DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION
RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA750)
Migration of Contaminated Groundwater Under Control

Facility Name: **Great Lakes Chemical Corporation**
Facility Address: **Nitro, West Virginia**
Facility EPA ID #: **WVD005005087**

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 ("YES" 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 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 "YES" 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:

The RFI groundwater monitoring program has thus far included two groundwater sampling events. The first of these was conducted in May 2003, while the second was conducted from late October through early November 2003. Analytical data from these two sampling events identified several constituents in groundwater at concentrations in excess of federal maximum contaminant levels (MCLs) or other groundwater quality screening levels, as listed in Reference 1., Table 1. and summarized below.

Constituent Detected Above MCL / Tap Water RBC Or WV De Minimis	**Maximum Detected Concentration (ug/L) and Well Detected**	**Number of Wells in Exceedance**	**Screening Level* (ug/L)**
VOCs			
1,4Dioxane	2,000 J (MW-4S)	3/17	6
Benzene	710 (MW-4S)	3/17	5
Carbon Disulfide	38,000 (MW-3S(T))	1/17	1,000
Carbon Tetrachloride	19,000 (MW-11S)	2/17	5
Chloroform	3,100 (MW-11S)	2/17	80
Methylene Chloride	180 J (MW-11S)	3/17	5
Vinyl chloride	13 (MW-5S)	2/17	2

Reference(s):

1. FMC August 16, 2004 letter w/Environmental Indicator Evaluation CA750
2. RFI Phase I Draft RFI Results, (FMC 7/24/04 Presentation, Philadelphia, PA)
3. FMC September 22, 2004 Environmental Indicator Evaluation CA750 Revision, Attachment 1A
4. USEPA September 27, 2004 e-mail, J. Hwang-Re: GLCC Nitro - Revisions to EI CA750 (groundwater),

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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).

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

Constituent Detected Above MCL / Tap Water RBC Or WV De Minimis	Maximum Detected Concentration (ug/L) and Well Detected	Number of Wells in Exceedance	Screening Level* (ug/L)
SVOCs			
2,4-Dimethylphenol	200,000 (MW-4S)	2/17	730
2-Methyl phenol	11,000 J (MW-4S)	1/17	1,800
3- & 4-Methyl phenol	310,000 (MW-4S)	2/17	180
Benzo(b)fluoranthene	2.3 J (MW-12S)	1/17	0.091
N-nitrosodi-n-butylamine	1.5 J (MW-12D)	1/17	0.0019
Phenol	89,000 J (MW-4S)	1/17	11,000
Pyridine	100 L (MW-5S)	1/17	37
Metals			
Aluminum	44,000 (MW-15S)	1/17	37,000
Arsenic	154 (MW-15S)	8/17	10
Barium	10,200 J (MW-6S)	2/17	2,000
Beryllium	5.3 (MW-15S)	1/17	4
Cadmium	18.5 J (MW-6S)	1/17	6
Iron	126,000 (MW-12D)	14/17	11,000
Lead	84.3 (MW-15S)	3/17	15
Manganese	130,800 (MW-6S)	17/17	730
Thallium	20 (MW-12S)	11/17	2
Other			
Chloride	4,810,000 (MW-6S)	14/17	250,000
Sulfate	919,000 (MW-12D)	4/17	250,000
Total Dissolved Solids	5,000,000 (MW-6S)	16/17	500,000

Reference 1., Table 1 presents all groundwater data collected during the RFI and appropriate screening criteria. Reference 1., Figures 1 and 2 present the Facility location map and the locations of monitoring wells at the facility, respectively.

References: See Page 2.

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:

As shown on the cross-section diagrams in Reference 1., Figures 3, 4 and 5, and the water level contour maps in Figures 6 and 7, the Kanawha River forms the downgradient boundary for shallow and deep groundwater at the facility. Thus, the horizontal extent of migration is limited by the Kanawha River (i.e., the river is a 'physical' barrier to horizontal migration).

The potential for vertical migration is limited by the low permeability of the silts and clays that comprise the upper portion of the unconsolidated material beneath the Facility, and also by hydrologic factors attributable to the Kanawha River. The vertical extent of most of the constituents listed in #2 above is limited to the shallow screened wells in the silt and clay zone. Only one VOC and one SVOC were detected in excess of their screening criteria in wells screened in the sand aquifer immediately above the top of bedrock: 1,4-dioxane was detected in MW-15D, while n-nitrosodi-n-butylamine was detected in MW-12D. The only exceedances of inorganic parameters in the wells screened in the sand aquifer were for iron, manganese and thallium, which were detected in all deep wells (including the upgradient well) and are not believed to be site-related. The vertical gradient in groundwater is upward in the vicinity of the river (Reference 1., Table 2), preventing groundwater from migrating into the bedrock from the overlying sand aquifer.

Reference(s): See Page 2.

[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.

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 "YES" 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:

All groundwater at the facility is believed to discharge to the Kanawha River. Figures 1, 2 and 5 depict the location of the facility and the Kanawha River. Figure 6 depicts water table elevation contours for wells screened at the water table, while Figure 7 depicts potentiometric contours for wells screened in the sand aquifer immediately above the top of the bedrock. Groundwater elevations were measured monthly for a one-year period to establish the fact that groundwater flow is consistent over time and is not affected by seasonal differences in conditions.

Reference(s): **See Page 2.**

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)?

____ If yes - skip to #7 (and enter "YES" 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.

Rationale:

Groundwater quality in the wells installed along the river bank (MW-11S, MW-12S, MW-12D, MW-13S, MW-14S, MW-15S and MW-15D) as measured in the October/November 2003 sampling event is considered to be representative of groundwater quality prior to entry into the hypothetic zone. As shown in Reference 1., Table 1, constituents that were detected in excess of ten times their MCLs or relevant screening criteria in one or more of these wells include three VOCs (carbon tetrachloride, chloroform and methylene chloride) and two SVOCs (benzo(b)fluoranthene and n-nitrosodi-n-butylamine). Maximum concentrations of each of these constituents in samples collected from these river bank monitoring wells in October and November 2004 are as follows:

Constituent Exceeding 10-times MCL/Tap Water RBC Or WV De Minimis value	**Maximum Detected Concentration (ug/L) and Well Detected**	**Screening Level (ug/L)**	**Multiple of Screening Level**
VOCs			
Carbon Tetrachloride	19,000 (MW-11S)	5	>100
Chloroform	2,800 (MW-11S)	80	>10, <100
Methylene Chloride	180 J (MW-11S)	5	>10, <100

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

Constituent Exceeding 10-times MCL/Tap Water RBC Or WV De Minimis value	Maximum Detected Concentration (ug/L) and Well Detected	Screening Level (ug/L)	Multiple of Screening Level
SVOCs			
Benzo(b)fluoranthene	2.3 J (MW-12S)	0.091	>10, <100
N-nitrosodi-n-butylamine	1.5 J (MW-12D)	0.0019	>100

Two inorganic constituents, iron and manganese, were also reported in the river bank wells at concentrations in excess of ten-times their respective screening levels. Iron was detected at a maximum concentration of 126,000 ug/l compared to a screening level of 11,000 ug/l, while manganese was reported at a maximum concentration of 14,000 ug/l compared to a screening level of 730 ug/l. Iron and manganese are naturally occurring constituents in groundwater that were detected at similar concentrations in virtually all groundwater samples collected throughout the facility, including upgradient locations. These constituents are considered to be indicative of background groundwater quality in the area and are therefore considered to be "insignificant" for the purposes of this EI evaluation for CA750.

Groundwater at the facility has been sampled on two occasions to date (May 2003 and October/November 2003). Additional data is required to support an evaluation of increasing or decreasing concentration trends. Constituent concentrations in the wells near the river bank were comparable between the two data sets.

The only constituents detected at concentrations exceeding 100 times their MCL or relevant screening level are carbon tetrachloride in MW-11S and MW-12S and n-nitrosodi-n-butylamine in MW-12D. The mass of these constituents discharged to the Kanawha River annually has been estimated as follows (see mass loading evaluation in Reference 1, Attachment 1):

Carbon tetrachloride – less than 7 grams per year (i.e. $< 7x10^{-3}$ kilograms per year)
N-nitrosodi-n-butylamine – less than 0.03 grams per year (i.e. $< 3x10^{-5}$ kilograms per year)

It should be noted that n-nitrosodi-n-butylamine was detected at an estimated concentration in only one well during only one of the two sampling events. Further monitoring may show this detection to be anomalous.

Reference(s): See Page 2.

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 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:

Reference 1., Attachment 1and Reference 3, Attachment 1A, provide the results of the FMC interim assessment that shows the discharge of groundwater contaminants into the surface water of the Kanawha River is adequately protective of receiving surface water, sediments, and eco-systems.

Reference(s): See Page 2.

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[4] Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refuge) 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:

Additional phases of the RFI will be performed to further characterize the facility. Downgradient groundwater will be monitored as part of these next phases of the RFI.

Reference(s): **See Page 2.**

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 **Great Lakes Chemical Company** facility , **EPA ID # WVD005005087**, located at Nitro, WV. 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) /s/ Date 9/27/04
(print) Vernon Butler
(title) RPM

Supervisor (signature) /s/ Date 9/27/04
(print) Bob Greaves
(title) Chief, RCRA Operations Branch
EPA Region III

Locations where References may be found:

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