

DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

Interim Final 2/5/99

RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA750)

Migration of Contaminated Groundwater Under Control

Facility Name: Pharmacia & Upjohn Caribe, Inc.
Facility Address: Highway No. 2 Km 60.0 Arcibo, PR 00612
Facility EPA ID #: PRD 090398074

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?

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, GPRRA). 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).

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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?

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 groundwater is contaminated with carbon tetrachloride (CCl₄) as a result of underground tank leakage in 1982. An estimated 15,300 gallons of waste material containing 65% CCl₄ and 35% acetonitrile leaked from the underground tank in a tank farm area at the site. Upon monitoring, 44 - 170 ppb CCl₄ was detected in the groundwater. Acetonitrile was not detected in the groundwater. The 44 - 170 ppb CCl₄ exceeded the MCL of 5 ppb CCl₄ set in the Superfund’s Record of Decision (ROD). [ref. Superfund ROD, September 30, 1988, EPA files; Remedial Action Report, October 30, 1998, EPA files; Preliminary close out report, Superfund, September 30, 1998, EPA files]

Investigations revealed that most of the contamination remained within the upper blanket sand deposits 25 to 100 feet below the ground surface in the saturated zone. In 1983 Upjohn installed extraction well UE-1 and soil vapor extraction system was installed and operated to remove the CCl₄ vapors from the unsaturated zone. Further, a concrete cap was placed over the tank farm area to eliminate precipitation infiltration and reduce migration of CCl₄ from the soil into groundwater. The SVE system was operated until 1988, when CCl₄ was no longer detectable in the soil. Since 1983, the extraction well UE-1 has continued to pump contaminated groundwater, which is treated by air stripping at an aeration tower and disposed of through an existing sinkhole on-site. [ref. Superfund ROD, September 1988, EPA files; Remedial Action Report, October 30, 1998, EPA files]

Footnotes:

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).

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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): Below the site, the Aymamon and Aguada formations, together approximately 1,800 feet, comprise the unconfined aquifer (water table aquifer). In the vicinity of the site, groundwater within the unconfined aquifer generally flows to the north, towards the Atlantic ocean which lies approximately 3.7 miles to the north. The water table is approximately 300 feet below ground surface at the site. Below the Aguada formation are the Cibao and the Lares formation, together 2,000 to 2,600 feet thick, which comprise the confined or artesian aquifer. The material between the water table aquifer and the artesian aquifer are mostly clay and the two aquifers are not connected. Thus, the artesian aquifer is not contaminated. [ref.: Superfund ROD, September 1988, EPA files; Preliminary close out report, Superfund, September 30, 1998, EPA files; Remedial action report, October 30, 1998; Quarterly monitoring reports, March 1998, March 1999, June 1999, EPA files]

Combined pumping of UE-1 and UE-2 has maximized the capture of the most highly contaminated groundwater from the unconfined aquifer and established a hydraulic gradient thereby preventing off-site migration of CCl₄ contaminated groundwater. The system is presently pumping and treating 1,200 gpm extracted contaminated groundwater and discharges it to the sinkhole at less than 5 ppb CCl₄. Groundwater extracted from UE-1 and UE-2 has CCl₄ concentration ranging from 35 ppb to 40 ppb. However, the air stripping system is very effective in treating the extracted water to the clean up standard (MCL of 5 ppb CCl₄) or less prior to discharge.

Currently, extraction wells UE-1 and UE-2 are sampled and analyzed for CCl₄ on a monthly basis. About 18 monitoring wells and the artesian wells are sampled and analyzed for CCl₄ on a quarterly basis. The data for the unconfined aquifer generally show a fair degree of variability, which is expected in a karst limestone terrain. The artesian wells consistently show non-detect for CCl₄.

In 1987 the groundwater plume was one stretch of 0.6 miles (3,168 feet) wide and approximately 2 miles (10,560 feet) long. Since March 1998, however, based on groundwater data collected, the plume has decreased markedly in size and split into two smaller plumes- one to the north (5,742 feet long by 820 feet wide) of the spill area and the other on the spill area (3,281 feet long by 984 feet wide). The monitoring wells downgradient of the respective plumes and on the perimeter of the plumes show non-detect in CCl_4 or well below 5 ppb. Data collected during quarterly monitoring in 1998 and 1999 (Figures 1, 2, and 3) show that the two plumes are not moving due to the hydraulic gradient established by the extraction well pumping. Further, the highest concentration of CCl_4 inside the plume to the north of the spill area is 8.7 ppb; the highest concentration of CCl_4 inside the plume in the spill area is 59 ppb (near UE-2 extraction well). A combination of natural attenuation and the operation of the pump and treat has been established to be very effective, and, will ultimately bring the CCl_4 concentration in the groundwater below the MCL of 5 ppb.

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.

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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): The site is on the north coast limestone region of Puerto Rico, which is a tropical, mature karst terrain with closed depressions, sinkholes, subsurface conduits and absence of surface water bodies. The groundwater in the water table aquifer at the site flows at about 0.004 feet per day in a northern direction towards the Atlantic Ocean which lies about 3.7 miles to the north.

The recent quarterly groundwater monitoring report shows that the CCl₄ concentration north of the plumes are non-detect. So there is no evidence that the contaminated groundwater is migrating to the Atlantic ocean. [ref.: Superfund ROD, September 1988, EPA files; Preliminary close out report, Superfund, September 1998, EPA files; Remedial action report, October 30, 1998; Quarterly monitoring reports, March 1998, March, 1999, June 1999, EPA files]

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

NOT APPLICABLE

_____ 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 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): _____

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

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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)? **NOT APPLICABLE**

_____ 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 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.

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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): The facility is on a long-term monitoring program. Upjohn will continue to operate, maintain, and monitor the groundwater extraction and treatment system as long as a long-term response action until EPA determines that the groundwater clean up standard of 5 ppb of CCl₄ has been attained. EPA will issue a five-year review report in September 2003 and make a determination whether groundwater monitoring will stop or continue. [Preliminary close out report, Superfund, September 1998, EPA files]

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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 **Pharmacia & Upjohn Caribe, Inc facility, EPA ID # PRD 0903980, located at Highway No. 2Km 60.0, Arecibo, PR 00612.** 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: original signed by
Samuel Ezekwo, Project Manager
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Date: 09/30/99

original signed by
Nicoletta DiForte, Section Chief
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