

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

**Facility Name:** Radford Army Ammunition Plant  
**Facility Address:** Route 114, Radford, Virginia 24141-0100  
**Facility EPA ID #:** VA1210 020730

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**

Radford Army Ammunition Plant (RAAP) is located in southwest Virginia in Pulaski and Montgomery counties. The Main Manufacturing Area (MMA) is located approximately five miles northeast of the city of Radford, Virginia, which is approximately ten miles west of Blacksburg and 47 miles southwest of Roanoke. RAAP is considered by the United States Environmental Protection Agency (EPA) to be a Federal Facility and the MMA is the area subject to the Resource Conservation and Recovery Act (RCRA) Corrective Action Permit (CA).

The initial requirements for the Corrective Action process at RAAP were specified in the RCRA permit issued by the U.S. EPA in 1989. The first phase of investigation required by the permit was completed in 1992. On October 31, 2000, the RCRA CA permit (VA1210020730), was reissued.

The EPA Corrective Action Permit of October 31, 2000 included 31 Site Screening Areas (SSAs), 6 Areas of Concern (AOCs), 38 Solid Waste Management Units and 5 Hazardous Waste Management Units (HWMUs) at the RAAP facility. The potential for groundwater contamination from each of these Units either has been assessed or will be assessed under the environmental efforts of the Installation Restoration Program, the RCRA Corrective Action Permit, the facility RCRA Operating Permits, or the facility RCRA Post Closure Care Permit.

Seventy-seven (77) units were identified for investigation and potential remediation pursuant to the CA permit. Numerous investigations and actions have been completed since the permit reissuance and reports were submitted to, and reviewed by EPA and the Virginia Department of Environmental Quality (VDEQ). All of the units have been investigated and 19 SWMUs were found to be contaminated and were addressed primarily through the removal of contaminated soil from the Site; 4 SWMUs will implement groundwater monitoring plans.

The primary contaminants of concern in groundwater at RAAP include metals, explosives, and chlorinated solvents.

**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 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”**<sup>1</sup> 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):

Groundwater monitoring wells onsite have been, or are currently, in use as designated monitoring points within the corrective action program. Several of the Units that have been actively monitored have been transitioned out of the groundwater monitoring program as the data have indicated that the groundwater at those sites no longer poses a risk. Several other units proposed remedies with ongoing monitoring including monitored natural attenuation. Currently, the groundwater at four of the HWMUs is monitored under a RCRA Post Closure Care Permit that is enforced by the VDEQ. These units are HWMUs - 5, 7, 10 and 16. Two former permitted solid waste landfills are also monitored under the VDEQ Solid Waste Management Regulations. Additionally, the, the Open Burning Ground (OBG), is monitored under a RCRA subpart X Permit (effective October 2005).

Groundwater sampling results for the VDEQ permitted units are presented in annual reports for each calendar year, the latest being 2010. The reports are submitted by March of the following year. Samples are collected semiannually at the HWMU’s, at the Solid Waste Landfills, and at the OBG. Based on the data presented in those reports there are inorganic detections but none that exceed Region III risk based concentrations (RBCs) for Tap Water or site specific Ground Water Protection Standards (GPSs). There are detections of Trichloroethene (TCE) at or slightly above the GPS (and subsequent Maximum Contaminant Level or MCL) of 0.005 mg/L at HWMU-5. The only other constituent detected above the respective GPS is perchlorate at the OBG. The GPS for perchlorate at the OBG is 0.026 mg/L which is consistent with Region III RBC. The calendar year 2010 maximum detection was 0.034 mg/L. The limited groundwater impacts at both HWMU-5 and OBG are being addressed under an ongoing corrective action program (HWMU-5) or proposed corrective action program (OBG) with the VDEQ.

At the issuance of this EI, two CA units will implement groundwater monitoring programs (Units 54 and 40) and two additional CA units that have completed characterization will propose groundwater monitoring (Units 48 and 49). Collectively the four units have reported perchlorate as high as 59.2 micrograms per liter (ug/l) from Unit 54 in 2003, but most recently at 3.6 and 2.9 ug/l (below the remedial goal of 10.9 ug/l) (SWMU 54 Monitored Natural Attenuation Interim Measures Work Plan April 2011); trichloroethene, carbon tetrachloride, and perchloroethene from Units 48 and 49 at 11.2 ug/l, 94.6 ug/l, and 2.9 ug/l, respectively (SWMUs 48 and 49 RCRA Facility Investigation/Corrective Measures Study Report, February 2009);chloroform was the only constituent reported above the USEPA tap water risk-based screening concentration from Unit 40 at 24 ug/l, but below the EPA MCL for total trihalomethanes (80 ug/l) (Solid Waste Management Units 40 and 71 RCRA Facility Investigation/ Corrective Measures Study Report April, 2009).

Footnotes:

<sup>1</sup>“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”<sup>2</sup> as defined by the monitoring locations designated at the time of this determination)?

- 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”<sup>2</sup>).
- If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the “existing area of groundwater contamination”<sup>2</sup>) – 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 hydraulic conditions and hydrogeology of the RAAP facility have been extensively studied. Facility wide studies have been conducted (Dye Tracing Study Report, RAAP – 1994; Facility-wide Background Study Report, RAAP – 2001; Current condition Report, Horseshoe Area RAAP – 2005) and numerous site specific studies have been conducted (see <http://www.radfordaapirp.org/inforepo/online-index.htm> for online access to these reports). The conclusions of each of these studies and the Calendar Year 2010 groundwater monitoring data indicate that the migration of constituents detected in the groundwater is stable. Future and ongoing sampling events will be used to confirm that migration of constituents detected in the groundwater at the RAAP facility remains within the horizontal and vertical extent of the existing areas of groundwater contamination. Each of the Units currently being monitored have Point of Compliance (POC) wells in locations proximate to the outer perimeter of contamination.

<sup>2</sup> “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.
- 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):

Compliance monitoring at the Permitted OBG reports detections of perchlorate at concentrations that frequently exceed the GPS of 0.026 mg/L. The Permitted OBG is located adjacent to the New River. Hydrogeologic characterization of the groundwater movement at the Unit has indicated that the groundwater trending beneath the OBG discharges to the New River. Based on this determination, it is likely that low levels (non-detectable) of perchlorate are reaching the New River. Similarly, SWMU 54 is located adjacent to the New River and reported historical detections of perchlorate exceeding the unit remedial goal (RG) of 0.0109 mg/l. While the most recent detections from 2007 are below the RG it is probable that groundwater containing low levels of perchlorate from SWMU 54 discharge to the New River.

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5. Is the **discharge** of “contaminated” groundwater into surface water likely to be “**insignificant**” (i.e., the maximum concentration<sup>3</sup> 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 “YE” status code in #8 if #7 = yes), after documenting:
- 1) the maximum known or reasonably suspected concentration<sup>3</sup> 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 judgment/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<sup>3</sup> 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<sup>3</sup> 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):

Groundwater data from the OBG indicate that perchlorate was detected in two onsite groundwater monitoring wells (13MW5 and 13MW4). The greatest concentration detected is less than 10 times the GPS, indicating the discharge of contaminated groundwater into surface water is likely to be insignificant. There are no data to indicate the presence of other conditions which could significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations. Groundwater data from SWMU 54 report significantly lower concentrations than the OBG.

Data from the United States Geological Survey (USGS) National Water Information System: Web Interface (<http://waterdata.usgs.gov/va/nwis/current/?type=flow>) for the Radford Virginia gauge # 03071000 indicates the 7Q10 flow of the New River is 919cfs. The Seven-day, 10-year low flow (7Q10) is the discharge below which the annual 7- day minimum flow falls in 1 year out of 10 on the long-run average. The recurrence interval of the 7Q10 is 10 years; the chance that the annual 7-day minimum flow will be less than the 7Q10 is 10 percent in any given year. The 7Q10 flow is typically used to determine the capacity of a river or stream to assimilate a pollution source. Assuming a depth of impacted aquifer discharging to the New river at 15 feet, the latitudinal dispersion limits of the plume at 500 feet, and the horizontal groundwater flow velocity at the OBG as  $4.25 \times 10^{-2}$  ft/day, the average volume of water discharged would be:  $Q = 15\text{ft} \times 500\text{ft} \times 4.25 \times 10^{-2}\text{ft/day} \times 1\text{day}/86,400\text{sec} = 0.00369\text{cfs}$ . The resultant groundwater flow volume represents a mixing at the 7Q10 flow of approximately 250,000 times. That mixing indicates that the perchlorate reaching the New River is at a concentration that does not represent an unacceptable impact to the receiving surface water, sediments, or eco-systems in the region.

<sup>3</sup> As measured in groundwater 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 implemented<sub>4</sub>)?

- 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<sub>5</sub>, 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):

<sup>4</sup> 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.

<sup>5</sup> 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?”

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):

RAAP will continue to regularly collect groundwater monitoring data in the future to verify that contaminated groundwater remains at current levels and current locations. The detections of Trichloroethene (TCE) at or slightly above the MCL of 0.005 mg/L at HWMU-5 will continue to be monitored semiannually under the groundwater monitoring requirements of the Post Closure Care Permit for that Unit. The detections of perchlorate at the Open Burning Ground will continue to be monitored semi-annually in accordance with the RCRA Subpart X permit for the OBG...The limited groundwater impacts at both HWMU-5 and the OBG are being addressed under corrective action programs with the VDEQ.

The facility under the Corrective Action permit will implement the approved groundwater monitoring programs at SWMUs 40 and 54 and propose and implement an appropriate groundwater monitoring program at SWMUs 48 and 49.

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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).

- YE - Yes, "Migration of Contaminated Groundwater under Control" has been verified. Based on a review of the information contained in this EI determination at the Radford Army Arsenal Plant, EPA ID # VA 1210020730, located at Route 114, Radford, VA 24141-0100. 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	<u>(signature)</u>	Date	<u>6/3/11</u>
	<u>(print) Erich Weissbart</u>		
	<u>(title) Project Manager</u>		
Supervisor	<u>(signature)</u>	Date	<u>6/3/11</u>
	<u>(print) Luis Pizarro</u>		
	<u>(title) Associate Director</u>		
	<u>EPA Region III</u>		

Locations where References may be found:

US EPA Region III  
Land & Chemicals Division  
1650 Arch Street  
Philadelphia, PA 19103

<http://www.radfordaapirp.org/inforepo/online-index.htm>

<http://www.radfordaapirp.org/invest/iap-current%20year.htm>

Contact telephone and e-mail numbers

(name) Erich Weissbart  
(phone #) 215-814-3284  
(e-mail) weissbart.erich@epa.gov