DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

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

Facility Name: Hamilton Technology Incorporated (General Dynamics Ordnance and Tactical Systems)
Facility Address: 901 Columbia Avenue Lancaster, PA 17604
Facility EPA ID #: PAD 067 096 370

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, (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"**[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):

Acronyms, figures, tables, and superscript references cited herein apply to those items presented in the EI Report completed for the Facility (URS, August 2009). A review of soil/groundwater characterization activities which have occurred at the Site is provided in the following discussion.

Thirty (30) monitoring wells were installed on-Site to monitor shallow, intermediate, and deep groundwater zones[34]. Well depths range from approximately 25 to 118 feet bgs. Based on measured groundwater elevations, it appears that there are two separate aquifer zones (shallow and deep) underlying the Site. Groundwater analytical results for these wells are tabulated in **Tables 2** and **3** of the EI report. URS generated TCE isoconcentration maps for both the shallow and deep aquifer zones based on 2005 groundwater analytical data. The isoconcentration maps are presented as **Figures 4** and **5**, respectively in the EI report.

Between June 19 and November 11, 1995, a groundwater recovery system was constructed at the Site to extract and treat impacted groundwater[64]. Treated groundwater is discharged to the City of Lancaster's POTW under agreement with effluent limits of less than 500 ppb for total VOCs and less than 360 ppm TSS. The average daily flow rate to the POTW is permitted for 136,800 gallons per day or 95 gallons per minute.

The three on-Site extraction wells and approximately 30 monitoring wells (MWs and VWs) are sampled regularly and analyzed for TCE, TCA, and 1,1-DCE. A summary of beginning and current analytical results for each sampling point is presented below. Bolded concentrations are above the PADEP Residential Nonuse Aquifer Medium Specific Concentrations, which are:

- 200 ug/l for TCA,
- 7 ug/l for 1,1-DCE, and
- 5 ug/l for TCE.

PADEP has approved a nonuse aquifer determination for properties located within the City of Lancaster.

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).

Sample Location	Sample Date	TCA (ug/l)	1,1-DCE (ug/l)	TCE (ug/l)	Sample Location	Sample Date	TCA (ug/l)	1,1-DCE (ug/l)	TCE (ug/l)
EW-1	12/13/1995	**52,200**	ND	**119,000**	MW-12S	12/13/1995	ND	ND	ND
	2/9/2019	**320**	**8**	**910**		2/19/2019	ND	ND	0.2 J
EW-2	12/13/1995	**255**	ND	**1,220**	MW-13D	12/13/1995	**816**	ND	**12,900**
	2/9/2019	170	4	**410**		2/19/2019	0.4 J	ND	**98**
EW-3	5/09/2014	**1,200**	**71**	**4,000**	MW-13M	12/13/1995	**809**	ND	**12,400**
	2/21/2019	0.3 J	2	5		2/19/2019	ND	.05 J	**56**
EW-4	5/08/2014	**21,000**	**650**	**45,000**	MW-14D	12/13/1995	ND	ND	**29.1**
	2/21/2019	**890**	**52**	ND		2/19/2019	ND	ND	ND
EW-5	5/07/2014	48	2	**200**	MW-14M	12/13/1995	ND	ND	ND
	2/9/2019	0.5 J	**72**	**310**		9/12/2016	ND	ND	ND
MW-1	12/13/1995	ND	ND	**24.3**	MW-14S	12/13/1995	ND	ND	ND
	2/20/2019	2	ND	**13**		2/19/2019	ND	ND	ND
MW-2	3/20/1996	ND	ND	8.2	MW-15	12/22/1995	ND	**12.2**	ND
	2/18/2019	ND	ND	0.7 J		2/18/2019	3	**8**	**89**
MW-3	12/13/1995	ND	ND	**5.1**	MW-16	12/13/1995	7.7	ND	**56.2**
	2/18/2019	ND	ND	1		2/19/2019	0.3 J	ND	**18**
MW-4	2/12/1996	ND	ND	**76.4**	MW-17	12/22/1995	ND	ND	ND
	2/18/2019	ND	ND	ND		2/19/2019	0.4 J	ND	4
MW-5	09/09/2013	ND	ND	5	MW-18	3/14/2013	**8,800**	**280**	**30,000**
	05/06/2014	ND	ND	4		2/21/2019	ND	0.8 J	0.2 J
MW-6	12/12/1996	**3,985**	ND	**11,595**	MW-19	3/14/2013	ND	ND	**10**
	2/19/2019	110	5	**280**		2/19/2019	ND	ND	0.6 J
MW-7D	12/22/1995	36.0	**37.0**	**240**	MW-20	9/09/2013	76	2 J	**160**
	2/21/2019	18	**810**	**1,400**		2/21/2019	10	1	3
MW-7S	12/13/1995	142	**159**	**1,070**	MW-21	9/09/2013	8	9	**130**
	2/21/2019	25	**30**	**630**		2/18/2019	0.8 J	0.5 J	**11**

MW-8	12/13/1995	ND	ND	**119**	MW-22	9/10/2013	**30,000**	**1,200**	**89,000**
	2/18/2019	2	ND	**8**		2/21/2019	**380**	**290**	ND
Sample Location	**Sample Date**	**TCA (ug/l)**	**1,1-DCE (ug/l)**	**TCE (ug/l)**	**Sample Location**	**Sample Date**	**TCA (ug/l)**	**1,1-DCE (ug/l)**	**TCE (ug/l)**
MW-9D	12/22/1995	ND	ND	ND	MW-23	9/10/2013	4	ND	**15**
	2/18/2019	ND	ND	0.5 J		2/20/2019	4	ND	**8**
MW-9S	12/22/1995	7.2	ND	**99.9**	MW-A	12/12/1996	ND	ND	**1,060**
	2/18/2019	ND	0.5 J	**6**		2/19/2019	5	ND	**32**
MW-10D	3/20/1996	**718**	ND	**3,730**	VW-1	3/19/1996	ND	ND	**232**
	9/09/1999	**238**	ND	**578**		2/18/2019	2	ND	**47**
MW-11D	12/12/1996	ND	ND	ND	VW-2	6/24/1996	32.0	1.0	**78.0**
	2/19/2019	ND	ND	0.6 J		2/19/2019	ND	ND	5
MW-11S	12/12/1996	ND	ND	13.0	VW-3	3/19/1996	**85,400**	ND	**252,000**
	2/19/2019	ND	ND	4		3/29/2006	**44,500**	**1,340**	**104,000**
MW-12D	12/13/1995	ND	ND	ND	VW-4	6/24/1996	**7,610**	**404**	**23,084**
	2/19/2019	ND	ND	0.4 J		2/19/2019	**14,000**	**300**	**35,000**
Effluent	3/19/1996	13.8	ND	106	VW-5	6/24/1996	ND	ND	**44.1**
	3/5/2018	2	ND	8		2/18/2019	0.3 J	0.9 J	31

Comparison of the 1992 TCE isoconcentration map for the deep aquifer zone (**Figure 5, EI report**) to the 2005 TCE isoconcentration map for the deep zone (**Figure 8, EI report**) shows an increase in concentrations in the area of groundwater extraction EW-1 (8,600 ppb) and verification well VW-3 (130,000 ppb). In addition, concentrations of TCE significantly increased at MW-7S and MW-7D since the startup of the groundwater remediation system, which may indicate a possible deeper source area or a source near the surface in the vicinity of these two wells that is being drawn down as a result of pumping extraction wells EW-1 and EW-2. Review of groundwater elevation data prior to startup of the treatment system (February 26, 1992) indicates there is some communication between the shallow and the deep aquifer zones[40].

A source near the surface of MW-7S/MW-7D is possible because the history of the processes conducted in this area are unknown, and there is little soil gas data (one soil point was tested with concentrations below method detection limits) for this portion of the Site[24,48]. It is also possible that NAPL may be present at depth; however, there is no documentation that NAPL has ever been observed during field activities. Based on this information, further delineation in the area of the MW-7 well pair is recommended

Another possible source of contamination to groundwater was possible via exfiltration from the city sewer lines of treated groundwater discharged to the City's POTW. Discharge limits of 500 ppb or less of total VOCs were stated in the Facility's discharge permit. Performance standards were deemed acceptable based on guidance provided by the USEPA under CERCLA and the Pennsylvania Water Management Office.

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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)?

☒ 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):

Acronyms and figures references cited herein apply to those items presented in the 2018 Semi-Annual Report completed for the Facility (GES, April 2018). A review of groundwater characterization activities which have occurred at the Site is provided in the following discussion.

Prior to startup of the remediation system, groundwater flow direction for the Site was toward the south-southwest. Since the start of the pumping of the groundwater treatment system in November 1995, the system has pumped and treated approximately 61.7 million gallons of groundwater from three extraction wells (EW-1, EW-2 and VW-4). Evaluation of 2005 on-Site groundwater elevation data indicates that on-Site hydrology is controlled by extraction wells EW-1 and EW-2, with the cone of depression extending beyond the Site boundary in both the shallow and deep aquifer zones. Groundwater flow direction is now towards these extraction wells. The groundwater gradient between EW-1 and the Site boundary is between 55 and 80 feet for both aquifer zones.

A bromine tracer investigation was initiated at the site in November 2014 to further define groundwater movement and the flow regimen during pump and treat system operation. At monitoring well MW-18, 330 gallons of 40% sodium bromide solution were drained into the well. Bromide was used to predict groundwater movement as it is very soluable in water. Solvents such as TCE are less soluable in water. Therefore, the results of this investigation suggest a conservative extent of zone of influence the remediation system has on VOC groundwater contamination. In February 2018, samples were collected from the entire monitoring network and analyzed for bromide to determine the distribution of bromide over 3 years after the solution was released to groundwater. The highest bromide concentrations remain centered around MW-18 **(Attachment 5, Semi-Annual Report)**. Overall, the tracer investigation has shown that groundwater movement is insignificant except when extraction wels are operating and creating zones of influence.

Sentinel wells screened in the shallow and deep aquifer at the downgradient southern and western boundaries of the Site (MW-16, MW-19, VW-1, MW-9d, MW-9s, MW-3, MW-8, and MW-21) have shown non-detect or significant decreases in VOC concentrations. An estimated cumulative total of 504 lbs of VOCs have been removed from groundwater by the pump ant treat system since October 2014.

[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.

☒ 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):

Groundwater underneath the Site flows towards Little Conestoga Creek. The Site is approximately a mile upstream from the creek. At this distance, about a mile, it is unlikely that contamination has reached the creek with the constant pumping of groundwater on-Site to maintain an inward gradient. In addition, primary groundwater impacts are found in the deep aquifer zone with VOCs found at depths of up to 110 feet below ground surface. As a result, the likelihood of discharge to shallower surface water bodies such as Little Conestoga Creek.

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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 "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.

☐ 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 and Reference(s):

[3] 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[4])?

☐ 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?"

☒ 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):

General Dynamics submits semi-annual groundwater remediation reports which includes groundwater gauging, groundwater monitoring, and groundwater elevation contour mapping. This monitoring requirement will continue until PADEP Residential Nonuse Aquifer Medium Specific Concentrations for VOCs (primarily 1,1,1-TCA, 1,1-DCA and TCE) are met in groundwater.

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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, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control" at the Safety Kleen facility , EPA ID # PAD 980 552 020, located at 5540 Memorial Drive, Allentown, PA. 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 _____ Date 9/5/19
John Hopkins
RCRA Project Manager

Supervisor _____ Date 9-6-19
Paul Gotthold
Associate Director
Region 3

Locations where References may be found:

US EPA Region III
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