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: **Ashland Inc. Distribution Company DSO Facility**
Facility Address: **7710 Polk Street, St. Louis, MO 63111**
Facility EPA ID #: **MOD031005341**

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 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 EI 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 ground water 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 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.

   Rationale and Reference(s):

   Groundwater sampling at the site (Figure 1) was conducted in March 2004 during Phase II of the RCRA Facility Investigation (RFI) and reported in the RFI Phase II Report submitted to Missouri Department of Natural Resources (MDNR) on July 8, 2004.

[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).

Several compounds were detected in site groundwater above the level of concern. A summary of the compounds detected during Phase II RFI activities is presented below:

Compound	High Groundwater Concentration (ug/L)	EPA Region IX PRGs (ug/L)	GTARC (ug/L)	Number of Wells Detected
1,1-Dichloroethane	130	**810**	NA	1 of 9
Benzene	**55**	**0.34**	**5**	3 of 9
Chlorobenzene	38	110	**100**	1 of 9
Chloroethane	**300**	**4.6**	NA	5 of 9
cis-1,2-Dichloroethene	**280**	**61**	**70**	2 of 9
Ethylbenzene	**790**	**2.9**	**700**	5 of 9
Toluene	**6800**	**720**	**150**	4 of 9
Trichloroethene	**1.4**	**0.028**	**5**	1 of 9
Vinyl Chloride	**1.8**	**0.02**	**2**	1 of 9
Xylenes (Total)	**3700**	**210**	**320**	4 of 9
2,4-Dimethylphenol	130	**730**	**540**	1 of 9
2-Fluorophenol	89	NA	NA	9 of 9
2-Methylnaphthalene	21	NA	NA	3 of 9
2-Methylphenol (o-cresol)	11	**1800**	NA	1 of 9
3-Methylphenol/4-Methylphenol	260	**1800/180**	NA	2 of 9
Bis(2-ethylhexyl) phthalate	**10**	**4.8**	**6**	1 of 9
Carbazole	**14**	**3.4**	NA	1 of 9
Naphthalene	**58**	**6.2**	**100**	2 of 9

(1) Numbers in bold exceed level of concern
(2) Screening criteria is the Missouri Tier 1 Groundwater Target Concentration (GTARC) (MDNR, 2001) or the USEPA Region IX Preliminary Remediation Goal (PRG) for Tap Water (USEPA Region IX, 2002).
(3) NA indicates PRG or GTARC is not established for this compound

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):
The site-wide groundwater evaluation completed in 2004 during Phase II of the RFI was presented in the "RFI Phase II Report, URS, 2004." Based on groundwater data obtained during this evaluation compared to historical investigations on site, the migration of groundwater containing VOCs appears to have stabilized. A summary of analytical data from the Phase II groundwater sampling is included in this report as Table 1. Further discussion is presented below.

Investigation into an on site release of Hi-Sol 10 (Cas#64742956) began in 1990 with the installation of monitoring wells to determine the extent of contamination. Dissolved and Light Non-Aqueous Phase Liquid (LNAPL), constituents were detected in groundwater at thicknesses up to 1.89 inches. In June and July 1996, an investigation by MDNR identified one SWMU and three AOCs requiring further investigation and reported the presence of free product in several wells. The groundwater contaminant plume consisted primarily of benzene, ethylbenzene, and xylenes, the source of which was apparently the 1990 Hi-Sol Leak.

Measurements taken in 2003 and 2004 indicate that the Hi-Sol 10 free product plume is

[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.

no longer evident except as a light sheen in MW-18 (installed as a replacement for MW-1 near the source of the plume) and MW-8. Historically, MW-1 had the greatest thickness of free product (1.8 inches in January 1990 and 1/8-inch in June 1996). MW-4, which had the second largest free product thickness (1.6 inches in January 1990), had decreased to just a sheen in June 1996. During the Phase II groundwater investigation in 2004, none of the monitoring wells had any measurable free product.

As shown in the following tables, BETX concentrations have dropped dramatically between the 1996 sampling and the 2004 sampling, concurrently with the disappearance of free product. In addition, BTEX analytical results from the ten wells sampled in 2004, including MW-18 and MW-4, are significantly below the solubility limit, indicating that free product is no longer present. The same decreasing BTEX trend is evident in MW-7 and MW-15 (a replacement for MW-14).

Well	January 1990	June 1996	January 2003	March 2004
MW-1	1.8 inches	1/8-inch	Not Located	Unmeasurable sheen (MW-18)
MW-2	0.2-inches	Not Located	Not Located	Not Located
MW-3	Sheen	Not Located	Not Located	Not Located
MW-4	1.6-inches	Sheen	Sheen	No sheen
MW-7		Sheen	Not Accessible	No sheen
MW-8			Sheen	Unmeasurable sheen
MW-11		No Sheen	Not Located	Not Located
MW-14		No Sheen	Not Located	No sheen (MW-15)

	MW-1 1996	MW-18 2004	MW-4 1996	MW-4 2004
Benzene	ND	ND	ND	2 µg/l
Ethylbenzene	ND	320 µg/l	ND	14 µg/l
Toluene	70,000 µg/l	6,800 µg/l	16,000 µg/l	ND
Xylenes	4,800 µg/l	3,200 µg/l	ND	ND
Total BETX	74,800 µg/l	10,320 µg/l	16,000 µg/l	16 µg/l

	MW-7 1996	MW-7 2004	MW-14 1996	MW-15 2004
Benzene	ND	ND	66 µg/l	ND
Ethylbenzene	ND	12 µg/l	ND	ND
Toluene	15,000 µg/l	36 µg/l	7.4 µg/l	1.1 µg/l
Xylenes	770 µg/l	46 µg/l	36 µg/l	ND
Total BETX	15,770 µg/l	94 µg/l	109.4 µg/l	1.1 µg/l

Horizontal Migration:
Because fuels and Hi-Sol 10 were identified as past releases at the site, benzene, toluene, ethylbenzene and total xylenes isoconcentration maps (Figures 2-5 of this document) were prepared based on the Phase II groundwater sampling results in the RFI Phase II Report (URS, 2004). The isoconcentration maps indicated plumes centered in the tank farm area with ethylbenzene roughly limited to the tank farm area with only well MW-8 showing an ethylbenzene concentration (850 µg/l) greater than the GTARC level. The xylene isoconcentration map indicated a similar plume shape and size with wells outside of the tank farm area showing concentrations below laboratory detection limits.

Phase II sampling indicated the semi-volatile organic compound (SVOC) bis(2-ethylhexl)phthalate above the GTARC limit of 6 µg/l in MW-8 (10 µg/l) only.

Vertical Migration:
Phase II monitoring wells were installed to top of bedrock and screened across the water table because most of the chemicals of concern are considered LNAPLs, and would typically float in the water column. Preferential flow of groundwater, through the more porous sand and granular fill material covering the site and along the steep valley walls of the bedrock surface and topography adjacent to the river, remains more likely than movement through the massive limestone bedrock as groundwater would tend to follow the path of least resistance. In addition, as documented in boring logs and cross-sections included in the Phase II report, a clay layer exists over much of the site atop the bedrock impeding downward movement of these constituents where the layer occurs. Thus, it appears that vertical extent is delineated by the top of bedrock.

Additional Discussion (Natural Attenuation):
During the Phase II RFI investigation, groundwater samples from MW-4, MW-6A, MW-16, and MW-17 were analyzed for natural attenuation parameters in addition to the chemical analysis. The data was evaluated with respect to whether natural attenuation processes are active on site. The evaluation follows the ranking system found in the guidance document "Designing Monitoring Programs to Effectively Evaluate the Performance of Natural Attenuation" (Air Force Center for Environmental Excellence, January 2000). As detailed in the RFI Phase II Report (URS, 2004), the natural attenuation sampling results indicated that natural attenuation is occurring within the plume with the following evidence:

- Bacteria plate counts for wells within the plume are much higher than for the downgradient wells where the contaminant food source has been exhausted.

- The dissolved oxygen level was 8.5 mg/l in MW-6A (the most upgradient well, but still within the plume) and decreased to 1.7 mg/l for MW-18 and 0.7 mg/l for MW-7 (both wells within the plume). The dissolved oxygen level remained less than 1.0 mg/l for wells MW-15 and MW-16, which are located immediately outside the downgradient plume edge. By way of comparison, for well MW-17, located outside

the plume and sidegradient to the flow direction, the dissolved oxygen concentration was 10.2 mg/l.

- Sulfate was not detected in three wells within the plume compared to 86 mg/l detected in downgradient well MW-16.

- Methane concentrations decreased thirteen-fold from 4,800 µg/l in MW-4 near the center of the plume to 360 µg/l in downgradient well MW-16.

- Nitrate concentrations in all wells were non-detect.

- For all wells, temperature and pH were both within the range appropriate to support biological activity.

Thus, the results of the sampling for natural attenuation parameters is consistent with and supports the reduction in product thickness followed by the reduction in chemical concentrations which has been observed historically on the site. Analysis of groundwater sampling data indicates that natural attenuation of VOCs is occurring at the site and is limiting migration of the plume.

Based on the analysis presented herein, the migration of groundwater containing VOCs is under control at the site. Routine groundwater sampling for VOCs will be conducted to document that the migration of groundwater containing VOCs remains under control.

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):

The groundwater gradient in the site area generally slopes to the east/southeast, towards the Mississippi River. Therefore, the possibility of contaminant discharges to surface water exists. However as discussed in item number 3, the migration of groundwater containing VOCs has stabilized and significant migration towards the Mississippi River has not been identified by groundwater sampling.

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)?

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

X 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 concentrations[3] 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.

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

Rationale and Reference(s):

Contaminant	Maximum Concentration (µg/L)	Adjusted Region 5 ESL (µg/L)
Toluene	6800	2530
Ethylbenzene	790	140
Xylene	3700	270
Bis(2-ethylhexyl)phthalate	10	3

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])?

   X 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 specialists, 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

[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.

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):

As discussed in item number 4, discharge of groundwater contaminants from the site into the Mississippi River has not been noted. Evidence supports the attenuation of contaminants before significant discharge to the river. However, since the possibility exists, the following activities were performed as part of the RFI Phase II investigation in 2004. Concentrations of constituents measured in perimeter downgradient groundwater monitoring wells (MW-15, MW-16, MW-17 and MW-20) were evaluated in the Ecological Risk Assessment contained in RFI Phase II Draft Report dated July 8, 2004. While the assessment in these draft documents showed that groundwater discharge to the Mississippi River is not significant, additional considerations were evaluated to insure protection of surface waters. The Draft RFI Phase II Report shows a marked decrease for current levels of contamination over historic levels and contaminant concentrations decreasing as the current groundwater plume moves off-site toward the Mississippi River. The contaminants discharging to the river above Ecological Screening Levels were Toluene, Ethylbenzene, Xylene, and Bis(2-ethylhexyl)phthalate. The low number of chemical contaminants reaching the Mississippi River helps support the natural attenuation of contaminants at the site and how contaminants are being reduced before any impact to the river. The four contaminants of potential impact to the river are also highly susceptible to aerobic biodegradation mechanisms that are available along the Mississippi River. The conditions along the Mississippi River down gradient from the facility are another factor to consider for contaminants discharging to the river. The Mississippi River is used extensively for barge traffic "parking" and transportation up and down the river. The heavy use for barge traffic in the area results in channel conditions limiting use of the river in this area. The Mississippi River has been extensively dredged in the area to increase channel depth to support the barge industry. Also, river channelization has increased flow velocities resulting in upper portions of the channel being extensively "rip-rapped" to prevent soil erosion, limiting biological diversity and habitat. All these factors contribute to the environmental setting and support the conclusion that **discharge** of "contaminated" groundwater from the Ashland facility into the Mississippi River is **"insignificant".**

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):

Regarding the site-wide groundwater assessment, recommendations for future action were made in the RFI Phase II Report (URS, 2004) as follows:

- Collect a comprehensive round of groundwater levels semiannually and develop new water table maps to verify flow direction.
- Conduct annual groundwater monitoring of all viable monitoring wells onsite for VOCs (EPA 8260) and SVOCs (EPA 8270 parameters).
- Collect groundwater samples from downgradient wells (MW-15, MW-16, MW-17, MW-19, and MW-20) semiannually and analyze for BTEX compounds.
- Conduct annual monitoring of all wells for dissolved oxygen concentrations to verify that natural attenuation is continuing.

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 Ashland facility, EPA ID #MOD031005341, located at 7710 Polk Street, St. Louis, 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) Original signed by Vin Journey on Date 9/30/04
(print) Vin Journey, R.G.
(title) Environmental Engineer II, Permits Section

Supervisor (signature) Original signed by Rich Nussbaum on Date 9/30/04
(print) Rich Nussbaum, P.E., R.G.
(title) Corrective Action Unit Chief, Permits Section
State of Missouri, Department of Natural Resources, Hazardous Waste Program

Locations where References may be found:

URS, RCRA Facility Investigation Phase II Report, July 2004 is available in the Hazardous Waste Program Permit Section files under the Ashland TSD file, offices located at 1738 E. Elm Street, Jefferson City, Missouri.

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