corporation
Central Foundry Division
Saginaw Grey Iron Plant
Attn: June Foulds

June 12, 1989

PROGRAM: QUARTERLY GROUNDWATER MONITORING - CROW ISLAND LANDFILL

Date Received: 5-16-89

ALD Number:	56716	56717	56718	56719	56720
Client I.D.:	MW-3	MW-4	MW-5	MW-6	MW-7
	5-16-89	5-16-89	5-16-89	5-16-89	5-16-89
	12:10 pm	1:45 pm	2:00 pm	1:15 pm	1:30 pm

PCB, ug/l

Aroclor 1242	<0.05	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	--	--	--	--	--
Aroclor 1260	<0.05	<0.05	<0.05	<0.05	<0.05

Q/r

807049

JUN 13 '89 12:44

FW06.004

**Landfill Groundwater Data
1991**

Page 18
Received: 08/29/91

DNR Laboratory
Results by Sample

REPORT

Work Order # 91-08-199

SAMPLE ID MW 7 FRACTION 09A TEST CODE SC 1 NAME Scan 1 Water
Date & Time Collected 08/26/91 Category

ANALYST WILFORD
ANALYZED 09/06/91
DILUTION 1

	UNITS <u>ug/L ppb</u>		DETECTION	
<u>CASE#</u>	<u>COMPOUND</u>	<u>RESULT</u>	<u>REMARK</u>	<u>LIMIT</u>
75-01-4	Vinyl chloride	ND		5.0
74-83-9	*Bromomethane	ND		5.0
75-00-3	*Chloroethane	ND		5.0
75-69-4	*Trichlorofluoromethane	ND		5.0
75-35-4	1,1-Dichloroethene	ND		1.0
75-09-2	Methylene chloride	ND		5.0
156-60-5	trans-1,2-Dichloroethene	ND		1.0
75-34-3	1,1-Dichloroethane	ND		1.0
156-59-2	cis-1,2-Dichloroethene	ND		1.0
67-66-3	Chloroform	ND		1.0
71-55-6	1,1,1-Trichloroethane	ND		1.0
56-23-5	Carbon tetrachloride	ND		1.0
107-06-2	1,2-Dichloroethane	ND		1.0
79-01-6	Trichloroethene	ND		1.0
78-87-5	1,2-Dichloropropane	ND		1.0
75-27-4	Bromodichloromethane	ND		1.0
10061-01-5	cis-1,3-Dichloropropene	ND		1.0
10061-02-6	trans-1,3-Dichloropropene	ND		1.0
79-00-5	1,1,2-Trichloroethane	ND		1.0
127-18-4	Tetrachloroethene	ND		1.0
124-48-1	Dibromochloromethane	ND		1.0
108-90-7	Chlorobenzene	ND		1.0
75-25-2	Bromoform	ND		1.0
79-34-5	1,1,2,2-Tetrachloroethane	ND		1.0

COMMENTS

ND = not detected at the specified detection limit.
* Compound identity not confirmed by second independent technique.

Page 19
received: 08/29/91

DNR Laboratory REPORT
Results by Sample

Work Order # 91-08-199

PLE ID MW 7 FRACTION Q9E TEST CODE SC 2 NAME Scan 2 Water
Date & Time Collected 08/26/91 Category

ANALYST WILFORD
ANALYZED 09/06/91
LUTION 1

	UNITS <u>ug/L ppb</u>	
<u>CASE#</u>	<u>COMPOUND</u>	<u>DETECTION</u> <u>RESULT REMARK</u> <u>LIMIT</u>
71-43-2	Benzene	ND 1.0
108-88-3	Toluene	ND 1.0
100-41-4	Ethylbenzene	ND 1.0
108-38-3	Xylene isomers	ND 1.0

COMMENTS

ND = not detected at the specified detection limit.

Page 20
Received: 08/29/91

DNR Laboratory
Results by Sample

REPORT

Work Order # 91-08-199

SAMPLE ID NW 6 FRACTION 10A TEST CODE SC 1 NAME Scan 1 Water
Date & Time Collected 08/26/91 Category

ANALYST WILFORD
ANALYZED 09/06/91
DILUTION 2

UNITS ug/L ppb

CASE	COMPOUND	RESULT	REMARK	DETECTION LIMIT
75-01-4	Vinyl chloride	ND		10
74-83-9	*Bromomethane	ND		10
75-00-3	*Chloroethane	ND		10
75-69-4	*Trichlorofluoromethane	ND		10
75-35-4	1,1-Dichloroethene	ND		2.0
75-09-2	Methylene chloride	ND		10
156-60-5	trans-1,2-Dichloroethene	ND		2.0
75-34-3	1,1-Dichloroethane	ND		2.0
156-59-2	cis-1,2-Dichloroethene	ND		2.0
67-66-3	Chloroform	ND		2.0
71-55-6	1,1,1-Trichloroethane	ND		2.0
56-23-5	Carbon tetrachloride	ND		2.0
107-06-2	1,2-Dichloroethane	ND		2.0
79-01-6	Trichloroethene	ND		2.0
78-87-5	1,2-Dichloropropane	ND		2.0
75-27-4	Bromodichloromethane	ND		2.0
10061-01-5	cis-1,3-Dichloropropene	ND		2.0
10061-02-6	trans-1,3-Dichloropropene	ND		2.0
79-00-5	1,1,2-Trichloroethane	ND		2.0
127-18-4	Tetrachloroethene	ND		2.0
124-48-1	Dibromochloromethane	ND		2.0
108-90-7	Chlorobenzene	ND		2.0
75-25-2	Bromoform	ND		2.0
79-34-5	1,1,2,2-Tetrachloroethane	ND		2.0

COMMENTS

ND = not detected at the specified detection limit.

* Compound identity not confirmed by second independent technique.

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Received: 08/29/91

DNR Laboratory REPORT
Results by Sample

Work Order # 91-08-199

SAMPLE ID MW 5 FRACTION 10B TEST CODE SC 2 NAME Scan 2 Water
Date & Time Collected 08/26/91 Category _____

ANALYST WILFORD
ANALYZED 09/06/91
DILUTION 2

	UNITS <u>ug/L ppb</u>		DETECTION	
<u>CASE#</u>	<u>COMPOUND</u>	<u>RESULT</u>	<u>REMARK</u>	<u>LIMIT</u>
71-43-2	Benzene	ND		2.0
108-88-3	Toluene	ND		2.0
100-41-4	Ethylbenzene	ND		2.0
108-38-3	Xylene isomers	ND		2.0

COMMENTS _____

ND = not detected at the specified detection limit.



NATIONAL
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NET Midwest, Inc.
Auburn Hills Division
1700 Harmon Road
Auburn Hills, MI 48326

Tel: (313) 391-2050
Fax: (313) 391-9697

ANALYTICAL REPORT

Ray Ilkka
GMC CNTRL FDRY GREY IRON
1629 N Washington Avenue
Saginaw, MI 48605-5073

09/30/1991

Job No.: 91.4818
Sample No.: 95111

cc: John Richardson
Row Island Landfill - SGI

Annual Groundwater

Sample Description: MW-6 08/26

Date Taken: 08/26/1991

Date Received: 08/26/1991

Parameter	Result	Unit	Date Analyzed	Lab Tech.	Methodology
DNR SCAN #1					
1-Bromo-3-chloropropane	<2.	ug/L	08/30/1991	njd	601 (5)
Bromodichloromethane	<5.	ug/L	08/30/1991	njd	601 (5)
Bromomethane	<5.	ug/L	08/30/1991	njd	601 (5)
Bromoform	<10.	ug/L	08/30/1991	njd	601 (5)
Carbon tetrachloride	<2.	ug/L	08/30/1991	njd	601 (5)
Chlorobenzene	<2.	ug/L	08/30/1991	njd	601 (5)
Chlorodibromomethane	<2.	ug/L	08/30/1991	njd	601 (5)
Chloroethane	<2.	ug/L	08/30/1991	njd	601 (5)
Chloroform	<2.	ug/L	08/30/1991	njd	601 (5)
cis-1,3-Dichloropropene	<2.	ug/L	08/30/1991	njd	601 (5)
trans-1,3-Dichloropropene	<2.	ug/L	08/30/1991	njd	601 (5)
1,1-Dichloroethane	<2.	ug/L	08/30/1991	njd	601 (5)
1,2-Dichloroethane	<2.	ug/L	08/30/1991	njd	601 (5)
1,1-Dichloroethene	<2.	ug/L	08/30/1991	njd	601 (5)
cis,trans-1,2-Dichloroethene	<2.	ug/L	08/30/1991	njd	601 (5)
1,2-Dichloropropane	<2.	ug/L	08/30/1991	njd	601 (5)
Methylene chloride	<2.	ug/L	08/30/1991	njd	601 (5)
1,2,2-Tetrachloroethane	<2.	ug/L	08/30/1991	njd	601 (5)
Tetrachloroethene	<2.	ug/L	08/30/1991	njd	601 (5)
1,1,1-Trichloroethane	<2.	ug/L	08/30/1991	njd	601 (5)
1,1,2-Trichloroethane	<2.	ug/L	08/30/1991	njd	601 (5)
Trichloroethene	<2.	ug/L	08/30/1991	njd	601 (5)
Trichlorofluoromethane	<2.	ug/L	08/30/1991	njd	601 (5)
Vinyl Chloride	<5.	ug/L	08/30/1991	njd	601 (5)

Susan K. Scott
Project Manager



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NET Midwest, Inc.
Auburn Hills Division
1700 Harmon Road
Auburn Hills, MI 48326

Tel: (313) 391-2050
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ANALYTICAL REPORT

Ray Ilkka
GMC CNTRL FDRY GREY IRON
1629 N Washington Avenue
Saginaw, MI 48605-5073

09/30/1991

Job No.: 91.4818
Sample No.: 95111

cc: John Richardson
Crow Island Landfill - SGI

Annual Groundwater

Sample Description: MW-6 08/26

Date Taken: 08/26/1991

Date Received: 08/26/1991

Parameter	Result	Unit	Date Analyzed	Lab Tech.	Methodology
DNR SCAN #2					
Benzene	<2.	ug/L	08/30/1991	njd	602 (5)
Ethylbenzene	<2.	ug/L	08/30/1991	njd	602 (5)
Toluene	<2.	ug/L	08/30/1991	njd	602 (5)
Styrene	<2.	ug/L	08/30/1991	njd	602 (5)
Xylene isomers	<2.	ug/L	08/30/1991	njd	602 (5)

Susan K. Scott
Susan K. Scott
Project Manager

**Landfill Groundwater Data
1992**



NATIONAL
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TESTING, INC.

June Foulds

GMC POWERTRAIN GREY IRON
1629 N Washington Avenue
Saginaw, MI 48605-5073

cc: John Richardson

GMPT-SGI TYPE III SANITARY LANDFILL

Quarterly Groundwater

ANALYTICAL REPORT

12/02/1992

Job No.: 92.52539

Sample No:	116218	116219	116220	116221	116222	116223
Date Sampled:	11/10/1992	11/10/1992	11/10/1992	11/10/1992	11/10/1992	11/10/1992
Sample Description:	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8
-- pH (Field)	units 8.53	8.05	7.62	7.32	8.16	10.15
-- Conductivity (Field)	umhos 1300.	1400.	1500.	7100.	1200.	1300.
-- Static Level	feet 10.82	6.96	8.94	0.50	0.50	11.05
Alkalinity, Bicarb. (CaCO3)	mg/L 45.	81.	330.	2500.	160.	<4.
Chloride	mg/L 270.	280.	120.	1400.	260.	310.
Sulfate	mg/L 140.	210.	280.	2.	110.	100.
Total Organic Carbon	mg/L 13.	16.	13.	260.	32.	12.
Calcium, dissolved	mg/L 63.	63.	130.	120.	66.	36.
Iron, dissolved	mg/L <0.02	<0.02	<0.02	0.30	<0.02	<0.02
Magnesium, dissolved	mg/L 28.	37.	56.	190.	40.	3.2
Sodium, dissolved	mg/L 120.	150.	76.	800.	120.	170.

Susan K. Scott
Susan K. Scott
Project Manager



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June Foulds
GMC POWERTRAIN GREY IRON
1629 N Washington Avenue
Saginaw, MI 48605-5073

cc: John Richardson
Crow Island Landfill - SGI

ANALYTICAL REPORT

09/08/1992
Job No.: 92.46200

Annual Groundwater

Sample No:	111834	111835	111836	111837	111838	111839
Date Sampled:	08/18/1992	08/18/1992	08/18/1992	08/18/1992	08/18/1992	08/18/1992
Sample Description:	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8
PH (Field)	8.48	7.48	7.58	8.08	8.08	10.22
Conductivity (Field)	1600.	1400.	1600.	7200.	1400.	1500.
Static Level	10.12	7.12	8.88	0.51	0.52	10.15
Alkalinity, Bicarb. (HCO ₃)	37.	150.	330.	3500.	210.	<4.
Chloride	360.	260.	250.	1400.	270.	290.
COD	19.	18.	14.	1000.	95.	14.
Nitrogen, Ammonia	<0.10	0.34	0.50	320.	2.1	0.50
Nitrogen, Nitrate	<0.02	0.04	0.06	0.71	<0.02	<0.02
Phenol (4-AAP)	0.030	<0.002	<0.002	0.005	<0.002	0.013
Sulfate	110.	250.	290.	7.	130.	130.
Total Organic Carbon	2.	3.	3.	220.	26.	3.
Cadmium, dissolved	<0.01	<0.01	<0.01	<0.01	<0.10	<0.01
Calcium, dissolved	72.	74.	150.	140.	63.	36.
Chromium, dissolved	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron, dissolved	0.04	0.05	<0.02	0.48	<0.02	<0.02
Lead, dissolved	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Magnesium, dissolved	29.	38.	68.	200.	41.	1.6
Sodium, dissolved	130.	140.	120.	820.	130.	180.

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Project Manager



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ANALYTICAL REPORT

June Foulds

GMC POWERTRAIN GREY IRON
1629 N Washington Avenue
Saginaw, MI 48605-5073

09/08/1992

Job No.: 92.46200

cc: John Richardson
Crow Island Landfill - SGI

Annual Groundwater

Sample No: 111834 111835 111836 111837 111838 111839
Date Sampled: 08/18/1992 08/18/1992 08/18/1992 08/18/1992 08/18/1992 08/18/1992
Sample Description: MW-3 MW-4 MW-5 MW-6 MW-7 MW-8

DNR SCAN #1					
1-Bromo-3-chloropropane	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
Bromodichloromethane	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
Bromomethane	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
Bromoform	ug/L <2.0	<2.0	<2.0	<2.0	<2.0
Carbon tetrachloride	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
Chlorobenzene	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
Chlorodibromomethane	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
Chloroethane	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
Chloroform	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
cis-1,3-Dichloropropene	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
trans-1,3-Dichloropropene	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethane	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
cis,trans-1,2-Dichloroethene	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	ug/L <1.0	<1.0	<1.0	<1.0	<1.0
Methylene chloride	ug/L <1.0	<1.0	<1.0	<1.0	<1.0

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Project Manager

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ANALYTICAL REPORT

June Foulds

GMC POWERTRAIN GREY IRON
1629 N Washington Avenue
Saginaw, MI 48605-5073

09/08/1992

Job No.: 92.46200

cc: John Richardson
Crow Island Landfill - SGI

Annual Groundwater

Sample No:	111834	111835	111836	111837	111838	111839
Date Sampled:	08/18/1992	08/18/1992	08/18/1992	08/18/1992	08/18/1992	08/18/1992
Sample Description:	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8
1,1,2,2-Tetrachloroethane	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0
Tetrachloroethene	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,1-Trichloroethane	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0
1,1,2-Trichloroethane	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0
Trichlorofluoromethane	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride	ug/L	<1.0	<1.0	<1.0	<1.0	<1.0

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GMC POWERTRAIN GREY IRON
1629 N Washington Avenue
Saginaw, MI 48605-5073

cc: John Richardson
Crow Island Landfill - SGI

Annual Groundwater

Sample No:
Date Sampled:
Sample Description:

DNR SCAN #2

Benzene
Ethylbenzene
Toluene
Styrene
Xylene isomers

111834	111835	111836	111837	111838	111839
08/18/1992	08/18/1992	08/18/1992	08/18/1992	08/18/1992	08/18/1992
MW-3	MW-4	MW-5	MW-6	MW-7	MW-8
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

ANALYTICAL REPORT

09/08/1992

Job No.: 92.46200

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Project Manager

**Landfill Groundwater Data
1993**

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Received: 08/19/92

DNR Laboratory
Results by Sample

REPORT

Work Order # 92-08-064

SAMPLE ID MW 6 FRACTION 04C TEST CODE SC 3 NAME Scan 3 Water
Date & Time Collected 08/18/92 Category _____

ANALYST JV TS
ANALYZED 09/01/92
DILUTION 1

	UNITS <u>ug/L ppb</u>		DETECTION	
CAS#	COMPOUND	RESULT	REMARK	LIMIT
541-73-1	1,3-Dichlorobenzene	ND		0.10
106-46-7	1,4-Dichlorobenzene	0.12		0.10
95-50-1	1,2-Dichlorobenzene	ND		0.10
67-72-1	Hexachloroethane	ND		0.010
108-70-3	1,3,5-Trichlorobenzene	ND		0.010
120-82-1	1,2,4-Trichlorobenzene	ND		0.010
87-61-6	1,2,3-Trichlorobenzene	ND		0.010
87-68-3	Hexachlorobutadiene	ND		0.010
95-94-3	1,2,4,5-Tetrachlorobenzene	ND		0.010
77-47-4	Hexachlorocyclopentadiene	ND		0.010
91-58-7	2-Chloronaphthalene	ND		0.20
634-66-2	1,2,3,4-Tetrachlorobenzene	ND		0.010
608-68-8	Pentachlorobenzene	ND		0.010
319-84-6	a-BHC	ND		0.010
118-74-1	Hexachlorobenzene	ND		0.010
319-85-7	b-BHC	ND		0.010
58-89-9	g-BHC (lindane)	ND		0.010
82-68-8	Pentachloronitrobenzene	ND		0.010
319-86-8	d-BHC	ND		0.010
76-44-8	Heptachlor	ND		0.010
309-00-2	Aldrin	ND		0.010
1024-57-3	Heptachlor epoxide	ND		0.010
5103-74-2	g-Chlordane	ND		0.010
959-98-8	Endosulfan I	ND		0.010
5103-71-9	a-Chlordane	ND		0.010
72-55-9	4,4'-DDE	ND		0.010
72-20-8	Endrin	ND		0.010
60-57-1	Dieldrin	ND		0.010
72-54-8	4,4'-DDD	ND		0.010
50-29-3	4,4'-DDT	ND		0.010
79-34-5	Hexabromobenzene	ND		0.010
72-43-2	Methoxychlor	ND		0.010
2385-85-5	Mirex	ND		0.010
53469-21-9	Aroclor 1242 (PCB)	ND		0.10
11097-69-1	Aroclor 1254 (PCB)	ND		0.10
11096-82-5	Aroclor 1260 (PCB)	ND		0.10
12674-11-1	*Aroclor 1016 (PCB)	ND		0.10
11104-28-2	*Aroclor 1221 (PCB)	ND		0.10
11141-16-5	*Aroclor 1232 (PCB)	ND		0.10
12672-29-6	*Aroclor 1248 (PCB)	ND		0.10
-	*Aroclor 1262 (PCB)	ND		0.10
11100-14-4	*Aroclor 1268 (PCB)	ND		0.10
37324-23-5	*BP-6 (PBB)	ND		0.050

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received: 08/19/92

DNR Laboratory REPORT
Results by Sample

Work Order # 92-08-064
Continued From Above

SAMPLE ID MW 6 FRACTION 04C TEST CODE SC 3 NAME Scan 3 Water
Date & Time Collected 08/18/92 Category _____

8001-35-2

*Toxaphene ND _____ 0.10

COMMENTS UnID PEAK

ND = not detected at the specified detection limit.
* Seldom encountered, reported semi-quantitatively.

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DNR Laboratory
Results by Sample

Work Order # 92-08-064

SAMPLE ID MW 7 FRACTION Q5A TEST CODE SC 1 NAME Scan 1 Water
Date & Time Collected 08/18/92 Category

ANALYST WILFORD
ANALYZED 08/19/92
DILUTION 1

	UNITS <u>ug/L ppb</u>			DETECTION
CAS#	COMPOUND	RESULT	REMARK	LIMIT
75-01-4	Vinyl chloride	ND		5.0
74-83-9	*Bromomethane	ND		5.0
75-00-3	*Chloroethane	ND		5.0
75-69-4	*Trichlorofluoromethane	ND		5.0
75-35-4	1,1-Dichloroethene	ND		1.0
75-09-2	Methylene chloride	ND		5.0
156-60-5	trans-1,2-Dichloroethene	ND		1.0
75-34-3	1,1-Dichloroethane	ND		1.0
156-59-2	cis-1,2-Dichloroethene	ND		1.0
67-66-3	Chloroform	ND		1.0
71-55-6	1,1,1-Trichloroethane	ND		1.0
56-23-5	Carbon tetrachloride	ND		1.0
107-06-2	1,2-Dichloroethane	ND		1.0
79-01-6	Trichloroethene	ND		1.0
78-87-5	1,2-Dichloropropane	ND		1.0
75-27-4	Bromodichloromethane	ND		1.0
10061-01-5	cis-1,3-Dichloropropene	ND		1.0
10061-02-6	trans-1,3-Dichloropropene	ND		1.0
79-00-5	1,1,2-Trichloroethane	ND		1.0
127-18-4	Tetrachloroethene	ND		1.0
124-48-1	Dibromochloromethane	ND		1.0
108-90-7	Chlorobenzene	ND		1.0
75-25-2	Bromoform	ND		1.0
79-34-5	1,1,2,2-Tetrachloroethane	ND		1.0

COMMENTS

ND = not detected at the specified detection limit.
* Compound identity not confirmed by second independent technique.

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Received: 08/19/92

DNR Laboratory REPORT
Results by Sample

Work Order # 92-08-064

SAMPLE ID MW 7 FRACTION Q5B TEST CODE SC 2 NAME Scan 2 Water
Date & Time Collected 08/18/92 Category _____

ANALYST WILFORD
ANALYZED 08/19/92
DILUTION 1

	UNITS <u>ug/L ppb</u>			DETECTION
<u>CASE#</u>	<u>COMPOUND</u>	<u>RESULT</u>	<u>REMARK</u>	<u>LIMIT</u>
71-43-2	Benzene	ND	_____	<u>1.0</u>
108-88-3	Toluene	ND	_____	<u>1.0</u>
100-41-4	Ethylbenzene	ND	_____	<u>1.0</u>
108-38-3	Xylene isomers	ND	_____	<u>1.0</u>

COMMENTS _____

ND = not detected at the specified detection limit.

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Received: 08/19/92

DNR Laboratory REPORT
Results by Sample

Work Order # 92-08-064

SAMPLE ID MW 7 FRACTION Q5C TEST CODE SC 3 NAME Scan 3 Water
Date & Time Collected 08/18/92 Category _____

ANALYST JV TS
ANALYZED 09/01/92
DILUTION 1

UNITS ug/L ppb

CAS#	COMPOUND	RESULT	REMARK	DETECTION LIMIT
541-73-1	1,3-Dichlorobenzene	ND		0.10
106-46-7	1,4-Dichlorobenzene	ND		0.10
95-50-1	1,2-Dichlorobenzene	ND		0.10
67-72-1	Hexachloroethane	ND		0.010
108-70-3	1,3,5-Trichlorobenzene	ND		0.010
120-82-1	1,2,4-Trichlorobenzene	ND		0.010
87-61-6	1,2,3-Trichlorobenzene	ND		0.010
87-68-3	Hexachlorobutadiene	ND		0.010
95-94-3	1,2,4,5-Tetrachlorobenzene	ND		0.010
77-47-4	Hexachlorocyclopentadiene	ND		0.010
91-58-7	2-Chloronaphthalene	ND		0.20
634-66-2	1,2,3,4-Tetrachlorobenzene	ND		0.010
608-68-8	Pentachlorobenzene	ND		0.010
319-84-6	a-BHC	ND		0.010
118-74-1	Hexachlorobenzene	ND		0.010
319-85-7	b-BHC	ND		0.010
58-89-9	g-BHC (lindane)	ND		0.010
82-68-8	Pentachloronitrobenzene	ND		0.010
319-86-8	d-BHC	ND		0.010
76-44-8	Heptachlor	ND		0.010
309-00-2	Aldrin	ND		0.010
1024-57-3	Heptachlor epoxide	ND		0.010
5103-74-2	g-Chlordane	ND		0.010
959-98-8	Endosulfan I	ND		0.010
5103-71-9	a-Chlordane	ND		0.010
72-55-9	4,4'-DDX	ND		0.010
72-20-8	Endrin	ND		0.010
60-57-1	Dieldrin	ND		0.010
72-54-8	4,4'-DDD	ND		0.010
50-29-3	4,4'-DDT	ND		0.010
79-34-5	Hexabromobenzene	ND		0.010
72-43-2	Methoxychlor	ND		0.010
2385-85-5	Mirex	ND		0.010
53469-21-9	Aroclor 1242 (PCB)	ND		0.10
11097-69-1	Aroclor 1254 (PCB)	ND		0.10
11096-82-5	Aroclor 1260 (PCB)	ND		0.10
12674-11-1	*Aroclor 1016 (PCB)	ND		0.10
11104-28-2	*Aroclor 1221 (PCB)	ND		0.10
11141-16-5	*Aroclor 1232 (PCB)	ND		0.10
12672-29-6	*Aroclor 1248 (PCB)	ND		0.10
- -	*Aroclor 1262 (PCB)	ND		0.10
11100-14-4	*Aroclor 1268 (PCB)	ND		0.10
37324-23-5	*BP-6 (PBB)	ND		0.050

Page 15
Received: 08/19/92

DNR Laboratory REPORT
Results by Sample

Work Order # 92-08-064
Continued From Above

SAMPLE ID NW 7 FRACTION 05C TEST CODE SC 3 NAME Scan 3 Water
Date & Time Collected 08/18/92 Category _____

8001-35-2 *Toxaphene ND 0.10
COMMENTS UnID PEAK

ND = not detected at the specified detection limit.
* Seldom encountered, reported semi-quantitatively.

NATURAL RESOURCES
COMMISSION

LARRY DEVUYST
PAUL EISELE
JAMES P. HILL
DAVID HOLLI
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JOHN ENGLER, Governor

DEPARTMENT OF NATURAL RESOURCES

ROLAND HARMES, Director

DEC 29 1992

Certified Mail
Return Receipt Requested

Mr. Joseph Toth
G.M.P.T. - Saginaw Grey Iron Plant
1629 North Washington Street
Saginaw, Michigan 48605

Dear Mr. Toth:

SUBJECT: Application for Solid Waste Disposal Area License

The staff of the Michigan Department of Natural Resources have reviewed your operating license application for a Type III sanitary landfill, known as G. M. - Grey Iron Landfill, located in Buena Vista Township, Saginaw County, Michigan. This review was conducted under the provisions of the Solid Waste Management Act, 1978 PA 641, as amended.

Based upon our review of your application, your license is hereby granted. Enclosed is your operating license with operating stipulations.

If you have any questions, please do not hesitate to contact Mr. Edwin Haapala, Saginaw/Bay District Supervisor, Waste Management Division at 517-684-9141, extension 8200.

Sincerely,

A handwritten signature in dark ink, appearing to read "R. Harmes", written over a horizontal line.

Roland Harmes
Director
517-373-2329

ACTING

Enclosure

cc: Saginaw County Health Department
Mr. Philip Roycraft, DNR
Mr. Edwin Haapala, DNR
Mr. Karl Zollner, Jr., DNR
Act 641 File

STATE OF MICHIGAN

DEPARTMENT OF NATURAL RESOURCES

G. M. - GREY IRON LANDFILL - TYPE III SANITARY LANDFILL

SOLID WASTE DISPOSAL AREA LICENSE

This license is issued under the provisions of Act 641, Public Acts of 1978, as amended, to permit the operation of a solid waste disposal area in the State of Michigan. This license does not obviate the necessity of obtaining other clearances and permits as may be required by state law or local ordinance. It is further made a condition of this license that the applicant give notice to public utilities in accordance with Act No. 53 of the Public Acts of 1974, being sections 460.701 to 460.718 of the Michigan Compiled Laws, and comply with each of the requirements of that Act. This facility shall not receive liquid wastes without special approval from the health department having jurisdiction or this office.

GRANTED TO: G.M.P.T. - SAGINAW GREY IRON PLANT

COUNTY: SAGINAW

ISSUE DATE: December 29, 1992

RESPONSIBLE PERSON TO CONTACT:

EXPIRATION DATE: (Two years from date of issue)

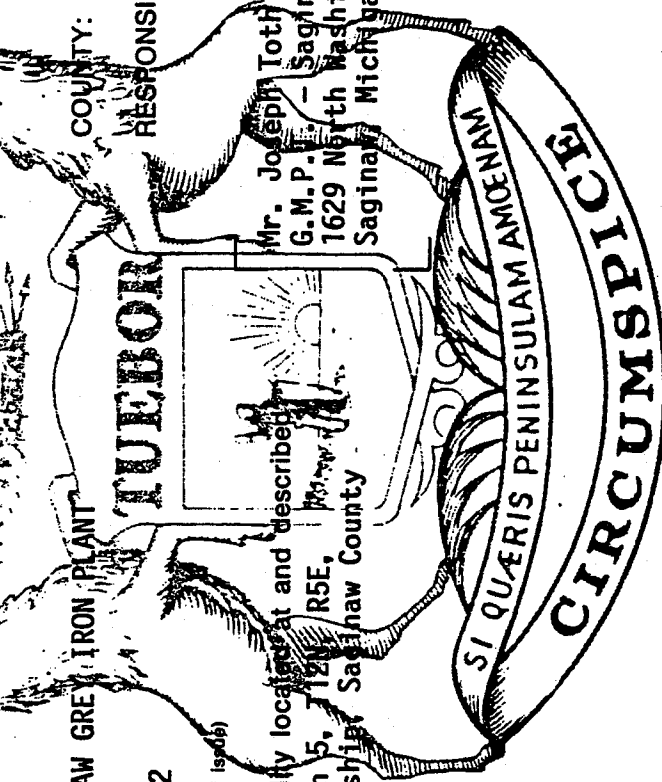
This license is applicable to the facility located at and described as follows:

SE 1/4 of Section 5, T12N, R5E,
Buena Vista Township, Saginaw County

Mr. Joseph Toti
G.M.P.T. - Saginaw Grey Iron Plant
1629 North Washington Street
Saginaw, Michigan 48605

Stipulations:

See Attached:



This license is subject to revocation by the Director of the Department of Natural Resources for any violation of the law under which it is issued or for any violation of the rules authorized thereunder, or any stipulations noted. This license shall be available through the licensee during the entire effective date and remains the property of the Director of the Department of Natural Resources. THIS LICENSE IS NOT TRANSFERABLE.

LICENSE NO. 8020

Roland Harmes, Director

ACTING

G. M. P. T. - SAGINAW GREY IRON PLANT

G. M. - GREY IRON LANDFILL

OPERATING LICENSE CONDITIONS

A. COVERAGE OF LICENSE

1. Pursuant to the Solid Waste Management Act, 1978 PA 641, as amended (hereinafter the "Solid Waste Management Act") and rules promulgated thereunder by the Michigan Department of Natural Resources (hereinafter the "Department"), a license is issued to THE General Motors Corporation, Powertrain Division - Saginaw Grey Iron Plant (hereinafter the "licensee") to operate a Type III sanitary landfill known as the G. M. - Grey Iron Landfill.

2. The G. M. - Grey Iron Landfill consists of 92.0 acres located in the SE 1/4 of Section 5, T12N, R5E, Buena Vista Township, Saginaw County (hereinafter the "facility"). The facility includes a newly certified disposal area (Phase III area 30.1 acres), previously licensed active fill areas (Phase I Area 13.55 acres and Phase II Areas 17.1 acres), and the new and existing leachate collection system.

The facility was originally shown in engineering plans approved under Construction Permit Number 0016 issued to the General Motors Corporation, Nodular Iron Landfill on March 25, 1980.

Revised Plan Sheets identified as CF 2361, Sheets 3-6 and 8-10, dated May 23, 1990, showing Phase I, II, and III of the facility were approved by the Department on December 28, 1990. Certified as-built plans for Phase III dated September 18, 1992 were also submitted.

3. The following sanitary landfill unit(s) (hereinafter "active fill areas") are the areas authorized for disposal of designated Type III solid waste, as described in Condition C.1 of this license, from the Grey Iron, Nodular Iron, and Malleable Iron Plants:

- a. Phase I, 13.55 acres
- b. Phase II, 17.1 acres
- c. Phase III, 30.1 acres

Phases I, II, and III, totaling 60.75 acres, have been certified by a registered professional engineer as fully constructed in accordance with engineering plans identified in Condition A.2 of this license. Phase I, II, and III, and other details of the facility are shown in Attachment A and are shown in the engineering plans identified in Condition A.2 of this license.

4. The licensee shall not dispose of solid waste in any area not authorized for disposal or above the elevations shown on the plans described in Condition A.2 of this license. The licensee shall operate and maintain the active fill areas, and associated active work areas, in accordance with the Solid Waste Management Act, its administrative rules, and this license.
5. The licensee has posted a bond in the amount of \$1,000,000.00 for the facility in accordance with Section 19(1)(a) of the Solid Waste Management Act.
6. No sanitary landfill unit(s) at this facility have been certified closed. When a registered professional engineer certifies that a sanitary landfill unit(s) or portion thereof has been closed, received final cover, and meets the applicable closure requirements of the Solid Waste Management Act, the licensee shall maintain and monitor, and bond these areas in accordance with Conditions I, J, and K of this license.
7. This Operating License No. 8020 supersedes and replaces Solid Waste Disposal Area License No. 7745 issued to the General Motors Corporation - Central Foundry Division on October 12, 1990.

B. COMPLIANCE WITH LICENSE

1. The licensee shall comply with all terms and conditions of this license. This license consists of the conditions contained herein, including those in any attachments, approved engineering plans, and the applicable regulations of the Solid Waste Management Act.

2. This license is based on the assumption that the information submitted in the license application received by the Department on October 12, 1992, and any subsequent amendments is accurate. Any material or intentional inaccuracies found in this information may be grounds for the revocation or modification of this license or other enforcement action. The licensee shall inform the Department Director or his or her designee of any material or intentional inaccuracies in the information of the application which would affect the licensee's ability to comply with the applicable rules or license conditions.
3. This license shall remain in effect until its expiration date, unless revoked or continued in effect, as provided by 1969 PA 306, as amended, or unless superseded by the issuance of a subsequent license.

C. ACCEPTABLE WASTE TYPES

1. Except as provided in Condition C.7 below, the licensee may only accept the following solid wastes for disposal at this facility:
 - a. The following non-hazardous wastes from Saginaw GM Malleable Iron Plant:
 - i. Pond dredgings.
 - ii. Hard iron room slag.
 - iii. Waste sand consisting of loose core sand, core butts, vacuum assisted casting mold sand, shot blast tailings, dry grind dust, shell sand, and molding sand.
 - iv. Induction furnace slag.
 - b. The following non-hazardous Type III designated solid wastes from Saginaw GM Grey Iron Casting Plant:
 - i. Lagoon sludge from lagoons 1-4.
 - ii. Wastewater treatment filter cake.

General Motors Corporation
Grey Iron
Operating License Conditions
Page 4

- iii. Hazardous waste lagoon sludge treated on-site to non-hazardous levels pursuant to a consent order signed on October 12, 1990.
- iv. Quenched slag.^a
- v. Construction and demolition wastes.
- vi. Trees and stumps.^a
- c. The following non-hazardous Type III designated solid wastes from the Saginaw GM Nodular Iron Casting Plant:
 - i. Construction and demolition wastes generated by the General Motors Corporation.
 - ii. Trees and stumps.^a

Acceptance of these wastes is subject to the Conditions C.2 through C.6 below of this license.

- 2. Acceptable waste materials shall not be mixed with other wastes that are not Type III wastes, or inert as defined by the Solid Waste Management Act.
- 3. Per R 299.4311(5), this Type III designation does not preclude the licensee from disposing of waste in accordance with the Solid Waste Management Act at a properly licensed Type II solid waste disposal facility or at an out-of-state facility in accordance with that state's solid waste disposal regulations.
- 4. The licensee shall notify the Department Director, in writing, within 90 days, of any significant changes in processes which could affect the quality of their solid waste materials.
- 5. Per R 299.4311(4), the licensee shall representatively sample and retest all waste streams (except trees and stumps), annually for the following parameters using the Toxicity Characteristic Leaching Procedures or by using Method 1312 found in the U.S. EPA document entitled "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" 3rd edition. The data shall be submitted to the Department's Saginaw/Bay District Supervisor of the Waste Management Division by no later than December 31st of each year:^a

Parameter

Arsenic
Barium
Cadmium
Chromium
Copper
Lead
Mercury
Selenium
Silver
Zinc

The licensee shall sample and analyze all those parameters listed above according to test methods and detection limits specified in Attachment C.

In addition, the licensee shall perform the following tests:

- a. Lagoon sludge from lagoons 1-4 shall be leached using TCLP extraction and analyzed for EPA Method 601/602 volatiles and EPA Method 604 phenols.
- b. Waste sand shall be leached using TCLP extraction and analyzed for EPA Method 601/602 volatiles and formaldehyde.
- c. Wastewater treatment filter cake shall be leached using TCLP extraction and analyzed for EPA Method 601/602 volatiles, formaldehyde, chloride, fluoride, and EPA Method 604 phenols.

The EP toxicity test may be found in 40 CFR 261, Appendix II. The TCLP test may be found in 40 CFR 268, Appendix I. Where an analytical procedure or detection limit has not been specified, the licensee shall use any U.S. EPA approved method for that parameter and the method detection limit.

- d. The licensee must representatively sample and retest the hazardous waste lagoon sludge treated on-site to non-hazardous levels pursuant to the consent order referenced in Condition C.1.b.iii of this license, a minimum of once every 60 days

using the Toxicity Characteristic Leaching Procedures for all those parameters and according to test methods and detection limits specified above.

6. The Type III designation shall immediately become void for any of the following reasons:
 - a. There is a change in the chemical composition of the wastes that causes the material to no longer be properly classed as Type III material.
 - b. The licensee does not comply with the conditions of this Type III designation.
 - c. Additional information demonstrates the waste is not properly classed as Type III material.
 - d. Additional information demonstrates the waste is causing environmental contamination.
7. The licensee shall not accept for disposal regulated hazardous waste, liquids, sewage, or materials that are known to adversely affect the liner, as required by R 299.4315(8).

D. MAINTENANCE OF CONSTRUCTED DISPOSAL AREAS

1. The licensee shall protect all constructed, but uncovered, portions of certified liners and leachate collection systems from root penetration, desiccation, freeze-thaw, weathering, and all other deteriorating processes so as to maintain the same degree of system performance and environmental protection that was present at the time of their original certification under R 299.4313.
2. The licensee shall repair any portion of the certified liner or leachate collection system, perimeter dike, or stormwater collection structure which is found to be deficient or damaged during the licensure of the area and have it recertified by a registered professional engineer before receiving waste in that portion of the certified liner or leachate collection, perimeter dike, or stormwater collection structure system in accordance with R 299.4313.

3. The licensee shall submit the recertification for Department review and approval.

E. ENVIRONMENTAL AND HUMAN HEALTH STANDARDS

The licensee shall operate the facility in a manner that will prevent all of the following:

1. Violations of the Water Resources Commission Act, 1929 PA 245, as amended (hereinafter "Act 245").
2. Violations of Subtitle D of the Federal Resources Conservation and Recovery Act, 40 CFR Parts 257 and 258.
3. Violations of the Soil Erosion and Sedimentation Control Act, 1972 PA 347, as amended.

F. GENERAL OPERATING REQUIREMENTS

1. The licensee shall comply with all operating requirements of R 299.4315.
2. The licensee shall limit access to the facility in accordance with R 299.4315(3).
3. The licensee shall spread solid waste so that it can be compacted in layers of not more than a depth of two feet.
4. The licensee shall not dispose of regulated hazardous wastes, liquids, or sewage in the facility.
5. The licensee shall not allow the burning of trees, stumps, brush, or other incoming waste at the facility, unless approved by the Department's Waste Management Division.
6. The licensee shall have those groundwater monitoring wells specified in Condition H.1 of this license sampled for the parameters and at the frequencies specified in Attachment B during the facility's operation, as required by R 299.4315(15).

G. LEACHATE COLLECTION AND TREATMENT

1. The licensee shall have a system to collect and remove leachate from the facility. It shall be capable of limiting the head at the lowest point in the system to not more than six inches as required by R 299.4308(1).
2. The licensee shall convey leachate removed from fill areas to a wastewater treatment facility capable of treating the leachate to meet appropriate discharge standards specified in a wastewater discharge permit issued pursuant to Act 245, and as required by R 299.4308(2).

H. GROUNDWATER MONITORING REQUIREMENTS

1. The licensee shall maintain and operate a groundwater monitoring program for the active fill and work areas consisting of the monitoring wells 3, 4, 5, 8, 9, 10B, 10C, BB, EE, HH, MM, and NN located on the map in Attachment A. The licensee shall sample and analyze water from the monitoring wells in accordance with the procedures specified below:
 - a. The static water level of all monitoring wells shall be obtained within a period not to exceed 24 hours prior to purging. The static water elevation shall be determined by methods giving precision to 1/8 inch or 0.01 foot, and shall be obtained prior to purging water from the wells for sampling. Measurements shall be made from the top of the casing with the elevation of all casings in the monitoring well system related to a permanent reference point, using United States Geological Survey datum.
 - b. All monitoring wells shall be sampled in order, from upgradient to downgradient. Monitoring wells located in areas of known groundwater contamination shall be sampled in order, from the least contaminated well to the most contaminated well.
 - c. All samples obtained shall be representative of the site's groundwater quality. To insure a representative sample, the licensee shall purge a volume of water from each monitoring well equal to or greater than three times the amount of water in

the well casing, or until dry, before obtaining a sample for collection and analysis. Monitoring wells shall be sampled immediately after purging where recovery rates allow. Where wells are pumped dry during purging, recovery rates shall be determined and recorded, and samples taken as soon as sufficient recovery occurs to allow collection of the necessary sample volume.

- d. If non-dedicated pumps or mobile sampling equipment are used, each piece of equipment shall be thoroughly cleaned and rinsed with distilled water before use in each monitoring well. Decontamination procedures shall minimize the potential for cross contamination and interference with analytical methods.
 - e. Water pumped from each monitoring well shall be discharged in a manner consistent with Act 245.
 - f. All wells shall be clearly labeled and shall be properly vented, capped, and locked when not in use. All wells shall be made visible throughout the year.
 - g. Prior to undertaking well replacement, plugging, abandonment, or repair, the licensee shall obtain the approval of the Chief of the Department's Waste Management Division.
- 2. The licensee shall sample and analyze groundwater from the monitoring wells identified in Condition H.1 for those parameters and at the frequencies listed in Attachment B according to the methods and detection limits specified in Attachment C.
 - 3. The licensee shall submit all quarterly monitoring results to the Department's Waste Management Division Saginaw/Bay District within 60 days of the end of each calendar quarter.

I. INTERIM AND FINAL COVER FOR ACTIVE FILL AREAS

- 1. The licensee shall place interim and final cover over the licensed landfill area in accordance with R 299.4316 and the engineering plans approved on March 25, 1980.

2. The licensee shall place two feet of compacted clay or an approved alternate cover over the entire surface of each portion of the final lift not more than three months after the final placement of waste within that portion of the landfill.
3. The licensee shall have a registered professional engineer verify construction of all final cover in accordance with R 299.4313.
4. The licensee shall submit the verification required in Condition I.3 to the Department for review and approval.

J. POST-CLOSURE MAINTENANCE AND MONITORING

1. At the time of the issuance of this license, no existing sanitary landfill units have been closed under the provisions of The Solid Waste Management Act.
2. After closure of a landfill and during the 30-year post-closure period, the licensee shall make repairs to the final cover as necessary to correct the effects of settling, subsidence, erosion, or other events. The licensee shall periodically monitor the post-construction settlement and, if necessary, adjust the final cover.
3. During the 30-year post-closure period, the licensee shall conduct groundwater monitoring in accordance with R 299.4314(15) and with Condition H of this license biannually, unless the Department Director or his/her designee approves a modification to this program agreed to by the licensee.

K. OPERATING, CLOSURE, AND POST-CLOSURE BONDING

1. The licensee shall maintain a bond for all active and closed sanitary landfill areas specified in Condition A of this license in accordance with Section 19 of The Solid Waste Management Act.
2. If the licensee has accomplished closure and post-closure maintenance and monitoring of the landfill in accordance with The Solid Waste Management Act, its rules, and this license, the licensee may request a release from the bond requirements of the Solid Waste Management Act.

General Motors Corporation
Grey Iron
Operating License Conditions
Page 11

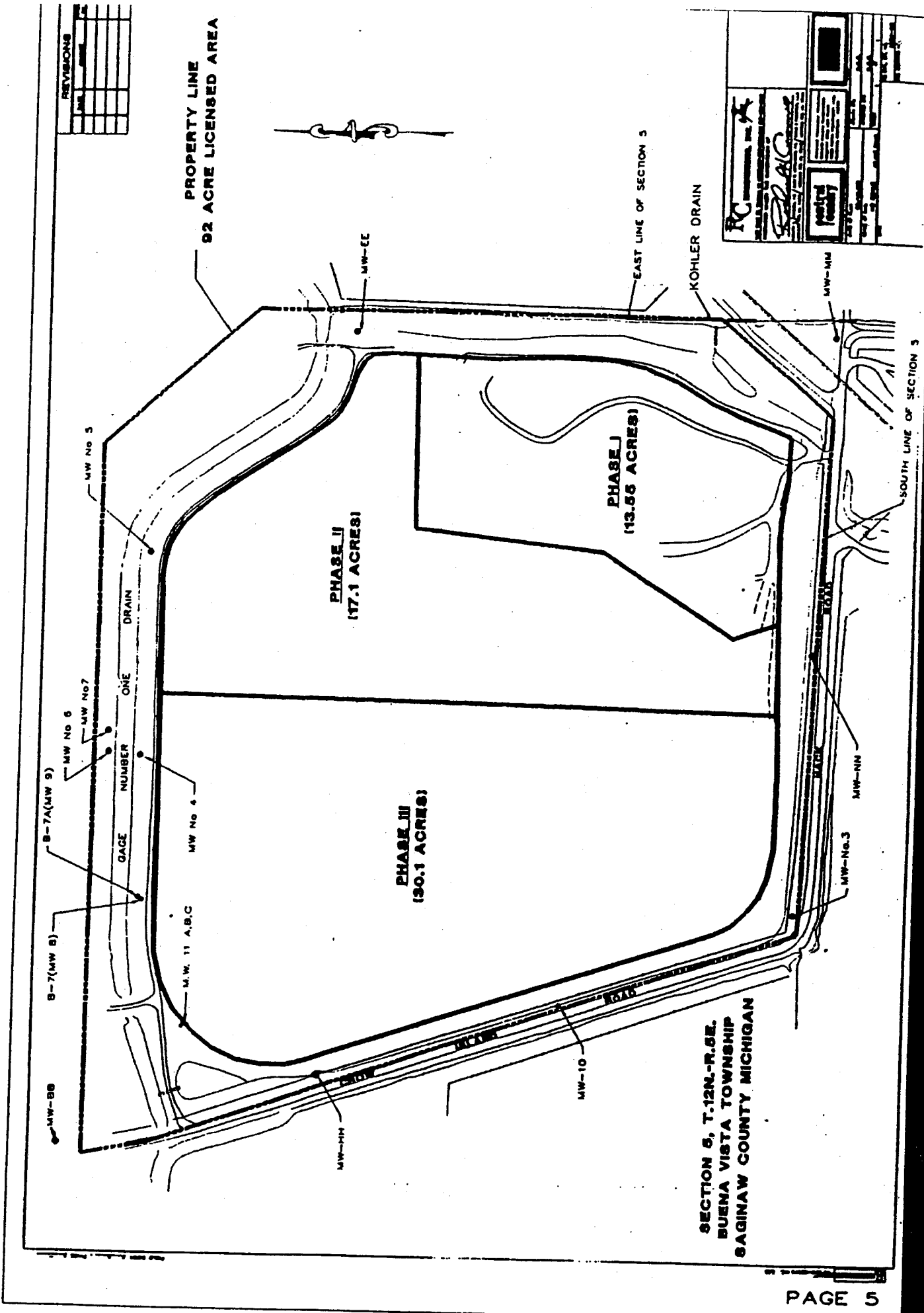
3. The licensee shall be deemed to be without the financial instruments required under Section 19 of the Solid Waste Management Act in the event of bankruptcy of the issuing institution, or a suspension to the authority of the institution issuing the bond. The licensee shall establish other financial instruments within 60 days of such an event.
4. The licensee shall renew a financial instrument and submit documentation of such renewal to the Department Director at least 60 days prior to the expiration date of the bond. The renewal bond need not take effect until the expiration of the previous bond.

L. PERPETUAL CARE FUND

The licensee shall maintain their established perpetual care fund as required by Section 19b of the Solid Waste Management Act to be used exclusively for closure, monitoring, and maintenance of the landfill and for response activity necessitated by a discharge from the facility.

ATTACHMENT A

GREY IRON TYPE III
SANITARY LANDFILL



GROUNDWATER MONITORING WELLS		
ANN	QRT	PARAMETER
X	X	Static Water Levels (U.S.G.S.)
X	X	pH (Field Measurement)
X	X	Specific Conductance (Field Measurement)
		Arsenic (dissolved)
		Barium (dissolved)
X		Cadmium (dissolved)
X	X	Calcium (dissolved)
X		Chromium (dissolved)
		Copper (dissolved)
X	X	Iron (dissolved)
X		Lead (dissolved)
X	X	Magnesium (dissolved)
		Manganese (dissolved)
		Mercury (dissolved)
		Nickel (dissolved)
		Phosphorus (dissolved)
		Potassium (dissolved)
		Selenium (dissolved)
X	X	Sodium (dissolved)
X		Zinc (dissolved)
X		Ammonia Nitrogen
X		Nitrate Nitrogen
X	X	Bicarbonate Alk. as HCO ₃
		Carbonate Alkalinity as CaCO ₃
X	X	Chloride
X		Phenolics
X	X	Sulfate
		Total Dissolved Solids
		Biochemical Oxygen Demand (BOD-5)
X		Chemical Oxygen Demand (COD)
X	X	Total Organic Carbon (TOC)
X		Purgeable Halocarbons
X		Purgeable Aromatic Hydrocarbons
		Chlorinated Hydrocarbons, PCB'S and Organochlorine Pesticides
		Phenols
		GC/MS Base Neutrals in Water

ANN=ANNUAL

LEACHATE MONITORING PARAMETERS		
ANN	QRT	PARAMETER
		Static Water Levels (U.S.G.S.)
		pH (Field Measurement)
		Specific Conductance (Field Measurement)
		Arsenic (total)
		Barium (total)
		Cadmium (total)
		Calcium (total)
		Chromium (total)
		Copper (total)
		Iron (total)
		Lead (total)
		Magnesium (total)
		Manganese (total)
		Mercury (total)
		Nickel (total)
		Potassium (total)
		Selenium (total)
		Silver (total)
		Sodium (total)
		Zinc (total)
		Ammonia Nitrogen
		Nitrate Nitrogen
		Bicarbonate Alk. as HCO ₃
		Carbonate Alkalinity as CaCO ₃
		Chloride
		Phenolics
		Sulfate
		Total Suspended Solids
		Biochemical Oxygen Demand (BOD -5)
		Chemical Oxygen Demand (COD)
		Total Organic Carbon (TOC)
		Purgeable Halocarbons
		Purgeable Aromatic Hydrocarbons
		Chlorinated Hydrocarbons, PCB'S and Organochlorine Pesticides
		Phenols
		GC/MS Base Neutrals in Water

QRT=QUARTERLY

GREY IRON LANDFILL
ATTACHMENT C
TEST METHODS & DETECTION LIMITS

This attachment provides the acceptable test methods and method detection limits. For the specific parameter to be analyzed and the sampling frequency see Attachment B

METALS

PARAMETER	TEST METHOD	METHOD
		DETECTION LIMIT mg/l
Aluminum	-----6010 OR 7020-----	0.05
Arsenic	-----6010 OR 7060-----	0.001
Barium	-----6010 OR 7080-----	0.01
Cadmium	-----6010 OR 7131-----	0.0002 .02*
Calcium	-----6010 OR 7140-----	1.0
Chromium	-----6010 OR 7191-----	0.001 .025*
Copper	-----6010 OR 7211-----	0.001 .02*
Iron	-----6010 OR 7380-----	0.020 .1*
Lead	-----6010 OR 7421-----	0.001 .05*
Magnesium	-----6010 OR 7450-----	1.0
Manganese	-----6010 OR 7460-----	0.02
Mercury	-----7470-----	0.0005
Nickel	-----6010 OR 7520-----	0.05
Potassium	-----6010 OR 7610-----	0.1
Selenium	-----6010 OR 7741-----	0.001
Sodium	-----6010 OR 7770-----	1.0
Zinc	-----6010 OR 7950-----	0.004 .05*

ANALYTICAL METHODS

Samples for dissolved metals should be filtered, preferably in the field, prior to preservation.

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 (third edition, 1986),

* Method Detection Limit for Leachate Analysis Only.

GREY IRON LANDFILL

IONS

Ammonia Nitrogen-----	4500-NH ₃ (D)-----	0.01
Nitrate Nitrogen-----	4500-NO ₃ (D)-----	0.01
Organic Nitrogen-----	4500-Norg(b)-----	0.05
Bicarbonate Alk. as HCO ₃ -----	2320B-----	5.0
Carbonate Alk, as HCO ₃ -----	2320B-----	10.0
Chloride-----	4500-Cl(C)-----	1.0
Cyanide -----	4500-CN(E)-----	0.005
Phenolics -----	5530(D)-----	0.01
Phosphorus-----	4500 P(E) -----	0.01
Sulfate -----	4500-SO ₄ (F)-----	2.0
Total Dissolved Solids-----	2540(C) ⁴ -----	20
Total Suspended Solids -----	2540(D) -----	5.0
Dissolved Oxygen (DO) -----	4500-O(C) -----	0.1
Biochemical Oxygen Demand (BOD-5)-----	5210(B) -----	2.0
Chemical Oxygen Demand (COD)---	5220(D) -----	3
Total Organic Carbon (TOC) ---	5310C -----	0.2

ANALYTICAL METHODS

Method numbers listed are for "Standard Methods for the Examination of Water and Wastes", 17th Edition 1989

GREY IRON LANDFILL

- PURGEABLE HALOCARBONS -

<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>	<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>
Vinyl Chloride	5.0	1, 2-Dichloroethane	1.0
Bromomethane	5.0	Trichloroethene	1.0
Chloroethane	5.0	1, 2-Dichloropropane	1.0
Trichlorofluoromethane	5.0	Bromodichloromethane	1.0
1, 1-Dichloroethene	1.0	cis-1, 3-Dichloropropene	1.0
Methylene chloride	5.0	trans-1, 3-Dichloropropene	1.0
trans-1, 2-Dichloroethene	1.0	1, 1, 2-Trichloroethane	1.0
1, 1-Dichloroethane	1.0	Tetrachloroethene	1.0
cis-1, 2-Dichloroethene	1.0	Dibromochloromethane	1.0
Chloroform	1.0	Chlorobenzene	2.0
1, 1, 1-Trichloroethane	1.0	Bromoform	1.0
Carbon tetrachloride	1.0	1, 1, 2, 2-Tetrachloroethane	1.0

ANALYTICAL METHODS

Federal Register Vol. 49, No 209, Friday, October 26, 1984
Method 601 - Purgeable Halocarbons, pp, 29-39

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 (third edition, 1986),
Method 5030, Purge and Trap Method 8010, Halogenated Volatile Organics.

- PURGEABLE AROMATIC HYDROCARBONS -

<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>	<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>
Benzene	1.0	Ethylbenzene	1.0
Toluene	1.0	Xylene isomers	1.0

ANALYTICAL METHODS

Federal Register, Vol. 49, No 209, Friday, October 26, 1984
Method 602 - Purgeable Aromatics, pp. 40-48

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 (third edition, 1986),
Method 5030, Purge and Trap and Method 8020, Aromatic Volatile Organics

NOTE: SW-846 Method 8240 is not appropriate for analyzing groundwater samples due to high detection limits.

GREY IRON LANDFILL
- CHLORINATED HYDROCARBONS, PCBs & ORGANOCHLORINE PESTICIDES -

<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>	<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>
1,3-Dichlorobenzene	1.0	Endrin	0.01
1,4-Dichlorobenzene	1.0	Dieldrin	0.01
1,2-Dichlorobenzene	1.0	4,4'-DDD	0.01
Hexachloroethane	1.0	4,4'-DDT	0.01
1,3,5-Trichlorobenzene	0.01	Methoxychlor	0.01
1,2,4-Trichlorobenzene	2.0	Mirex	0.01
1,2,3-Trichlorobenzene	0.01	a-BHC	0.01
Hexachlorobutadiene	2.0	b-BHC	0.01
1,2,4,5-Tetrachlorobenzene	0.01	d-BHC	0.01
Hexachlorocyclopentadiene	2.0	g-BHC (lindane)	0.01
2-Chloronaphthalene	2.0	Aroclor 1242 (PCB)	0.1
1,2,3,4-Tetrachlorobenzene	0.01	Aroclor 1254 (PCB)	0.1
Pentachlorobenzene	0.01	Aroclor 1260 (PCB)	0.1
Hexachlorobenzene	1.0	Aroclor 1016 (PCB)	0.1
Heptachlor	0.01	Aroclor 1221 (PCB)	0.1
Aldrin	0.01	Aroclor 1232 (PCB)	0.1
Heptachlor epoxide	0.01	Aroclor 1248 (PCB)	0.1
g-Chlordane	0.01	Toxaphene	0.10
Endosulfan I	0.01		
a-Chlordane	0.01		
4,4'-DDE	0.01		

Analytical Method - Methods for Organic Chemical Analysis of Municipal & Industrial Wastewater, Method 608: "Pesticides and PCBs", Method 612: "Chlorinated Hydrocarbons", and Appendix A: "Definition and Procedure for the Determination of the Method Detection Limit", U.S. EPA - 600/4-82-057, July 1982.

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 (third edition, 1986), Method 3510 or 3520 for sample preparation and Method 8080, Organochlorine Pesticides and PCBs, and Method 8120, Chlorinated Hydrocarbons.

- PHENOLS -

<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>	<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/</u>
Phenol	10.0	2,4,6-Trichlorophenol	10.0
2-Chlorophenol	10.0	2,4,5-Trichlorophenol	10.0
2-Nitrophenol	10.0	2,4-Dinitrophenol	50.0
2,4-Dimethylphenol	10.0	4-Nitrophenol	40.0
2,4-Dichlorophenol	10.0	2-Methyl-4,6-dinitrophenol	40.0
4-Chloro-3-methylphenol	10.0	Pentachlorophenol	40.0

Analytical Method - Federal Register 40 CFR, Part 136, EPA, Friday, October 26, 1984, pp 23-35, 58-66, 198-210.

Manual of Analytical Quality Control. EPA 600/2-81-059, April 1981, pp 285-311.

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 (third edition, 1986), Method 3510 or 3520 for sample preparation and Method 8040, Phenols.

- GC/MS BASE NEUTRALS IN WATER -

<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>	<u>COMPOUND</u>	<u>DETECTION LIMIT (ug/l)</u>
Bis(2-Chloroethyl) ether	1	N-Nitrosodiphenyl amine	5
1,3-Dichlorobenzene	1.0	1,2-Diphenylhydrazine	2
1,4-Dichlorobenzene	1.0	4-Bromodiphenyl ether	2
1,2-Dichlorobenzene	1	Hexachlorobenzene	1
bis(2-Chloroisopropyl) ether	1	Phenanthrene	1
N-Nitroso-di-n-propylamine	2	Anthracene	1
Hexachloroethane	1	Di-n-butyl phthalate	1
Nitrobenzene	2	Fluoranthene	1
Isophorone	1	Benzidine	15
bis(2-chloroethoxy) methane	2	Pyrene	1
1,2,4-Trichlorobenzene	2	Butyl benzyl phthalate	1
Naphthalene	1	Benzo (a) anthracene	1
Hexachlorobutadiene	2	3,3'-Dichlorobenzidene	10
Hexachlorocyclopentadiene	2	Chrysene	1
2-Chloronaphthalene	2	bis(2-ethylhexyl) phthalate	2
Dimethyl phthalate	2	Di-n-octyl phthalate	2
Acenaphthylene	1	Benzo (b) fluoranthene	2
2,6-Dinitrotoulene	5	Benzo (k) fluoranthene	2
Acenaphthene	1	Benzo (a) pyrene	2
2,4-Dinitrotoluene	5	Indeno (1,2,3-c,d) pyrene	5
Fluorene	1	Dibenzo (a,h) anthracene	5
Diethyl phthalate	1	Benzo (g,h,i) perylene	5
4-Chlorodiphenyl ether	1		

Analytical Method - Federal Register Vol. 49 No. 209, October 26, 1984, Method 625
 pp. 43416-29

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA
 Publication SW-846 (third edition), Method 3510 or 3520 for sample preparation
 and Method 8250, Gas Chromatography/Mass Spectrometry for Semivolatile Organics:
 Packed Column Technique.

Toxicity Characteristic Leaching Procedure (TCLP)

"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA
 Publication - SW - 846 (third edition) - Method 1311

These acceptable method detection limits are applicable to groundwater monitoring performed pursuant to Act 641 permit and license activities. These detection limits may not be applicable to environmental monitoring activities performed pursuant to other environmental statutes. Facilities subject to regulation under other environmental statutes should consult with the appropriate DNR Division for further information regarding appropriate analytical detection limits.

If the level of detection can be maintained, other analytical references and methods may be used, if prior approval is obtained from the District Supervisor, Waste Management Division.

This attachment will be updated annually on April 1 of each year.



HYDRO RESEARCH SERVICES
Water Management Division
Clow Corporation

408 Auburn Avenue
Pontiac, MI 48058

313 334-1630
313 334-4747

July 24, 1984

Keck Consultants
1099 W. Grand River
Williamston, MI 48895
Attn: Mr. Joe Sheahan
Project # 0363-1236

Samples Received: 6/18/84

Hydro Numbers:	79734	79735	79736	79737
Client I.D.:	MW 1D	MW 2D	MD 3D	MW 4D
pH	7.59	7.10	7.59	7.43
B.O.D. ₅ , mg/l	9	3	6	4
Chemical Oxygen Demand, mg/l	230	17	45	28
Total Organic Carbon, mg/l	8	24	9	7
Nitrogen, Nitrite, N, mg/l	0.05	0.02	0.13	<0.02
Nitrogen, Nitrate, N, mg/l	0.94	<0.02	0.36	<0.02
Nitrogen Ammonia, N, mg/l	0.31	0.22	0.36	0.55
Organic Nitrogen, N, mg/l	2.7	2.2	0.94	1.1
Chloride, Cl, mg/l	44	440	51	54
Sulfate, SO ₄ , mg/l	610	690	450	240
Total Dissolved Solids, mg/l	1510	3090	1300	930
Dissolved Iron, Fe, mg/l	<0.02	<0.02	<0.02	<0.02
Phenol, mg/l	0.003	0.004	0.005	<0.002
Total Cyanide, TCN, mg/l	<0.02	<0.02	<0.02	<0.02
Dissolved Cadmium, Cd, mg/l	<0.01	0.02	<0.01	<0.01
Dissolved Chromium, Cr, mg/l	<0.02	<0.02	<0.02	<0.02
Dissolved Copper, Cu, mg/l	0.04	0.03	0.04	0.02
Dissolved Nickel, Ni, mg/l	0.11	0.14	0.07	0.09
Dissolved Lead, Pb, mg/l	<0.05	<0.05	<0.05	<0.05
Dissolved Zinc, Zn, mg/l	0.27	6.5	0.11	0.10
Dissolved Arsenic, As, mg/l	<0.005	<0.005	<0.005	<0.005



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Williamston, MI 48895
Attn: Mr. Joe Sheahan
Project # 0363-1236

Samples Received: 6/18/84

Hydro Numbers:	79738	79739	79740	79741
Client I.D.:	MW 5D	MW 6D	MW 7D	MW 8D
pH	7.40	7.56	7.26	7.49
B.O.D. ₅ , mg/l	15	4	4	3
Chemical Oxygen Demand, mg/l	28	<5	26	<5
Total Organic Carbon, mg/l	26	15	14	18
Nitrogen, Nitrite, N, mg/l	<0.02	0.05	<0.02	0.28
Nitrogen, Nitrate, N, mg/l	<0.02	0.21	0.05	0.06
Nitrogen Ammonia, N, mg/l	0.33	0.40	0.38	2.9
Organic Nitrogen, N, mg/l	2.9	2.2	1.7	1.4
Chloride, Cl, mg/l	54	71	83	140
Sulfate, SO ₄ , mg/l	220	170	400	190
Total Dissolved Solids, mg/l	860	860	1420	870
Dissolved Iron, Fe, mg/l	<0.02	<0.02	<0.02	<0.02
Phenol, mg/l	0.002	<0.002	<0.002	0.003
Total Cyanide, TCN, mg/l	<0.02	<0.02	<0.02	<0.02
Dissolved Cadmium, Cd, mg/l	<0.01	<0.01	<0.01	<0.01
Dissolved Chromium, Cr, mg/l	<0.02	<0.02	<0.02	<0.02
Dissolved Copper, Cu, mg/l	<0.02	<0.02	<0.02	0.03
Dissolved Nickel, Ni, mg/l	0.08	0.06	0.08	0.07
Dissolved Lead, Pb, mg/l	<0.05	<0.05	<0.05	<0.05
Dissolved Zinc, Zn, mg/l	1.3	0.14	0.56	0.22
Dissolved Arsenic, As, mg/l	<0.005	<0.005	<0.005	<0.005



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1099 W. Grand River
Williamston, MI 48895
Attn: Mr. Joe Sheahan
Project # 0363-1236

Samples Received:	6/18/84			
Hydro Numbers:	79742	79743	79744	79745
Client I.D.:	MW 34	D-4	D-3S	D-2S
pH	8.49	9.01	7.92	7.59
B.O.D. ₅ , mg/l	2	42	8	4
Chemical Oxygen Demand, mg/l	<5	160	380	45
Total Organic Carbon, mg/l	11	60	75	21
Nitrogen, Nitrite, N, mg/l	<0.02	0.03	0.08	<0.02
Nitrogen, Nitrate, N, mg/l	0.10	0.03	<0.02	<0.02
Nitrogen Ammonia, N, mg/l	0.47	1.6	1.1	0.29
Organic Nitrogen, N, mg/l	2.1	3.8	3.9	0.48
Chloride, Cl, mg/l	51	370	240	29
Sulfate, SO ₄ , mg/l	80	270	220	10
Total Dissolved Solids, mg/l	510	1230	1810	520
Dissolved Iron, Fe, mg/l	<0.02	<0.02	0.10	0.24
Phenol, mg/l	0.003	0.018	<0.002	<0.002
Total Cyanide, TCN, mg/l	<0.02	<0.02	<0.02	<0.02
Dissolved Cadmium, Cd, mg/l	<0.01	<0.01	<0.01	<0.01
Dissolved Chromium, Cr, mg/l	<0.02	<0.02	<0.02	<0.02
Dissolved Copper, Cu, mg/l	<0.02	<0.02	<0.02	0.02
Dissolved Nickel, Ni, mg/l	<0.02	0.05	0.07	0.04
Dissolved Lead, Pb, mg/l	<0.05	<0.05	<0.05	<0.05
Dissolved Zinc, Zn, mg/l	0.17	3.0	0.04	0.03
Dissolved Arsenic, As, mg/l	<0.005	<0.005	<0.005	<0.005



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Keck Consultants
1099 W. Grand River
Williamston, MI 48895
Attn: Mr. Joe Sheahan

Project # 0363-1236

Samples Received: 6/18/84

Hydro Numbers:	79746	79747	79749	79749
Client I.D.:	N.Ditch	N.Ditch East	N.Spring	MW36
pH	7.56	7.58	7.04	10.24
B.O.D. ₅ , mg/l	1	1	6	7
Chemical Oxygen Demand, mg/l	<5	<5	<5	26
Total Organic Carbon, mg/l	15	18	15	9
Nitrogen, Nitrite, N, mg/l	0.14	0.15	<0.02	<0.02
Nitrogen, Nitrate, N, mg/l	0.44	0.24	0.02	0.08
Nitrogen Ammonia, N, mg/l	3.1	3.2	0.98	0.15
Organic Nitrogen, N, mg/l	2.8	2.5	2.5	1.5
Chloride, Cl, mg/l	160	170	61	62
Sulfate, SO ₄ , mg/l	180	170	130	80
Total Dissolved Solids, mg/l	900	920	890	350
Dissolved Iron, Fe, mg/l	0.05	0.04	0.11	0.02
Phenol, mg/l	<0.002	<0.002	0.004	0.002
Total Cyanide, TCN, mg/l	<0.02	<0.02	<0.02	<0.02
Dissolved Cadmium, Cd, mg/l	<0.01	<0.01	<0.01	<0.01
Dissolved Chromium, Cr, mg/l	<0.02	<0.02	<0.02	<0.02
Dissolved Copper, Cu, mg/l	<0.02	<0.02	<0.02	0.02
Dissolved Nickel, Ni, mg/l	0.03	0.05	0.04	0.02
Dissolved Lead, Pb, mg/l	<0.05	<0.05	<0.05	0.14
Dissolved Zinc, Zn, mg/l	0.03	0.04	0.04	0.42
Dissolved Arsenic, As, mg/l	<0.005	<0.005	<0.005	<0.005



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1099 W. Grand River
Williamston, MI 48895
Attn: Mr. Joe Sheahan
Project # 0363-1236

Samples Received:	6/18/84		
Hydro Numbers:	79750	79751	79752
Client I.D.:	D-1	Confluence of N&S Ditch	S. Ditch
pH	8.22	7.62	7.06
B.O.D. ₅ , mg/l	<1	1	10
Chemical Oxygen Demand, mg/l	<5	8	65
Total Organic Carbon, mg/l	11	18	23
Nitrogen, Nitrite, N, mg/l	<0.02	0.19	0.28
Nitrogen, Nitrate, N, mg/l	0.05	0.14	0.18
Nitrogen Ammonia, N, mg/l	0.17	2.4	3.0
Organic Nitrogen, N, mg/l	2.1	2.3	8.0
Chloride, Cl, mg/l	130	140	140
Sulfate, SO ₄ , mg/l	280	150	150
Total Dissolved Solids, mg/l	840	820	830
Dissolved Iron, Fe, mg/l	0.02	0.09	0.12
Phenol, mg/l	0.002	0.003	0.003
Total Cyanide, TCN, mg/l	<0.02	<0.02	<0.02
Dissolved Cadmium, Cd, mg/l	<0.01	<0.01	<0.01
Dissolved Chromium, Cr, mg/l	<0.02	<0.02	<0.02
Dissolved Copper, Cu, mg/l	<0.02	<0.02	<0.02
Dissolved Nickel, Ni, mg/l	0.04	0.05	0.05
Dissolved Lead, Pb, mg/l	<0.05	<0.05	<0.05
Dissolved Zinc, Zn, mg/l	0.07	0.03	0.03
Dissolved Arsenic, As, mg/l	<0.005	<0.005	<0.005



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Williamston, MI 48895
Attn: Mr. Joe Sheahan
Project # 0363-1236

Samples Received:

6/18/84

Hydro Numbers:

80411

Client I.D.:

D-3

pH

7.24

B.O.D.₅, mg/l

42

Chemical Oxygen Demand, mg/l

110

Total Organic Carbon, mg/l

26

Nitrogen, Nitrite, N, mg/l

<0.02

Nitrogen, Nitrate, N, mg/l

0.31

Nitrogen Ammonia, N, mg/l

1.4

Organic Nitrogen, N, mg/l

0.10

Chloride, Cl, mg/l

73

Sulfate, SO₄, mg/l

<3

Total Dissolved Solids, mg/l

370

Dissolved Iron, Fe, mg/l

<0.02

Phenol, mg/l

<0.002

Total Cyanide, TCN, mg/l

<0.02

Dissolved Cadmium, Cd, mg/l

<0.01

Dissolved Chromium, Cr, mg/l

<0.02

Dissolved Copper, Cu, mg/l

<0.02

Dissolved Nickel, Ni, mg/l

<0.02

Dissolved Lead, Pb, mg/l

<0.05

Dissolved Zinc, Zn, mg/l

0.02

Dissolved Arsenic, As, mg/l

<0.005


Linda Carey, Manager
Analytical Services

STATE OF MICHIGAN



JAMES J. BLANCHARD, Governor

DEPARTMENT OF NATURAL RESOURCES

RONALD O. SKOGG, Director
Gordon E. Guyer

November 18, 1987

NATURAL RESOURCES COMMISSION

THOMAS J. ANDERSON
E. R. CAROLLO
MARLENE J. FLUHARTY
STEPHEN F. MONSMA
O. STEWART MYERS
RAYMOND POUPORE
HARRY H. WHITELEY

William Hudson
Saginaw Nodular Iron Plant
Central Foundry Division
General Motors Corporation
2100 Veterans Memorial Parkway
Saginaw, Michigan 48601

Re: Fairchild Waste Control a.k.a. Tri-City Refuse Removal

Dear Mr. Hudson:

I apologize for the slight delay in getting back to you regarding our discussions of November 9th concerning the unpermitted wastewater discharges from the Fairchild Waste Control a.k.a. Tri-City Refuse Removal operation at 2360 N. 23rd Street.

On May 20, 1987, Department of Natural Resources Conservation Officers and other regulatory personnel executed a search warrant at the facility mentioned above. The search warrant followed Departmental employee observations of solid waste facility operating violations and Larry Fairchild's refusal to allow the inspection of the facility by DNR and Saginaw County Health Department personnel. Amongst other discoveries, the search uncovered the presence of a discharge originating from a floor drain the maintenance garage. Testing of the drain determined that its discharges outletted onto the ground at approximately the southwest corner of the Fairchild Waste Control processing building. Oily, watery liquid was observed in a partially buried 55 gallon drum receptacle which thence overflowed onto the ground. Samples were seized of the liquid as well as the soil below the overflow. The following laboratory results were determined by the DNR

laboratory (value in ppm):

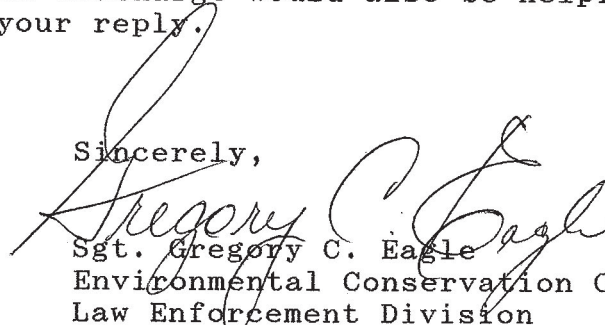
<u>Parameter</u>	<u>Liquid</u>	<u>Soil (Total)</u>	<u>Soil (Leachate)</u>
Cadmium	nd	nd	nd
Chromium	nd	270	nd
Copper	nd	37	0.1
Nickel	nd	29	nd
Lead	nd	49	nd
Zinc	nd	430	1.4
Oil & Grease	3000	13000	---
COD	7300	---	---
TOC	1700	---	---

A large area of stained soils was observed below the discharge and the direction of flow appeared to be to the southeast in a direction towards and onto your property.

During the tour of this property with you on November 9th, you indicated that the low area receiving the discharge extended over onto GM property. You also informed us that the casings observed just inside the property line to the southeast of the discharge were monitoring wells installed on GM property. You further indicated that the wells did have some prior sampling and analysis history.

We are preparing an investigative report for submittal to the local prosecuting attorney. A statement of your position regarding the discharge would be helpful in the preparation of a complete investigative report. In addition, any laboratory history regarding the water quality of the surface water and the groundwater in the vicinity of the aforementioned discharge would also be helpful. I will look forward to your reply.

Sincerely,



Sgt. Gregory C. Eagle
Environmental Conservation Officer
Law Enforcement Division
Michigan Department of Natural Resources
411J East Genesee Street
Saginaw, Michigan 48607
517/771-1731

cc: Lt. B. Murphy, LED-EIS
E. Haapala, WMD/Saginaw
file #217-053-87

Attachment B



DRAFT MEMORANDUM

To: Nate Nemani, U.S. EPA REF. No.: 058502

FROM: John-eric Pardys/Gary Klepper/kf/13 DATE: April 6, 2015

CC: Dave Favero (RACER), Michael Tomka

RE: **Ammonia in Groundwater Evaluation
Saginaw Nodular Industrial Land, Saginaw, MI**

Conestoga-Rovers & Associates (CRA) has prepared the following memorandum per RACER's request to evaluate the necessity for conducting further activities associated with ammonia in groundwater above Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria in monitoring wells next to the Saginaw River at Revitalizing Auto Communities Environmental Response Trust's (RACER's) Saginaw Nodular Industrial Land (Site) in Saginaw, Michigan. This evaluation has been completed in general accordance with the Michigan Department of Environmental Quality's (MDEQ's) document entitled, "*Groundwater/Surface Water Interface Pathway Compliance Options (GSICO)*". The GSICO was issued by the MDEQ Remediation and Redevelopment Division (RRD) as Draft "Resource Materials" in June of 2014 and was developed, "to provide information to MDEQ staff and contractors on compliance options (for) the GSI pathway."

Statutory obligations pursuant to 1994 PA 451, the Natural Resources and Environmental Protection Act (NREPA) relative to the GSI pathway were substantially revised in June of 2012 with the addition of Section 20120e to NREPA (Part 201 GSI amendments). The GSICO does not establish regulatory obligations for addressing the GSI pathway, but reflects an effort by MDEQ to help explain options and methods for addressing the pathway as available pursuant to the Part 201 amendments and NREPA.

Background

Groundwater samples initially collected as part of the Resource Conservation and Recovery Act Facility Investigation (RFI) conducted between 1998 and 2005 in multiple phases at the Site, included the analysis of total ammonia in groundwater. Total ammonia in groundwater in the RFI Phase 1C Report (CRA, April 2007) was screened against Michigan Part 201 Industrial Commercial II, III, and IV Drinking Water Criteria and Michigan Part 201 Industrial Commercial II, III, and IV Groundwater Volatilization to Indoor Air Criteria but not to Michigan Part 201 Groundwater Surface Water Interface (GSI) Criteria. Figures 13.3 and 13.4 from the RFI Phase 1C Report presents the groundwater screening results for groundwater samples collected in Investigative Unit (IU) G. The results indicate that total ammonia was reported above Michigan Part 201 Industrial Commercial II, III, and IV Drinking Water Criteria (10 milligrams per liter [mg/L]) in seven monitoring locations at concentrations ranging from 12.0 to 93.7 mg/L. The Human Health Risk

Assessment (HHRA) and Ecological Risk Assessment (ERA) were included as part of the RFI Phase 1C Report. The following conclusions were made in the HHRA regarding ammonia.

"The baseline HHRA concluded that the potential exposures to routine workers, maintenance workers, trespassers, and off-facility residents were not significant relative to reasonable maximum exposure under current and reasonably expected future land and groundwater uses at and around the Facility. However, there was the potential for unacceptable non-cancer hazards to a hypothetical construction worker from exposures to elevated ammonia and pH levels in shallow groundwater in IU G. In addition, there was a potential for unacceptable exposures to off-Facility construction workers if off-Facility migration of overburden groundwater from IU G, exhibiting high pH levels, were to occur. The non-cancer hazard and cancer risk threshold for corrective action were 1 and 10⁻⁴ (per U.S. EPA RCRA guidance), respectively." (ENVIRON – HHRA, 2007)

Upon review of the HHRA tables, total ammonia concentrations between 33.0 mg/L and 55.7 mg/L and higher were identified as exceeding U.S. EPA's risk limits.

The following general conclusions were made in the ERA regarding the potential for constituents to migrate from groundwater to surface water,

"The significance of potential exposures to constituents that could potentially migrate from shallow groundwater in each on-Facility IU to the Saginaw River was evaluated based on the shallow groundwater discharges estimates, taking into consideration Facility-specific hydraulic conductivity of this water bearing zone, the observed hydraulic gradient, and the saturated thickness of this zone. This evaluation determined that the potential migration of constituents in on-Facility groundwater to the Saginaw River is not expected to result in unacceptable ecological risks." (Exponent - ERA, 2007)

Upon review of the ERA tables, total ammonia was included in the evaluation of risk, however, there was no criterion included for which to compare the levels of total ammonia, and therefore, no issues relating to ammonia were identified.

Environmental Indicator (EI) reports (ENVIRON, 2003) were submitted for the Site (CA750 – Migration of Contaminated Groundwater Under Control and CA725 – Current Human Health Exposures Under Control) which were approved by U.S. EPA on September 29, 2004 and August 25, 2004, respectively. The EI report identified that the concentration of total ammonia in one RFI groundwater sample at monitoring well MW-04864 (6.6 mg/L) exceeded Part 201 GSI Criteria (0.736 mg/L). The federal ambient water quality criteria, at the time of the report, for total ammonia was approximately 5.6 mg/L (Criteria Maximum Concentration, or CMC, at a pH of 9) and 1.3 mg/L (Criteria Continuous Concentration or CCC at a pH of 8). The EI report concluded the following with respect to ammonia,

*"By comparison, detected concentrations were less than 10 times the CMC and CCC, and therefore, the discharge of groundwater containing **total ammonia at this concentration are expected to be insignificant** (U.S. EPA, 1999)" (emphasis added)*

As part of the EI report, a groundwater monitoring program was initiated to confirm that the existing areas of groundwater contamination at the Site remain stable. The initial EI monitoring program included total ammonia as one of the parameters at one monitoring well location (MW-04854), north of IU G. The EI program was expanded to include total ammonia at additional monitoring wells in the 2008 annual EI sampling event by GM. The EI program was expanded again to include total ammonia at monitoring wells located upgradient of the GSI compliance wells and within the potential source area in the 2014 annual EI sampling event by RACER. Figure 1 presents the results of the EI monitoring to date.

A mixing zone determination request (MZDR) was made to the MDEQ in 2009 by GM (Attachment A.1) to address venting of groundwater with elevated ammonia in two separate areas of the broader GM property: Ammonia Part 1 venting area, with a discharge of 1.73 cubic feet per second (cfs), and Ammonia Part 2 venting area, with a discharge of 0.81 cfs. The Ammonia Part 2 venting area groundwater discharge is the ammonia "plume" of concern at the RACER property, and based upon relative flows and pH conditions, the MZDR did not require any "recommendations.... to be necessary to protect against acute or chronic un-ionized ammonia toxicity" (i.e., the Ammonia Part 2 plume did not pose "a reasonable potential to discharge chemicals to cause or contribute to water quality standards (WQS) being exceeded.", unlike the findings for the Ammonia Part 1 plume for which a mixing-zone based value was identified). Attachment A.2 presents a copy of MDEQ's determination. The MZDR also states that, beyond the mixing-zone values identified for the Ammonia Part 1 (non-RACER) plume:

"No ammonia recommendations for any other GM-SMCO groundwater venting should be necessary to protect against acute or chronic un-ionized ammonia toxicity based on data provided in the MZDR. Pollutants affecting dissolved oxygen in the receiving water are not expected to be present at problematic levels in the venting discharges." (MDEQ, December 11, 2009)

GSI Criteria for Ammonia and Pathway Compliance Options per Section 20120e (and GSICO)

"Generic" GSI criteria for ammonia pursuant to NREPA (Part 201) are identified in Table 1 of administrative rules for MDEQ- RRD "Cleanup Criteria Requirements for Response Activity" (specifically, Rule 44). The criterion identified for ammonia is stated as "CC" which is explained in the footnotes of the administrative rule to be dependent upon: a) whether the receiving water body is protected as a cold water or warm water resource, and b) the amount of ammonia which is present in the "unionized" form, which is dependent upon the temperature and pH of the receiving water.

The receiving waters (Saginaw River) are classified and protected as a warm water resource. Only a fraction of total ammonia (unionized ammonia) is considered toxic. Water quality standards which are the basis for GSI criteria are the "Rule 57" water quality values identified by MDEQ for warm water resources as 53 micrograms per liter ($\mu\text{g/L}$) (for chronic exposures) and 420 $\mu\text{g/L}$ (for acute exposures) of unionized ammonia. The footnote explaining the Part 201 GSI criterion for ammonia provides a table for interpreting the percentage of total ammonia concentrations which are in the unionized form under various conditions of temperature and pH. Similarly, U.S. EPA guidance entitled, "Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater 2013" (U.S. EPA, April 2013) provides two tables for acute and chronic total ammonia based on various pH and temperatures (see Attachment B).

The previous MZDR for this Site (and also for a similar condition downstream from the Site at the Middleground Landfill located at Bay City which is also on the Saginaw River) indicates MDEQ finds "mixing" of venting groundwater to be such that "chronic" impacts are not likely, and that venting in excess of concentrations protective of acute impacts (420 µg/L unionized ammonia) would be a condition requiring response activity to ensure adequate resource protection. However, as described above, the ammonia plume venting from the RACER property (Ammonia Part 2 plume) was actually considered to be so limited as to not even pose a potential for exceeding either acute or chronic water quality standards.

As discussed above, and further addressed later in this memorandum, the proper interpretation of concentrations of unionized ammonia from measurements of total ammonia is necessary to evaluate compliance with the relevant "GSI Criteria" benchmark for this Site.

While compliance with GSI criteria as measured in groundwater samples prior to venting into surface water is one means of evaluating GSI pathway compliance, Section 20120e (and the GSICO) identifies several other means of demonstrating and meeting obligations relative to the pathway. The primary options which appear applicable in this situation (individually, or in combination) are briefly reviewed and summarized as follows:

1. *Groundwater Venting at Less than Generic GSI Criteria* (Section 20120e(1)(a)) – when properly considering pH and temperature many points will meet the generic criteria, especially that protective of acute impacts. However the generic criterion for chronic impacts is often exceeded in groundwater prior to venting.
2. *Groundwater Venting at Less than Mixing-Zone based Criteria* (Section 20120e(1)(c)) – identification of a GSI criteria based upon a mixing-zone determination generally results in the generic GSI criterion being raised from the value protective of chronic exposure (53 µg/L unionized for ammonia) to that protective of acute exposures (420 µg/L unionized for ammonia) at locations with a high receiving water flow and volume such as the Saginaw River. In this case the previously discussed MZDR resulted in a conclusion that the RACER ammonia plume (Ammonia Part 2 venting area) did not pose a reasonable potential to contribute to water quality standards being exceeded (either acute or chronic). Existing data supports a conclusion that unionized ammonia concentrations do not exceed criteria protective of acute exposures (when pH and temp are properly used to interpret the unionized fraction of ammonia from measured concentrations of total ammonia) so, conditions clearly are compliant with what would be allowed based upon mixing-zone based criteria.
3. *De minimis impact on surface water resources* (Section 20120e(14))– although there is no clear benchmark in the GSICO or elsewhere as to what constitutes *de minimis* impact, the relative ammonia mass flux and venting rate from the Site to the Saginaw River is such that a *de minimis* conclusion would be very appropriate (and highly likely to be supported by MDEQ), especially in light of the MZDR conclusion relative to the Ammonia Part 2 venting area [RACER plume]
4. *Natural Attenuation* (Section 20120e(16)), *Modeling Demonstration* (Section 20120e(1)(f)), and *Ecological Demonstration* (Section 20120e(1)) – these are additional options to evaluate and demonstrate pathway compliance, however given options 2 and 3 above appear to be sufficient to conclude that further activities are not required to address the GSI pathway, there does not seem to be a need to use these more robust investigation and evaluation tools.

Ammonia Evaluation

The HHRA included in the 2007 RFI identified a potential for unacceptable non-cancer hazard to a hypothetical construction from exposures to elevated ammonia. The data in the HHRA tables identify that total ammonia concentrations between 33 mg/L and 55.7 mg/L and higher exceed U.S. EPA's risk limits. Figure 1 presents the most current data collected from the Site for total ammonia. Based on the current available total ammonia data, which is all below 33 mg/L, ammonia no longer exceeds U.S. EPA's risk limits. Therefore, there is no current human health risks associated with ammonia at the Site.

The EI groundwater monitoring program has continued to present total ammonia data exceeding GSI criteria at the GSI monitoring wells (MW-03945 and MW-04051), however, based on the mixing zone determination (MDEQ, December 11, 2009) total ammonia concentrations below 8.88 mg/L (highest concentration of total ammonia from the Ammonia Part 2 venting area of the MZDR) are protective of acute and chronic un-ionized ammonia toxicity, assuming the pH of groundwater stays around 7. Based on the current available total ammonia and pH data, all total ammonia concentrations at the GSI monitoring wells are below 8.88 mg/L and pH continues to be at around 7. Therefore, there is no further action required with regards to total ammonia, besides on-going monitoring to confirm total ammonia levels remain below 8.88 mg/L.

In addition, to the above evaluation CRA proposes to modify how ammonia is reported in the annual EI monitoring results. To date, ammonia has been reported as total ammonia. The toxic fraction of total ammonia is unionized, therefore CRA proposes to calculate and report both total and unionized ammonia. Table 1 attached to this memorandum was originally developed for the Middleground Landfill located at Bay City, downstream of the Site and was approved for use by the MDEQ. The calculations for unionized ammonia involve averaging pH and temperature of groundwater from a given monitoring well and of surface water from the Saginaw River in order to calculate the unionized fraction. Table 1 presents the total ammonia data, pH, and temperature from the most recent EI sampling event for the three GSI monitoring wells (MW-04257, MW-04051, MW-03945) and one additional monitoring well upgradient of the GSI monitoring wells (MW-04250R). The Saginaw River temperature and pH are the average of readings obtained from the USGS gaging station 4157000 (located about approximately 4 miles upstream from MW-03945), for the month of November between 1967 and 2012. Concentrations of unionized ammonia in the three GSI monitoring wells are below the chronic and the acute criteria for unionized ammonia.

Conclusion

It is CRA's opinion that further activities to address ammonia above GSI criteria in monitoring wells next to the Saginaw River at the Site are not necessary as conditions satisfy the requirements of NREPA when evaluated pursuant to Section 20120e and options discussed in the GSICO reference materials. Monitoring of the conditions would continue to be of value to ensure conditions remain as currently understood and characterized, and might be required by MDEQ if particular NREPA Part 201 compliance conclusions were to be requested. CRA proposes that the current EI monitoring program, with some minor adjustments, is adequate to monitor ammonia to ensure conditions remain as currently understood. Table 2 is a copy of the current EI monitoring program, which has been adjusted to include additional parameters (pH and temperature) for monitoring locations located within 400 feet of the Saginaw River (area where GSI is

relevant), as well as, pH and temperature from the Saginaw River. The EI monitoring program adjustments are highlighted in **bold**.

Encl.

Figure 1 – Summary of EI Locations and Results (1998 – 2014)

Table 1 – Groundwater Ammonia FAV Compliance Worksheet

Table 2 – Revised EI Monitoring Program

Attachment A – Mixing Zone Determination Documents

Attachment B – Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater 2013 (U.S. EPA, April 2013)

TABLE 1

**GROUNDWATER AMMONIA FAV COMPLIANCE WORKSHEET
GSI COMPLIANCE SAMPLING EVENT OF NOVEMBER 2014
NODULAR IRON INDUSTRIAL LAND
SAGINAW, MICHIGAN**

<i>GSI Compliance Point Number (WELL ID)</i>	<i>Measured Total NH₃ (mg/L)</i>	<i>Groundwater Temperature (° C)</i>	<i>Groundwater pH</i>	<i>Saginaw River Temperature (° C)</i>	<i>Saginaw River pH</i>	<i>Average Temperature (° C)¹</i>	<i>Average pH²</i>	<i>% Unionized NH₃³</i>	<i>Calculated Unionized NH₃ (mg/L)</i>
MW-04257	0.35	13.63	7.32	12.95	8.06	13.29	7.55	0.84%	0.003
MW-04051	4.4	13.99	7.13	12.95	8.06	13.47	7.38	0.58%	0.026
MW-03945	7.3	11.65	7.01	12.95	8.06	12.30	7.27	0.42%	0.030
MW-04250R	2.7	10.40	10.00	12.95	8.06	11.68	8.36	4.58%	0.124

Notes:

- ^{1.} Temperature is the average of the groundwater temperature and the Saginaw river temperature
- ^{2.} pH value for average of groundwater and Saginaw River H⁺ concentrations
- ^{3.} Ammonia toxicity equations taken from Steven C. Chapra "Surface Water-Quality Modeling", McGraw-Hill Series in Water Resources and Environmental Engineering 1997

Boxed Value indicates exceedance of FAV criterion of 0.42 mg/L.

TABLE 2

**REVISED EI MONITORING PROGRAM
NODULAR FACILITY, SAGINAW, MICHIGAN**

<i>IU</i>	<i>Location</i>	<i>Parameter</i>	<i>Monitoring Purpose</i>	<i>Propose to Eliminate from EI Monitoring</i>	<i>Comments</i>
G	MW-04250/MW-04250R	mercury	GSI	No	
G	MW-04250/MW-04250R	pH	GSI	No	
G	MW-04250/MW-04250R	ammonia	GSI	No	
G	MW-04250/MW-04250R	temperature	GSI	No	
G	MW-04757	ammonia	GSI	No	
G	MW-04757	pH	GSI	No	
G	MW-04757	temperature	GSI	No	
Wells added in 2007 per EPA's email request dated August 8, 2007.					
G	MW-03945	pH	GSI	No	
G	MW-03945	ammonia	GSI	No	
G	MW-03945	temperature	GSI	No	
G	MW-04051	pH	GSI	No	
G	MW-04051	ammonia	GSI	No	
G	MW-04051	temperature	GSI	No	
G	MW-04257	pH	GSI	No	
G	MW-04257	ammonia	GSI	No	
G	MW-04257	temperature	GSI	No	
Wells added in 2013 per RACER's recommendation dated October 23, 2013					
G	MW-04836	pH	GSI	No	
G	MW-04836	ammonia	GSI	No	
G	MW-04835	pH	GSI	yes	Monitoring well consistently in standing water
G	MW-04835	ammonia	GSI	yes	Monitoring well consistently in standing water
G	MW-05036	pH	GSI	No	
G	MW-05036	ammonia	GSI	No	
G	MW-8	pH	GSI	No	
G	MW-8	ammonia	GSI	No	
Well to be added to the the 2014 monitoring program					
G	MW-04040	ammonia	GSI	No	
G	MW-04040	pH	GSI	No	
G	MW-04040	temperature	GSI	No	
Sampling Location to be added to the 2015 monitoring program					
G	Saginaw River (next to MW-03945)	pH	GSI	No	
G	Saginaw River (next to MW-03945)	temperature	GSI	No	

Notes:

- Table updated to remove select parameters based on 4 consecutive rounds below criteria.
- Wells evaluated using most recent groundwater data compared to appropriate EI criteria.
- Since 2005 all samples for metals analyses have been collected using low flow sampling techniques and were unfiltered.
- GSI = Selected to monitor stability based on exceedances of groundwater surface water interface criteria in most recent samples.
- NA - Not applicable.

Attachment A

Mixing Zone Determination documents

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: Eric Alexander
Surface Water Quality Assessment Section
Water Bureau

FROM: Liane J. Shekter-Smith, P.E., Assistant Division Chief
Waste and Hazardous Materials Division

DATE: **October 1, 2009**

SUBJECT: **General Motors, SMCO**
Mixing Zone Determination Request, **Saginaw Bay** District

General Information

We are requesting a mixing zone determination for the above referenced facility, located in the **SW 1/4** of the **SE 1/4** of **Section 07**, **SE 1/4** of the **SE 1/4** of **Section 07**, **SW 1/4** of the **SW 1/4** of **Section 07**, **NW 1/4** of the **NW 1/4** of **Section 18**, **NE 1/4** of the **NE 1/4** of **Section 18**, **NE 1/4** of the **NE 1/4** of **Section 18**, **NW 1/4** of the **NW 1/4** of **Section 17**, **T12N**, **R 5E** in **Saginaw County**.

WHMD or U.S. Environmental Protection Agency Contact Person: **Ron Stone** Phone #: **517-373-7141**

District Supervisor/Unit Chief: **Virginia Himich**

Phone #: **517-373-7974** FAX #: **517-373-4797**

Priority: (to be filled out by the Assistant Division Chief)

☒ **four week response** ☐ **eight week response**

Facility Information

1. Please advise of the name of the receiving water body and the location of the venting groundwater contaminant plume; the map is attached. Please indicate if the discharge is to a public recreational area, a Great Lake, an inland lake or a wetland.

Saginaw River

- a. This is a ☐ new, ☐ increased, or ☒ existing discharge. If new or increased discharge, see Attachment 3.

b. This is a discharge to a ☐ Great Lake, ☐ Inland Lake or ☐ wetland, ☒ not applicable.

c. Is human body contact expected in the receiving water? ☐ yes ☒ no

2. General information regarding the origin of the pollutants. This includes the location, nature, and chemical characteristics of the source of the groundwater contamination plume(s):

Saginaw Metal Casting Operations (SMCO) Facility or the former Nodular Iron Foundry. Ammonia and pH have been reported above GSI criteria in groundwater samples from monitoring wells located next to the Saginaw River.

Technical Information

3. The name; Chemical Abstract Service (CAS) Number; worst case maximum concentration of contaminants reaching, or predicted to reach; the GSI. Generally, the highest concentration of the contaminant found in the groundwater would be appropriate to represent the worst case maximum. If source contaminants have not yet reached the groundwater but are expected to do so, source concentrations should be identified and noted as such.

Chemical or General Chemistry Parameter	CAS #	Worst Case Maximum GSI Discharge Concentration	Average Surface Water Conc. Upstream (if available)
pH	NA	5.39 (low)	NA
pH	NA	10.89 (high)	
Ammonia	7664-41-7	9.45 mg/L	NA

4. The maximum discharge rate of the venting groundwater contaminant plume in cubic feet per second. The maximum discharge rate must be recorded in the Request Form to ensure protection from acute effects to aquatic life. More than just the rate should be included here; all calculations need to be shown.

Please see Table 1 for a breakdown of the discharge rate calculations of the venting groundwater plume. Figures 1 and 2 attached show the approximate reaches of

groundwater venting for ammonia and pH, including their longitudinal distances as well as approximate saturated zone thicknesses.

The hydraulic conductivity of the fill material and the hydraulic gradient used in these calculations was 2.2×10^{-1} cm/s (0.0072 ft/s) and 0.016 (ft/ft) respectively and the hydraulic gradient represents the gradient directly adjacent to the Saginaw River (CRA, 2007).

Based on the calculations shown in Table 1, the maximum discharge rate for ammonia is calculated to be 2.53 ft³/s. For high pH the maximum discharge rate is 0.76 ft³/s and for low pH the maximum discharge rate is 2.05 ft³/s.

5. The location of other contaminant plumes entering the receiving surface water body, their constituents and concentrations, if available:

Attachments

cc:

TABLE 1
GM SMCO - RESPONSE TO ITEM NO. 4
CALCULATIONS
MAXIMUM DISCHARGE RATE OF VENTING CONTAMINANT PLUME

Page 1 of 2

Equation Used:

Darcy's Law: $Q = KiA$

Where: Q = discharge [ft^3/s]

K = hydraulic conductivity [ft/second]

i = hydraulic gradient [ft/ft]

A = cross sectional area of saturated fill [ft^2]

Darcy's Law Parameters:

1.) Hydraulic Gradient, i

- a) Calculated i at river location (close to MW-03746, using Figure 3.7)

change in total head: 585 feet - 581 feet = 4 feet

length over this head interval: $(0.8 \text{ cm} \times (500' / 1.3 \text{ cm})) = 307.7 \text{ feet}$

$i = (4' / 307.7') = 0.013$

- b) Calculated i immediately adjacent to Saginaw River = 0.016

Source:

CRA. 2007. Resource Conservation and Recovery Act - Facility Investigation - Phase 1C Report - Revised. March. (page 30).

The hydraulic gradient used for calculations was 0.016, as it is a more conservative estimate.

2.) Hydraulic Conductivity, K

- a) Calculated K in the fill material = $2.2 \times 10^{-1} \text{ cm}/\text{s} = 0.0072 \text{ ft}/\text{s}$

Source:

CRA. 2007. Resource Conservation and Recovery Act - Facility Investigation - Phase 1C Report - Revised. March. (page 30).

3.) Height (average) of saturated fill material (used in cross sectional area calculation)

- a) Based on elevation values taken from Figures 3.5 and 3.7

Figure 3.7: <u>Water Level (feet)</u>	Figure 3.5: <u>Top of Native Clay (feet)</u>	<u>Thickness of Saturated Layer (feet)</u>
584	578	6
581	572	9
582.45	565.46	16.99
580.54	571.94	8.6
585	580	5
Average Thickness:		9.1

** Please note that this value of 9.1 feet is used for all calculations except for pH-low. The closest saturated thickness data for this area yields 16.9 feet, so a thickness of 17 feet was used as average in that case.

TABLE 1
GM SMCO - RESPONSE TO ITEM NO. 4
CALCULATIONS
MAXIMUM DISCHARGE RATE OF VENTING CONTAMINANT PLUME

Parameter:

Ammonia

Part 1 - See Figure 2

Length of discharge zone: (10.7 cm x (200 ft/1.3 cm)) = 1646 ft
 Average thickness of zone: 9.1 ft
 Hydraulic conductivity, K: 0.0072 ft/s
 Hydraulic Gradient, i: 0.016

Max. Discharge Rate, Q = 1646 ft x 9.1 ft x 0.0072 ft/s x 0.016 = 1.73 ft³/s

Part 2 - See Figure 2

Length of discharge zone: (5.0 cm x (200 ft/1.3 cm)) = 769 ft
 Average thickness of zone: 9.1 ft
 Hydraulic conductivity, K: 0.0072 ft/s
 Hydraulic Gradient, i: 0.016

Max. Discharge Rate, Q = 769 ft x 9.1 ft x 0.0072 ft/s x 0.016 = 0.81 ft³/s

Total Max. Discharge Rate: 2.53 ft³/s

pH - High

See Figure 2

Length of discharge zone: (4.7 cm x (200 ft/1.3 cm)) = 723 ft
 Average thickness of zone: 9.1 ft
 Hydraulic conductivity, K: 0.0072 ft/s
 Hydraulic Gradient, i: 0.016

Total Max. Discharge Rate, Q = 723 ft x 9.1 ft x 0.0072 ft/s x 0.016 = **0.76 ft³/s**

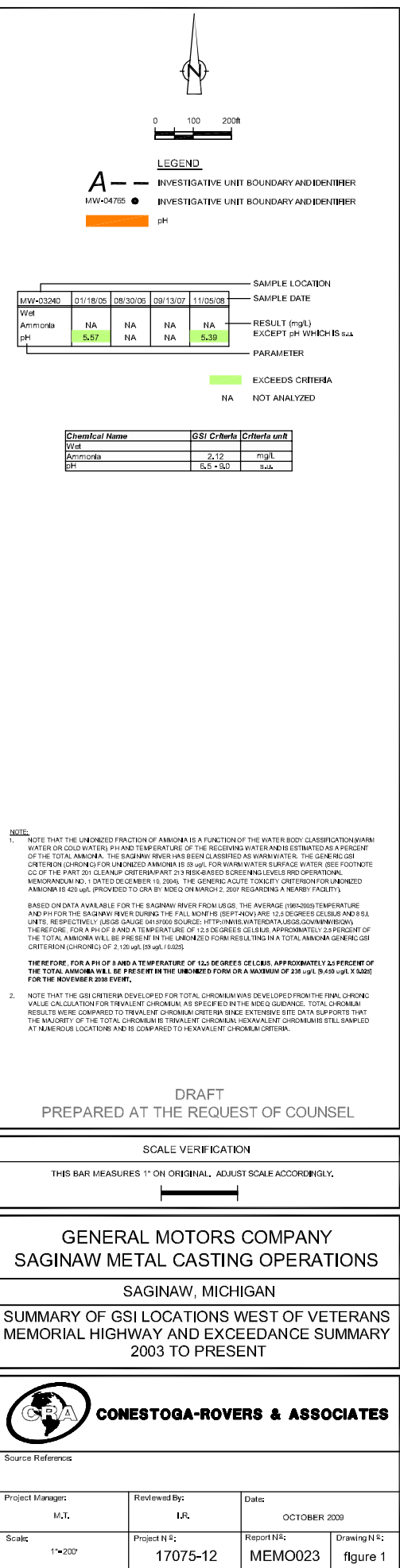
pH - Low

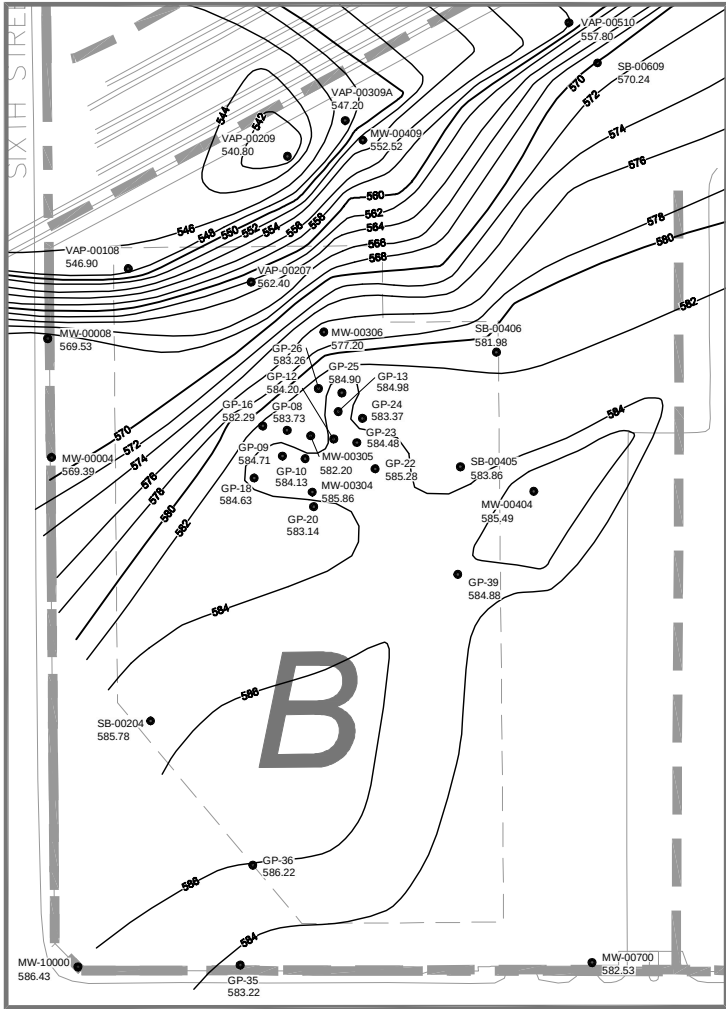
See Figure 1

Length of discharge zone: (6.8 cm x (200 ft/1.3 cm)) = 1046 ft
 Average thickness of zone: 17 ft
 Hydraulic conductivity, K: 0.0072 ft/s
 Hydraulic Gradient, i: 0.016

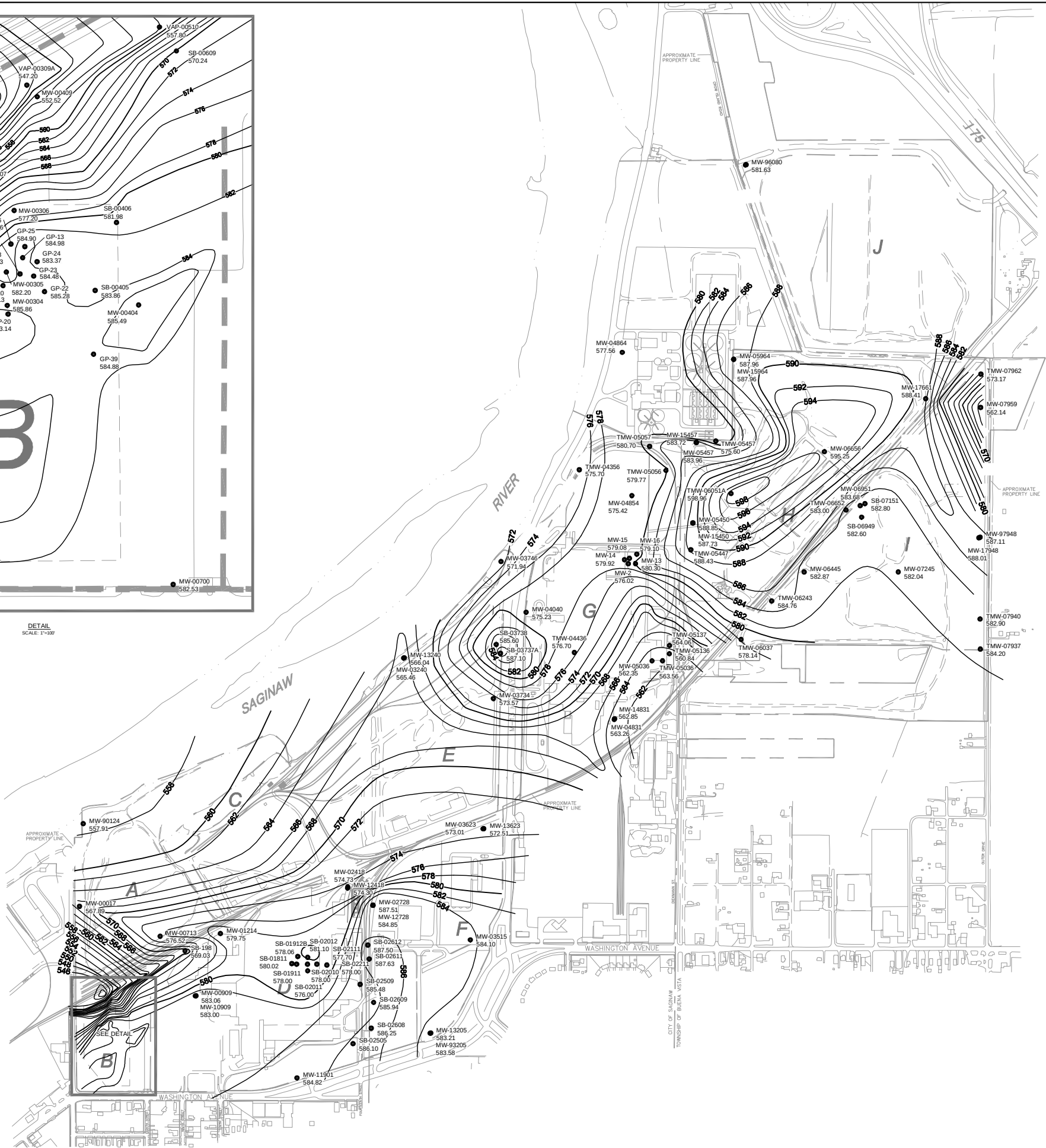
**Note average thickness of zone in this location is 17 ft, not 9.1 ft

Total Max. Discharge Rate, Q = 1046 ft x 17 ft x 0.0072 ft/s x 0.016 = **2.05 ft³/s**





DETAIL
SCALE 1"=100'



0 200 500ft

LEGEND

580 TOP OF CLAY CONTOUR (IL AMSL-NAVD 88)

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.



GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS

SAGINAW, MICHIGAN

TOP OF NATIVE CLAY
CONTOURS



CONESTOGA-ROVERS & ASSOCIATES

Source Reference:

MICHIGAN STATE PLANE SOUTH, NAD 83 USING INTERNATIONAL FEET, NGVD 88

Project Manager:

I.R.

Reviewed By:

M.T.

Date:

FEBRUARY 2007

Scale:

1" = 500'

Project N°:

17075-16

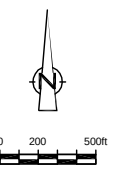
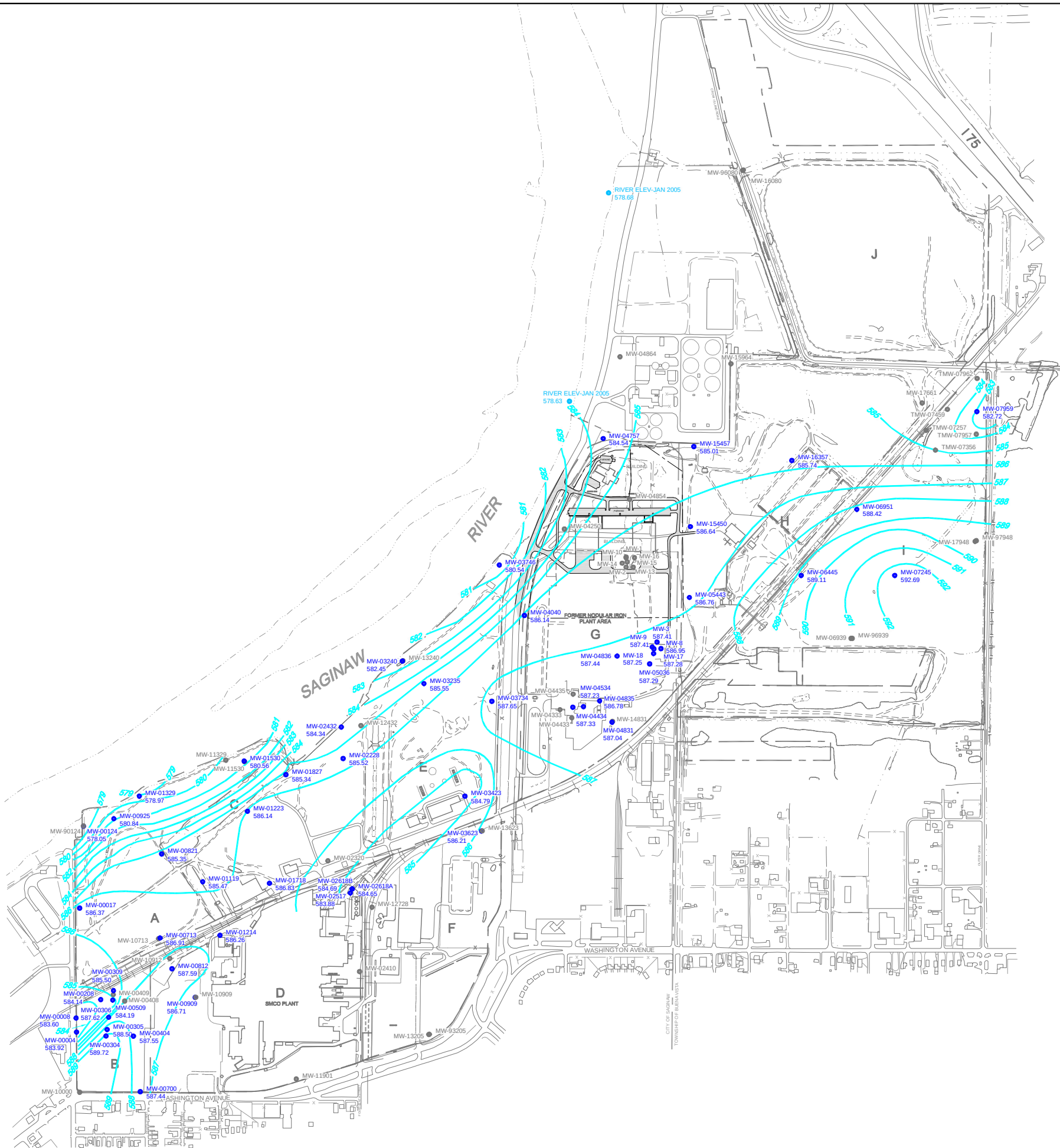
Report N°:

027

Drawing N°:

figure 3.5

17075-16(027)GN-WA039 FEB 05/2007



- LEGEND**
- GROUNDWATER ELEVATION FT. AMSL (NAVD 88)
 - EXISTING MONITORING WELL WITH GROUNDWATER ELEVATION (JANUARY 2005)
 - EXISTING MONITORING WELL

SCALE VERIFICATION

THIS BAR MEASURES 1" ON ORIGINAL. ADJUST SCALE ACCORDINGLY.

GENERAL MOTORS CORPORATION
SAGINAW METAL CASTING OPERATIONS

SAGINAW, MICHIGAN

UPPER WATER BEARING ZONE
GROUNDWATER CONTOUR MAP



Source Reference:

Project Manager: I.R.	Reviewed By: M.T.	Date: FEBRUARY 2007
Scale: 1" = 500'	Project No: 17075-16	Report No: 027
		Drawing No: figure 3.7

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: Nate Nemani, Resource Conservation and Recovery Act of 1976 Corrective Action Project Manager, Land and Chemicals Division, Remediation and Reuse Branch, U.S. Environmental Protection Agency

FROM: Ronald Stone, Senior Geologist, Waste and Hazardous Materials Division, Michigan Department of Environmental Quality 

DATE: January 12, 2010

SUBJECT: Implementation of a Mixing Zone Request; General Motors - Saginaw Metal Castings Operation (GM-SMCO); MID 041 793 340

The Michigan Department of Environmental Quality (MDEQ), Waste and Hazardous Materials Division (WHMD), has reviewed the request for a Mixing Zone Determination for venting groundwater to the Saginaw River from GM-SMCO in Saginaw County, Michigan and forwarded that request to the MDEQ, Water Bureau (WB). The attached response provided by the WB identifies the acceptable concentration limits for discharge of the various chemicals characterized in the mixing zone request to the Saginaw River.

Based on the information provided by the WB, it is determined that there is a reasonable potential for the discharge of some chemicals to cause or contribute to water quality standards (WQS) being exceeded.

Recommended mixing zone-based groundwater surface water interface (GSI) values are summarized in the table below:

Table 1: Plume Venting to the Saginaw River

Parameter	Final Acute Value	Final Chronic Value	Reported Worst Case Maximum Site Concentration
pH	6.5 - 9.0 S.U.		
Ammonia Nitrogen	3.1 mg/l		

General Comments

1. The final acute values listed above are the acute mixing zone-based GSI criteria. These limits are provided for chemicals determined to have a reasonable potential to exceed the acute mixing zone-based GSI criteria. These values (as well as the generic GSI criteria for other chemicals not specifically identified in the mixing zone request) must not be exceeded at the GSI compliance monitoring wells; if they are, further remedial action will be required. The facility has the following options in regards to parameters that exceed the acute mixing zone-based GSI criteria in site monitoring wells:
 - a. If any existing exceedances are upgradient of the compliance monitoring wells, GM-SMCO must demonstrate that data from all of the compliance monitoring wells in the Mixing Zone Compliance Monitoring Plan are, and will be, in compliance with acute

mixing zone-based GSI criteria for those parameters. Averaging of groundwater data is not allowed for comparison to generic GSI or acute mixing zone-based GSI criteria, nor is it allowed for bioaccumulative contaminants of concern. Acute mixing zoned-based or generic GSI criteria may not be exceeded in any individual GSI compliance monitoring well.

- b. Prevent the discharge of all parameters that exceed the acute mixing zone-based GSI criteria in the GSI compliance monitoring wells. This option would require the focus of subsequent site investigations to hydrogeologically define remediation designs for capturing the groundwater discharge, further plume characterization, and identification of sources for source control measures.
2. It has been determined that any other parameter on the mixing zone request form, not given a recommended mixing zone-based GSI criteria in the table above (if any) or in the attached memorandum, will not cause or contribute to WQS being exceeded at this time. This determination is based upon the reported maximum values in the mixing zone request, which was submitted to the WB by the WHMD.

In order to demonstrate the groundwater discharge long-term compliance with the mixing zone-based GSI criteria, GM-SMCO will need to submit a Mixing Zone Compliance Monitoring Plan for review and approval. The Mixing Zone Compliance Monitoring Plan should include a Sampling and Analysis Plan (to address both mixing zone chemicals and other chemicals reported in the mixing zone request), identification of the wells that GM-SMCO proposes to sample to show compliance with the mixing zone-based GSI criteria (along the GSI at the GSI point of compliance) and any sentinel wells within the appropriate portions of the plume, and provide an explanation of the monitoring schedule and reporting process.

Should you have any questions regarding this letter or the Mixing Zone Determination, please contact me via e-mail at stoner@michigan.gov or by telephone at 517-373-7141.

Attachment

cc/att: Ms. Cheryl Howe, WHMD
Ms. Rhonda Klann, Remediation and Redevelopment Division
Mr. David Slayton, WHMD
Corrective Action File

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: Liane Shekter Smith, Assistant Division Chief
Waste and Hazardous Materials Division

FROM: Erik Sunday, Surface Water Assessment Section, Water Bureau

DATE: December 11, 2009

SUBJECT: General Motors Corp-Saginaw Metal Casting Operations (GM-SMCO)
Groundwater venting discharge

The Surface Water Assessment Section has evaluated Water Quality-Based Effluent Limits (WQBELs) for the GM-SMCO groundwater venting discharge. The existing GM-SMCO facility is continuously venting groundwater to the Saginaw River from four groundwater-surface water interfaces (GSIs) as described in the November 12, 2009, Mixing Zone Determination Request (MZDR) forwarded to SWAS by Waste and Hazardous Materials Division (WHMD):

Ammonia Part 1 – 1.73 cubic feet per second (cfs) (1.12 million gallons per day (MGD))
Ammonia Part 2 – 0.81 cfs (0.52 MGD)
pH-High – 0.76 cfs (0.49 MGD)
pH-Low – 2.05 cfs (1.33 MGD)

The above venting flow rates are maximum flows. The vents are located in Sections 7, 17, and 18 of T12N, R5E of Saginaw County. The pH-High groundwater venting flows to the Saginaw River through the Ammonia Part 1 venting area. Therefore, these two vents have been treated as a single vent with a maximum flow rate of 2.49 cfs (1.73 cfs + 0.76 cfs) in developing WQBELs. The combined Ammonia Part 1 and pH-High vent discharges to the Saginaw River downstream of the Carrollton Bar, while the Ammonia Part 2 and pH-Low vents discharge to a channel of the Saginaw River southeast of the Carrollton Bar.

The monthly exceedance flows (in cfs) for the Saginaw River below the Carrollton Bar at the point of discharge of the combined Ammonia Part 1 and pH-High vents are as follows:

	<u>JAN.</u>	<u>FEB.</u>	<u>MAR.</u>	<u>APR.</u>	<u>MAY</u>	<u>JUNE</u>
50%	2200	2510	6950	6830	3640	1880
95%	750	800	1560	2220	1180	740
	<u>JULY</u>	<u>AUG.</u>	<u>SEP.</u>	<u>OCT.</u>	<u>NOV.</u>	<u>DEC.</u>
50%	1150	980	1000	1250	2010	2380
95%	550	500	510	600	750	780

The monthly exceedance flows (in cfs) for the channel of the Saginaw River southeast of the Carrollton Bar at the point of discharge of the Ammonia Part 2 and pH-Low vents are as follows:

	<u>JAN.</u>	<u>FEB.</u>	<u>MAR.</u>	<u>APR.</u>	<u>MAY</u>	<u>JUNE</u>
50%	1630	1860	5140	5050	2700	1390
95%	560	590	1160	1640	870	550
	<u>JULY</u>	<u>AUG.</u>	<u>SEP.</u>	<u>OCT.</u>	<u>NOV.</u>	<u>DEC.</u>
50%	850	730	740	930	1490	1760
95%	410	370	380	440	560	580

The Saginaw River is protected for warmwater fish, other indigenous aquatic life and wildlife, agriculture, navigation, industrial water supply, public water supply at the point of intake, partial body contact recreation, total body contact recreation from May 1 to October 31, and fish consumption.

Ammonia concentrations and pH are the primary concerns for this facility's venting groundwater. Average values of groundwater pH in the four venting areas were computed from data contained in the MZDR:

Ammonia Part 1 – 7.06 S.U.
Ammonia Part 2 – 6.86
pH-High – 11.19
pH-Low – 5.48

SWAS recommends a pH range of 6.5 to 9.0 S.U. for all venting groundwater discharges to the Saginaw River year-round. Table 1 contains total ammonia recommendations based on meeting the 0.420 mg/l warmwater un-ionized ammonia acute toxicity criterion in the combined Ammonia Part 1 and pH-High venting. No ammonia recommendations for any other GM-SMCO groundwater venting should be necessary to protect against acute or chronic un-ionized ammonia toxicity based on data provided in the MZDR. Pollutants affecting dissolved oxygen in the receiving water are not expected to be present at problematic levels in the venting discharges.

The fraction of total ammonia existing as un-ionized ammonia is calculated, in part, from the pH of the venting groundwater. For the combined Ammonia Part 1 and pH-High venting, the upper value of the WQBEL pH range, 9.0 S.U., was used in the calculation of WQBELs based on un-ionized ammonia toxicity. The recommendations in Table 1 apply for groundwater pH's of 9.0 S.U. or lower. If the groundwater venting is permitted to discharge at a pH greater than 9.0 S.U., WQBELs for the combined Ammonia Part 1 and pH-High venting will need to be recalculated. For evaluation of the pH-Low and Ammonia Part 2 ventings, a pH of 7.1 S.U. was used based on the calculated average pH for the Ammonia Part 1 venting.

The attached effluent limit recommendations are based on water quality standards. We have not addressed treatment practicality or cost effectiveness. Our recommendations do not imply that other considerations should not be taken into account when deciding on permit limits.

**Table 1. GM-SMCO pH and ammonia toxicity-based WQBEL recommendations
Combined Ammonia Part 1 and pH-High groundwater venting
WQBELs assume a pH of 9.0 S.U. or less in venting groundwater**

Parameter	Months	Conc. (mg/l)	Load (lb/d)	Basis	Rationale
NH3-N	Year round	3.1	42	Daily Max.	Acute warmwater toxicity

Design Flow = 2.49 cfs (1.61 MGD)

cc: Jon Bloemker, Saginaw Bay District Supervisor, SWAS, WB
Eric Alexander/Groundwater Venting File, SWAS, WB

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

INTEROFFICE COMMUNICATION

TO: Liane Shekter Smith, Assistant Division Chief
Waste and Hazardous Materials Division

FROM: Erik Sunday, Surface Water Assessment Section, Water Bureau

DATE: December 11, 2009

SUBJECT: General Motors Corp-Saginaw Metal Casting Operations (GM-SMCO)
Groundwater venting discharge

The Surface Water Assessment Section has evaluated Water Quality-Based Effluent Limits (WQBELs) for the GM-SMCO groundwater venting discharge. The existing GM-SMCO facility is continuously venting groundwater to the Saginaw River from four groundwater-surface water interfaces (GSIs) as described in the November 12, 2009, Mixing Zone Determination Request (MZDR) forwarded to SWAS by Waste and Hazardous Materials Division (WHMD):

Ammonia Part 1 – 1.73 cubic feet per second (cfs) (1.12 million gallons per day (MGD))
Ammonia Part 2 – 0.81 cfs (0.52 MGD)
pH-High – 0.76 cfs (0.49 MGD)
pH-Low – 2.05 cfs (1.33 MGD)

The above venting flow rates are maximum flows. The vents are located in Sections 7, 17, and 18 of T12N, R5E of Saginaw County. The pH-High groundwater venting flows to the Saginaw River through the Ammonia Part 1 venting area. Therefore, these two vents have been treated as a single vent with a maximum flow rate of 2.49 cfs (1.73 cfs + 0.76 cfs) in developing WQBELs. The combined Ammonia Part 1 and pH-High vent discharges to the Saginaw River downstream of the Carrolton Bar, while the Ammonia Part 2 and pH-Low vents discharge to a channel of the Saginaw River southeast of the Carrolton Bar.

The monthly exceedance flows (in cfs) for the Saginaw River below the Carrolton Bar at the point of discharge of the combined Ammonia Part 1 and pH-High vents are as follows:

	<u>JAN.</u>	<u>FEB.</u>	<u>MAR.</u>	<u>APR.</u>	<u>MAY</u>	<u>JUNE</u>
50%	2200	2510	6950	6830	3640	1880
95%	750	800	1560	2220	1180	740
	<u>JULY</u>	<u>AUG.</u>	<u>SEP.</u>	<u>OCT.</u>	<u>NOV.</u>	<u>DEC.</u>
50%	1150	980	1000	1250	2010	2380
95%	550	500	510	600	750	780

The monthly exceedance flows (in cfs) for the channel of the Saginaw River southeast of the Carrolton Bar at the point of discharge of the Ammonia Part 2 and pH-Low vents are as follows:

	<u>JAN.</u>	<u>FEB.</u>	<u>MAR.</u>	<u>APR.</u>	<u>MAY</u>	<u>JUNE</u>
50%	1630	1860	5140	5050	2700	1390
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Ammonia concentrations and pH are the primary concerns for this facility's venting groundwater. Average values of groundwater pH in the four venting areas were computed from data contained in the MZDR:

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Ammonia Part 2 – 6.86
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SWAS recommends a pH range of 6.5 to 9.0 S.U. for all venting groundwater discharges to the Saginaw River year-round. Table 1 contains total ammonia recommendations based on meeting the 0.420 mg/l warmwater un-ionized ammonia acute toxicity criterion in the combined Ammonia Part 1 and pH-High venting. No ammonia recommendations for any other GM-SMCO groundwater venting should be necessary to protect against acute or chronic un-ionized ammonia toxicity based on data provided in the MZDR. Pollutants affecting dissolved oxygen in the receiving water are not expected to be present at problematic levels in the venting discharges.

The fraction of total ammonia existing as un-ionized ammonia is calculated, in part, from the pH of the venting groundwater. For the combined Ammonia Part 1 and pH-High venting, the upper value of the WQBEL pH range, 9.0 S.U., was used in the calculation of WQBELs based on un-ionized ammonia toxicity. The recommendations in Table 1 apply for groundwater pH's of 9.0 S.U. or lower. If the groundwater venting is permitted to discharge at a pH greater than 9.0 S.U., WQBELs for the combined Ammonia Part 1 and pH-High venting will need to be recalculated. For evaluation of the pH-Low and Ammonia Part 2 ventings, a pH of 7.1 S.U. was used based on the calculated average pH for the Ammonia Part 1 venting.

The attached effluent limit recommendations are based on water quality standards. We have not addressed treatment practicality or cost effectiveness. Our recommendations do not imply that other considerations should not be taken into account when deciding on permit limits.

Table 1. GM-SMCO pH and ammonia toxicity-based WQBEL recommendations
Combined Ammonia Part 1 and pH-High groundwater venting
WQBELs assume a pH of 9.0 S.U. or less in venting groundwater

Parameter	Months	Conc. (mg/l)	Load (lb/d)	Basis	Rationale
NH3-N	Year round	3.1	42	Daily Max.	Acute warmwater toxicity

Design Flow = 2.49 cfs (1.61 MGD)

cc: Jon Bloemker, Saginaw Bay District Supervisor, SWAS, WB
Eric Alexander/Groundwater Venting File, SWAS, WB

Attachment B

Aquatic Life Ambient Water Quality Criteria for Ammonia – Freshwater 2013
(U.S. EPA, April 2013)

Table 5a. Temperature and pH-Dependent Values of the CMC (Acute Criterion Magnitude) – *Oncorhynchus spp.* Present.

pH	Temperature (°C)																
	0-14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6.5	33	33	32	29	27	25	23	21	19	18	16	15	14	13	12	11	9.9
6.6	31	31	30	28	26	24	22	20	18	17	16	14	13	12	11	10	9.5
6.7	30	30	29	27	24	22	21	19	18	16	15	14	13	12	11	9.8	9.0
6.8	28	28	27	25	23	21	20	18	17	15	14	13	12	11	10	9.2	8.5
6.9	26	26	25	23	21	20	18	17	15	14	13	12	11	10	9.4	8.6	7.9
7.0	24	24	23	21	20	18	<u>17</u>	15	14	13	12	11	10	9.4	8.6	8.0	7.3
7.1	22	22	21	20	18	17	15	14	13	12	11	10	9.3	8.5	7.9	7.2	6.7
7.2	20	20	19	18	16	15	14	13	12	11	9.8	9.1	8.3	7.7	7.1	6.5	6.0
7.3	18	18	17	16	14	13	12	11	10	9.5	8.7	8.0	7.4	6.8	6.3	5.8	5.3
7.4	15	15	15	14	13	12	11	9.8	9.0	8.3	7.7	7.0	6.5	6.0	5.5	5.1	4.7
7.5	13	13	13	12	11	10	9.2	8.5	7.8	7.2	6.6	6.1	5.6	5.2	4.8	4.4	4.0
7.6	11	11	11	10	9.3	8.6	7.9	7.3	6.7	6.2	5.7	5.2	4.8	4.4	4.1	3.8	3.5
7.7	9.6	9.6	9.3	8.6	7.9	7.3	6.7	6.2	5.7	5.2	4.8	4.4	4.1	3.8	3.5	3.2	3.0
7.8	8.1	8.1	7.9	7.2	6.7	6.1	5.6	5.2	4.8	4.4	4.0	3.7	3.4	3.2	2.9	2.7	2.5
7.9	6.8	6.8	6.6	6.0	5.6	5.1	4.7	4.3	4.0	3.7	3.4	3.1	2.9	2.6	2.4	2.2	2.1
8.0	5.6	5.6	5.4	5.0	4.6	4.2	3.9	3.6	3.3	3.0	2.8	2.6	2.4	2.2	2.0	1.9	1.7
8.1	4.6	4.6	4.5	4.1	3.8	3.5	3.2	3.0	2.7	2.5	2.3	2.1	2.0	1.8	1.7	1.5	1.4
8.2	3.8	3.8	3.7	3.5	3.1	2.9	2.7	2.4	2.3	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.2
8.3	3.1	3.1	3.1	2.8	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.96
8.4	2.6	2.6	2.5	2.3	2.1	2.0	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.93	0.86	0.79
8.5	2.1	2.1	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.2	1.1	0.98	0.90	0.83	0.77	0.71	0.65
8.6	1.8	1.8	1.7	1.6	1.5	1.3	1.2	1.1	1.0	0.96	0.88	0.81	0.75	0.69	0.63	0.59	0.54
8.7	1.5	1.5	1.4	1.3	1.2	1.1	1.0	0.94	0.87	0.80	0.74	0.68	0.62	0.57	0.53	0.49	0.45
8.8	1.2	1.2	1.2	1.1	1.0	0.93	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37
8.9	1.0	1.0	1.0	0.93	0.85	0.79	0.72	0.67	0.61	0.56	0.52	0.48	0.44	0.40	0.37	0.34	0.32
9.0	0.88	0.88	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37	0.34	0.32	0.29	0.27

Table 5b. Temperature and pH-Dependent Values of the CMC (Acute Criterion Magnitude) – *Oncorhynchus spp.* Absent.

pH	Temperature (°C)																				
	0-10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6.5	51	48	44	41	37	34	32	29	27	25	23	21	19	18	16	15	14	13	12	11	9.9
6.6	49	46	42	39	36	33	30	28	26	24	22	20	18	17	16	14	13	12	11	10	9.5
6.7	46	44	40	37	34	31	29	27	24	22	21	19	18	16	15	14	13	12	11	9.8	9.0
6.8	44	41	38	35	32	30	27	25	23	21	20	18	17	15	14	13	12	11	10	9.2	8.5
6.9	41	38	35	32	30	28	25	23	21	20	18	17	15	14	13	12	11	10	9.4	8.6	7.9
7.0	38	35	33	30	28	25	23	21	20	18	<u>17</u>	15	14	13	12	11	10	9.4	8.6	7.9	7.3
7.1	34	32	30	27	25	23	21	20	18	17	15	14	13	12	11	10	9.3	8.5	7.9	7.2	6.7
7.2	31	29	27	25	23	21	19	18	16	15	14	13	12	11	9.8	9.1	8.3	7.7	7.1	6.5	6.0
7.3	27	26	24	22	20	18	17	16	14	13	12	11	10	9.5	8.7	8.0	7.4	6.8	6.3	5.8	5.3
7.4	24	22	21	19	18	16	15	14	13	12	11	9.8	9.0	8.3	7.7	7.0	6.5	6.0	5.5	5.1	4.7
7.5	21	19	18	17	15	14	13	12	11	10	9.2	8.5	7.8	7.2	6.6	6.1	5.6	5.2	4.8	4.4	4.0
7.6	18	17	15	14	13	12	11	10	9.3	8.6	7.9	7.3	6.7	6.2	5.7	5.2	4.8	4.4	4.1	3.8	3.5
7.7	15	14	13	12	11	10	9.3	8.6	7.9	7.3	6.7	6.2	5.7	5.2	4.8	4.4	4.1	3.8	3.5	3.2	2.9
7.8	13	12	11	10	9.3	8.5	7.9	7.2	6.7	6.1	5.6	5.2	4.8	4.4	4.0	3.7	3.4	3.2	2.9	2.7	2.5
7.9	11	9.9	9.1	8.4	7.7	7.1	6.6	3.0	5.6	5.1	4.7	4.3	4.0	3.7	3.4	3.1	2.9	2.6	2.4	2.2	2.1
8.0	8.8	8.2	7.6	7.0	6.4	5.9	5.4	5.0	4.6	4.2	3.9	3.6	3.3	3.0	2.8	2.6	2.4	2.2	2.0	1.9	1.7
8.1	7.2	6.8	6.3	5.8	5.3	4.9	4.5	4.1	3.8	3.5	3.2	3.0	2.7	2.5	2.3	2.1	2.0	1.8	1.7	1.5	1.4
8.2	6.0	5.6	5.2	4.8	4.4	4.0	3.7	3.4	3.1	2.9	2.7	2.4	2.3	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.2
8.3	4.9	4.6	4.3	3.9	3.6	3.3	3.1	2.8	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.96
8.4	4.1	3.8	3.5	3.2	3.0	2.7	2.5	2.3	2.1	2.0	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.93	0.86	0.79
8.5	3.3	3.1	2.9	2.7	2.4	2.3	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.2	1.1	0.98	0.90	0.83	0.77	0.71	0.65
8.6	2.8	2.6	2.4	2.2	2.0	1.9	1.7	1.6	1.5	1.3	1.2	1.1	1.0	0.96	0.88	0.81	0.75	0.69	0.63	0.58	0.54
8.7	2.3	2.2	2.0	1.8	1.7	1.6	1.4	1.3	1.2	1.1	1.0	0.94	0.87	0.80	0.74	0.68	0.62	0.57	0.53	0.49	0.45
8.8	1.9	1.8	1.7	1.5	1.4	1.3	1.2	1.1	1.0	0.93	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37
8.9	1.6	1.5	1.4	1.3	1.2	1.1	1.0	0.93	0.85	0.79	0.72	0.67	0.61	0.56	0.52	0.48	0.44	0.40	0.37	0.34	0.32
9.0	1.4	1.3	1.2	1.1	1.0	0.93	0.86	0.79	0.73	0.67	0.62	0.57	0.52	0.48	0.44	0.41	0.37	0.34	0.32	0.29	0.27

Table 6. Temperature and pH-Dependent Values of the CCC (Chronic Criterion Magnitude).

pH	Temperature (°C)																							
	0-7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
6.5	4.9	4.6	4.3	4.1	3.8	3.6	3.3	3.1	2.9	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.6	1.5	1.5	1.4	1.3	1.2	1.1
6.6	4.8	4.5	4.3	4.0	3.8	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1
6.7	4.8	4.5	4.2	3.9	3.7	3.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1
6.8	4.6	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1
6.9	4.5	4.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0
7.0	4.4	4.1	3.8	3.6	3.4	3.2	3.0	2.8	2.6	2.4	2.3	2.2	2.0	<u>1.9</u>	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	0.99
7.1	4.2	3.9	3.7	3.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.95
7.2	4.0	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0	0.96	0.90
7.3	3.8	3.5	3.3	3.1	2.9	2.7	2.6	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0	0.97	0.91	0.85
7.4	3.5	3.3	3.1	2.9	2.7	2.5	2.4	2.2	2.1	2.0	1.8	1.7	1.6	1.5	1.4	1.3	1.3	1.2	1.1	1.0	0.96	0.90	0.85	0.79
7.5	3.2	3.0	2.8	2.7	2.5	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.95	0.89	0.83	0.78	0.73
7.6	2.9	2.8	2.6	2.4	2.3	2.1	2.0	1.9	1.8	1.6	1.5	1.4	1.4	1.3	1.2	1.1	1.1	0.98	0.92	0.86	0.81	0.76	0.71	0.67
7.7	2.6	2.4	2.3	2.2	2.0	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.94	0.88	0.83	0.78	0.73	0.68	0.64	0.60
7.8	2.3	2.2	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.95	0.89	0.84	0.79	0.74	0.69	0.65	0.61	0.57	0.53
7.9	2.1	1.9	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.2	1.1	1.0	0.95	0.89	0.84	0.79	0.74	0.69	0.65	0.61	0.57	0.53	0.50	0.47
8.0	1.8	1.7	1.6	1.5	1.4	1.3	1.2	1.1	1.1	1.0	0.94	0.88	0.83	0.78	0.73	0.68	0.64	0.60	0.56	0.53	0.50	0.44	0.44	0.41
8.1	1.5	1.5	1.4	1.3	1.2	1.1	1.1	0.99	0.92	0.87	0.81	0.76	0.71	0.67	0.63	0.59	0.55	0.52	0.49	0.46	0.43	0.40	0.38	0.35
8.2	1.3	1.2	1.2	1.1	1.0	0.96	0.90	0.84	0.79	0.74	0.70	0.65	0.61	0.57	0.54	0.50	0.47	0.44	0.42	0.39	0.37	0.34	0.32	0.30
8.3	1.1	1.1	0.99	0.93	0.87	0.82	0.76	0.72	0.67	0.63	0.59	0.55	0.52	0.49	0.46	0.43	0.40	0.38	0.35	0.33	0.31	0.29	0.27	0.26
8.4	0.95	0.89	0.84	0.79	0.74	0.69	0.65	0.61	0.57	0.53	0.50	0.47	0.44	0.41	0.39	0.36	0.34	0.32	0.30	0.28	0.26	0.25	0.23	0.22
8.5	0.80	0.75	0.71	0.67	0.62	0.58	0.55	0.51	0.48	0.45	0.42	0.40	0.37	0.35	0.33	0.31	0.29	0.27	0.25	0.24	0.22	0.21	0.20	0.18
8.6	0.68	0.64	0.60	0.56	0.53	0.49	0.46	0.43	0.41	0.38	0.36	0.33	0.31	0.29	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.18	0.16	0.15
8.7	0.57	0.54	0.51	0.47	0.44	0.42	0.39	0.37	0.34	0.32	0.30	0.28	0.27	0.25	0.23	0.22	0.21	0.19	0.18	0.17	0.16	0.15	0.14	0.13
8.8	0.49	0.46	0.43	0.40	0.38	0.35	0.33	0.31	0.29	0.27	0.26	0.24	0.23	0.21	0.20	0.19	0.17	0.16	0.15	0.14	0.13	0.13	0.12	0.11
8.9	0.42	0.39	0.37	0.34	0.32	0.30	0.28	0.27	0.25	0.23	0.22	0.21	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.12	0.11	0.10	0.09
9.0	0.36	0.34	0.32	0.30	0.28	0.26	0.24	0.23	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.09	0.09	0.08