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Transmitted Via Overnight Delivery

September 28, 2016

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Mr. Nathan Freeman
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Re: FMC Corporation, Middleport, NY
EPA ID No. NYD002126845
AOC Docket No. II-RCRA-90-3008(h)-0209
DER Site No. 932014
Amended Part 373 Permit Application

Dear Ms. Gardell and Mr. Freeman:

FMC Corporation (FMC) submitted an Amended Part 373 Permit Application for its Middleport facility to the New York State Department of Environmental Conservation (NYSDEC) by letter dated May 18, 2015. That submittal included a draft *North Site Cover Operations and Maintenance Plan* (Parsons, May 2015) and a draft *Groundwater Extraction System Operation and Maintenance Manual* (Parsons, May 2015). The NYSDEC provided comments on those plans by emails dated July 15, 2016 and July 19, 2016. FMC and the NYSDEC discussed the NYSDEC's comments during a conference call held on August 17, 2016 and it was agreed that FMC would revise the documents based on the NYSDEC's comments and the August 17th discussion by September 30, 2016. Accordingly, the following revised documents associated with the Amended Part 373 Permit Application are enclosed (on CD only):

- Attachment D - North Site Cover Operations, Monitoring and Maintenance Plan, and the
- Attachment E – Groundwater Extraction System Operations and Maintenance Manual

If you have questions or would like additional information, please contact me directly by telephone at (215) 299-6554 or by email at shawn.tollin@fmc.com.

Sincerely,

Shawn J. Tollin
Manager, Environmental Remediation

Enclosures

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GROUNDWATER EXTRACTION SYSTEM OPERATION AND MAINTENANCE MANUAL

FMC MIDDLEPORT SITE
EPA ID NO. NYD002126845

Prepared for:

FMC Corporation

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September 2016

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ACRONYMS

Acronym	Definition / Description
Agencies	NYSDEC and USEPA, when referred to collectively
AOC	Administrative Order on Consent
BFBT	Blast fractured bedrock migration control trench
bgs	Below ground surface
CSI	Central Surface Impoundment
FMC	FMC Corporation
FT AMSL	Feet above mean sea level
GAL	Gallon(s)
GPM	Gallon(s) per minute
GWES	Groundwater Extraction System
HASP	Health and Safety Plan
HDPE	High-density polyethylene
HOA	Hand-off-auto (switch)
ICM	Interim corrective measure
MCC	Motor control center
mg/L	Milligram(s) per liter
NYSDEC	New York State Department of Environmental Conservation
O&M	Operations and maintenance
PLC	Programmable logic controller
PVC	Polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SPDES	State Pollutant Discharge Elimination System
SOP	Standard operating procedure
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
WTP	Water treatment plant

1.0 INTRODUCTION

1.1 General

FMC Corporation (FMC) has prepared this Operations and Maintenance (O&M) Manual for the Groundwater Extraction System at its facility in Middleport New York (Facility or Site) (Figure 1). The Groundwater Extraction System was designed, built and operated under the Administrative Order on Consent (AOC), Docket No. II RCRA-90-3008(h)-0209, entered into by FMC, the New York State Department of Environmental Conservation (NYSDEC), and the United States Environmental Protection Agency (USEPA) (the latter two entities are collectively referenced herein as "Agencies") and effective July 2, 1991.

This document describes the operation and maintenance (O&M) requirements of the groundwater extraction system and includes:

- A general description of the system and individual systems components
- A description of the system operation and general operating procedures
- Identification of system maintenance requirements, inspection checklists and maintenance schedules
- Health and safety protocols to be followed during operations and maintenance of the system
- An O&M plan
- A contingency plan

1.2 Site Description

The Middleport Facility is located on approximately 102 acres in the southeast corner of the Village of Middleport, and Town of Royalton, New York (Figure 1). The area surrounding the Facility primarily consists of a mixture of commercial and residential properties. The entire perimeter of the Facility is fenced with two monitored, gated entrances. The Facility is bounded to the north by a railroad line, to the south by commercial properties and a state highway (Route 31), to the east by agricultural land and an auto salvage yard, and to the west by residential properties. The Royalton-Hartland Junior-Senior High School, vacant industrial/commercial properties and residential properties are located immediately north of the railroad line. FMC currently utilizes the Facility for pesticide formulation and packaging.

1.3 Background

As a result of past manufacturing operations and waste management practices at the Facility, the subsurface areas within the northern portion of the Facility's property contain contamination. Various chemicals and compounds were identified in the overburden and shallow bedrock groundwater beneath the Facility and in monitoring wells installed beyond the Facility’s eastern, western, and northern perimeters.

Since 1988, FMC has been operating a groundwater extraction system, which currently consists of six blast-fractured bedrock migration control trenches (BFBTs A through F), 10 associated extraction wells, and one additional extraction well not associated with the

BFBTs. The system has been subsequently modified to include seven BFBTs and 14 recovery wells.

Groundwater extraction interim corrective measures specifically accomplish two objectives:

- They minimize off-site migration of contaminants in groundwater within the overburden and shallow bedrock zones. This is achieved by creating hydraulic depressions sufficient to reduce or reverse groundwater movement off-site through extraction and infiltration barriers.
- The mass of Facility contaminants in groundwater is reduced as contaminants are extracted with the groundwater.

Extracted groundwater is managed through the Facility's water treatment plant (WTP), which is described in the Operation, Maintenance and Monitoring Manual, FMC Middleport Site Water Treatment Plant (Arcadis 2009) ("WTP OM&M Manual). Operation of the WTP is subject to the terms and conditions of the Facility's State Pollutant Discharge Elimination System (SPDES) permit.

1.4 O&M Manual Organization

In addition to this introduction, the O&M manual contains seven sections, as described below.

Section 2.0 describes the system components including the BFBTs, extraction wells, pump houses, conveyance structures and storage tanks, electrical power, and control system. Section 3.0 addresses normal system operations, with specific instructions for operating the various system components. Section 4.0 describes system maintenance activities, routine inspections and recordkeeping requirements. Section 5.0 summarizes health and safety requirements, which are described in greater detail in the Facility Health and Safety Plan (HASP) for the Site remedial systems. Section 6.0 provides a contingency plan, summarizing procedures to be followed in the event of an emergency or disruption to extraction system operations. Section 7.0 includes references for the documents cited in the text of this O&M manual.

2.0 SYSTEM DESCRIPTION

2.1 General

The groundwater extraction system is comprised of six major system components, as follows:

- BFBTs
- Extraction wells
- Pump houses
- Conveyance structures and storage tanks
- Electrical power
- Controls systems

In general, the flow of groundwater on the Facility is intercepted by a BFBT. The water levels in the trenches are controlled by a pump located in a groundwater extraction well. The well pump is triggered to begin operating when the level of water within the well reaches an elevation set point. Groundwater is then pumped from the extraction well through a force main. Groundwater from wells C-EX1, C-EX2, A-758X, and A-759X is pumped directly to the groundwater storage tanks (T-1101/T-1102) for temporary storage prior to on-site treatment in the Facility's WTP. Water from wells D-EX1, D-EX2, G-EX1, G-EX2, G-EX3, A-542RX, A-752X, A-757X, A-760A, and BC-752X is pumped to Tank T-1000 and staged for pretreatment through an air stripper before being transferred to the groundwater storage tanks (T-1101/T-11020). The pretreatment system is located in Building 74 (Figure 2). These components are described in greater detail in the following subsections.

2.2 Blast Fractured Bedrock Trenches

There are seven BFBTs on-site (Trenches A through G). The blast fracturing was conducted by drilling blasting shot holes on approximately 5-foot centers along the trench alignment. The blast zones typically extended to depths of approximately 25 feet below ground surface (bgs) into the underlying bedrock. The locations of the trenches are shown in Figure 3. Typical construction details are provided in the 2005 Groundwater ICM Construction and Performance Report (Geomatrix-BBL 2005).

Trench A is located east of the former eastern surface impoundment with a north-south orientation and an approximate length of 300 feet. The recovery system in the trench became operational in April 1995 and provides a linear hydraulic barrier to off-site migration to the east. Trench A has one groundwater recovery well (A-756X) that is located at the southern end of the trench.

Trench B is located within the northern part of the Site where the former Central Surface Impoundment was located and is oriented in an east-west direction. This trench is 200 feet long and creates a hydraulic barrier to off-site migration to the north. The recovery system in Trench B began operating in February 1996. Trench B has one groundwater recovery well (A-758X) that is located toward the eastern end of the trench.

Trench C is located in the northwest part of the Site, directly to the west of Trench B. This trench is designed to create a hydraulic barrier to the migration of groundwater

off-site. Trench C is approximately 820 feet long and began operating in early 1999. Trench C has three groundwater recovery wells. Well C-EX1 is located in the western end of the trench. Well A-758X is located in the center of the trench, and well C-EX2 is located in the eastern end of the trench.

Trench D is located in the northeastern part of the Site and is directly adjacent to Trench B. This trench is designed to create a hydraulic barrier to the migration of groundwater off-site. Trench D is approximately 480 feet long and began operating in early 1999. In 2005, the eastern 190 feet of Trench D was re-blasted to increase the hydraulic capture. Trench D has three groundwater recovery wells. Well A-760X is located in the western end of the trench. Well D-EX1 is located just east of the center of the trench, and Well D-EX2 is located in the eastern end of the trench.

Trench E is located in the central-eastern part of the Site in the vicinity that once housed methylene chloride storage tanks. This trench is 275 feet long and was designed to collect groundwater impacted with methylene chloride. The recovery system in Trench E began operating in February 1996. Trench E has one groundwater recovery well (A-757X) that is located at the southern end of the trench.

A second well not directly associated with Trench E (Well BC-752X) is located to the west of the trench and is designed to recover water and methylene chloride from the deeper bedrock zone. Well BC-752X is constructed to a depth of 78 feet below ground surface.

Trench F is located southeast of the former Central Surface Impoundment and consists of two short intersecting trenches centered on a single recovery well (A-542RX). The trench was designed to improve the collection of contaminated groundwater in the area.

Trench G is located in the northeast part of the Site to the west of Trench D. This trench is 790 feet long and was designed to extend the hydraulic barrier to the east side of the Facility. The recovery system in Trench G began operating in July 2005. Trench G has three groundwater recovery wells. G-EX1 is located toward the western end of the trench. Well G-EX2 is located toward the center of the trench, and G-EX3 is located on the eastern end of the trench.

2.3 Extraction Wells

There are 14 groundwater extraction wells at the Facility; the locations relative to the seven trenches are described above. Thirteen of the wells are associated with the BFBTs and are used to recover groundwater within the shallow bedrock, which typically is 20 to 30 feet below ground surface. The fourteenth well (BC-752X) located west of Trench E, is screened at a greater depth to recover bedrock zone groundwater. Well construction details are summarized in Table 1 and in the extraction well construction logs that are provided in Appendix A. Note that all bedrock extraction wells have their casing vented either through the pump house roofs or sidewall to vent any natural gas from the bedrock formation and prevent gas build-up in the pump house.

2.4 Pump Houses

Extraction well pump houses are aboveground, heated, fiberglass enclosures secured to a concrete pad. Pump houses contain pump controls, flow control equipment, flow metering equipment, a heat tracing controller, and connection points for the force main

and electrical systems. Typical details for the extraction wells pump houses are included in Appendix B. Each well and pump house generally include the following components:

- Submersible pump
- Level transducer
- Flow pressure sensor
- Isolation valves
- Pressure gauge
- Pit-less adaptor
- Flow rate indicator/transmitter
- Heater with thermostat
- Venting fan with screen
- Fluorescent vapor tight light fixture
- Mechanical and plumbing connections between individual components within each pump house

2.5 Conveyance Structures and Storage Tanks

Extraction wells are connected to common conveyance piping (force main) to transfer the water to one of three storage tanks to be held for treatment.

Materials used for the construction of the force mains including welded carbon steel, epoxy resin pipe, and polyvinyl chloride (PVC) and HDPE piping. The locations or the specific pipe materials are not well identified in reference documents.

The majority of the piping has been installed above ground, although several sections have been installed at or below grade to accommodate vehicle access and railroad crossings. All of the conveyance piping is insulated and equipped with heat trace. Controls for the heat trace are included in either the well houses, the pre-treatment building or in the T-1101/1102 booster pump house.

Feeder force mains are 1-1/2 inches in diameter. The collector force main running west after the junction of the A-756X, A-757X, and BC-752X force main is 2-inch-diameter epoxy resin, as is the force main running from the effluent tank on the pretreatment system. This force main feeds into a 4-inch-diameter carbon steel line at a point immediately after the junction with the force main from the (former) Central Surface Impoundment (CSI) sumps 15 and 7 and Trench B extraction well A-758X, located near Trench F extraction well A-542RX. This 4-inch-diameter line then runs west and empties its groundwater into tanks T-1101/T-1102 for eventual treatment at the Facility WTP. The force main connecting the tanks to the WTP is also a 4-inch-diameter line. A cross-section view of a typical aboveground force main is included in Appendix B.

Tank T-1100 is a 1,000-gallon poly tank located inside Building 74. This tank is used to store collected groundwater prior to pretreatment and conveyance to Tank T-8100 and then to T-1101/1102.

Tanks T-1101 and T-1102 are located due north of the former boiler house. Each tank has a nominal capacity of 600,000 gallons. The tanks are constructed of carbon steel and are equipped with bottom shell nozzles for loading and unloading, an interconnected overflow pipe, and liquid level indicators.

2.6 Electrical Power

Electrical power is supplied to the pump houses from a number of different locations.

Located in the motor control center (MCC) in Building 70, the 480V, 3 Phase, 200A power is located in MCC#4, Cabinet #5. Power from here is distributed to seven pump houses.

Transformers in each pump house are used to step down the voltage to 240V for the pumps and 120V for all other pump house components requiring power.

For extraction well A-756X, electrical power and pump control has been maintained in the well house for former extraction well A-753A. Power and control wiring run in conduits attached to the force main connecting A-756X to the former A-753A well house.

Electrical power for the extraction wells and associated equipment for pump houses C-EX1 and C-EX2 is provided by overhead lines with a distribution panel located on a pole located near C-EX1. A copy of the electrical drawings is included in Appendix C.

Electrical power for the extraction wells and associated equipment for the pump houses for the D and G trenches is provided through overhead lines running from Building 74 (pre-treatment building). The main breaker is located in the Motor Control Center located in Building 70.

Single-phase transformers and power distribution panels and surge protection systems are located in each well house.

2.7 Control Systems

The groundwater extraction system is fully automated and is controlled through two systems. The Supervisory Control and Data Acquisition (SCADA) system, which is located in the WTP, is connected to the local logic controllers and provides flow and level monitoring, run status and interlock controls. Additional information regarding the SCADA system is included in the WTP OM&M Manual (Arcadis 2009).

Local monitoring and control of the extraction wells is provided through the MicroLogix 1000 programmable logic control (PLC) panel in each well house. The local controls monitor the water level in the well, turn the pumps on and off, and record the instantaneous and totalized flows from the well house into the conveyance piping.

3.0 SYSTEM OPERATION

Normal system operation is described in Section 3.1. The operation of individual system components and typical operating procedures are presented in Sections 3.2 and 3.3. Contingency procedures to be implemented in case of a shutdown of the WTP are presented in Section 6.0.

The operation of the groundwater extraction system is under the control of the Water Treatment Plant Operator (Operator) who is assigned control of the plant during that shift. The Operator reports to the WTP Superintendent (Superintendent) who is responsible for the operation of all of the groundwater extraction and sump collection systems and treatment plant operations. The WTP Superintendent reports to the Facility Environmental Health and Safety (EHS) Manager.

3.1 Normal System Operation

During normal system operation, groundwater is extracted from each of the groundwater recovery wells and transferred to a groundwater holding tank. As previously stated in Section 2.1, water from 10 of the wells is transferred to tank T-1000 and staged for pre-treatment. Water from four of the extraction wells is transferred directly to tanks T-1101/T-1102. The local well pump controls and instrumentation include the following components:

- Pump motor starter
- MicroLogix PLC
- MicroView data entry and display keypad
- Magnetic flow transmitter
- Well level transmitter
- Pump discharge pressure switch

The pump motor starter panel is equipped with a hand-off-auto (HOA) switch. In the hand position the pump runs continuously. In the auto mode, the pump cycles on and off based on the level in the well.

The PLC receives signals from the level transmitter, flow transmitter, pump control switch and pressure switch and SCADA system, along with data entered from the keypad. Based on its programming, it will send signals to start and stop the well pump and alarm light. The MicroView keypad is used to display operating data and enter set points.

The pump start level and pump stop levels are entered from the MicroView interface and are easily adjusted by the operator. Flow and well level can be continuously monitored from the keypad. The flowmeter provides an accurate and reliable measure of flow rate and totalized flow.

A pressure switch is located in the pump discharge piping. It is used to shut down the pump in a high discharge pressure condition. If blockage in the piping occurs or a valve between the force main and storage tank is shut, the pressure will exceed the trip point. After a short delay, the pressure switch signal will shut down the pump. Once the pump shuts down, the PLC waits until the pressure is below the trip point for 15 minutes before

restarting it. This is to prevent the pump from frequent cycling due to the loss of discharge pressure when the pump shuts down.

The flow meter sends a signal to the PLC allowing the flow rate and total flow to be displayed from the control panel. The controls include a well high level alarm. When the level exceeds the set point, an alarm signal light outside the well house will flash. From the MicroView keypad, the following information can be displayed by choosing the desired data type from the main screen:

WELL FLOW RATE (in gallons per minute)	GPM (resolution of 0.1 gal)
TOTALIZED FLOW (in gallons)	GAL (resolution of 1 gal)
WELL LEVEL (in feet above mean sea level)	FT AMSL (resolution of 0.1 feet)
PUMP STATUS	STOPPED / RUNNING
WELL LEVEL	NORMAL / HIGH
PUMP DISCHARGE PRESSURE	NORMAL / HIGH

GPM – gallon(s) per minute
GAL – gallon(s)
FT AMSL – feet above mean sea level

The following set points are entered using the MicroView interface:

PUMP START LEVEL	(FT AMSL)
PUMP STOP LEVEL	(FT AMSL)
WELL LEVEL HIGH SET POINT	(FT AMSL)
LEVEL TRANSMITTER ELEVATION	(FT AMSL)

The set points can be entered by choosing SETUP from the main screen. The set point screens are password protected to prevent an inadvertent change of set points. The set points for the PUMP START LEVEL and the PUMP STOP LEVEL must be greater than the LEVEL TRANSMITTER ELEVATION by at least 0.5 foot to be in the valid range. If a lower value is entered, the PLC will automatically use the LEVEL TRANSMITTER elevation plus 0.5 foot as the set point. There must be at least 0.5 feet between the PUMP START LEVEL and the PUMP STOP LEVEL. The data point descriptions used above may be shortened on the MicroView display due to space limitations on the display. Levels are entered to one place past the decimal point. Include the decimal point when entering the values. Set points may be periodically changed to meet the operational goals of the recovery system. A summary table of the set points being used as of the date of this Plan are included in Appendix I.

The well house piping also includes a pressure gauge for monitoring discharge pressure to the force main, a well water sample tap, double check valves (to prevent any back flow to the well), shutoff valves and a flow control valve. The flow control valve is used to restrict the well discharge and reduce cycling of the pump. The flow control valve may take the form of a diaphragm valve or a pressure-regulating valve. Operation of the

various system components and operating procedures are presented in the following sections.

3.2 System Components

The systems and components presently in place at all extraction wells, as well as the entire force main system, overburden groundwater extracting sump pumps and related valves, piping and the storage tanks, are all identified on drawings included in Appendix B.

Specifications, operating criteria and manufacturers information for the various system components are identified in the information included in Appendix D.

The O&M manuals or manufacturer's literature in these appendices are subdivided according to specific pump houses or groups of pump houses.

3.3 Operating Procedures

3.3.1 General

All system operation activities must be performed in accordance with the Health and Safety protocols presented in Section 5.0 and all applicable facility rules and guidelines. The operating procedures presented herein provide guidance for routine operations which will be performed throughout the life of the system. Additional procedures to be followed in the event of a shutdown of the Facility WTP, an emergency, or for complete shutdown of the system are presented in Section 6.0.

Standard operating procedures (SOPs) for startup and shutdown of the equipment are included in the Groundwater Extraction System SOPs (Appendix E).

3.4 Standard Operating Settings and Adjustments

The following operating settings for various system components were preset during installation and must be maintained, except where noted otherwise:

1. HEAT TRACE THERMOSTATS

   Heat trace thermostats are set at 35°F to protect all insulated and heat traced portions of the pipe from freeze up.

2. PUMPHOUSE HEATER THERMOSTATS

   Pump house heater thermostats are set at 50°F to protect exposed piping within the pump house from freeze up.

3. PUMP SETTINGS

   The pump set into the deeper, open core-hole extraction well (BC-752X), is installed with the pump intake a minimum of 5 feet above the bottom of the well. The pump set into intermediate depth, screened interval extraction well (A-542RX), is installed with the pump intake a minimum of 1/2 foot above the bottom of the screen. For shallower screened interval extraction wells (A-756X, A-757X, A-758X) pumps are installed with the pump intake a minimum of 2 feet above the bottom of the screen. For wells A-759X and A-760X, the pumps are installed a minimum of 1/2 foot above the bottom of the screen.

   Pumps cannot be reset without removal and adjustment of the complete drop

pipe and pump assembly.

4. LEVEL CONTROL SETTINGS

   All site extraction wells now use a pressure transducer level control system. This system uses a pressure transducer set a short distance above the bottom of the pump intake. The transducer reads the pressure above it and relays this data to the MicroLogix 1000 PLC which converts this data into a water level. The PLC controls the groundwater pumping levels based on the programmed pump on/off set points. The level settings should be set so that the pump may run for a minimum of 1 to 4 minutes prior to shutoff. This setting may be fine-tuned using the flow control valves.

5. FLOW CONTROL VALVES

   The flow control valve on each discharge line is a pressure relief valve which may be manually adjusted to regulate flow from the extraction well. Flow should be adjusted from the pump to ensure the pump runs for a minimum duration of 1 to 4 minutes prior to shut off by the low level switch to avoid excessive cycling of the pump.

6. PRESSURE SWITCH

   The pressure switch is pre-set to stop the pump when line pressure reaches 100 psi and re-start the pump when line pressure drops to 70 psi. The pressure limits and range may be adjusted at the pressure switch.

4.0 SYSTEM MAINTENANCE

System maintenance requirements include routine system inspections, scheduled component maintenance, unscheduled maintenance in response to inspection reports or component failure and record keeping of all maintenance activities. Routine maintenance and inspection requirements are outlined in Section 4.3. Non-routine maintenance procedures are included in Section 4.4

4.1 Recordkeeping

Recordkeeping related to the groundwater extraction system (GWES) involves written documentation of the following tasks:

- Startups and shutdowns for each extraction well
- Routine inspection and maintenance
- Scheduled and unscheduled maintenance

Records of unscheduled maintenance performed, including work done and parts replaced, must be retained in the system maintenance file maintained by the WTP.

4.2 General Maintenance

General maintenance items form the GWES include maintaining the areas around the well houses to provide access throughout the year. Through the summer months, the areas around the pump houses and force mains will be will be maintained by mowing of the grass. Approved herbicides may be applied around the force mains and tanks to limit the growth of vegetation.

During the winter months, the areas around the well houses and tanks will be kept clear of snow to allow access. Where roadways are present, they should be plowed and sanded to maintain vehicle access.

4.3 Routine Inspections and Maintenance

Routine operating procedures are those tasks which involve scheduled inspection and maintenance of the GWES equipment and appurtenances. These maintenance events ensure that all GWES components are maintained in accordance with the manufacturer's operations and maintenance manuals, and service bulletins. All routine maintenance activities events shall be documented in the WTP operations logbook. In addition, all routine maintenance events shall be detailed in each respective quarterly progress report, as well as the annual report for that respective reporting period.

A summary of the routine GWES inspection and maintenance services and their typical frequencies of completion is provided on Table 4-1. Copies of manufacturers' O&M manuals are provided in Appendices D. The following subsections provide the procedures to be completed as part of the routine maintenance events for the major system components:

Table 4-1: Routine Inspection and Maintenance Service Requirements				
Inspection / Maintenance Item	Frequency			
	Daily	Monthly	Semi-Annual	Annual
Well houses (visual inspection of well houses, controls, operating conditions, obvious maintenance issues, flowmeter readings)	X			
Well houses and tanks (check for leaks and exercise valves)		X		
Pump House (check valves, max discharge pressure, piping and pipe supports)			X	
Force Mains (check supports, pressures, insulation and heat trace operational)			X	
System inspections (level transducer set points, interlock and alarm checks, and controls inspection)				X

4.3.1 Daily Inspections and Maintenance

Daily inspections of the GWES are necessary to ensure that the pump house components are operational. Inspections of the pump houses should be completed daily during operation of the WTP. Items to be included in this inspection include:

- Recording of totalized flow volumes
- Verification that the pump and control systems are working
- Verification that the water level in the well is within the set point limits
- A general visual inspection of the well houses, well casings, force mains, electrical and control systems for any obvious signs of maintenance items to be addressed
- In the winter, verification that the heat trace system is functioning.

Documentation for the daily inspection will include the recording of the totalized flowmeter reading and current water elevation on the extraction well readings form (Appendix F). Any maintenance items which need to be addressed will be recorded in the WTP log book. Maintenance items noted during the daily inspections will be addressed as quickly as feasible. Minor items should be addressed as soon as parts and required subcontractors are available. Major maintenance items that require more planning will be brought to the attention of the WTP Superintendent to address and schedule for completion.

4.3.2 Monthly Inspection and Maintenance

Monthly inspections of the GWES should be performed in conjunction with one of the daily inspections and should include the following additional activities:

- In each pump house and at tanks T-1000, T-8100, and T-1101/T-1102:
  - Open and close all valves and lubricate, as required; and
  - Inspect within the well house and along the force main piping for signs of water leakage.

Documentation for the monthly inspection will include a notation in the WTP logbook that the inspection was completed. Maintenance items noted during the inspections will be addressed as quickly as feasible. Minor items should be rectified as soon as parts and required subcontractors are available. Major maintenance items that require more planning will be brought to the attention of the WTP Superintendent to address and schedule for completion.

4.3.3 Semi-Annual Inspection and Maintenance

Semi-annual inspections of the GWES should be performed as follows:

- In each pump house:
  - Determine and record maximum discharge pressure produced by the pump (override pressure switch to determine maximum discharge pressure);
  - Inspect and check operation of double check valve;
  - Check pipe and pipe supports for signs of corrosion – repaint, as required; and
  - Lubricate valves as required.
- Force mains:
  - Inspect all pipe supports, hangers and brackets; ensure pipes are fully supported and supports are secure; inspect supports for signs of corrosion and damage; repair and/or repaint, as required; and
  - Ensure insulation and covers are intact and secure; ensure heat trace is operational prior to October 31 each year; re-inspect half-way through winter.

Documentation for the semi-annual inspections will include a notation in the WTP logbook that the inspection was completed. Maintenance items noted during the inspections will be addressed as quickly as feasible. Minor items should be rectified as soon as parts and required subcontractors are available. Major maintenance items that require more planning will be brought to the attention of the WTP Superintendent to address and schedule for completion.

4.3.4 Annual Inspection and Maintenance

Annual inspections of the GWES should be performed as follows:

- Set-point evaluation of level transducers

- Interlock and alarm checks: The function of the extraction system alarms and interlocks will be checked and confirmed to be operating in accordance with the list included in Appendix G.

Documentation for the annual inspection will include a notation in the WTP logbook that the inspection was completed. Maintenance items noted during the inspections will be addressed as quickly as feasible. Minor items should be rectified as soon as parts and required subcontractors are available. Major maintenance items that require more planning will be brought to the attention of the WTP Superintendent to address and schedule for completion.

4.3.5 Replacement Parts

FMC will minimize program downtime due to equipment failure by providing replacement parts as soon as possible after equipment failure is discovered. Replacement components will be kept on-Site for installation in case of failure of:

- Submersible pumps
- Pressure transducers
- Pump house heaters

These components are the ones that have the greatest likelihood of failing. If replacement parts are not readily available within seven days after equipment failure, spares will be kept on hand at the WTP. A list of the parts to be kept on site is included in Appendix H.

4.4 Non-Routine Maintenance

Non-routine maintenance activities are those tasks which involve out-of-scope maintenance and upkeep of the GWES equipment. Non-routine maintenance activities shall be conducted in response to GWES shutdown conditions and as a result of decreased equipment performance. All non-routine maintenance events shall be documented in WTP Logbook. In addition, all non-routine maintenance events shall be detailed in each respective quarterly progress report, as well as the annual report for that respective reporting period. Following the completion of any non-routine maintenance event, the start-up procedures as documented in Appendix E, shall be completed to confirm normal system operation.

4.4.1 System Alarms

The GWES is equipped with an alarm notification system to indicate when the system is not operating properly, resulting in an alarm condition and system shut down. All alarms are indicated on the SCADA screen in the WTP control room. For some alarms, an automated email notification is sent to the WTP Superintendent and designated staff.

The following is a list of the alarms for the system:

Well level high; Programmed for each of the recovery wells, the alarm is triggered when the water level in the well reaches a predetermined set point. Alarm is made to the control room display.

No flow for 3 consecutive days; Programmed for each of the recovery wells, the alarm is triggered if there is no change in the flowmeter reading for 3 consecutive days. Alarm is made to the control room display, and an email is sent to the operations staff.

No flow for 5 consecutive days; Programmed for each of the recovery wells, the alarm is triggered if there is no change in the flowmeter reading for 3 consecutive days. Alarm is made to the control room display.

No flow for 7 consecutive days; Programmed for each of the recovery wells, the alarm is triggered if there is no change in the flowmeter reading for 3 consecutive days. Alarm is made to the control room display.

In the event that an alarm is activated, the appropriate maintenance and repairs shall then be conducted (usually within 48 hours), as specified in the WTP OM&M Manual and/or this GWES O&M Manual, and the GWES will subsequently be restarted. The shutdown date/time, system start-up date/time, a general description of the alarm condition and a summary of the actions performed to address the alarm condition, shall be documented in the WTP log.

Operational concerns shall be noted in the WTP Log and the respective quarterly progress report.

4.4.2 Cleanout of Extraction Wells

Iron oxidizing and sulfate reducing bacterial fouling of the extraction well screen, sand pack, and the pump and force mains may occur. This can inhibit groundwater flow, and therefore, drawdown of the groundwater in the wells and trenches. Biomass in the pumps and force mains inhibits efficient groundwater conveyance to the treatment plant.

Because of the difficulty of completely eliminating bacteria from the extraction wells, and the need to maintain good hydraulic connectivity between the extraction well screens/sand packs and the blast fractured bedrock trenches, the well treatment procedures described below will be performed, at a minimum, semi-annually (April and October) at all extraction wells. Bacterial presence in the extraction wells will be monitored by the inspection of the well groundwater using transparent Teflon® bailers at the time of the quarterly extraction well sampling events and at other times, if warranted.

Well treatments may include the addition of acid (hydroxyacetic acid) treatment in each well, followed by shock chlorination using sodium hypochlorite. Additional procedures may be used including the addition of sodium hypochlorite only, or the addition of sodium hypochlorite and glacial acetic acid.

4.4.2.1 Acid Treatment Procedures

The extraction well should be shut down at least 12 hours before the beginning of the treatment to allow groundwater recovery. Prior to the addition of any acid into the well casing, the pressure transducer probe and cable should be removed from the well.

Hydroxyacetic (glycolic) acid (70 percent) solution will be used to dissolve the bacteria in the wells. Hydroxyacetic acid is relatively non-corrosive and produces little or no toxic fumes. The acid is an excellent bactericide and simultaneously dissolves bacterial iron deposits as well as other mineral scale. Hydroxyacetic acid is also a chelating agent and so will keep the metal ions created by dissolution of the mineral scale in suspension.

Hydroxyacetic acid will be added to the wells at two quarts 70 percent acid solution per one foot of 8-inch diameter well screen/riser (or 6-inch diameter open hole) below the static groundwater table. The acid solution will be pumped through small diameter tubing to the midpoint elevation of the well screen (or open hole interval) using a peristaltic pump. Following the addition of the acid, a volume of water equal to that standing in the well will be added to drive the acid solution through the well screen slot openings and into the sand-pack and formation.

The well pump should run for approximately ten minutes to introduce the acid solution into the well pump and force main. The well will then sit for a minimum of two hours. After adding the water, the water in the well will be surged with a centrifugal pump and large diameter hosing. Thirty to fifty gallons of water should be rapidly pumped from the well into a wastewater container. The end of the suction hose should be rapidly raised and lowered along the length of the well screen while pumping. Then the containerized water should be rapidly pumped back into the well. This procedure should be repeated a minimum of two times. The centrifugal pump and hosing will then again be used to withdraw the acid solution and bacterial debris from the well casing into a truck-mounted 250 gallon wastewater container or equivalent for transport. The end of the suction hosing will again be raised and lowered repeatedly from the bottom to the top of the well screen while pumping the wastewater container full. The well will then be restarted and allowed to run for a minimum of one hour. The wastewater container will be emptied into the Tanks T-1101/T-1102 sump pit and the container flushed with potable water. Water in the sump pit will be pumped to Tanks T-1101/T-1102 for treatment at the Facility's WTP.

4.4.2.2 Shock Chlorination

After the acid treatment and pump-out of the acid solution and bacterial debris, the well will be pumped a minimum of one hour and the pH measured. If the pH is less than 6.0, the well will continue to be pumped until pH has stabilized and is equal to or greater than 6.0. A pH of less than 6.0 may indicate that hydroxyacetic acid may still be present in the well. If appreciable hydroxyacetic acid is present in the well when the sodium hypochlorite is later added, a toxic fume may be generated.

The well will then be shut off after the pH is equal to or greater than 6.0. After the water level has stabilized, shock chlorination will be performed. Sodium hypochlorite at a concentration of 12.5 percent (in water) will be added to the well via peristaltic pump and small diameter tubing to the midpoint elevation of the well screen (or open-hole interval). The amount of sodium hypochlorite to be added will be such that the concentration in the well exceeds 1000 milligrams per liter (mg/L) (shock chlorination). One gallon of 12.5 percent sodium hypochlorite solution is sufficient to produce a chlorine concentration of 1000 mg/L in 125 gallons of water. After addition of the solution, a volume of potable water equal to that present in the well column will be added to the well to drive the sodium hypochlorite solution through the well screen. Note that when calculating the amount of sodium hypochlorite to add to the well, this additional volume of water should be included in the total.

Following the addition of the sodium hypochlorite solution, the well will sit for a minimum of two hours. Prior to this, the well pump should be run for approximately ten minutes to introduce the sodium hypochlorite solution into the well pump and force main. The water in the well will then be surged with a centrifugal pump and large diameter hosing. Thirty to fifty gallons of water should be rapidly pumped from the well into the wastewater container. The end of the suction hose should be rapidly raised and lowered along the

length of the well screen while pumping. Then the containerized water should be rapidly pumped back into the well. This procedure should also be repeated a minimum of two times. The centrifugal pump and hosing will then again be used to withdraw the sodium hypochlorite solution and bacterial debris from the well casing into a truck mounted wastewater container for transport. The wastewater container will be emptied into the Tanks T-1101/T-1102 sump pit and the container flushed with potable water. Water in the sump pit will be pumped to Tanks T-1101/T-1102 for treatment at the Facility's WTP.

The end of the suction hosing will again be raised and lowered repeatedly from the bottom to the top of the well screen while pumping the wastewater container full. The well will then be restarted.

4.4.2.3 Additional Bacteria Preventative Control Measures

Additional bacteria control measures may be conducted between the semi-annual well cleanouts to address bacterial fouling of the well screen. Groundwater from the wells may be inspected for bacteria during extraction well sampling events and at any time that well operating efficiency may indicate a bacteria-caused problem. If significant bacterial growth or detritus is observed between the semi-annual well cleanouts, an abbreviated acid and sodium hypochlorite treatment may be performed.

4.5 Trouble Shooting

Trouble shooting procedures reviewed herein apply to common and routine problems that may be encountered and are intended to isolate the problem. Correction of the problems will depend upon the component(s) which failed. Operators should refer to manufacturer's instructions for specific components once a problem has been identified. The following common problems may be encountered:

- No flow through system
- No flow from single pump house

Procedures for indicating the source of these problems are presented in the following sections.

4.5.1 No Flow Through System

During normal operations, flow from the collector force main will empty into the storage tanks T-1000, T-1101, or T-1102. Some of the tanks also receive overburden groundwater collected from overburden groundwater collection underdrains and sumps. This combined sump and extraction well water is then batch fed to the WTP.

Changes to the level indicators on the sides of the storage tanks should correspond to the total flow readings from all pump houses and sumps. If there is no change in the level indicator, make certain that the valves from the sumps and pump house leading into the storage tanks are open. If these valves are open, check force mains for leaks where visible or signs of leakage where buried.

4.5.2 No Flow from Single Pump House

During normal operations, if a particular pump house has no change in totalized flow between inspections, the following items should be checked:

- Ensure power is available at pump house and line valves are open.

- If pump is shut down due to high pressure, check for a blockage in the line.
- Open sampling port (collect water) and observe flow (if any). If the pump is running and there is flow in the system, but no flow registered on the meter, initiate repairs to the flow sensor in accordance with the appropriate maintenance manual.

  When the pump turns ON and water is extracted, the level on the PLC display will drop (menu item 3: water level and flow). If no flow is registering on the in-line magnetic flow meter, the unit needs repair. Alternately, if flow is registering and being totalized on the in-line meter and the PLC display does not indicate a dropping water level or flow, this unit needs maintenance, most likely a transducer replacement.
- If there is no flow and the pressure switch did not cut out the pump, remove the well cap or access port cover and check the water level in the well. If the water level is below the high level setting, allow the well sufficient time to recover and continue to monitor the water level.

  If the water level is above the high level setting and there is no flow, refer to the appropriate pump manufacturer's manual.

5.0 HEALTH AND SAFETY

The Facility Health and Safety Plan (HASP) provides overall health and safety information and requirements for any work conducted as part of Resource Conservation and Recovery Act (RCRA) corrective action activities. The following describes work specific to groundwater extraction system O&M.

5.1 General

The primary contaminant of concern, with respect to the extracted groundwater, is methylene chloride. Additional parameters which may be present in the groundwater include arsenic, carbofuran, 7-hydroxy-benzofuran, chlorinated pesticides, metals and volatile organic compounds (VOCs).

All personnel involved in the O&M of the GWES must be familiar with and observe the health and safety protocols contained herein, as well as all applicable plant health and safety guidelines as presented in the HASP.

5.2 Training

The description of the work being performed for O&M of the groundwater extraction system includes:

- Routine daily operations;
- General maintenance activities associated with groundwater pumps and pumping equipment;
- Groundwater sampling activities; and
- Decontamination activities.

The following hazards/risks may be associated with these activities:

- Potential contact with contaminated groundwater;
- Potential vapor emissions;
- Potential contact with decontamination fluids or acid/caustic solutions;
- Slip, trip, fall hazards associated with climbing ladder;
- Potential back injuries from heavy lifting;
- Physical hazards (i.e. potential explosive atmosphere);
- Potential pinch hazards; and
- Hazards present when using any specialized decontamination equipment (e.g. steam cleaning unit).

Prior to beginning work on these tasks, a task specific review will be completed to identify the potential hazards associated with the task and any means and methods which can be employed to mitigate those hazards. A description of this review process is included in the HASP.

5.3 Personal Protective Equipment

Personnel involved in the maintenance or operation of the GWES that may come in contact with potentially contaminated groundwater will be equipped as required by the provisions of the HASP, in addition to equipment required by plant regulations.

5.4 Emergency Response Plan

In the event of a serious injury, explosion, fire, spill or other serious incident, the WTP Operator or the WTP Superintendent will be notified immediately so that he or she may contact the Facility's EHS Manager. It may be necessary for FMC to enact the Facility's RCRA Contingency Plan or Emergency Action Plan.

6.0 CONTINGENCY PLAN

6.1 General

This section includes a summary of procedures and reference documents to be followed in the event of a facility emergency situation or disruption to the extraction system operations.

6.2 Emergency Operations

FMC maintains a series of plans which address the actions to be taken in the event of an emergency situation. These plans contain provisions to minimize hazards to human health and the environment from fires, explosions or any unplanned release of hazardous waste or hazardous waste constituents. Plans maintained by the Facility include:

- RCRA Contingency Plan
- Spill Prevention Report
- Spill Prevention, Control and Countermeasure Plan
- Facility Emergency Action Plan
- HASP

All personnel active in the on-site operation of GWES will be trained in the requirements and procedures contained in these plans.

6.3 Operations Contingency Plan

6.3.1 Pump House Shutdown

The equipment contained in the pump houses runs automatically, and will continue to run if left unattended. In the event of a situation where the operation of the recovery wells need to be stopped, the power may be shut down by:

- Wells may be shut down individually from the well-specific pump house.
- The pumps may be shut down from the groundwater storage tanks, leading to a high tank level situation and allowing the programmed interlock to halt the operation of the wells.
- Shutting down the power from the motor control center associated with the block of extraction wells.
- Additional information regarding these procedures is included in the WTP OM&M Manual.

There are requirements included in the Groundwater Monitoring Program for reporting to the Agencies if groundwater extraction wells are shut down. Refer to the program document for additional information regarding that process.

7.0 REFERENCES

Arcadis. 2009. Operation, Maintenance and Monitoring Manual, FMC Middleport Site Water Treatment Plant, Arcadis, January 2009.

Geomatrix-BBL. 2015. 2005 Groundwater ICM Construction and Performance Report. December 2005.

Parsons. 2016. Health and Safety Plan, FMC Middleport Site, EPA ID No. NYD002126845. October 2016.