DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

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

Facility Name: **FMC Corporation**
Facility Address: **100 Niagara Street, Middleport, NY 14105**
Facility EPA ID #: **NYD002126845**

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.

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 RCRAInfo national database ONLY as long as they remain true (i.e., RCRAInfo status codes must be changed when the regulatory authorities become aware of contrary information).

BACKGROUND

FMC Corporation (FMC) owns and operates a pesticide formulations facility situated on approximately 102 acres of land in Middleport, New York. Surrounding land use includes the grounds of the Royalton-Hartland School District to the north (including the Middle School and High School), agricultural land to the east, and a mix of residential, commercial and industrial properties to the west and south. Please see Figure 1 (attached).

The site has been used for manufacturing or formulation of pesticides products since the 1920s. Products historically manufactured at the facility include lime, arsenic and lead based pesticides, sulfur dust, dinitrocresol, dithiocarbamate pesticides, carbofuran and karbutilate. Products historically formulated at the facility include chlorinated pesticides, organophosphate pesticides and methyl carbamates.

References:

RCRA Facility Investigation Report, January 29, 1999.

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 "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.

Background:

Prior to 1974, pesticide wastes were handled in accordance with standard practices of the time. Those practices included the storage, treatment, and/or disposal in lagoons or land (landfills and trenches) at the site. As a result of these practices, soils and groundwater at the facility have been extensively contaminated with arsenic, lead, chlorinated pesticides, ethylene thiourea (a degradation product of some of the dithiocarbamate pesticide products), methylene chloride, ammonia, and other chemicals.

Groundwater flow occurs in the overburden and fractured bedrock beneath the facility and surrounding areas. The shallow bedrock zone consists primarily of weathered and fractured limestone and sandstone, and the deep bedrock consists of primarily sandstones. A layer of shale (the Cambria Shale formation) is present between the shallow and deep bedrock regimes. The direction of regional groundwater flow is to the north/northwest. The primary pathway for groundwater migration is the shallow bedrock zone, with more limited flow in the overburden and deep bedrock zones.

Groundwater monitoring has been performed at the site since the 1970s and continues today. Currently, eighty-six (86) monitoring wells are monitored for groundwater quality, and one hundred and seventy (170) monitoring wells are monitored for water levels. Generally, the groundwater quality monitoring program consists of the semi-annual monitoring of four site specific indicator parameters (ammonia, arsenic, ethylene thiourea and methylene chloride) and the biannual monitoring of a comprehensive list of eighty-six (86) site specific constituents. Please see Figure 2 (attached).

Groundwater is contaminated with more than 50 chemical contaminants. Table 1 indicates some of the significant contaminants, along with the maximum historical detection for that contaminant, and the associated 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).

criteria.

A vapor intrusion evaluation was completed for off-site structures (including the Middle School and High School) and it was determined that the vapor intrusion pathway was not complete. Evaluation of the potential for vapor intrusion at on-site structures is in progress.

References:

RCRA Facility Investigation Report, January 29, 1999.

FMC Corporation Middleport Facility Third Quarter 2005/2006 Progress Report, December 2004.

FMC Corporation Middleport Facility Fourth Quarter 2003/2004 Progress Report, August 2006.

FMC Corporation Middleport Facility First Quarter 2006/2007 Progress Report, February 2007.

Groundwater Monitoring Program, April 1, 1998.

Letter, Bethoney to Bona, dated June 7, 2006 (Re: Air Sampling Results at Royalton Hartland School Buildings).

Letter, McGinnis to Mortefolio/Infurna, dated March 22, 2007 (Re: Submission of revised On-site Vapor Intrusion Work Plan).

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:

The highest levels of groundwater contamination are on site, especially in the vicinity of historic land disposal areas, or in the vicinity of historic spills. Significant groundwater contamination is present at the site boundaries (especially to the north and the east) and lower levels of contamination are present at off-site locations, generally within 500 feet of the facility's boundaries. Monitoring wells are located down gradient of the area of impacted

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[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.

groundwater, and these wells are regularly monitored as part of the groundwater monitoring program. A comprehensive groundwater monitoring program has been in place for over twenty years, and reported results indicate that ongoing migration of groundwater contamination is not occurring (contaminated groundwater is stable).

FMC currently operates an extensive groundwater remediation program. The northern half of the facility is capped and surface water from the northern portion of the site is all directed to the western surface impoundment, and ultimately to FMC's treatment plant, thus isolating rainwater and surface water runoff from contacting waste material. Water is pumped from directly under the cap with the use of underdrain systems and french drains and the water is directed to the treatment plant. The groundwater pump and treat system includes groundwater recovery from several extraction wells placed in trenches that have been blasted into the bedrock to enhance groundwater recovery yields. These blasted bedrock trenches run along most of the northern and eastern property boundary lines. Groundwater is also recovered from wells that target the source of groundwater contamination, near the center of the facility. The current groundwater pump and treat program includes fourteen extraction wells. All recovered groundwater is treated at FMC's treatment plant. FMC's remedial system is expected to beneficially impact groundwater quality, especially over the long term.

It should also be noted that FMC completed a Private Water Well Study in 2002. The study identified 258 private wells within a one mile radius of the facility. Most of these wells, however, were either not accessible, not used for drinking water, or not used at all. Nine of the privately owned wells were used for drinking water purposes. (Municipal water is supplied to all entities within the limits of the Village of Middleport.) A total of 48 wells were sampled for a comprehensive list of site specific constituents, including all of the wells used for potable drinking water supply, and most of the other wells that were still in use. Analytical results indicated that there were no impacts that could be attributed to operations at the facility. The results of this study further confirm that groundwater migration has stabilized.

FMC also implemented a study to determine the source of ammonia found in deep bedrock wells located off-site. Several monitoring wells, including deep bedrock monitoring wells, were tested for tritium to determine if the formation water in the deep bedrock is hydraulically isolated. (We would expect water exposed to the atmosphere after bomb testing in the 1950s to have higher levels of tritium.) The tritium results for the deep bedrock wells were all less than one Tritium Unit, indicating that the formation water is hydraulically isolated. This strongly supports a determination that the ammonia in the off-site deep bedrock is naturally occurring and cannot be attributed to facility operations.

References:

FMC Corporation Middleport Facility First Quarter 2006/2007 Progress Report, February 2007

Private Water Well Study Summary Report, August 13, 2002.

Supplemental Report Results of Bedrock Groundwater Isotope Investigation, February 2007.

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:

Groundwater does not discharge to surface water bodies. However, it should be noted that certain tributaries located north of the facility have significant soil and sediment contamination that is attributed to historical operations at the facility. The contaminated sediment is believed to have been transported by surface water run off from the site over the course of several decades. Remedial options are now being explored.

References:

Draft 2002 Sampling Program Report, June 2003.

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.

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

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

[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.

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.

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:

Please see description of the remedial program and associated monitoring program described in questions 2 and 3 above. The groundwater monitoring program is expected to continue indefinitely.

8. Check the appropriate RCRAInfo 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).

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[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.

__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 **FMC Corporation** facility , EPA ID # **NYD002126845** ,located at **100 Niagara Street, Middleport, New York.** 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: Denise M. Radtke Date: 5/14/07
Name Denise Radtke
Title Engineering Geologist 3

Supervisor: Edwin Dassatti Date: 5/14/07
Name Edwin Dassatti, P.E.
Title Environmental Engineer 4

Director: Edwin Dassatti Date: 5/14/07
Edwin Dassatti, P.E.
Bureau of Hazardous Waste and Radiation Management
Division of Solid and Hazardous Materials

Locations where References may be found:

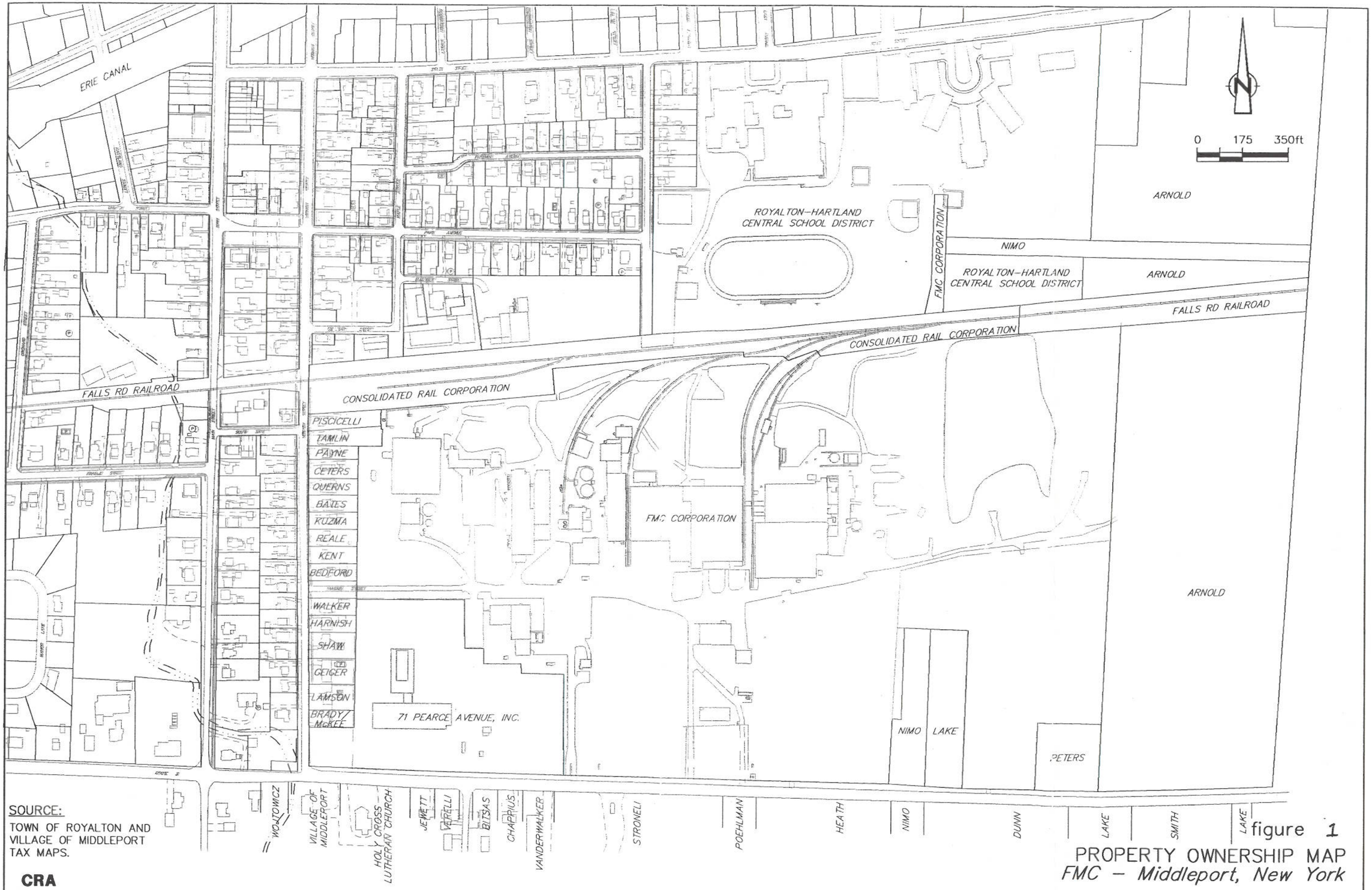
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233-7258

Contact, telephone number and e-mail:

Denise Radtke
(518) 402-8594
dmradtke@gw.dec.state.ny.us

Table 1 - Maximum Historical Detection in Groundwater

Parameter	GW Criteria (ug/l)	Maximum Result (ug/l)
Ammonia	2000	5,810,000
Arsenic	10	920,000
Ethylene Thiourea	Non-Detect	440,000
7-Hydroxybenzofuran	NA	19,000
Baygon	NA	2.9
Carbaryl	29	3,000
Carbofuran	15	10,400
Chloropropham	5	1,200
Karbutilate	5	43,900
Cadmium	5	410
Lead	15	2,070
Mercury	0.7	15,000
Selenium	10	953
Zinc	2000	18,500
2,4-D	50	77
Total Dithiocarbamates	NA	226,000
4,4-DDT	0.2	6,100
Alpha-BHC	Non-Detect	820
Beta BHC	Non-Detect	160
Delta-BHC	Non-Detect	1,700
Gamma-BHC	Non-Detect	1,200
1,4-Dichlorobenzene	3	260
Acetone	50	2,600
Benzene	1	1,250,000
Chlorobenzene	5	1,250,000
Chloroform	7	1,300
Ethylbenzene	5	1,250,000
Methylene Chloride	5	44,000,000
Toluene	5	1,250,000
Trichloroethene	5	540,000
Xylene	5	1,250,000



SOURCE:
TOWN OF ROYALTON AND VILLAGE OF MIDDLEPORT TAX MAPS.

CRA

02788-90(055)GN-NF061 JAN 25/99

figure 1

PROPERTY OWNERSHIP MAP
FMC – Middleport, New York

LEGEND:

- SHALLOW BEDROCK MONITORING WELL
- OVERBURDEN MONITORING WELL
- DEEP BEDROCK MONITORING WELL
- EXTRACTION WELL
- SHALLOW BEDROCK PIEZOMETER
- OVERBURDEN PIEZOMETER
- DEEP BEDROCK PIEZOMETER
- A-17 'A' BEDROCK ZONE
- B-867 'B' BEDROCK ZONE
- C-532 'C' BEDROCK ZONE
- DE-1003 'D/E' BEDROCK ZONE
- BLAST FRACTURED TRENCH

NOTES:

1. BASE MAP PREPARED FROM ELECTRONIC CAD FILE FROM CLIENT MADE BY "CONESTOGA-ROVERS & ASSOCIATES", DRAWING I.D. 04798-00(011GN-NF003, DATED MAY 9, 2003, AT A SCALE OF 1"= 300'.
2. ALL LOCATIONS ARE APPROXIMATE.

0 200' 400'
GRAPHIC SCALE

FMC MIDDLEPORT SITE NIAGARA COUNTY, NEW YORK
FIRST QUARTER 2006/2007 PROGRESS REPORT

SITE HYDRAULIC MONITORING WELL NETWORK

ARCADIS BBL
Infrastructure, environment, facilities

FIGURE 2