

**Documentation of Environmental Indicator Determination
in accordance with EPA Interim Final Guidance 2/5/99**

**RCRA Corrective Action
Environmental Indicator (EI) RCRA Info Code (CA750)**

Migration of Contaminated Groundwater Under Control

Facility Name: BASF
Facility Address: 3150 Highway JJ, Hannibal, Missouri
Facility EPA ID #: MOD050226075

1. Has **all** available relevant/significant information on known and reasonably suspected releases to the 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 #8 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for 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 EIs 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 Determination status codes should remain in RCRA Info national database ONLY as long as they remain true (i.e., RCRA Info 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 [e.g., Maximum Contaminant Levels (MCLs), the maximum permissible level of a contaminant in water delivered to any user of a public water system under the Safe Drinking Water Act]) 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.

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 appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

Rationale and Reference(s):

A total of 326 groundwater samples were collected during the Phase I and Phase II RCRA Facility Investigations. The analytical results confirm the presence of 1,2-dichloroethane (1,2) and monochlorobenzene (MCB) at concentrations exceeding maximum contaminant levels in groundwater beneath the site. Additionally, concentrations of benzene and trichloroethylene have been detected at concentrations exceeding maximum contaminant levels in groundwater at the site, albeit, to a lesser extent. The extent of the constituents of concern has been delineated. Perimeter groundwater monitoring wells in all directions have consistently been non-detect.

References:

- RCRA Facility Investigation Report, July 22, 2005.
- Phase II RCRA Facility Investigation Report, October 13, 2006.

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.

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.

Rationale and Reference(s):

Historical operation of the site provided conditions for the 1,2-dichloroethane and MCB impacted groundwater to exist as a stable plume that was not migrating from the site. This conclusion is supported by groundwater analytical data collected over the period from 1996 through 2005.

Several factors affecting the site hydrology have changed in the recent past that have altered groundwater flow directions to consistently flow to the south instead of alternating between the north and the south. These conditions include:

1. Industrial Wells 7, 8, and 9 were shut down in October 2004 as part of the Industrial Well Shut Down test. The plant operations have converted to clarified water and can no longer use the untreated water from Industrial Wells 7, 8, and 9.
2. Industrial Well 13, located in the west central portion of the site was rehabilitated and returned to service at a pumping rate of 1500 gallons per minute.
3. The elevation of water within the Borrow Pit Pond that surrounds the southern and eastern property owned by BASF has been historically maintained by the plant at an elevation of 461 feet above mean sea level (ft amsl). The minimal elevation of the Mississippi River as maintained by the U.S. Corps of Engineers (USACE) is 461 ft amsl. Therefore, the borrow pit impoundments acted as the southern hydrologic boundary during periods of low river stage that flattened the hydraulic gradient across the site. In 2006, the elevation in the impoundments was decreased to approximately 458 ft amsl to minimize erosion of the adjacent levee and thus allowed a steeper southerly gradient to be established.
4. The Hannibal area has experienced a sustained drought since 2004. This has decreased local recharge from precipitation, which has allowed the water table to remain at an elevation below that of the lowest river stage.

These conditions contributed to a marked increase in monochlorobenzene concentrations in monitoring well MW-10S. However, constituents of concern have not been detected in the perimeter monitoring wells MW-11S, MW-12S, and MW-17S through MW-20S. Additionally, counter measures have been implemented at the plant to counter the hydraulic influences that have allowed constituents of concern (COC) impacted groundwater to migrate south-southeast of the plant towards MW-10S. These counter measures include:

1. Discontinued pumping of the Borrow Pit Pond elevation down to 458 ft amsl allowing the pond elevation to refill with precipitation to an approximate elevation of 461 to 462 ft amsl. This elevation is greater than the minimal elevation of the Mississippi River as maintained by the USACE.
2. Discontinued pumping of Industrial Well 13 in favor of Wells 10 through 12 located along the Mississippi River to the northwest of the areas of concern (Figure 1).

3. Implement quarterly sampling of monitoring wells MW-9S and MW-10S and perimeter wells 11S, MW-12S, and MW-17S through MW-20S.

Quarterly sampling to verify that the counter measures are effective have shown that MCB concentrations at MW-10S have stabilized and perimeter wells MW-11S, MW-12S, MW-17S, MW-18S, MW-19S, and MW-20 continue to be non-detect.

References:

- RCRA Facility Investigation Report, July 22, 2005.
- Phase II RCRA Facility Investigation Report, October 20, 2006.
- Groundwater Sample Results for September/October 2006, January 2007, February 2007, April 2007, and July 2007.
- Revised RFI Report Materials, May 3, 2007.
- Groundwater Sampling Event Data Transmittal, June 8, 2007.

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

_____ If yes - continue after identifying potentially affected surface water bodies.

 X 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):

Contaminated groundwater does not discharge into surface water bodies at the site. An industrial well shutdown test was conducted from September 2004 through December 2005 to determine if the COC were able to migrate into the Mississippi River from the site. The result of the 20-month industrial well shut down test demonstrated that the Mississippi River, which is maintained at a minimal river stage by the USACE for barge traffic, is a losing stream under almost all conditions. Therefore, the COC are unable to enter the Mississippi River regardless of the industrial well’s operation status.

References:

- RCRA Facility Investigation Report, July 22, 2005.
- Phase II RCRA Facility Investigation Report, October 13, 2006.

5. Is the **discharge** of “contaminated” groundwater into surface water likely to be “**insignificant**” (i.e., the maximum concentration³ of each contaminant discharging into

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

surface water is less than 10 times the appropriate groundwater "level," and there are no other conditions (e.g., the nature or 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)?

_____ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration³ 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 concentration³ 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 the 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): _____

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 implemented⁴)?

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.

_____ 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(s), 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 cannot 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): _____

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

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.

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):

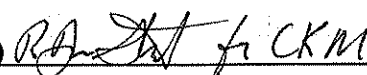
All groundwater monitoring wells are sampled semi-annually. Quarterly sampling of downgradient perimeter wells MW-9S, MW-10S, MW-12S, MW-13S, MW-17S, MW-18S, MW-19S, and MW-20S, (Figure 2) will continue until the end of 2008 at which time the need to continue quarterly sampling of perimeter wells will be re-evaluated.

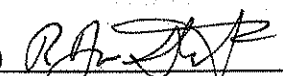
8. Check the appropriate RCRA Info status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

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 BASF facility, EPA ID # MOD050226 075, located at 3150 Highway JJ, Hannibal, Missouri. 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)  Date 9-12-07
(Print) Christine Kump-Mitchell, P.E.
(Title) Environmental Engineer

Supervisor: (Signature)  Date 9-12-07
(Print) R. Bruce Stuart, P.E., R.G.
(Title) Chief, Groundwater Unit
(EPA Region or State) Missouri

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Locations where References may be found:

Missouri Department of Natural Resources
1738 East Elm Street, Jefferson City, Missouri
Hazardous Waste Program files:
BASF, Hannibal – TSD and GWM Files:

Contact telephone and e-mail numbers

(Name) Christine Kump-Mitchell, P.E.
(Phone #) (314) 416-2960 Ext. 256
(E-mail) christine.kump@dnr.mo.gov

ref: *ca750epa.doc*