RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA750)
Migration of Contaminated Groundwater Under Control

Facility Name: Arkema Inc., East Plant, West Plant, West Brine Field
Facility Address: Riverview Plant
17168 West Jefferson Ave.
Riverview, MI 48192
Facility EPA ID #: MID 005 363 114

1. Has **all** available relevant/significant information on known and reasonably suspected releases to groundwater media, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

   __X__ If yes - check here and continue with #2 below.

   _____ If no - re-evaluate existing data, or

   _____ If data are not available skip to #6 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EIs developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA. The "Migration of Contaminated Groundwater Under

Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated groundwater and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination and the need to restore, wherever practicable, contaminated groundwater to be suitable for its designated current and future uses.

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

2. Is **groundwater** known or reasonably suspected to be "contaminated"[1] above appropriately protective "levels" (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

__X__ If yes – continue after identifying key contaminants, citing appropriate "levels", and referencing supporting documentation.

_____ If no – skip to #8 and enter "YE" status code, after citing appropriate "levels", and referencing supporting documentation to demonstrate that groundwater is not "contaminated".

_____ If unknown – skip to #8 and enter "IN" status code.

Rationale and Reference(s):

The Arkema site consists of three basic hydrogeologic units:

- A shallow water bearing zone, which extends from 3 to 16 ft below ground surface, and is comprised of fill and silty sand units. Within the zone, the groundwater flow direction across the Site is highly variable and is dependent on seasonal fluctuations in the Detroit River. The direction of flow along the eastern edge of the Site adjacent to the Detroit River is either east or west, toward or away from the Detroit River, although groundwater flow in the southwest corner appeared to be somewhat static due to the proximity of Monguagon Creek and the West Plant's retention pond. Seasonal changes limit the shallow groundwater flow in any one direction across the site.

- An intermediate clay aquitard which is a confining layer between the shallow water bearing zone and the deep water bearing zone. Groundwater flow in the aquitard is predominantly downward because of an observed steeper vertical hydraulic gradient.

- A deep water bearing zone which is encountered between 51 and 56 ft below ground surface, and is confined by the overlaying intermediate aquitard. Groundwater flow within this is towards the southwest. Groundwater migration rates in this zone are conservatively estimated to be approximately 36.5 ft/year.

The drinking water exposure pathway is not relevant at the Site, since the shallow groundwater is not used as a drinking water source. The *Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action* states that "higher cleanup levels may be appropriate, for a given facility when the groundwater designation is not a current or reasonably expected

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriately protective risk-based "levels" (for the media, that identify risks within the acceptable risk range).

source of drinking water, and contaminants would not result in unacceptable impact to hydraulically connected surface water bodies". Shallow groundwater at the Site and in the immediate area is not used currently as a source of drinking water, nor is it expected to be used as a source of drinking water in the future. The deep aquifer is not used for drinking water purposes due to its naturally poor quality. Therefore, the shallow and deep aquifer was screened against relevant criteria based on non-potable potential routes of exposure to contaminants. These criteria are the Michigan Department of Environmental Quality (MDEQ), Part 201 Groundwater Volatilization to Indoor Air Inhalation Criteria [GVIIC]), direct contact Groundwater Contact Criteria [GCC]) and groundwater/surface water [GSI].

Considering these potential exposures, the following constituents were identified as having exceedances of GVIIC, GCC and/or GSI criteria:

East Plant:

Concentrations of constituents detected in groundwater samples collected for the East Plant RF and collected in 2004 in support of the Environmental Indicator determinations were screened against GVIIC, GCC and GSI criteria (Refer to Attachment 2 Table 1). The following site-related constituents were identified as having concentrations in exceedance of criteria:

Dioxins/Furans - 2,3,7,8-TCDD TEQ
Inorganics - cadmium, copper, cyanide, lead, manganese, mercury, selenium, silver, vanadium
PCBs/Pesticides - Aroclor 1254, 4,4'-DDE, aldrin, alpha-BHC, gamma chlordane, heptachlor, heptachlor epoxide
SVOCs - 2,4,6-trichlorophenol, 4-chloro-3-methylphenol, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, hexachlorobenzene, naphthalene, phenanthrene
VOCs - carbon tetrachloride, chloroform, vinyl chloride

West Plant:

Concentrations of constituents detected in groundwater samples collected for the West Plant RFI and collected in 2004 and 2005 in support of the Environmental Indicator determinations were screened against GVIIC, GCC and GSI criteria (Refer to Attachment 2 Table 2). The following site-related constituents were identified as having concentrations in exceedance of screening criteria:

Dioxins/Furans - 2,3,7,8-TCDD TEQ
Inorganics - selenium

West Brine Field:

Concentrations of constituents detected in groundwater samples collected for the West Brine Field RFI and collected in 2004 in support of the Environmental Indicator determinations were screened against GVIIC, GCC and GSI criteria (Refer to Attachment 2 Table 3). The following site-related constituents were identified as having concentrations in exceedance of screening criteria:

Inorganics - cadmium, copper, cobalt, copper, lead, manganese, mercury, nickel, thallium, vanadium, zinc

3. Has the **migration** of contaminated groundwater **stabilized** (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater"[2] as defined by the monitoring locations designated at the time of this determination)?

__X__ If yes - continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimensions of the "existing area of groundwater contamination"[2].

_____ If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the "existing area of groundwater contamination"[2]) – skip to #8 and enter "NO" status code, after providing an explanation.

_____ If unknown – skip to #8 and enter "IN" status code.

Rationale and Reference(s):

East Plant:

Shallow groundwater at the East Plant flows easterly into the Trenton Channel of the Detroit River, which runs along the downgradient property boundary of the site. Groundwater migration to the Trenton Channel at the East Plant is monitored using MW-005, MW-007, MW-015/015R, MW-019, MW-023, and MW-024. Constituents including 2,3,7,8-TCDD TEQ, copper, cyanide, lead, manganese, mercury, selenium, silver, 2,4,6-trichlorophenol and naphthalene exceeded GSI criteria in groundwater collected from these groundwater/surface water interface (GSI) wells in May and July 2004 (CRA, 2004b). Each GSI well at the East Plant contains various GSI criteria exceedances. However, concentrations are generally stable to decreasing over the eleven-year period from 1993 to 2004. Additionally, highly conservative loading calculations on the data (Attachment 1) have shown that concentrations do not result in unacceptable impacts to the Trenton Channel.

A sandy, silty clay unit functions as an aquitard between shallow groundwater in the overlying fill and silty sand units and the deeper groundwater confined in the underlying bedrock. The aquitard is about 35 feet thick on average and exhibits very low hydraulic conductivity (0.001 to 0.008 feet/day) and limits horizontal and vertical migration rates to 5.69×10^{-4} feet/year (maximum) and 0.045 feet/year, respectively. The low permeability of the sandy, silty, clay unit, along with groundwater flow data showing slow vertical flow, indicate that the vertical migration of constituents to the deep confined water-bearing zone is occurring, but at extremely low rates (groundwater flow through the aquitard would take approximately 780 years) (CRA, 2004a).

[2] "existing area of contaminated groundwater" is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of "contamination" that can and will be sampled/tested in the future to physically verify that all "contaminated" groundwater remains within this area, and that the further migration of "contaminated" groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

West Plant:

Water table gradients at the West Plant are extremely flat and therefore flow is somewhat variable across the site. Shallow groundwater on the eastern third of the West Plant flows toward the East Plant. Shallow groundwater on the western two-thirds converges toward a filled historic drainage feature, which trends north/south where it then moves southerly towards Monguagon Creek. In a small portion of the northern part of the site, groundwater flows north towards Pennsylvania Avenue.

Groundwater flowing to the east is addressed in the *East Plant* discussion above; groundwater flowing to the south is monitored by wells MW-016, MW-018, MW-019 and MW-217 (replacing MW-017), all of which are designated GSI wells due to the presence of Monguagon Creek across the southern property boundary; and groundwater flowing to the north is monitored by wells MW-001, MW-011, and MW-012.

Only 2,3,7,8-TCDD TEQ (PCDDs/PCDFs) and selenium have been encountered above criteria at the West Plant GSI. Selenium was identified above GSI criteria in MW-017 only (in 2000, prior to it being damaged). However, selenium is believed to be a naturally occurring constituent and was discussed in the West Plant RFI Report (CRA, 2002b). PCDDs/PCDFs have been detected in MW-016 and MW-217. Concentrations of PCDDs/PCDFs detected at the West Plant are stable to decreasing over the eleven-year period from 1993 to 2004. Additionally, the most downgradient monitoring well, MW-018, has not shown any exceedances and MW-019 has been found to be dry. Furthermore, MW-217 has not shown detected concentrations of PCDDs/PCDFs for two sampling events since May 2004.

To date, there have been no exceedances of GVIIC or GCC in the northern monitoring wells (MW-001, MW-011, and MW-012).

West Brine Field:

Shallow groundwater at the West Brine Field flows very slowly from the northern and southern property boundaries inward toward the Huntington Drain where the flows converge and move easterly toward Monguagon Creek (CRA, 2002a; CRA, 2004b).

The two most recent sampling events (May and July 2004) identified only manganese and thallium above GSI criteria Manganese was detected in MW-002, MW-003 and MW-004 and thallium was detected in MW-002. The constituent concentrations are believed to be representative of Site-specific background as these metals were not used in any Site manufacturing processes. Their presence is not considered to be associated with a "plume" having a potential for migration.

4. Does "contaminated" groundwater **discharge** into **surface water** bodies?

__X__ If yes – continue after identifying potentially affected surface water bodies.

_____ If no – skip to #7 (and enter a "YE" status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater "contamination" does not enter surface water bodies.

_____ If unknown – skip to #8 and enter "IN" status code.

Rationale and Reference(s):

East Plant:

Based on information collected during the East Plant RFI, shallow groundwater flow at the site is observed to migrate towards the Trenton Channel of the Detroit River. The primary constituent migration pathway for dissolved-phase constituents is horizontally through the sandy fill and thin, discontinuous lenses of sand within the peat unit of the shallow water-bearing zone (CRA, 2004a; CRA, 2004b).

West Plant:

Surface water bodies at he West Plant include Pond 4 (SWMU 4) and Pond 6 (Area 8). Pond 4, which is better characterized as a process unit, is a permitted National Pollutant Discharge Elimination System (NPDES) surface impoundment used for settling, skimming, and equalization of West Plant process wastewaters and non-contact cooling water prior to discharge (CRA, 2002b). The impoundment was constructed with steel sheeted walls and a clay liner; therefore, groundwater is not expected to discharge to Pond 4.

Pond 6, a former bermed surface impoundment, is located in a hydraulically upgradient portion of the West Plant site. The bottom of Pond 6 is very shallow and is dry at various times throughout the year. It is not anticipated that affected groundwater from the site would discharge to Pond 6.

Monguagon Creek is south of the southern property boundary of the West Plant and is the likely discharge point for much of the shallow groundwater flow on the West Plant. For this reason, MW-016, MW-018, MW-019 and MW-217 (replaced MW-017), which are located near the discharge point, are designated as GSI wells.

West Brine Field:

Groundwater at the West Brine Field flows from the north and south towards the Huntington Drain that transects the center of the site from east to west. The Huntington Drain is a shallow, intermittent surface drainage feature.

5. Is the **discharge** of "contaminated" groundwater into surface water likely to be "**insignificant**" (i.e., the maximum concentration[3] of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level", and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

__X__ If yes - **skip to #7** (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concetration[3] of key contaminants discharged above their groundwater "level", the value of the appropriate "level(s)", and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgement/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or eco-system.

_____ If no – (the discharge of "contaminated" groundwater into surface water is potentially significant) – continue after documenting: 1) the maximum known or reasonably suspected concentration[3] of each contaminant discharged above its groundwater "level", the value of the appropriate "level(s)", and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations3 greater than 100 times their appropriate groundwater "levels", the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

_____ If unknown – enter "IN" status code in #8.

Rationale and Reference(s):

East Plant:

East Plant groundwater discharges to the Trenton Channel of the Detroit River. The loading of site constituents to the Trenton Channel was calculated using the methodologies in Section 3.3.1.2 of the Groundwater Investigation Report (CRA, 2004b). Using conservative parameter values and maximum groundwater concentrations, modeled surface water concentrations representing loading to the Trenton Channel do not exceed GSI criteria (refer to Attachment 1). The results of the loading evaluation indicate that groundwater discharge to surface water in the Trenton Channel is insignificant.

West Plant:

As stated in the rationale for Question 4, contaminated groundwater is not anticipated to discharge to surface water on the West Plant. The only potential surface water discharge is to Monguagon Creek located south of the southern plant property boundary. As stated previously,

[3] As measured in groundwater prior to entry to the groundwater-surface water/sediment interaction (e.g., hyporheic) zone.

only PCDDs/PCDFs and selenium have been encountered above criteria at the West Plant GSI. However, PCDDs/PCDFs have not been identified in the most downgradient monitoring wells (sampled most recently in February and April 2005) and selenium, detected at concentrations well below the GSI criteria, is believed to be a naturally occurring constituent (CRA, 2002b).

West Brine Field:

The two most recent sampling events (May and July 2004) identified only manganese and thallium above GSI criteria. Manganese was detected in MW-002, MW-003 and MW-004 and thallium was detected in MW-002. The constituent concentrations have been detected at concentrations well below the GSI criteria and are believed to be representative of Site-specific background as these metals were not used in any Site manufacturing processes.

6. Can the **discharge** of "contaminated" groundwater into surface water be shown to be "**currently acceptable**" (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

_____ If yes – continue after either: 1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site's surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR 2) providing or referencing an interim-assessment[5], appropriate to the potential for impact, that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialist, including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment "levels", as well as any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

_____ If no – (the discharge of "contaminated" groundwater can not be shown to be "currently acceptable") – skip to #8 and enter "NO" status code, after documenting the currently unacceptable impacts to the surface water body, sediments, and/or eco-systems.

_____ If unknown – skip to 8 and enter "IN" status code.

Rationale and Reference(s):

[4] Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.

[5] The understanding of the impacts of contaminated groundwater discharges into surface water bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediments or eco-systems.

7. Will groundwater **monitoring**/measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the "existing area of contaminated groundwater"?

   __X__ If yes – continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the "existing area of groundwater contamination".

   _____ If no – enter "NO" status code in #8.

   _____ If unknown – enter "IN" status code in #8.

   Rationale and Reference(s):

   Future Site-wide ground water monitoring will be performed as part of the Corrective Action. A perimeter well monitoring network will be in place to ensure that no constituents will be migrating off-site, and to monitor concentration of contaminants that would potentially migrate into the Trenton Channel. Details of the groundwater-monitoring program will be developed during the Corrective Measures Study phase of the project.

Environmental Indicator (EI) RCRIS code (CA750)
Migration of Contaminated Groundwater Under Control

8. Check the appropriate RCRIS status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

__X__ YE – Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control: at the **Arkema Inc., East Plant, West Plant, and West Brine Field properties**, EPA ID# **MID 005 363 114**, located at **Riverview Plant, 17168 West Jefferson Ave., Riverview, MI 48192.** Specifically, this determination indicates that the migration of "contaminated" groundwater is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater". This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

_____ NO – Unacceptable migration of contaminated groundwater is observed or expected.

_____ IN – More information is needed to make a determination.

Completed by (signature) Tammy Moore Date 6/21/05

(print) TAmmy Moore

(title) Env. Scientist

Supervisor (signature) George J. Hamper Date 6-22-05

(print) George J. Hamper

(title) Chief CA Section, ECAB

(EPA Region or State) R5

Locations where References may be found:

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ACRONYM LIST

bgs	below ground surface
GCC	groundwater contact criteria
GSI	groundwater/surface water interface
GVIIC	groundwater volatilization to indoor air inhalation criteria
MDEQ	Michigan Department of Environmental Quality
PCBs	polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
RFI	RCRA facility investigation
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCDD	tetrachlorodibenzo-*p*-dioxin
TEQs	toxicity equivalents
US EPA	United States Environmental Protection Agency
VOC	volatile organic compound

REFERENCES

CRA, 2002a. *Final RCRA Facility Investigation Report - West Brine Field.* Prepared for Arkema Inc. (formerly ATOFINA Chemicals, Inc and Elf Atochem North America, Inc.), February 2002.

CRA, 2002b. *Final RCRA Facility Investigation Report - West Plant.* Prepared for Arkema Inc. (formerly ATOFINA Chemicals, Inc and Elf Atochem North America, Inc.), June 2002.

CRA, 2004a. *Revised Final RCRA Facility Investigation Report - East Plant.* Prepared for Arkema Inc. (formerly ATOFINA Chemicals, Inc and Elf Atochem North America, Inc.), July 2004.

CRA, 2004b. Groundwater Investigation Report In Support of Environmental Indicator (EI) Determinations for the East Plant, West Plant, and West Brine Field. August, 2004.

CRA, 2005a. Groundwater Investigation Letter Report in Response to the United States Environmental Protection Agency (U.S. EPA) Letter Dated December 16, 2004. March 30, 2005.

ATTACHMENT 1

TRENTON CHANNEL LOADING EVALUATION
EAST PLANT
ARKEMA INC.
RIVERVIEW/WYANDOTTE, MICHIGAN

MAY AND JULY 2004 EI SAMPLING EVENTs - SUMMARY OF DETECTED CONSTITUENTS IN GSI WELLS EXCEEDING PART 201 GSI CRITERIA[1]:

Aquifer Location				*GSI*	*GSI*	*GSI*	*GSI*	*GSI*	*GSI*	*GSI*	*GSI*
Sample Location		*Part 201*	*Maximum*	*MW-007*	*MW-007*	*MW-007*	*MW-019*	*MW-019*	*MW-023*	*MW-023*	*MW-024*
Sample Identification		*GSI Criteria*	*Concentration*	*EA03-EP-MW007-01*	*EA03-EP-MW007-01*	*EA03-EP-MW007-02*	*EA03-EP-MW019-01*	*EA03-EP-MW019-01*	*EA03-EP-MW023-01*	*EA03-EP-MW023-01*	*EA03-EP-MW024-01*
Sample Date			*(mg/L)*	*5/4/2004*	*7/7/2004*	*7/7/2004*	*5/3/2004*	*7/8/2004*	*5/4/2004*	*7/8/2004*	*5/4 and 5/5, 2004*
Sample Type						*Duplicate*					
Dioxins/Furans	*Units*										
Dioxin Toxicity Equivalent (TEQ)	mg/L	0.00000001	0.00000022	0.00000011 J	0.000000049 J	0.000000051 J	0.00000022 J	0.00000002 J	--	--	--
Metals											
Copper	mg/L	0.01	0.019	0.0057	0.0053	0.0057	ND(0.0020)	ND(0.0020)U	0.019	0.0068	0.0065
Cyanide (total)	mg/L	0.0052	0.042	0.042	0.018	0.018	ND(0.0050)	ND(0.0050)	ND(0.0050)	0.013	ND(0.0050)
Lead	mg/L	0.012	0.019	0.0020 J	ND(0.0030)	ND(0.0030)	ND(0.0030)	ND(0.0030)	0.019	0.0024 J	ND(0.0030)
Manganese	mg/L	0.60	2.8	0.017	0.015	0.014 J	0.22	0.13	1.8	1.1	2.8
Mercury	mg/L	0.0000013	0.000057	ND(0.00020)	ND(0.00020)U	ND(0.00020)U	ND(0.00020)	0.000038 J	ND(0.00020)	0.000057 J	ND(0.00020)
Selenium	mg/L	0.005	0.0084	0.0084 J	ND(0.0020)UJ	0.0072 J	ND(0.0020)	0.0013 J	ND(0.040)	ND(0.010)UJ	ND(0.020)
Silver	mg/L	0.0002	0.00043	0.00043 J	0.000084 J	ND(0.00050)UJ	ND(0.00050)	ND(0.00050)UJ	0.00037 J	0.00016 J	0.00012 J
Semi-volatile Organic Compounds (SVOCs)											
2,4,6-Trichlorophenol	mg/L	0.005	0.009	0.0075	0.009	0.0089	ND(0.004)	ND(0.004)	--	ND(0.004)	ND(0.008)
Naphthalene	mg/L	0.013	0.033	ND(0.005)	0.0025 J	0.0026 J	ND(0.005)	ND(0.005)	--	ND(0.005)	0.033

Note:

1. Only groundwater samples with GSI exceedances are shown. Groundwater samples collected from MW-005 and MW-015/15R did not have GSI exceedances. Therefore, their results are not shown herein.

LOADING CALCULATION VARIABLES AND EQUATION:

			MW-005	*MW-007*	*MW-15/15R*	*MW-019*	*MW-023*	*MW-024*
K = Hydraulic Conductivity (ft/day) - Max. from Tbl 3.3 of the EP RFI (CRA, 2004a)	=	37.44	1.73	37.44	1.19	7.33	3.80	23.14
i = Gradient (ft/ft) - Max. from Nov. 1993 to Aug. 2004 - See Tbl 3.1 (CRA, 2004b)	=	0.040	0.015	0.027	0.016	0.038	0.040	0.032
n_e = Effective Porosity (unitless)	=	0.3						
V = Maximum Seepage Velocity (V = K* i / n_e) (ft/day)	=	4.99						
L = Length of River Segment (ft) - Entire Shoreline of the East Plant	=	2,400						
T = Thickness of the Unconsolidated Layer (ft) (30 ft depth of river + 10 feet into river)	=	40						
Q_{gw} = Aquifer Discharge (V*L*T) (ft^3/day)	=	479,232						
C_{gw} = Maximum Concentration Detected in GSI wells (mg/L)	=	(See Above)						
Q_{sw} = Discharge Rate of River (ft^3/day) - See Tbl C.1 (CRA, 2004b)	=	1.30E+10						

C_{sw} = Modeled Trenton Channel Concentration = $(C_{gw} * Q_{gw}) / (Q_{gw} + (0.1*Q_{sw}))$

LOADING CALCULATION RESULTS:

	Maximum Detected Groundwater Concentration used in Model (C_{gw}) (mg/L)	Resulting Modeled Trenton Channel Concentration (C_{sw}) (mg/L)	Part 201-GSI (mg/L)	Modeled Trenton Channel Concentration Exceed GSI Criteria?
Dioxin Toxicity Equivalent (TEQ)	2.20E-07	8.12E-11	1.00E-08	No
Copper	1.90E-02	7.01E-06	1.00E-02	No
Cyanide (total)	4.20E-02	1.55E-05	5.20E-03	No
Lead	1.90E-02	7.01E-06	1.20E-02	No
Manganese	2.80E+00	1.03E-03	6.00E-01	No
Mercury	5.70E-05	2.10E-08	1.30E-06	No
Selenium	8.40E-03	3.10E-06	5.00E-03	No
Silver	4.30E-04	1.59E-07	2.00E-04	No
2,4,6-Trichlorophenol	9.00E-03	3.32E-06	5.00E-03	No
Naphthalene	3.30E-02	1.22E-05	1.30E-02	No

ATTACHMENT 2 / TABLE 1

SUMMARY OF DETECTED CONSTITUENTS IN GROUNDWATER EXCEEDING PART 201 CRITERIA
EAST PLANT - 2004 DATA
ARKEMA INC.
RIVERVIEW/WYANDOTTE, MICHIGAN

Aquifer Location		*Groundwater*	*Groundwater*		*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*
Sample Location		*Surface water*	*Volatilization*	*Groundwater*	*MW-007*	*MW-007*	*MW-007*	*MW-019*	*MW-019*	*MW-023*	*MW-023*	*MW-024*
Sample Identification		*Interface*	*to Indoor Air*	*Contact*	*EA03-EP-MW007-01*	*EA03-EP-MW007-01*	*EA03-EP-MW007-02*	*EA03-EP-MW019-01*	*EA03-EP-MW019-01*	*EA03-EP-MW023-01*	*EA03-EP-MW023-01*	*EA03-EP-MW024-01*
Sample Date		*(GSI)*	*(GVIIC)*	*(GCC)*	*5/4/2004*	*7/7/2004*	*7/7/2004*	*5/3/2004*	*7/8/2004*	*5/4/2004*	*7/8/2004*	*5/4/2004*
Sample Type		*a*	*b*	*c*			*Duplicate*					
Dioxins/Furans	*Units*											
Dioxin Toxicity Equivalent (TEQ)	mg/L	0.00000001	NLV	0.00000001	0.00000011 J[ac]	0.000000049 J[ac]	0.000000051 J[ac]	0.00000022 J[ac]	0.00000002 J[ac]	--	--	--
Metals												
Copper	mg/L	0.010	NLV	7400	0.0057	0.0053	0.0057	ND(0.0020)	ND(0.0020)U	0.019[a]	0.0068	0.0065
Cyanide (total)	mg/L	0.0052	NLV	57	0.042[a]	0.018[a]	0.018[a]	ND(0.0050)	ND(0.0050)	ND(0.0050)	0.013[a]	ND(0.0050)
Lead	mg/L	0.012	NLV	ID	0.0020 J	ND(0.0030)	ND(0.0030)	ND(0.0030)	ND(0.0030)	0.019[a]	0.0024 J	ND(0.0030)
Manganese	mg/L	0.60	NLV	9100	0.017	0.015	0.014 J	0.22	0.13	1.8[a]	1.1[a]	2.8[a]
Mercury	mg/L	0.0000013	0.056	0.056	ND(0.00020)	ND(0.00020)U	ND(0.00020)U	ND(0.00020)	0.000038 J[a]	ND(0.00020)	0.000057 J[a]	ND(0.00020)
Selenium	mg/L	0.005	NLV	970	0.0084 J[a]	ND(0.0020)UJ	0.0072 J[a]	ND(0.0020)	0.0013 J	ND(0.040)	ND(0.010)UJ	ND(0.020)
Silver	mg/L	0.0002	NLV	1500	0.00043 J[a]	0.000084 J	ND(0.00050)UJ	ND(0.00050)	ND(0.00050)UJ	0.00037 J[a]	0.00016 J	0.00012 J
Pesticides												
4,4'-DDE	mg/L	--	NLV	0.027	--	--	--	--	--	--	--	--
Aldrin	mg/L	0.00001	0.18	0.00034	--	--	--	--	--	--	--	--
alpha-BHC	mg/L	--	2	0.06	--	--	--	--	--	--	--	--
gamma-Chlordane	mg/L	--	0.056	0.015	--	--	--	--	--	--	--	--
Heptachlor	mg/L	0.00001	0.18	0.0029	--	--	--	--	--	--	--	--
Heptachlor epoxide	mg/L	ID	NLV	0.009	--	--	--	--	--	--	--	--
Semi-Volatile Organic Compounds (SVOCs)												
2,4,6-Trichlorophenol	mg/L	0.0044	NLV	10	0.0075[a]	0.009[a]	0.0089[a]	ND(0.004)	ND(0.004)	--	ND(0.004)	--
Benzo(a)pyrene	mg/L	ID	NLV	0.001	ND(0.004)	ND(0.004)	ND(0.004)	ND(0.004)	ND(0.004)	--	ND(0.004)	--
Benzo(b)fluoranthene	mg/L	ID	ID	0.0015	ND(0.004)	ND(0.004)UJ	ND(0.004)UJ	ND(0.004)	ND(0.004)	--	ND(0.004)	--
Benzo(g,h,i)perylene	mg/L	--	NLV	0.001	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	--	ND(0.005)	--
Chrysene	mg/L	ID	ID	0.0016	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	ND(0.005)	--	ND(0.005)	--
Naphthalene	mg/L	0.013	31	31	ND(0.005)	0.0025 J	0.0026 J	ND(0.005)	ND(0.005)	--	ND(0.005)	--
Volatile Organic Compounds (VOCs)												
Chloroform (Trichloromethane)	mg/L	0.17	180	150	ND(0.002)	ND(0.002)	ND(0.002)	ND(0.001)	ND(0.001)	--	ND(0.001)	--

Notes:

NLV - Not likely to volatilize

ID - Inadequate date to develop criterion

J - Estimated concentration.

UJ - Estimated reporting limit.

U - The analyte was analyzed, but was qualified not detected above the value identified.

ND ( ) - Not detected above the value in parenthesis.

[ ] - Constituent exceeds Criteria

ATTACHMENT 2 / TABLE 1

SUMMARY OF DETECTED CONSTITUENTS IN GROUNDWATER EXCEEDING PART 201 CRITERIA
EAST PLANT - 2004 DATA
ARKEMA INC.
RIVERVIEW/WYANDOTTE, MICHIGAN

Aquifer Location		*Groundwater*	*Groundwater*		*Shallow - GSI*	*Shallow*	*Shallow*	*Shallow*	*Shallow*	*Shallow*	*Shallow*	*Shallow*
Sample Location		*Surface water*	*Volatilization*	*Groundwater*	*MW-024*	*MW-009*	*MW-009*	*MW-012*	*MW-017*	*MW-017*	*MW-017*	*MW-020*
Sample Identification		*Interface*	*to Indoor Air*	*Contact*	*EA03-EP-MW024-01*	*EA03-EP-MW009-01*	*EA03-EP-MW009-01*	*EA03-EP-MW012-01*	*EA03-EP-MW017-01*	*EA03-EP-MW017-01*	*EA03-EP-MW017-02*	*EA03-EP-MW020-02*
Sample Date		*(GSI)*	*(GVIIC)*	*(GCC)*	*5/5/2004*	*5/6/2004*	*7/9/2004*	*5/5/2004*	*5/5/2004*	*7/8/2004*	*7/8/2004*	*7/7/2004*
Sample Type		*a*	*b*	*c*							*Duplicate*	*Duplicate*
Dioxins/Furans	***Units***											
Dioxin Toxicity Equivalent (TEQ)	mg/L	0.00000001	NLV	0.00000001	--	0.0000035 J[c]	0.00000019 J[c]	0.000000038[c]	0.00000000071 J	0.0000000007 J	--	0
Metals												
Copper	mg/L	0.010	NLV	7400	--	ND(0.0020)U	ND(0.0027)U	0.0017 J	0.0063	ND(0.0043)U	ND(0.0043)U	ND(0.0029)U
Cyanide (total)	mg/L	0.0052	NLV	57	--	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0050)	ND(0.0050)
Lead	mg/L	0.012	NLV	ID	--	ND(0.0030)	ND(0.0030)	ND(0.0030)	0.0025 J	ND(0.0030)	ND(0.0030)	ND(0.060)
Manganese	mg/L	0.60	NLV	9100	--	1.7	1.8	1.2	8.0	6.3	5.4	30.9
Mercury	mg/L	0.0000013	0.056	0.056	--	ND(0.00020)	0.000084 J	ND(0.00020)	ND(0.00020)	0.00013 J	0.00013 J	ND(0.00021)U
Selenium	mg/L	0.005	NLV	970	--	0.093	0.083 J	0.00086 J	1.3	0.39 J	0.59 J	ND(0.0020)UJ
Silver	mg/L	0.0002	NLV	1500	--	ND(0.00050)	ND(0.00050)UJ	ND(0.00050)	0.00023 J	0.000093 J	0.000077 J	0.0020 J
Pesticides												
4,4'-DDE	mg/L	--	NLV	0.027	--	0.0086 J	0.29[c]	--	ND(0.0005)	ND(0.005)	ND(0.001)	--
Aldrin	mg/L	0.00001	0.18	0.00034	--	0.0064 J[c]	0.19[bc]	--	ND(0.0005)	ND(0.005)	ND(0.001)	--
alpha-BHC	mg/L	--	2	0.06	--	0.023	0.63[c]	--	0.00036 J	ND(0.005)	0.00038 J	--
gamma-Chlordane	mg/L	--	0.056	0.015	--	ND(0.0025)	0.07[bc]	--	ND(0.0005)	ND(0.005)	ND(0.001)	--
Heptachlor	mg/L	0.00001	0.18	0.0029	--	0.012[c]	0.34[bc]	--	ND(0.0005)	ND(0.005)	ND(0.001)	--
Heptachlor epoxide	mg/L	ID	NLV	0.009	--	0.0036	0.1[c]	--	ND(0.0005)	ND(0.005)	ND(0.001)	--
Semi-Volatile Organic Compounds (SVOCs)												
2,4,6-Trichlorophenol	mg/L	0.0044	NLV	10	ND(0.008)	ND(0.4)	ND(0.64)	ND(0.004)	ND(0.1)	ND(0.08)	ND(0.13)	ND(0.004)
Benzo(a)pyrene	mg/L	ID	NLV	0.001	ND(0.008)	ND(0.4)	ND(0.64)	ND(0.004)	ND(0.1)	ND(0.08)	ND(0.13)	0.0012 J[c]
Benzo(b)fluoranthene	mg/L	ID	ID	0.0015	ND(0.008)	ND(0.4)	ND(0.64)	ND(0.004)	ND(0.1)	ND(0.08)	ND(0.13)	0.0019 J[c]
Benzo(g,h,i)perylene	mg/L	--	NLV	0.001	ND(0.01)	ND(0.5)	ND(0.8)	ND(0.005)	ND(0.12)	ND(0.1)	ND(0.17)	0.0013 J[c]
Chrysene	mg/L	ID	ID	0.0016	ND(0.01)	ND(0.5)	ND(0.8)	ND(0.005)	ND(0.12)	ND(0.1)	ND(0.17)	0.0019 J[c]
Naphthalene	mg/L	0.013	31	31	0.033[a]	2.8	4.5	ND(0.005)	0.087 J	0.075 J	0.11 J	0.00086 J
Volatile Organic Compounds (VOCs)												
Chloroform (Trichloromethane)	mg/L	0.17	180	150	ND(0.0017)	44	44	ND(0.001)	1600[bc]	1600[bc]	1800[bc]	0.014

Notes:

NLV - Not likely to volatilize

ID - Inadequate date to develop criterion

J - Estimated concentration.

UJ - Estimated reporting limit.

U - The analyte was analyzed, but was qualified not detected above the value identified.

ND ( ) - Not detected above the value in parenthesis.

[ ] - Constituent exceeds Criteria

ATTACHMENT 2 / TABLE 2

SUMMARY OF DETECTED CONSTITUENTS IN GROUNDWATER EXCEEDING PART 201 CRITERIA
WEST PLANT - 2004 AND 2005 DATA
ARKEMA INC.
RIVERVIEW, MICHIGAN

Aquifer Location		*Groundwater*	*Groundwater*		*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*
Sample Location		*Surface water*	*Volatilization*	*Groundwater*	*MW-016*	*MW-016*	*MW-016*	*MW-217*	*MW-217*	*MW-217*	*MW-217*
Sample Identification		*Interface*	*to Indoor Air*	*Contact*	*EA03-WP-MW016-01*	*EA03-WP-MW016-01*	*EA03-WP-MW016-01*	*EA03-WP-MW217-01*	*EA03-WP-MW217-02*	*EA03-WP-MW217-01*	*EA03-WP-MW217-01*
Sample Date		*(GSI)*	*(GVIIC)*	*(GCC)*	*5/12/2004*	*7/15/2004*	*4/21/2005*	*5/12/2004*	*5/12/2004*	*7/15/2004*	*4/21/2005*
Sample Type		*a*	*b*	*c*					*Duplicate*		
Dioxins/Furans	*Units*										
Dioxin Toxicity Equivalent (TEQ)	mg/L	0.00000001	NLV	0.00000001	0	0.000000012 J[ac]	0.0000000047	0.000000096 J[ac]	0.000000038 J[ac]	0	0

Notes:

NLV - Not likely to volatilize
J - Estimated concentration.
[ ] - Constituent exceeds Criteria

ATTACHMENT 2 / TABLE 2

SUMMARY OF DETECTED CONSTITUENTS IN GROUNDWATER EXCEEDING PART 201 CRITERIA
WEST PLANT - 2004 AND 2005 DATA
ARKEMA INC.
RIVERVIEW, MICHIGAN

Aquifer Location		*Groundwater*	*Groundwater*		*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow*	*Shallow*	*Shallow*	*Shallow*
Sample Location		*Surface water*	*Volatilization*	*Groundwater*	*MW-018*	*MW-018*	*MW-018*	*MW-005*	*MW-005*	*MW-005*	*MW-006*
Sample Identification		*Interface*	*to Indoor Air*	*Contact*	*EA03-WP-MW018-01*	*EA03-WP-MW018-02*	*EA03-WP-MW018-01*	*EA03-WP-MW005-01*	*EA03-WP-MW005-01*	*EA03-WP-MW005-01*	*EA03-WP-MW006-01*
Sample Date		*(GSI)*	*(GVIIC)*	*(GCC)*	*2/9/2005*	*2/9/2005*	*4/21/2005*	*5/12/2004*	*7/15/2004*	*4/21/2005*	*5/11/2004*
Sample Type		*a*	*b*	*c*		*Duplicate*					
Dioxins/Furans	*Units*										
Dioxin Toxicity Equivalent (TEQ)	mg/L	0.00000001	NLV	0.00000001	0	0	0	0.000000057[c]	0.0000000026 J	0.000000000055	0

Notes:

NLV - Not likely to volatilize
J - Estimated concentration.
[ ] - Constituent exceeds Criteria

ATTACHMENT 2 / TABLE 2

SUMMARY OF DETECTED CONSTITUENTS IN GROUNDWATER EXCEEDING PART 201 CRITERIA
WEST PLANT - 2004 AND 2005 DATA
ARKEMA INC.
RIVERVIEW, MICHIGAN

Aquifer Location		*Groundwater*	*Groundwater*		*Shallow*	*Shallow*	*Shallow*	*Shallow*	*Shallow*	*Shallow*	*Shallow*
Sample Location		*Surface water*	*Volatilization*	*Groundwater*	*MW-006*	*MW-010*	*MW-010*	*MW-013*	*MW-013*	*MW-014*	*MW-014*
Sample Identification		*Interface*	*to Indoor Air*	*Contact*	*EA03-WP-MW006-01*	*EA03-WP-MW010-01*	*EA03-WP-MW010-01*	*EA03-WP-MW013-01*	*EA03-WP-MW013-01*	*EA03-WP-MW014-01*	*EA03-WP-MW014-01*
Sample Date		*(GSI)*	*(GVIIC)*	*(GCC)*	*7/14/2004*	*5/10/2004*	*7/13/2004*	*5/10/2004*	*7/13/2004*	*5/12/2004*	*7/14/2004*
Sample Type		*a*	*b*	*c*							
Dioxins/Furans	*Units*										
Dioxin Toxicity Equivalent (TEQ)	mg/L	0.00000001	NLV	0.00000001	0	0	0	0.000000000074 J	0	0	0

Notes:

NLV - Not likely to volatilize
J - Estimated concentration.
[ ] - Constituent exceeds Criteria

ATTACHMENT 2 / TABLE 2

SUMMARY OF DETECTED CONSTITUENTS IN GROUNDWATER EXCEEDING PART 201 CRITERIA
WEST PLANT - 2004 AND 2005 DATA
ARKEMA INC.
RIVERVIEW, MICHIGAN

Aquifer Location		*Groundwater*	*Groundwater*		*Shallow*	*Shallow*	*Shallow*	*Shallow*	*Deep*	*Deep*	*Deep*
Sample Location		*Surface water*	*Volatilization*	*Groundwater*	*MW-015*	*MW-015*	*MW-015*	*MW-015*	*MW-200*	*MW-200*	*MW-201*
Sample Identification		*Interface*	*to Indoor Air*	*Contact*	*EA03-WP-MW015-01*	*EA03-WP-MW015-05*	*EA03-WP-MW015-01*	*EA03-WP-MW015-01*	*EA03-WP-MW200-01*	*EA03-WP-MW200-02*	*EA03-WP-MW201-01*
Sample Date		*(GSI)*	*(GVIIC)*	*(GCC)*	*5/12/2004*	*5/12/2004*	*7/14/2004*	*4/21/2005*	*6/24/2004*	*6/24/2004*	*6/22/2004*
Sample Type		*a*	*b*	*c*						*Duplicate*	
Dioxins/Furans	*Units*										
Dioxin Toxicity Equivalent (TEQ)	mg/L	0.00000001	NLV	0.00000001	0.000000028 J[e]	0.00000024 J[e]	0.0000000045 J	0	0	0	0

Notes:

NLV - Not likely to volatilize
J - Estimated concentration.
[ ] - Constituent exceeds Criteria

ATTACHMENT 2 / TABLE 3

SUMMARY OF DETECTED CONSTITUENTS IN GROUNDWATER EXCEEDING PART 201 CRITERIA
WEST BRINE FIELD - 2004 DATA
ARKEMA INC.
RIVERVIEW, MICHIGAN

Aquifer Location		*Groundwater*	*Groundwater*		*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*	*Shallow - GSI*
Sample Location		*Surface water*	*Volatilization*	*Groundwater*	*MW-002*	*MW-002*	*MW-003*	*MW-004*
Sample Identification		*Interface*	*to Indoor Air*	*Contact*	*EA03-BF-MW002-01*	*EA03-BF-MW002-01*	*EA03-BF-MW003-01*	*EA03-BF-MW004-01*
Sample Date		*(GSI)*	*(GVIIC)*	*(GCC)*	*5/7/2004*	*7/12/2004*	*7/12/2004*	*5/7/2004*
Sample Type		*a*	*b*	*c*				
Metals								
Manganese	mg/L	1.32	NLV	9100	2.6[a]	4.2[a]	2.9[a]	1.8[a]
Thallium	mg/L	0.0037	NLV	13	0.0058[a]	0.0043[a]	0.00054 J	0.00022 J

Notes:

NLV - Not likely to volatilize

J - Estimated concentration.

[ ] - Constituent exceeds Criteria