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DRAFT Corrective Measures Study (CMS) Report –

Suspected Air Deposition and Culvert 105 Study Areas

May 2011 DRAFT

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DRAFT Corrective Measures Study (CMS) Report –

Suspected Air Deposition and Culvert 105 Study Areas

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Middleport, New York

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Tables

Figures

Appendices

Executive Summary

This Draft CMS Report is FMC's work product. It was prepared by FMC's team of professionals and experts from inside and outside the company. FMC conferred with the Agencies in preparing the draft report, and attempted to address various comments provided by the Agencies on the draft report. However, FMC understands that the Agencies do not necessarily agree with or accept the various conclusions, determinations, assessments, assertions or judgments which are expressed by FMC throughout this draft report. Many of these instances where FMC has stated its opinion in this draft report are identified by specific text or by a footnote which references this paragraph so as to clearly differentiate such opinions from the factual information provided in the report.

FMC Corporation (FMC) has completed a study of corrective measures alternatives (CMAs) under the terms and conditions of the Administrative Order on Consent (AOC), Docket No. II RCRA-90-3008(h)-0209, effective July 2, 1991, 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 collectively referred to herein as "the Agencies"). The corrective measures study (CMS) was completed in accordance with the Agencies'-approved August 2009 *Corrective Measures Study Work Plan for Suspected Air Deposition and Culvert 105 Study Areas* (CMS Work Plan) and includes the identification, evaluation, and FMC's justification/recommendation of corrective measures for the Suspected Air Deposition Area South of the Erie Canal and West of the Niagara/Orleans County Line, and Culvert 105 and Flood Zone study areas ("CMS Study Areas").

This report presents the findings of the CMS. After review by the Agencies, a Draft CMS Report will be issued for public comments. The Agencies will hold a formal public comment period and public meeting to present and receive comments on the Draft CMS Report. The Agencies will then respond to comments and will announce the Agencies' preliminary selection of a CMA by means of a "Preliminary Statement of Basis". The Agencies then will hold a second formal public comment period and public meeting on the Preliminary Statement of Basis. After public comments have been received, the Agencies will respond to comments and provide their selection of the final corrective measures for the CMS Study Areas.

After the Agencies select the final corrective measures for the CMS Study Areas, FMC will begin the Corrective Measures Implementation (CMI) phase. This phase includes activities associated with planning, designing, constructing and maintaining the selected remedy, and associated community participation and outreach activities.

Description of CMS Study Areas

FMC owns and operates a pesticide formulating facility located in the Village of Middleport and the Town of Royalton, Niagara County, New York ("Facility" or "Site"). FMC and predecessor companies operated the Facility for the manufacturing and/or formulation of agricultural products since the 1920s. Manufacturing ceased in 1985. Since that time, FMC has only conducted formulating (and packaging) operations. Past

releases have resulted in the occurrence of FMC-related contamination at the Facility and the CMS Study Areas. The predominant constituent of concern within the off-Site study areas is arsenic.

In 2009, FMC completed the investigation of (1) the Suspected Air Deposition Area South of the Erie Canal and West of the Niagara/Orleans County Line; and (2) the Culvert 105 and Flood Zone. The results of the investigations are presented in the *RCRA Facility Investigation (RFI) Report Volume II – Suspected Air Deposition Study Area 1 (South of the Erie Canal and West of the Niagara/Orleans County Line) and Culvert 105 Study Area South of the Erie Canal)* (RFI Report Volume II) dated September 2009 and *RCRA Facility Investigation (RFI) Report Volume IV – Culvert 105 and Flood Zone* (RFI Report Volume IV), dated September 2009. The Agencies communicated approval of RFI Report Volume II and Volume IV by letters dated October 6, 2009 and September 1, 2009, respectively, and directed FMC to perform a CMS for the areas identified in the approved RFI Report Volume II and Volume IV.

The CMS Study Areas are mostly comprised of residential properties. The remainder of the properties consist of commercial, industrial, agricultural or undeveloped lands, Village of Middleport- and Town of Royalton-owned land (i.e., right-of ways, wastewater treatment plant) and the Royalton-Hartland Central School District (Roy-Hart) property. Culvert 105 is a system (approximately 1.3 miles in length) for the collection and conveyance of municipal stormwater drainage that consists of a combination of buried pipes and open ditches, extending from the FMC-owned North Railroad Property immediately north of the Site to its confluence with Tributary One of Jeddo Creek.

Overview of CMS Activities

As stated in the Agencies'-approved RFI reports and the CMS Work Plan, the CMS considered the following:

- Arsenic is the primary constituent of concern in soil that has/will influence the scope of remedial efforts in the CMS Study Areas.

- Arsenic is a naturally occurring element present in soil as a result of both geological background and use of man-made products. In western New York, there is evidence that suggests that arsenical pesticides were used in some fruit orchards. Therefore, the local background concentration of arsenic in soil is a key consideration in delineation of arsenic concentrations which could potentially be attributable to releases from the FMC Facility.

- The CMS Study Areas includes 18 properties with no soil sample data. With agreement by the Agencies, these 18 CMS properties were not included in the estimates of remedial area and soil volume under the CMAs, with the exception of three properties located along the Culvert 105 buried pipe. FMC will offer to perform soil sampling and analysis on the unsampled properties pursuant to a process to be approved by the Agencies. If written permission is obtained from the property owner, then the sampling and analysis would be conducted and, if warranted, FMC would remediate the sampled property consistent with the approved corrective measures.

- Involvement of the community and affected property owners in the CMS process is critical to the successful implementation of any corrective measures. As specified in the CMS Work Plan, several interim deliverables were prepared for review and early input and comments from the Agencies, the community and/or affected property owners. Comments received on the interim deliverables were incorporated into the CMS, as appropriate.

The CMS includes community participation activities; FMC's human health and ecological risk assessments; pilot studies for phytoremediation and soil tilling/blending; identification and evaluation of tree preservation measures; evaluation of disposal options for excavated soil and other remediation wastes; development of CMAs; evaluation of the CMAs; FMC's justification and recommendation of a CMA for the CMS Study Areas.

Identification and Screening of Corrective Measures Technologies

CMAs were developed incorporating the following retained corrective measures technologies: no further action; institutional controls; access restrictions; monitoring and maintenance; soil excavation and use of a Corrective Action Management Unit (CAMU) situated on the Site or use of appropriate off-Site disposal facilities; sewer removal/replacement; soil tilling/blending; and tree preservation measures e.g., limited excavation within protected root zone).

Phytoremediation of soil arsenic was evaluated in site-specific pilot studies performed over two growing seasons. The pilot study results indicated minimal arsenic uptake by plants with no measurable drop in the soil arsenic concentrations. In FMC's opinion, phytoremediation is not considered a viable technology for the CMS Study Areas for reasons expressed in the Section 4.2.1 of this report.

An evaluation of tree preservation measures, involving Middleport-specific information and consultation with qualified and experienced experts, was performed in support of the CMS. The results of the evaluation indicate that in certain cases, mechanical methods or pneumatic pressure can be used for excavation to a depth of 6 inches or more over a tree's entire root zone during a single construction season. In FMC's opinion, the ability to excavate soils within the protected root zone successfully to depths greater than 6 inches depends on 1) the vertical and horizontal extent of soil removal required to achieve soil cleanup goals, 2) property-specific factors (i.e., soil characteristics, and owner input), and 3) tree-specific factors (i.e., tree species, age, health, stability, location and condition). The advice of a qualified local arborist relying on site-specific information will be considered during the design phase in the development of soil excavation methods, depths and area required to preserve a tree. Limited excavation (i.e., maximum depth of 6 inches) using either mechanical methods or pneumatic pressure would present the best opportunity to preserve selected trees based upon practicability of implementation, probabilities for tree survivability, tree structural stability concerns, and safety concerns for workers, residents, and the community. The determination of whether a specific tree can or cannot be preserved on any property identified for remediation will be made in consultation with the property owner and the Agencies during the design phase (CMI).

The CMS included an evaluation of the following on-Site and off-Site remediation waste disposal options:

On-Site Disposal Option

The on-Site disposal option consists of constructing and using an engineered consolidation area or CAMU at the eastern portion of the FMC Facility. The proposed CAMU would be used for the permanent management of non-hazardous soils or other non-hazardous materials (collectively referred to as remediation waste) generated in the course of remedial actions from the CMS Study Areas. The proposed CAMU would be constructed in accordance with RCRA regulations to a maximum height of 28 feet (at its highest point from its base elevation) and a maximum footprint (i.e., area at its base) of approximately 16.9 acres on the eastern portion of the FMC Facility. After placing the final cover atop the CAMU, the ground surface would be vegetated with a variety of low-maintenance grasses and shrubs. Trees would be planted at select locations along the perimeter to achieve an appearance consistent with the open, rural, and natural character of the surrounding area,

Off-Site Disposal Options

The possible off-Site disposal options considered in the CMS are as follows:

- Commercial Landfill - Off-Site disposal of remediation waste at an appropriate commercial landfill(s) permitted in accordance with applicable rules and regulations (e.g., 6NYCRR Part 360).

- Beneficial Reuse at a Commercial Landfill - Beneficial reuse of non-hazardous remediation soil as daily landfill cover at an appropriate off-Site commercial landfill(s) that is permitted in accordance with applicable rules and regulations.

The further options for transport for the off-Site disposal options are as follows:

- Truck Transportation - Remediation waste would be transported by truck (e.g., 30-ton capacity) to an appropriately permitted commercial landfill for disposal or beneficial reuse as daily cover.

- Railcar Transportation - Remediation waste would be transported by railcars (e.g., 100-ton gondolas or possibly inter-modal containers) to an appropriately permitted commercial landfill for disposal or beneficial reuse daily cover.

A description and evaluation of these disposal options is presented in Appendix D. For the purposes of making detailed comparisons between CMAs, both the CAMU and an off-Site disposal option, consisting of a combination of the aforementioned options, have been included in the CMAs, as described below.

Disposal Options included in the CMAs

- **Placement and permanent management of non-hazardous soil and other remediation wastes in a CAMU with a total height of 28 feet from its base elevation.** Remediation wastes would be transported from the excavation areas by smaller trucks (12 cubic yard capacity dump trucks required for use on residential streets during the previously completed interim remedial measures) and placed in the CAMU that would be located on the FMC Facility. The CAMU would be used, maintained and closed by FMC in accordance with the plans that would be subject to review and approval by the Agencies. The CAMU would be located in an area of the FMC Facility where there are existing engineering and administrative controls to prevent exposure to or migration of remediation waste. The proposed location for the CAMU includes the Eastern Surface Impoundment (ESI) Fill Area that has been used in the past for the temporary on-Site placement and management of off-Site generated remedial soils in conjunction with Agencies' approval of Interim Corrective Measures (ICMs) or Interim Remedial Measures (IRMs), with final disposition to be determined during the CMS process.

- **Off-site disposal at a commercial landfill(s) with beneficial reuse of a portion of the remediation waste as daily cover.** This option assumes for the purposes of the CMS that 25% of the remediation waste will be beneficially reused as landfill cover material and 75% of the remediation waste will be disposed in a commercial landfill as non-hazardous solid waste. The material may be transported directly or indirectly (use of temporary remedial soil staging areas at the Site) to the appropriate commercial landfill. For the purposes of this CMS, the transportation option would consist of loading remediation wastes into smaller size trucks for transport to and stockpiling within a temporary staging area located at the eastern portion of the FMC Plant Site. Remediation wastes accumulated in the temporary staging area(s) would subsequently be loaded into larger trucks (e.g., 30-ton capacity) or railcars for transport to the commercial landfill.

Disposal evaluations presented in this CMS are based on truck transport of remediation waste for purposes of making detailed comparisons between CMAs, with the conceptual evaluations of the rail transport options. For reasons described in the CMS Report, including Appendix D, FMC has concluded that rail transport offers no advantages over truck transport at this time. That conclusion was based on FMC's past experience in using rail transport for remediation wastes, consultation with FMC's experts and logistical providers, and the additional considerations presented in Attachment D-2.

Description of the Corrective Measures Alternatives (CMAs)

The CMAs listed below have been identified and developed to address the presence of potentially FMC-related arsenic in the Suspected Air Deposition Study Area and the Culvert 105 Study Area.

- Alternative 1 (also referred to as CMA 1) – No Further Action

- Alternative 2 (also referred to as CMA 2) – Remediation of soil with arsenic concentrations above 20 mg/kg on each property, including the non-ICM area of the Roy-Hart School property. Appropriate institutional controls would be established on properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 3 (also referred to as CMA 3) – Remediation of soil on residential properties to a post-remediation average arsenic concentration of 20 mg/kg on each property with a maximum residential property soil arsenic concentration of 40 mg/kg. Post-remediation soil arsenic goals would be higher for nonresidential land usages. Appropriate institutional controls would be established on the following properties: a) the non-ICM area of the Roy-Hart School property; b) properties remediated to non-residential post-remediation soil arsenic goals; and c) properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 4 (also referred to as CMA 4) – Remediation to a post-remediation average arsenic concentration of 30 mg/kg with a maximum concentration of 60 mg/kg. No further action would be implemented on the non-ICM area of the Roy-Hart School property. Appropriate institutional controls would be established on properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 5 (also referred to as CMA 5) – Remediation to a post-remediation average arsenic concentration of 40 mg/kg on each property and a maximum concentration of 80 mg/kg. No further action would be implemented on the non-ICM area of the Roy-Hart School property. Appropriate institutional controls would be established on properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 6A (also referred to as CMA 6A) - Remediation of soil on residential, public, and institutional properties to a post-remediation average arsenic concentration of 20 mg/kg on each property with a maximum soil arsenic concentration of 35 mg/kg. Soil remediation levels would be higher for other land usages. Soil remediation of the non-ICM portion of the Roy-Hart School property would not be performed. Appropriate institutional controls would be established on the following properties: a) non-ICM area of the Roy-Hart School property; b) properties remediated to post-remediation soil arsenic goals for agricultural, commercial, industrial, railroad and utility land usages; and c) properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 6B (also referred to as CMA 6B) – Same as CMA 6A, except that CMA 6B includes remediation of the non-ICM portion of the Roy-Hart School property to the post-remediation soil arsenic cleanup goals for residential and public/institutional properties (20 mg/kg average and a maximum of 35 mg/kg). No institutional controls would be established for the non-ICM portion of the Roy-Hart School property.

- Alternative 7A (also referred to as CMA 7A) – Same as CMA 6A, except that CMA 7A will have a maximum post remediation soil arsenic cleanup level of 30 mg/kg for residential and public/institutional properties.

- Alternative 7B (also referred to as CMA 7B) – Same as CMA 7A, except that CMA 7B includes remediation of the non-ICM portion of the Roy-Hart School property to the post-remediation soil arsenic cleanup goals for residential and public/institutional properties (20 mg/kg average and a maximum of 30 mg/kg). No institutional controls would be established for the non-ICM portion of the Roy-Hart School property.

- Alternative 8 (also referred to as CMA 8) – Remediation of all properties, including the non-ICM portion of the Roy-Hart School property, but excluding the Wooded Parcel, to a post-remediation average arsenic concentration of 20 mg/kg and a maximum concentration of 30 mg/kg for each property. CMA 8 also includes removal/replacement of all remaining buried pipe portions of Culvert 105.

Common Elements of the Corrective Measures Alternatives are as follows:

a. Continued implementation of the Site Management Plan for the Wooded Parcel- The Wooded Parcel was remediated in 2007-2008 and deed restrictions were recorded for the property. Inspection, monitoring and maintenance activities were implemented under an Agencies'-approved Site Management Plan beginning in 2008, and would continue under each of the CMAs. (Note: In January 2011, FMC provided the Agencies with its legal analysis of the Wooded Parcel deed restrictions which indicate that these restrictions cannot be unilaterally removed by the current or any future owner of this parcel. However, if as a result of the ongoing Agencies' review, the permanency of these restrictions cannot be confirmed to the Agencies' satisfaction, other remedial options for this parcel may need to be evaluated.)

b. No Further Action for Previously Remediated Properties - No further action for 31 properties remediated during the 2003 ICM and the 2007-2008 Early Actions for which the property owners received letters from the Agencies stating that no use restrictions were required and that no further sampling or other actions are needed. As stated in the Agencies' letters, the arsenic concentrations in the remaining soil at the remediated properties were consistent with area residential background concentrations and normal sampling and data variability.

c. Remediation to CMA-Specific Post-Remediation Soil Arsenic Goals – Achieved by soil excavation and removal. Where appropriate, excavation may be supplemented with or replaced with in-place soil tilling/blending.

d. Remediation Waste Disposal Options – On-Site and off-Site waste disposal options, as previously described, are included in the detailed evaluation of the CMAs.

e. Property Restoration – Placement of backfill (clean fill soil and top soil, as appropriate) to original grade where soils are excavated. Lawns would be restored by seeding or placement of sod.

f. Tree Preservation – Opportunities to preserve trees would be identified in consultation with the property owner and a qualified local arborist relying on site-specific information during the CMI, after the Agencies select the final corrective measures and soil cleanup goals for the study area. The property owner will have the final decision on whether their property will be remediated and on preservation of trees on their property. During the CMI design phase, FMC will provide the property owner with information needed to make an informed decision concerning tree preservation and FMC's recommendation regarding the viability of preserving the tree(s) within the remediation area.

g. Property-Specific Features within the Remediation Area - Landscaping features, sidewalks, driveways, and other property-specific features (e.g., pools, sheds, fences), would be replaced in-kind where removal is necessary. The need for removal of any property-specific features would be determined during the design of the CMI phase, in consultation with the affected property owners and the Agencies.

h. Culvert 105 Remediation – Where soil around Culvert 105 is to be removed, the culvert would be replaced in-kind (either as buried pipe or open ditch) along the existing alignment. CMAs 2 through 7B included remediation (removal and replacement) of buried pipe sections of Culvert 105 to meet the CMA-specific post-remediation soil arsenic goals. CMA 8 assumes remediation along the entire length of the Culvert 105 buried pipe sections that were not installed as part of previous ICMs.

i. Institutional Controls – Would be used to require further evaluation/action by FMC if the property use changes to residential; and/or address intrusive activities that may be conducted on a property using a Site or Soil Management Plan (see note under "a" above).

j. Remedial Design and Pre-design Activities - A remedial design would be required as part of the CMI phase to provide technical drawings, plans and specifications, as well as other project specific plans necessary to implement the CMI construction activities. Pre-design activities necessary to support the remedial design would also be conducted.

The major differences between Alternatives 2 through 8 are:

- number of properties to be remediated;
- volume and extent of soil to be remediated;
- lineal footage of buried Culvert 105 pipe to be removed and replaced;

- estimated duration of remediation; and
- number of properties requiring institutional controls.

These items have been estimated for each CMA as follows:

CMA	1	2	3	4	5	6A	6B	7A	7B	8
Number of Additional Properties to be Remediated	0	181	152	86	48	157	158	164	165	179
Estimated Additional Volume of Soil to be Remediated (cubic yards)	0	228,000	69,000	38,000	28,000	85,000	98,000	101,000	119,000	162,000
Total Estimated Area of Soil to be Remediated (acres)	0	127	50	26	18	62	73	71	85	104
Estimated Additional Length of Culvert 105 Buried Pipe to be Removed and Replaced (lineal feet)	0	1,325	1,185	900	900	1,185	1,185	1,185	1,185	3,025
Estimated Number of Construction Seasons (May to November) to Complete the Remediation (see Note)	0	10	5	3	2	6	6	7	7	8
Number of Properties Requiring Institutional Controls	0	11	25	14	14	22	21	22	21	0

Note:

1. The estimated number of construction seasons presented for each CMA in the above table is based on FMC's experience performing remediation on residential properties in Middleport in 2003 and 2007 and assumes a considerable and manageable level of effort during each construction season. The actual number of construction seasons for the selected CMA or CMAs, will be determined during the CMI planning stage through an Agencies' approved schedule.

CMA Evaluation Criteria

The CMAs were evaluated based on the ability to attain the project-specific Corrective Action Objectives (CAOs) issued by the Agencies using the following criteria specified in the approved CMS Work Plan:

1) Community/Property Owner Acceptance

2) Technical (effectiveness, performance, reliability, implementability and safety)

3) Environmental (potential short- and long-term beneficial and adverse impacts on the environment)

4) Human Health (short-term (i.e., risks during implementation) and long-term (i.e., after implementation)

5) Institutional (consideration of federal, state, and local rules and regulations)

6) Cost (capital, engineering and long-term operation/maintenance)

7) Green Remediation Practices (net environmental benefit)

Summary of FMC's Justification and CMA Recommendation

FMC's recommended CMA for the Suspected Air Deposition and Culvert 105 Study Areas and justification for the recommended CMA are based on the detailed evaluation of alternatives by FMC using the CAOs and the evaluation criteria set forth in the approved CMS Work Plan.

All CMAs result in acceptable long-term human health risks (i.e., for all of the alternatives, 1 through 8, the estimated excess life-time cancer risks are within or below the range of 10^{-4} to 10^{-6}, and the non-cancer hazard indices are below the target value of 1). There is very little difference in the amount of human health risk reduction achieved between the CMAs.[1]

All of the CMAs also result in acceptable ecological risks in the Culvert 105 area north of Sleeper Street, the area of focus requested by the Agencies based on the perception that this is the area where the presence of wildlife might be anticipated.[1.]

The CMAs differ more substantially with respect to the remaining evaluation criteria - i.e., community/property owner acceptance; technical effectiveness, performance, reliability, implementability and safety; the environmental impacts associated with CMA implementation; short-term human health risks associated with CMS implementation; institutional compliance; and adherence to green remediation practices.

[1] See bolded paragraph at the beginning of this Executive Summary.

CMA 1 satisfies more evaluation criteria than any other CMA. However, it does not satisfy the institutional compliance criterion because it is inconsistent with the CAO stating that the "point of departure," or starting point, for corrective action risk-management decisions pertaining to arsenic in soil with respect to residential properties is the site-specific residential background soil arsenic value(s).

CMA 2 satisfies the institutional criterion in part because it adopts the most stringent application of the arsenic concentration (20 mg/kg) that the Agencies have represented as generally being the upper limit of local background level for residential properties. However, CMA 2 is not consistent with CAO No. 1 which requires corrective action decision-making to be based on site-specific data, including current and reasonably anticipated future land use(s).[1] CMA 2 applies a putative residential background value for arsenic in soil to all properties in the CMS Study Areas, including those which are not now and are not reasonably anticipated to be residential. Moreover, in FMC's opinion, apart from very small differences in long-term human health and ecological risk reduction, CMA 2 compares unfavorably to all the other CMAs with respect to the remaining evaluation criteria.

CMAs 3 and 6A through 7B satisfy the institutional criteria and are consistent with the CAOs requiring the use of site-specific residential background for soil arsenic values as the point of departure for corrective action decision-making with respect to residential properties and allowing the use of alternative (higher) values for non-residential properties.[1] These CMAs and CMA 8 were assessed by FMC as moderate for the community/property owner acceptance, technical, and environmental evaluation criteria.

CMA 8 is inconsistent with CAO No. 1 for the same reason that CMA 2 is inconsistent with that CAO[1]. CMA 8 applies putative residential background values for arsenic in soil to all properties in the CMS Study Areas, regardless of current and reasonably anticipated future use. CMA 8 is therefore assessed by FMC as unfavorable for the institutional criteria. It is also assessed by FMC as unfavorable for the environmental and short-term safety criteria.

CMAs 4 and 5 do not satisfy the institutional criteria for the same reasons that CMA 1 does not.

CMAs 2 and 8 were assessed by FMC as unfavorable for the green remediation practices criterion, primarily due to the large amount of soil to be remediated and transported under either disposal option. Likewise, CMAs 3 and 6A through 7B were assessed by FMC as unfavorable for the off-Site disposal option, and as favorable for the CAMU disposal option due primarily to the relatively smaller amounts of soil to be remediated and truck loads of material to be transported.

The soil which would be generated by implementation of the CMAs is well-suited to disposal in an on-Site CAMU. The use of the CAMU would essentially entail the relocation of soils that pose no unacceptable

[1] See bolded paragraph at the beginning of this Executive Summary.

human health or environmental risks at their current locations to an on-Site secure unit where they would also pose no unacceptable human health or environmental risks.[1] Considering this, and given the potential cost savings, greater flexibility during construction, lower resource utilization, lower potential for greenhouse gas and particulate emissions, and lower probability of traffic accidents associated with the CAMU option compared to off-Site disposal, FMC recommends use of the CAMU as the disposal option under all of the CMAs. The CAMU also has the added benefit of preserving off-Site commercial landfill space for its intended purpose (i.e., garbage and waste disposal) and is consistent with the industrial use of the property.

On the basis of the detailed evaluation and critical comparison of alternatives, FMC recommends CMA 3 as the preferred final corrective measure and use of a designated CAMU for disposal and management of the remediation waste.

[1] See bolded paragraph at the beginning of this Executive Summary.

Acronyms, Abbreviations, and Units of Measure

Agencies	NYSDEC and USEPA
AOC	Administrative Order on Consent
CAMU	Corrective Action Management Unit
CAO	Corrective Action Objective
CFR	Code of Federal Regulations
CMA	Corrective Measures Alternative
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COC	Constituent of Concern
CTE	Central Tendency Exposure
EcoSSL	Ecological Soil Screening Level
ESI	Eastern Surface Impoundment
FMC	FMC Corporation
HHRA	Human Health Risk Assessment
ICM	Interim Corrective Measure
IRM	Interim Remedial Measure
MCIG	Middleport Community Input Group
mg/kg	milligrams per kilogram
NFA	No Further Action
NYCRR	Compilation of the Rules and Regulations of the State of New York

NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
OM&M	Operations, Maintenance and Monitoring
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RME	Reasonable Maximum Exposure
ROW	right-of-way
Roy-Hart	Royalton-Hartland
SWMU	Solid Waste Management Unit
USEPA	United States Environmental Protection Agency

1. Introduction

This Draft CMS Report is FMC's work product. It was prepared by FMC's team of professionals and experts from inside and outside the company. FMC conferred with the Agencies in preparing the draft report, and attempted to address various comments provided by the Agencies on the draft report. However, FMC understands that the Agencies do not necessarily agree with or accept the various conclusions, determinations, assessments, assertions or judgments which are expressed by FMC throughout this draft report. Many of these instances where FMC has stated its opinion in this draft report are identified by specific text or by a footnote which references this paragraph so as to clearly differentiate such opinions from the factual information provided in the report.

FMC Corporation (FMC) prepared this *Draft Corrective Measures Study Report for the Suspected Air Deposition and Culvert 105 Study Areas, FMC Corporation, Middleport, New York* (Draft CMS Report) under the terms and conditions of 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 collectively referred to herein as "the Agencies"), effective July 2, 1991 (USEPA et al., 1991). Pursuant to Section VI.3.d of the AOC and the approved *Corrective Measures Study Work Plan for Suspected Air Deposition and Culvert 105 Study Areas* (AMEC Geomatrix, 2009a; CMS Work Plan), this report identifies and screens corrective measures technologies, develops and evaluates corrective measures alternatives (CMAs), and provides a recommended CMA(s) with support justification under the Resource Conservation and Recovery Act (RCRA) Corrective Action program, for the Suspected Air Deposition Area South of the Erie Canal and West of the Niagara/Orleans County Line, and Culvert 105 and Flood Zone (see Figure 1-1). These two areas are referred to hereafter in this report as the "CMS Study Areas."

Submittal of this Draft CMS Report is the first of several steps in completing the CMS Report for these CMS Study Areas and in the Agencies' selection of a final corrective measure(s) for the CMS Study Areas. This process is described below in Section 1.2.

1.1 Overview

FMC owns and operates a pesticide formulating facility located in the Village of Middleport and the Town of Royalton, Niagara County, New York ("Facility", "Plant" or "Site"). FMC and predecessor companies operated the Facility for the manufacturing and/or formulation of agricultural products since the 1920s. Manufacturing ceased in 1985. Since that time, FMC has only conducted formulating (and packaging) operations at the Facility. Past releases have resulted in the occurrence of FMC-related contamination at the Facility and the CMS Study Areas. As documented in the RCRA Facility Investigation (Volumes II and IV), approved by the Agencies, the predominant constituent of concern within the off-Site study areas is arsenic. In 2005, FMC and the Agencies agreed that FMC should proceed to implement investigative, monitoring and remedial programs under the RCRA Corrective Action program using an operable unit approach for nine study areas consistent with Section VI.3.d of the AOC. The CMS Study Areas that are the subject of this report represent two of the nine study areas.

Details of the investigation, monitoring and remediation activities, to date, within the CMS Study Areas are presented in the reports listed below.

- *RCRA Facility Investigation Report Volume I – Background and Related Information* (RFI Report Volume I), dated September 2009 (ARCADIS and AMEC Geomatrix 2009)

- *RCRA Facility Investigation Report Volume II – Suspected Air Deposition Study Area 1 (South of the Erie Canal and West of the Niagara/Orleans County Line) and Culvert 105 Study Area South of the Erie Canal)* (RFI Report Volume II), dated September 2009 (ARCADIS 2009a)

- *RCRA Facility Investigation Report Volume IV – Culvert 105 and Flood Zone* (RFI Report Volume IV), dated September 2009 (ARCADIS 2009b)

The Agencies communicated approval of RFI Report Volumes I and IV by letter dated September 1, 2009 and Volume II by letter dated October 6, 2009. A discussion of the nature and extent of potential FMC-related constituents in these areas and the basis for delineating the respective areas that comprise the CMS Study Areas is presented in RFI Report Volumes II and IV.

The CMS Study Areas are mostly comprised of residential properties. The remainder of the properties consists of commercial, industrial, agricultural or undeveloped lands, Village of Middleport- and Town of Royalton-owned land (i.e., right-of ways, sanitary wastewater treatment plant) and the Royalton-Hartland Central School District (Roy-Hart) property. Culvert 105 is a municipal stormwater conveyance system (approximately 1.3 miles in length) beginning at the FMC-owned property along the mainline railroad tracks (referred to as the North Railroad Property) and flowing northward until it joins Tributary One of Jeddo Creek, north of the Village of Middleport sanitary wastewater treatment plant. The beginning portion of Culvert 105 from the FMC-owned property to the Erie Canal consists of all buried pipes; the remainder consists of a combination of buried pipes and open ditches (see Figure 1-1).

1.2 CMS Activities

CMS activities performed in accordance with the CMS Work Plan are listed below, along with a summary of the current status of the listed activities:

- Community participation (on-going)

- Pilot studies for soil tilling/blending and phytoremediation (completed, results summarized in this Draft CMS Report)

- Risk assessments (presented in this Draft CMS Report)

- Identification, description, and screening of corrective measures technologies (presented in this Draft CMS Report)

- Identification and development of Corrective Measures Alternatives (CMAs) (presented in this Draft CMS Report)

- Evaluation of the CMAs (presented in this Draft CMS Report)

- FMC's justification and recommendation of a CMA (presented in this Draft CMS Report)

- Reports, including interim deliverables required as part of the pilot studies and technical memoranda on CMS support tasks (reports were previously submitted) and Draft and Final CMS Reports

Submittal of the Draft CMS Report is one of several steps in completing the CMS Report for these CMS Study Areas and in the Agencies' selection of a final corrective measure(s) for the CMS Study Areas. This process consists of the following:

- Corrective Action Objectives and CMS Work Plan - The Agencies, in consultation with the NYSDOH, issued the corrective action objectives that formed a basis for the CMS Work Plan prepared and submitted by FMC. The Agencies communicated their approval of the CMS Work Plan by letter dated September 14, 2009.

- Draft CMS Report - FMC performed the CMS pursuant to the approved CMS Work Plan and presented the results to the Agencies in a preliminary Draft CMS Report submitted to the Agencies on June 15, 2010, with the preliminary draft report appendices submitted on July 14, 2010 ("2010 Draft CMS Report"). The Agencies provided comments and directives to FMC on the 2010 Draft CMS Report in September 2010. After various exchanges of correspondences and meetings/discussions between FMC and the Agencies, FMC agreed, by letter dated December 21, 2010, to revise the Draft CMS Report to comply with the Agencies' directives presented the Agencies' December 2, 2010 letter and as modified by the Agencies' December 17, 2010 email. FMC subsequently revised the Draft CMS Report as required by the Agencies and issued the report for public comment.

- Draft CMS Report Public Comment Period - Agencies will hold a 45-day public comment period and public meeting on the "final" Draft CMS Report, which will include FMC's recommended corrective measures.

- Agencies' Preliminary Statement of Basis - Agencies will consider and respond to public comments on the Draft CMS Report and will issue a "Preliminary Statement of Basis" that identifies the Agencies' preliminary selection of corrective measures.

- Preliminary Statement of Basis Public Comment Period - Agencies will hold a 45-day public comment period and public meeting on the Agencies' preliminary selection of corrective measures.

- Agencies' Final Selection of Corrective Measures - Agencies will consider and respond to public comments on the Preliminary Statement of Basis and will select the final corrective measures for the CMS Study Areas. The Agencies may then request that FMC issue a Final CMS Report that will incorporate comments from the Agencies on the Draft CMS Report and the Agencies' final selected corrective measures. The Agencies will issue a Final Decision/Statement of Basis and responsiveness summary.

After the Agencies determine the final corrective measures for the CMS Study Areas, FMC will begin the Corrective Measures Implementation (CMI) phase. The CMI phase consists of activities associated with planning, designing, constructing, maintaining and monitoring of the remedy selected. In addition, community participation and outreach activities will be conducted during the CMI to provide information to and opportunities for input from the community and affected property owners on the CMI.

1.3 Corrective Action Objectives and CMS Evaluation Criteria

By letter dated March 26, 2009 (provided in Appendix A of this Draft CMS Report), the Agencies, in consultation with the New York State Department of Health (NYSDOH), issued corrective action objectives (CAOs) for off-Site soil and sediment corrective measures studies, excluding the FMC Facility and the FMC-owned North Railroad Property. Based on the CAOs, as described in the CMS Work Plan, site-specific CMAs were developed and evaluated consistent with the AOC. The CMAs were evaluated based on the extent to which each CMA meets the CAOs and against the seven evaluation criteria listed below.

1) Community/Property Owner Acceptance

2) Technical (effectiveness, performance, reliability, implementability and safety)

3) Environmental (potential short- and long-term beneficial and adverse impacts on the environment)

4) Human Health (risks during and after implementation)

5) Institutional (consideration of federal, state, and local rules and regulations)

6) Cost (capital, engineering and long-term operation/maintenance)

7) Green Remediation Practices (net environmental benefit)

In this Draft CMS Report, the results of detailed and comparative evaluations of the CMAs, based on the achievement of the CAOs and the above criteria, are used to present FMC's justification and recommendation of corrective measures for the CMS Study Areas.

1.4 Report Organization

This Draft CMS Report is organized as follows:

Title		Purpose
Executive Summary		
Section 1	Introduction	Provides background information and describes the purpose of this Draft CMS Report
Section 2	CMS Interim Deliverables and Community Participation	Identifies the deliverables related to the CMS that were provided for review by the Agencies, NYSDOH, and other project-specific stakeholders; and summarizes the associated opportunities provided by FMC for public discussion and comment on these deliverables
Section 3	CMS Study Areas Description	Provides a detailed description of the CMS Study Areas with a summary of the remedial activities previously completed by FMC
Section 4	Identification, Description, and Screening of Corrective Measures Technologies	Identifies and provides a detailed description of the corrective measures technologies considered, and evaluates and screens these technologies
Section 5	Detailed Descriptions of Corrective Measures Alternatives	Provides a detailed description of each of the CMAs
Section 6	FMC's Risk Assessment	Presents a summary of FMC's human health and ecological risk assessments
Section 7	Evaluation of Corrective Measures Alternatives	Presents the seven criteria required to evaluate the CMAs followed by FMC's evaluation of CMAs using these criteria
Section 8	FMC's Justification and Recommendation of the Corrective Measures Alternative	Presents FMC's recommendation and justification of the CMA for the CMS Study Areas
Section 9	References	

Title		Purpose
Appendices	Various titles	The appendices present technical and administrative details of the CMS Study Areas, including FMC's site-specific human health risk evaluation, a responsiveness summary for comments received from the community and Agencies during the CMS process, and other supporting information used in the CMS

2. CMS Interim Deliverables and Community Participation

2.1 Interim Deliverables Related to the CMS Process

As specified in the CMS Work Plan (approved by the Agencies by letter dated September 14, 2009), several interim deliverables specifically related to the CMS process were prepared for purposes of obtaining early input and comments from the Agencies, the community and/or affected property owners. These deliverables consisted of the following:

- *Arsenic Phytoremediation Pilot Study Report* originally submitted by FMC letter dated March 13, 2009 and revised report submitted by FMC letter dated July 31, 2009 (AMEC Geomatrix 2009).

- *Corrective Measures Soil Study Tilling/Blending Pilot Study Work Plan* (ARCADIS 2009c), submitted by FMC letter dated October 9, 2009.

- *FMC Middleport Risk Management Approach for the Corrective Measures Study, Suspected Air Deposition and Culvert 105 Study Areas* (Integral Consulting Inc. 2009), submitted by FMC letter dated October 30, 2009.

- *Draft Reasonably Anticipated Future Land Usages Map for the CMS Suspected Air Deposition and Culvert 105 Study Areas and Other Environmental Areas South of Pearson/Stone Roads*, which was submitted by FMC letter dated November 6, 2009 and includes a description of the basis for identification of future land uses.

- *Corrective Measures Study Technical Memorandum - Evaluation of Tree Preservation Measures for Suspected Air Deposition and Culvert 105 Study Areas* (ARCADIS 2010a), submitted by FMC letter dated February 9, 2010.

- *Corrective Measures Study Soil Tilling/Blending Pilot Study Report* (ARCADIS 2010b), submitted by FMC letter dated March 17, 2010.

- *2009 Arsenic Phytoremediation Pilot Study Results* (AMEC Geomatrix 2010), submitted by FMC letter dated March 31, 2010.

2.2 Community Participation

FMC provided opportunities for project-specific stakeholders to obtain information and to provide input on these deliverables, and the *Draft CAMU Application* (ARCADIS 2008) submitted by FMC letter dated March 27, 2008, as part of outreach activities as follows:

1. Copies of the above-referenced deliverables were provided to the Middleport Community Input Group, *the Middleport Remedi*ation Advisory Group, Village of Middleport representatives and officials and other local elected officials; placed in the project document repository in the Middleport Free Library; and posted on the following websites:

    - FMC's CMS website: www.middleportny.com

    - Middleport Community Input Group website: www.middleport-future.com

2. Periodic updates on the progress of the CMS were provided on the website at www.middleport-ny.com and in FMC's Community Connection newsletters.

3. FMC's Community Liaison located at 17 Vernon Street in Middleport was available to discuss the CMS activities and/or answer questions.

4. FMC discussed the information in the CMS deliverables and answered questions concerning the CMS activities during the monthly MCIG meetings.

5. Information sessions and/or meetings were held in Middleport concerning the November 2009 *Draft Reasonably Anticipated Future Land Use Map for the CMS Suspected Air Deposition and Culvert 105 Study Areas and Other Environmental Areas South of Pearson/Stone Roads* and included:

    - October 15, 2009 meeting with Village of Middleport and Towns of Royalton and Hartland officials

    - November 12, 2009 meeting with Royalton-Hartland (Roy-Hart) Central School District Superintendent

    - November 17, 2009 community information session

    - December 3, 2009 community information session

    - December 9, 2009 information session with Village of Middleport and Towns of Hartland and Royalton officials and Roy-Hart Superintendent and School Board members

6. Information sessions and/or meetings concerning the *FMC Middleport Risk Management Approach for the Corrective Measures Study, Suspected Air Deposition and Culvert 105 Study Areas Study Areas* were held on November 4, 5, and 17, 2009 and December 3, 2009 in Middleport. In addition, a soil exposure survey was prepared and distributed by FMC to the affected owners of the properties within the CMS Study Areas.

7. Information sessions and/or meetings concerning the *Corrective Measures Study Technical Memorandum - Evaluation of Tree Preservation Measures for Suspected Air Deposition and Culvert 105 Study Areas* were held on March 10, 15, 22 and 23, 2010 in Middleport. A survey questionnaire concerning the tree preservation measures was prepared and distributed by FMC to affected owners of the properties within the CMS Study Areas.

8. An information session concerning the *Corrective Measures Study Soil Tilling/Blending Pilot Study Report* and the *2009 Arsenic Phytoremediation Pilot Study Results* report was held on May 20, 2010 in Middleport.

9. Prior to (beginning in November 2006) and after submittal of the March 2008 CAMU Application (through June 2010), FMC provided numerous opportunities to local residents, Village of Middleport and Town of Royalton officials, the Middleport Community Input Group (MCIG) and other stakeholders to obtain information and to provide informal comments on FMC's proposed CAMU. The informal comments received and FMC's responses to the comments are presented in Table 1 of Attachment D-1 in Appendix D.

Comments from the community and the Agencies' on the interim deliverables and FMC's responses to the comments are summarized in the following appendices:

Appendix B	CMS Interim Deliverables, Agencies Comments and FMC's Responses to Comments on Tree Preservation Measures Technical Memorandum, Soil Tilling/Blending Pilot Study Report, and 2009 Arsenic Phytoremediation Pilot Study Results
Appendix C	Basis for Reasonably Anticipated Future Land Usages for the Suspected Air Deposition and Culvert 105 Study Areas
Appendix D	Description and Evaluation of Disposal Options
Appendix F	FMC Middleport Human Health Risk Assessment for the Corrective Measures Study, Suspected Air Deposition and Culvert 105 Study Areas

As identified in Section 1.2, FMC submitted the 2010 Draft CMS Report to the Agencies as a preliminary draft document. Community outreach activities for the preliminary draft report included the following:

- FMC discussed the 2010 Draft CMS Report and answered questions at the July 15, 2010 and September 28, 2010 Middleport Community Input Group (MCIG) meetings

- FMC and NYSDEC presented the status of the 2010 Draft CMS Report and review of the correspondence at the December 9, 2010 MCIG meeting

- Posted information on FMC's CMS website: www.middleportny.com

- FMC's Community Liaison at 17 Vernon Street in Middleport was available to discuss the report and/or answer questions

- Periodic updates on the progress of the CMS were provided on the website at www.middleport-ny.com and in FMC's Community Connection newsletters

3. CMS Study Areas Description

The areas included in the CMS Study Areas, as established in the Agencies'-approved RFI Report Volumes II and IV, include those colored green on Figure 1-1 and portions of Property AE2 (if future soil sampling indicates that FMC related soil contamination extends onto Property AE2). As documented in the RFI Reports, the primary FMC-related constituent of concern in the CMS Study Areas is arsenic. The CMS addresses both surface and subsurface soils (i.e., to a depth of up to approximately six feet below ground surface, depending upon the Culvert 105 pipe depth).

There are some properties/areas located within the geographical boundaries of the CMS Study Areas that are either excluded from the CMS or have been evaluated in a manner which excludes soil from estimates of remedial soil area/volumes. These properties/areas are as follows:

- No Further Action (NFA) Properties (shown in yellow on Figure 1-1):
    - The 46 residential properties sampled in 2004 and 2005 that received a letter from the Agencies in February 2007 that stated the following: 1) concentrations of arsenic in soil at those properties were consistent with residential background concentrations in the area (range of 3.3 to 21.1 mg/kg, and allowing for data variability above this range); 2) residents did not need to restrict the use of their yards due to the concentrations of arsenic in soils; and 3) "no further sampling or other actions are necessary at this time."
    - The 29 properties that received a letter from the Agencies in November 2009 that stated the properties would not be included in the CMS Study Areas based on data presented in RFI Report Volume II.
- The need to remove soil beneath driveways, sidewalks, and other non-permanent structures (e.g., pools and sheds) will be determined on a case-by-case basis during the design phase of the CMI. For the purposes of this CMS, the estimation of soil remediation area and volume for the CMAs included soil beneath driveways, sidewalks, and/or the footprint of a non-permanent structure. Similarly, the portion of public roads/street traversed by the Culvert 105 buried pipe was included in the estimated area of remediation if soil removal surrounding the pipe is necessary based on the CMA remediation goals.
- Un-sampled Properties (shown in green with black cross-hatching on Figure 1-1) and Property AE2. These 18 CMS properties were not sampled during the RFI because access permission could not be obtained from the property owner. The 18 un-sampled properties are as follows: B8, F7, F11, F12, G5, G8, I15, I19, L2, M4, N15, N16, P10, S26, T5, R1a-b, AC5 and AE-2. With agreement by the Agencies, these 18 CMS properties were not part of the soil area/volume estimates under the CMAs, with the exception of three properties located along the Culvert 105 buried pipe (i.e., B8, M4, and AC5). FMC will offer to perform soil sampling and analysis at the 18 unsampled properties pursuant to a process approved by the Agencies. If written permission is obtained from the property owner, then the sampling

and analysis would be conducted and if warranted the property would be remediated consistent with the approved corrective measures.

3.1 Description of Prior Remedial Activities

FMC has performed a number of interim remedial activities (referred to variously as an Interim Remedial Measure [IRM], Interim Corrective Measure [ICM], and Early Action) within the CMS Study Areas to address arsenic-containing soils. These activities were intended to expedite final remediation and were approved by one or both of the Agencies. The interim remedial activities conducted within the CMS Study Areas activities involved excavation of approximately 80,000 cubic yards of soil from 36 off-Site properties and replacement of the excavated soil with clean imported backfill and topsoil. The majority of the excavated soil was placed within and adjacent to the former Eastern Surface Impoundment (ESI) at the northeastern portion of the Facility (collectively known as the "ESI Fill Area"), and the remainder was disposed off-Site. These activities are summarized in Table 3-1 and are discussed in the following subsections. The locations where the interim remedial activities were performed are shown on Figure 3-1.

3.1.1 1996 Bleacher Area IRM

In 1996, FMC implemented an IRM to remove soil to the south and west of the southern bleachers at the Roy-Hart School Property. Soil was removed to a minimum depth of 2 feet. Approximately 2,200 cubic yards of excavated soil was placed in the ESI Fill Area. The IRM was performed in accordance with the provisions of an Administrative Consent Order (Index No. B9-0221-96-06 IRM) between the NYSDEC and FMC, effective July 8, 1996 (NYSDEC and FMC 1996).

A summary of the Roy-Hart School Bleacher Area IRM project is presented in the *Bleacher Area Excavation Project, Final Construction Report*, dated October 1996 and revised January 1997 (CRA 1997). The NYSDEC approved the report by letter dated February 12, 1997 (NYSDEC 1997) and issued the *Record of Decision, FMC Corporation Site, Operable Unit 4, Bleacher Area, Village of Middleport, Niagara County, Site Number 9-32-014* in February 1999 (NYSDEC 1999). NYSDEC's Record of Decision stated that the arsenic containing soils had been addressed and no further action was required for this operable unit.

3.1.2 1999 Roy-Hart ICM

In 1998, the Agencies determined that an ICM was required to remove arsenic-containing soil from the athletic field area in the southern portion of the Roy-Hart School Property. In accordance with a work plan (CRA 1999) approved by the Agencies, FMC excavated soil within the ICM Area to varying depths based on 30 mg/kg arsenic in soil and backfilled the excavated area in the summer of 1999. Post-ICM surface soils in the ICM area have arsenic concentrations below 5 mg/kg based on the backfill sampling results, and over 90% of the data from post-ICM sampling of the remaining sub-surface soils in the ICM area indicates arsenic concentrations below 20 mg/kg, with well over half indicating arsenic concentrations below 10 mg/kg. Approximately 39,000 cubic yards of excavated soil was placed in the ESI Fill Area. FMC restored

the ICM area and constructed new athletic facilities (i.e., football field, all weather track, bleachers, lighting, concession stand, fencing, etc.) in the summer of 2000.

By letter dated May 26, 2000, the Agencies informed the Roy-Hart School District that "the Agencies have determined that the entire school yard is suitable for both athletic and non-athletic uses by all school children, in terms of their exposure to known school yard soil arsenic concentrations," with final remedial decisions subject to the completion of the RFI and CMS process. The *ICM Construction Report, Roy-Hart School Football Field Area Excavation Project* (CRA 2000) was submitted to the Agencies in November 2000, and summarizes the completed ICM activities.

3.1.3 2003 West Properties ICM

In 2003, FMC excavated soil from the West Properties ICM Area and removed the Facility's former outfall sewer. The ICM area included 14 residential properties (A1A, A1B, A1C, A1D, A1E, A1F, A1G, A1H, A1I, AIJ, AIK, A1L, A1M and A1N) on South Vernon Street and Main Street, public right-of-ways adjacent to these properties, and right-of-ways (ROWs) north and south of FMC-owned Niagara Street. The excavation depths ranged from 0.5 to 7 feet below surface grade. Approximately 15,000 cubic yards of excavated soil was placed in the ESI Fill Area.

The completed ICM activities are described in the *Construction Report for the West Properties Soil and Former Sewer Removal ICM* (Geomatrix January 2007), which was approved by the Agencies by letter dated March 6, 2007. In February 2004, the Agencies issued letters to the owners of the 14 residential properties and to the Village of Middleport, stating that the arsenic concentrations in soil at the 14 residential properties and adjacent public ROWs did not require that they restrict their use of their properties.

3.1.4 2005 North Railroad Property Phase 1 ICM

Although not within the CMS Study Areas, the FMC-owned North Railroad Property is immediately upstream of the inlet to Culvert 105, and some of the remedial work completed at the North Railroad Property by FMC in 2005 partially extended into the Suspected Air Deposition Study Area (*Phase 1 North Railroad Property ICM* [BBL 2006]). The work activities included the excavation of soils to enable installation of an engineered cover system (a minimum of 2 feet of soil was excavated from the area along the north side of the railroad), the re-grading and re-direction of drainage areas to the Culvert 105 inlet, and the construction of an engineered cover system over the Phase 1 ICM area. Portions of the engineered cover system extended onto the Roy-Hart School Property and the Wooded Parcel. Following completion of this work, only water collected within the North Ditch portion of the North Railroad Property discharges to Culvert 105. Activities had previously been conducted by FMC (in 1976 and 1987-1988) with respect to areas of the Facility and North Railroad Property (not within the CMS Study Area) to prevent migration of stormwater from the Facility to the Culvert 105 storm sewer drainage system (refer to Section 2 of RFI Report Volume IV).

3.1.5 2007-2008 Early Actions

In 2007 and 2008, FMC conducted interim remedial actions at three off-Site areas located north of the FMC Facility (Figure 3-1):

- Easternmost Parcel of the North Commercial/Industrial Area - referred to as the "Wooded Parcel." Prior to implementation of the Early Action remedial work in 2007, this parcel was heavily wooded; however, all the trees and vegetation were removed as part of the remedial work. The area was restored with a grass cover (and a portion covered temporarily with gravel). Arborvitaes were planted along the southern portion of the Wooded Parcel and pine trees were planted on the eastern portion of the Wooded Parcel, along Alfred Street. Therefore, while the parcel may now be more accurately described as the "formerly Wooded Parcel," for consistency it will be referred to in this document as the "Wooded Parcel." The Wooded Parcel includes the inlet section of Culvert 105 and access corridor from Park Avenue known as "P14".

- P-Block Properties - 12 residential parcels that are bordered by Park Avenue to the north and by the Wooded Parcel and/or Elizabeth Street to the south (P1, P2, P3, P4, P5, P6, P7, P8, P9, P11, P12 and P13).

- Culvert 105 between Sleeper Street and the Canal - eight properties along the open ditch sections of the Culvert 105 storm sewer system north of the Erie Canal and south of Sleeper Street (AA1, AB4, AB5, AB6, AC1, AC2, AC3 and AC4).

The remedial field activities performed during the Early Actions conducted in 2007 and 2008 included:

- Excavation of 3 to 24 inches of soil from 12 residential properties along Park Avenue and Maple Avenue and associated public ROWs

- Abandonment of a section of Culvert 105 at the Wooded Parcel, extension of the North Ditch, and installation of a new inlet section of Culvert 105

- Excavation of a minimum of 24 inches of soil at the Wooded Parcel and replacement with clean backfill, including excavation of 48 inches of soil from an approximately 20-foot wide strip along the southern and eastern property lines of the Wooded Parcel

- Removal and disposal of accumulated sediment within manholes and catch basins of Culvert 105 south of the Erie Canal

- Flushing of the Culvert 105 buried pipe sections north of the Erie Canal to Sleeper Street and removal of soil/sediment from these sections

- Excavation of 12 to 24 inches of soil/sediment from and along the three existing open ditch sections of Culvert 105 between the Erie Canal and Sleeper Street and installation of new buried storm sewer pipes and manholes to replace the three open ditch sections (resulting in no open ditch sections remaining south of Sleeper Street)

Approximately 23,750 cubic yards of excavated soil was placed in the ESI Fill Area during the Early Actions. The completed activities are described in the *2007 Early Action Construction Report* (ARCADIS 2010c), which was approved by the Agencies by letter dated March 4, 2010.

In December 2008 and November 2009, the Agencies issued letters to the owners of the properties that were addressed by the Early Action activities. For 19 of the 21 properties (excepting Property AB4 and the Wooded Parcel), the Agencies' letters stated that the soil arsenic concentrations were consistent with area residential background concentrations (3.3 to 21.1 mg/kg) determined from the February 2003 Report on the Development of Arsenic Background in Middleport Soils (CRA 2003), that there was no reason for the owners to restrict the use of their properties, and that no further sampling or other actions were necessary at the properties, with the exception of soil along unremediated Culvert 105 buried pipe sections that traverse Properties AB5 and AC4. These pipe sections on Properties AB5 and AC4 are addressed herein (see Section 5.2).

Future use of the Wooded Parcel has been restricted by imposing deed restrictions. These deed restrictions include provisions relative to disturbance and maintenance of the soil cover system that run with the land and cannot be unilaterally removed by the property owner. Additionally, these restrictions incorporate by reference the *North Commercial/Industrial Area Wooded Parcel Site Management Plan Relative to 2007 Early Action Remedial Work* (ARCADIS 2009d) identified below.

Additional items associated with the Early Actions include the following post-construction activities: 1) inspection/maintenance of the Wooded Parcel soil cover system; 2) monitoring of the portion of Culvert 105 located within the Wooded Parcel (including the Culvert 105 inlet and two catch basins); and 3) monitoring/maintenance for sediment chamber MH-N9 and manhole MH-N8B, including collecting and analyzing storm water samples, monitoring the thickness of sediment in the base of the structures, collecting and analyzing samples of the sediment, and removing sediment when necessary. Sediment chamber MH-N9 is located along Culvert 105 and within Margaret Droman Park, immediately north of the Erie Canal. Manhole MH-N8B is located approximately 50 feet north of and downstream from, sediment chamber MH-N9. Details on these maintenance and monitoring activities are provided in the following plans:

- *North Commercial/Industrial Area Wooded Parcel Site Management Plan Relative to 2007 Early Action Remedial Work* (ARCADIS 2009d). Approved by the Agencies by letter dated May 19, 2009

- *Culvert 105 Sediment Chamber MH-N9 at Margaret Droman Park 2007 Early Actions Monitoring and Maintenance Plan Relative to Remedial Work* (ARCADIS 2009e). Approved by the Agencies by letter dated March 5, 2009

3.2 Land Usages within the CMS Study

Maps identifying current land usages and reasonably anticipated future land usages (as determined by FMC) within the CMS Study Areas are provided as Figures 3-2 and 3-3, respectively. The basis for identification of the reasonably anticipated future land usages is provided in Appendix C.

The Agencies' CAOs state that "[r]easonably anticipated future land uses will be identified in consultation with the community." Therefore, as part of the CMS, FMC prepared a *Draft Reasonably Anticipated Future Land Usages Map for the CMS Suspected Air Deposition and Culvert 105 Study Areas and Other Environmental Areas South of Pearson/Stone Roads*, which was submitted by FMC letter dated November 6, 2009 and includes a description of the basis for identification of future land uses. As described in Section 2, FMC consulted with, and obtained feedback from, community stakeholders and the Agencies on anticipated future land usages. A revised map of reasonably anticipated future land usages for the CMS Study Areas (see Figure 3-3) was prepared by FMC after consideration of the comments received on the draft map. A summary of the comments on the draft map and FMC's responses are presented in Appendix C.

4. Identification, Description, and Screening of Corrective Measures Technologies

This section identifies, describes, and provides a screening evaluation of corrective measure technologies and discusses several other topics relevant to the identification and development of site-specific CMAs.

4.1 Identification of Potentially Applicable Corrective Measures Technologies

As presented in the CMS Work Plan, potentially viable technologies appropriate for the CMS Study Areas and the CAOs were identified based on the following primary considerations:

- Arsenic in soils is the primary constituent of concern that has/will influence the scope of remedial efforts in the CMS Study Areas. Accordingly, corrective measures technologies that can effectively remove or isolate arsenic-containing soil or effectively reduce the soil arsenic concentrations were identified and used in the development of the CMAs.

- Arsenic is a naturally occurring element present in soil as a result of both geological background and use of man-made products. In western New York, there is evidence that suggests that arsenical pesticides were used in some fruit orchards. Therefore, the local background concentration of arsenic in soil is a key consideration in delineation of arsenic concentrations which could potentially be attributable to releases from the FMC Facility.

- Current and reasonably anticipated future land usages (see Section 3.2 for a discussion of current and reasonably anticipated future land usages as determined by FMC) and environmental settings within the CMS Study Areas.

- Minimization of potential disruption of the community and residents.

- Consideration of potential methods for removal of soil within the protected root zones of mature trees and/or of potential measures that may reduce the need to remove trees within the remediation areas.

- Results of pilot studies to obtain additional data concerning the feasibility of certain technologies.

- Identification of “green” technologies and evaluation of technologies consistent with USEPA’s and NYSDEC’s “Green Remediation” practices (refer to USEPA and NYSDEC’s website locations, including: http://www.clu-in.org/greenremedation/ and http://www.dec.ny.gov/environmentdec/64595.html).

- Identification and evaluation of both on-Site and off-Site options for the permanent disposal of non-hazardous remediation soil and debris (collectively “remediation wastes”), as discussed in Appendix D.

- The off-Site disposal options include direct disposal or reuse as soil cover material at commercial landfills potentially suitable for disposal of remediation wastes, and logistical considerations associated with loading and transporting materials to the commercial landfill(s).

- The on-Site disposal option consists of the use of an engineered, on-Site consolidation area (Corrective Action Management Unit or "CAMU") constructed, in accordance with RCRA regulations, in the eastern portion of the FMC Facility ("Facility" or "Site") for the permanent disposal of non-hazardous soil and other remediation waste at the eastern portion of the FMC Facility. The CAMU rules were promulgated to facilitate implementation of RCRA corrective action by allowing the consolidation and management of remediation wastes (e.g., wastes generated during cleanup activities) at associated RCRA-regulated facility. The CAMU state and federal regulations [6 NYCRR Part 373-2.19 (c)(3) and 40 CFR Part 264.552(c)] specify requirements for designating a CAMU. Attachment D-1 in Appendix D presents further description of FMC's proposal for the CAMU, including descriptions of the CAMU designation process, responses to comments received to date from the Agencies and community on the FMC CAMU proposal, and the regulatory basis for designation of the proposed CAMU.

The following technologies were identified for consideration in the development of CMAs:

1. No Further Action involves no further remedial activities. This technology does not include the implementation of any additional soil excavation or remedial activities beyond those already completed by FMC to address arsenic in soils. The completed remedial activities in the CMS Study Areas involved the removal of approximately 80,000 cubic yards of soil from 36 off-Site properties and remedial actions within and along Culvert 105 south of Sleeper Street, including the Wooded Parcel. Subsequent to the remedial activities, inspection, maintenance and monitoring activities were initiated at the Wooded Parcel and Margaret Droman Park and a deed restriction was implemented at the Wooded Parcel. No further action would include continuation of these OM&M activities in accordance with plans approved by the Agencies.

2. Institutional Controls involve the use of administrative measures to prevent or reduce the potential for human exposure to impacted soil. Institutional controls may include: use of deed restrictions (would require property owner consent); private property agreements/easements (would require property owner consent and would not require intervention of government authority); and environmental easements (would require property owner consent and intervention of NYSDEC). Institutional controls also include governmental controls such as zoning classifications that specify allowed land use.

3. Access Restrictions consist of physical measures to restrict access and/or maintain the integrity of another technology. Access restrictions include the installation and maintenance of one or more of the following: 1) warning signs; 2) fences; and 3) engineered covers (e.g., layers of clean soil, pavement).

4. Monitoring and Maintenance consists of activities required to verify and maintain the effectiveness of an implemented remedial measure.

5. Soil Excavation/CAMU involves physical removal of soil containing arsenic that exceeds the selected cleanup goal and placement of that soil in a Corrective Action Management Unit (CAMU) at the FMC Facility. A CAMU is defined as "an area within a facility that is used only for managing remediation wastes and for implementing corrective action or cleanup at the facility" (6NYCRR 370.2(b)(37) and 40 CFR 260.10). CAMUs and engineered on-Site consolidation areas have been selected by Agencies at numerous other sites within New York State and across the country.

6. Soil Excavation/Off-Site Disposal involves the removal of soils containing arsenic and disposal of that soil in a permitted commercial off-Site landfill. Two off-Site disposal options have been identified: disposal at a permitted commercial off-Site landfill and beneficial reuse as daily cover at a permitted commercial off-Site landfill. Two potential options for transporting the soil to the offsite commercial landfill have also been identified: truck transportation and rail car transportation.

7. Sewer Cleaning and Slip-lining typically entails removal of accumulated sediment within a sewer pipe (i.e., Culvert 105). In areas where the pipe is sufficiently damaged or deteriorated such that collapse of soil into the pipe is a risk during or after cleaning, slip-lining (i.e., a method of installing a new pipe or pipe lining material inside an existing pipe) may be considered. Details regarding Culvert 105 (e.g., construction, alignment, maintenance, and monitoring) are presented in Appendix E of this report.

8. Sewer Removal/Replacement involves the removal of buried sections of Culvert 105 and replacement of those sections in-kind when excavation of soil surrounding the pipe is warranted based on existing soil data collected near the buried pipe.

9. Phytoremediation involves the use of certain plants to reduce arsenic concentrations in soil. Plant materials accumulate arsenic and require periodic harvesting/removal and off-Site disposal. Phytoremediation is considered a "green" technology per USEPA's and NYSDEC's green remediation concepts and strategies.

10. Soil Tilling/Blending involves the tilling or blending of soil to reduce arsenic concentrations and to recycle land/soil. Soil tilling/blending is an in-situ technology and is considered in FMC's opinion to be a "green" technology because it conserves two resources (fill/soil from off-Site borrow pits and space within off-Site commercial disposal facilities).

11. Tree Preservation Measures may involve limited depth excavations, specialized soil excavation methods and/or protocols within the protected root zone of a tree, and/or potential measures that may minimize the need to remove trees within the remediation areas (e.g., flexible soil clean-up goals).

4.2 Evaluation of Phytoremediation and Soil Tilling/Blending

The following pilot studies were conducted, on behalf of FMC, to facilitate development of the CMAs:

- 2008-2009 Phytoremediation Pilot Study
- 2009 Soil Tilling/Blending Pilot Study

The results of the pilot studies and evaluations are summarized in the following sections. Under separate cover, detailed pilot study reports have been submitted to the Agencies. The pilot study reports are identified in the discussion below, and Appendix B presents and addresses comments received from the community and the Agencies on these submittals.

4.2.1 Arsenic Phytoremediation Pilot Study

A site-specific arsenic phytoremediation pilot study was performed in two phases in 2008-2009. The pilot study included a laboratory research study by Cornell University and field studies conducted in Middleport during the 2008 and 2009 growing seasons. The study was performed to evaluate the effectiveness and feasibility of using phytoremediation to remove arsenic from soils in various off-Site FMC study areas. The 2008 pilot study results were presented in a report entitled *Arsenic Phytoremediation Pilot Study Report* (AMEC Geomatrix 2009b). By letter dated April 2, 2009, the Agencies, in consultation with the NYSDOH, provided comments on the March 2009 Report, determined that further study of the Brake Fern was warranted and directed FMC to submit an addendum to the approved 2008 Work Plan for continuation of the Phytoremediation Pilot Study in 2009. The report was later revised to incorporate the Agencies' comments and was submitted to the Agencies on July 31, 2009. FMC implemented additional pilot study activities concerning the Brake Fern in 2009. The results of the 2009 study activities were presented in a report entitled *2009 Arsenic Phytoremediation Pilot Study Report* (AMEC Geomatrix 2010). The Agencies provided comments on the March 2010 report by letter dated June 9, 2010.

Appendix B of this CMS Report includes the 2009 pilot study report, the Agencies' June 9, 2010 comment letter and FMC's responses to the Agencies' comments on the 2009 Arsenic Phytoremediation Pilot Study Report. No written comments were received from the community on the reports regarding the 2008 or 2009 studies.

As detailed in the March 2009 Report (AMEC Geomatrix 2009b), the 2008 pilot study results demonstrated: 1) very low arsenic uptake in the plants tested, with the possible exception of the Brake Fern; and 2) the arsenic uptakes in the Brake Fern were higher than the other plants tested, but were well below uptakes observed in Brake Ferns in remedial projects in other parts of the United States, as documented in published articles. The Brake Fern is a sub-tropical plant that is not well-suited to the colder weather conditions in Middleport. Based on the results of the pilot test and in consultation with its experts and consultants, FMC concluded that the Brake Fern would not likely generate sufficient biomass to effectively remove arsenic from Middleport soil in a reasonable amount of time.

As directed by the Agencies, FMC continued the pilot study in 2009 to further evaluate the Brake Fern. The pilot study results presented in the March 2010 Report (AMEC Geomatrix 2010) indicate that the Brake Fern (*Pteris vittata*) may be perennially sustainable in a Middleport climate if properly insulated over the winter periods and that arsenic concentrations in the Brake Ferns were higher in the 2009 study than in the 2008 study. These arsenic uptake concentrations were, however, well below the uptake concentrations observed in Brake Ferns by researchers at sites in Florida and other states (approximately 4 to 10 times less). The lower uptakes found in this study may be attributable to the relatively low bioavailability of arsenic in the soils in the Middleport area, shorter growing season, and/or colder temperatures in the Middleport area compared to other published study sites. Based on the results of the pilot tests and in consultation with its experts and consultants, FMC concluded that regardless of actual uptake amount by the Brake Fern, these sub-tropical plants do not produce sufficient biomass in the Middleport area to effectively remove arsenic from the soils in a timely manner. Based on the estimated uptake during the 2009 growing season, it is estimated that phytoremediation using the Brake Fern (*Pteris vittata)* would take over 133 years to remove approximately 50 percent of arsenic mass in the upper 12 inches of soil in Middleport, or it would take approximately 37 years to reduce the average soil concentration by 5 mg/kg. Therefore, in FMC's opinion, phytoremediation of Middleport soils using the Brake Fern would not be effective or a feasible technology for reducing soil arsenic concentrations in the CMS Study Areas in a reasonable period of time. Accordingly, FMC did not incorporate this technology into the CMAs.

4.2.2 Soil Tilling/Blending Pilot Study

A soil tiling/blending pilot study was performed in 2009 to obtain site-specific information on the effectiveness and feasibility of soil tilling or blending as a technology in the CMS. FMC performed the work in accordance with the *Corrective Measures Study Soil Tilling/Blending Pilot Study Work Plan* (ARCADIS 2009) submitted to the Agencies by FMC letter dated October 9, 2009. That work plan was not reviewed by the Agencies.

The effectiveness of soil tilling/blending was evaluated based on the ability to reduce soil arsenic concentrations in the CMS Study Areas and to achieve arsenic concentrations in soil that meet the CAOs, as measured by soil analytical data. Feasibility was based on the ability of the equipment to access the areas and effectively till or blend the soil. The pilot study was conducted at two locations within the CMS Study Areas. The locations were selected for use in the pilot study based on (1) a review of the pre-existing soil sampling data; (2) the relatively flat, open terrain of these sites; and (3) their location in undeveloped areas.

The findings of this pilot study are detailed in the *Corrective Measures Study Soil Tilling/Blending Pilot Study Report* (ARCADIS 2010b). The Pilot Study Report, the Agencies' May 10, 2010 letter that provides comments on FMC's Pilot Study Report, FMC's responses to comments from the Agencies and the community are included in Appendix B of this CMS Report.

Based on the results of the pilot study and consultation with FMC's experts, FMC concluded that soil tilling or blending is a viable corrective measures technology for remediation of soil in the CMS Study Areas that conserves soil by minimizing or eliminating (on a property-specific basis) the need to import soil for fill purposes from a borrow source (which occurs as part of an excavation and removal remedy). Accordingly, FMC has retained soil tilling or blending for further evaluation in the CMS. Site-specific information developed during the pilot study (e.g., equipment type, depth of mixing, level of effort required, maximum and average resulting arsenic concentrations, and associated costs) is incorporated into the development and evaluation of CMAs. Additionally, the applicability of soil tilling/blending would be based on factors specific to the property and/or area identified for remediation. These factors include 1) physical characteristics of the area to be remediated (e.g., proximity to structures, location of underground features, location of utilities, proximity to trees), 2) the soil arsenic concentrations in the remediation area are sufficiently low enough to achieve the soil arsenic remediation goals, 3) the distribution of arsenic in the soil remediation area, and 4) the estimated vertical and horizontal extent of soil that would be required to be tilled/blended to achieve the soil arsenic remediation goals selected by the Agencies for the CMA.

4.3 Evaluation of Tree Preservation Measures

The project-specific CAOs issued by the Agencies in March 2009 specifically state that one of the goals of corrective measures is to "[m]inimize disturbance and disruption of the community so that the character of the neighborhoods can be maintained." The preservation of trees is understood to be an important element in maintaining the character of the Middleport community and/or an affected property. Therefore, a study of potential tree preservation measures was included as a task in the CMS Work Plan.

Tree preservation measures were evaluated by FMC's environmental consultant (i.e., ARCADIS of New York, Inc ["ARCADIS"]) using Middleport-specific information and in consultation with AMEC Geomatrix and other experts (i.e., local arborists - The Tree Doctor). The results of the evaluation were presented in FMC's interim CMS-related deliverable entitled, *Corrective Measures Study Technical Memorandum – Evaluation of Tree Preservation Measures for Suspected Air Deposition and Culvert 105 Study Area*, dated February 2010 and prepared by ARCADIS (ARCADIS 2010a) (referred to herein as "Technical Memorandum"). The Agencies commented on the Technical Memorandum by letter dated April 5, 2010. The Technical Memorandum, the Agencies' April 5, 2010 letter, comments from the community, and FMC's responses to comments are included in Appendix B of this CMS Report. Based on the information contained in the Technical Memorandum and in consultation with FMC's qualified and experienced experts, FMC's conclusions regarding tree preservation measures are summarized below.

- Any disturbance (e.g., soil removal, soil tilling, soil compaction) within the protected root zone could jeopardize the health or stability of an otherwise healthy tree. For this reason, the most common approach in soil remediation projects is to remove the tree and replant with a new tree.

- Removal of larger trees and replanting with smaller, nursery stock trees would have an effect on the aesthetic character of an affected property and the neighborhood. Based upon inventories of trees located in ROWs in the Village of Middleport, approximately 80% of the trees have a trunk diameter of greater than 10 inches. Decades of growth time would likely be needed to achieve this size.

- Some trees cannot or should not be preserved. The determination of whether a tree can or cannot be preserved is dependent on a number of property-specific or tree-specific factors. For example, an older tree with dwindling health would have a low probability of long-term survival if any soil removal was attempted within the protected root zone.

- For those select trees for which preservation is determined to be feasible and appropriate, FMC has concluded based on consultation with its experts that in certain cases, limited depth excavation (i.e., maximum depth of 6-inches) using either mechanical or pneumatic pressure would present the best opportunity to preserve the tree. This finding is based upon the practicability of implementation, probabilities for tree survivability, tree structural stability concerns, and safety concerns for workers, residents, and the community. In FMC's opinion, the depth of excavation should be limited to approximately 6 inches below the soil surface within the protected root zone, and completed in one continuous effort.

The scope of any soil remediation on a property identified for remediation will be based on the corrective measures and the soil cleanup goals selected by the Agencies. Depending on the final remediation goals and property-specific soil arsenic data, only portions of a property may require remediation. The exact vertical and horizontal extent of any soil remediation required to meet the soil remediation goals on a property will be determined during the design activities of the Corrective Measures Implementation (CMI). At that time, this information will be presented to the affected property owner, and any tree(s) within in the soil remediation area will be identified. FMC will consult with the property owner to identify trees that the owner may want preserved. If the owner wants a tree or trees preserved, then the tree(s) will be further evaluated to determine if preservation will be viable. This determination will be based on 1) the vertical and horizontal extent of soil removal required to achieve soil cleanup goals, 2) property-specific factors (i.e., soil characteristics), and 3) tree-specific factors (i.e., tree species, age, health, stability, location and condition). In addition, a qualified arborist will help evaluate the tree identified for preservation and provide input on the viability of preservation of the tree and possible tree preservation methods based on site-specific information. After a tree is initially identified for preservation by the owner, additional soil sampling and analysis within the protected root zone of trees may be performed to refine the vertical and horizontal extent of soil removal within the protected root zone. This additional data may be used to help determine if the tree can be preserved based specifically on the soil arsenic concentrations within the protected root zone of the tree and the soil cleanup goals, and may be used to develop methods to preserve the tree(s).

The property owner will have the final decision on whether their property will be remediated and on preservation of trees on their property. FMC will provide the property owner with information needed to make an informed decision concerning tree preservation and FMC's recommendation regarding the viability of preserving the tree(s) within the remediation area during the CMI design phase. Such information will also

include the soil data near the tree(s) identified for preservation; vertical and horizontal extent of soil removal within the protected root zone required by the Agencies to comply with the remediation goals; information concerning the condition of the tree and any recommendation from a qualified arborist; and proposed tree preservation methods. If tree preservation is not possible based on the vertical and horizontal extent of excavation required to meet the soil cleanup goals, then the property owner will be informed of the issues related to leaving contaminant levels in soil above the soil cleanup goals.

4.4 Evaluation of Technologies for Culvert 105 Buried Pips

As identified in Section 1.1 and detailed in Appendix E, Culvert 105 is a municipal stormwater conveyance system that consists of a combination of buried pipes and open ditches. The technologies identified above for the buried pipe sections of Culvert 105 include: sewer cleaning/slip-lining and sewer removal/replacement. The poor condition of some pipe sections, as well as the varied pipe materials (e.g., tile, black corrugated poly) and diameters (ranging from an estimated 8" to 36") may limit the effectiveness/ability to implement sewer cleaning/slip-lining. Slip-lining of the buried pipe sections of Culvert 105 would not prevent potential exposure to soil surrounding the pipe that may contain arsenic at concentrations exceeding the remediation goals for a CMA, and it would require long-term maintenance. Additionally, the relatively shallow depths of the buried pipes within the CMS Study Areas (less than 6 feet below grade) facilitate the ability to remove/replace the buried pipes if required as part of the soil removal activities. Therefore, for the purposes of this CMS, sewer cleaning/slip-lining has not been incorporated by FMC into the CMAs. Where buried Culvert 105 pipes are present within the soil to be remediated under a given CMA, it was assumed that the culvert pipe would be removed and replaced in-kind.

4.5 Evaluation of Remediation Waste Disposal Options

As listed in Section 4.1, the following on-Site and off-Site remediation waste disposal options consist of the following:

1. Placement and management of remediation wastes in an engineered, on-Site consolidation area (i.e., CAMU) on the FMC Facility.

2. Off-Site disposal of remediation waste at a permitted commercial landfill as non-hazardous waste, with truck or rail transportation.

3. Off-Site disposal remediation waste at a permitted commercial landfill as daily soil cover in a beneficial re-use scenario, with truck or rail transportation.

Based on the soil data collected from the CMS Study Areas, and data collected during the performance of the interim remedial measures described in Section 3.1, soil and debris that would be removed will be characterized as non-hazardous wastes, as defined by applicable state and federal rules and regulations (e.g., 6NYCRR Part 371). Therefore, options for disposal as non-hazardous wastes were considered.

Descriptions and an evaluation of these options for managing excavated soil, along with detailed information regarding the proposed CAMU and the CAMU designation process, are provided in Appendix D and summarized below.

4.5.1 On-Site Disposal Option

This Draft CMS Report provides sufficient information on the CAMU to evaluate the waste disposal options for remediation wastes generated as part of the corrective action program for the FMC Middleport Facility and the off-Site study areas situated south of Pearson/Stone Roads (e.g., Tributary One and Flood Plain South of Pearson/Stone Roads). Attachment D-1 of Appendix D describes the proposed CAMU, including a description of the regulatory basis for the designation of a CAMU at the FMC Plant Site, the conceptual design of the CAMU, the technical basis for key CAMU design parameters and estimated costs for use of the CAMU as a disposal option. As discussed in Appendix D, after presentation of the CAMU conceptual design in the Draft CMS Report and if the Agencies indicate their intention to select the CAMU disposal option, FMC will submit a revised CAMU Application (originally submitted in March 2008) to present the detailed CAMU design and other supporting information (e.g., design drawings and specifications, filling/operations plan, post closure plan, etc.) required by the CAMU rules and regulations and the Agencies. The revised CAMU Application will be subject to public review and comment. The Agencies will review the CAMU Application with consideration of the public comment and approve, disapprove and/or request changes to the CAMU. If approved by the Agencies, the CAMU would be constructed/used as part of the CMI phase for the Suspected Air Deposition and Culvert 105 Study Area.

The CAMU, if approved, could also be used for the disposal of remediation wastes associated with other FMC study areas situated south of Pearson/Stone Roads (e.g., Tributary One and Flood Plain South of Pearson/Stone Roads). The potential value for use on other FMC Middleport remediation projects should also be considered in the evaluation of the waste disposal options for this CMS. The potential future benefits (e.g., less utilization of off-Site landfill facilities, reduced transportation requirements, greater flexibility during implementation) would be similar to those associated with the Suspected Air Deposition and Culvert 105 Study Areas, as discussed in Appendix D. Accordingly, the CAMU will be evaluated in this CMS based on its potential use in the CMAs considered for the Suspected Air Deposition and Culvert 105 Study Areas and for other FMC study areas south of Pearson/Stone Roads. However, since the excavation requirements (if any) of other remediation projects are indeterminable at this time (pending the findings of future corrective measures studies), this CAMU will also be evaluated assuming that it will be utilized to its full design capacity. The proposed CAMU location is on the eastern portion of the FMC Facility and would be constructed in two phases: Phase 1 would involve continued use of the ESI Fill Area and Solid Waste Management Unit (SWMU) Group C Area, and Phase 2 would be new placement of remediation waste south of Phase 1 (refer to Figure 4-1). Overall, the maximum footprint of the CAMU would be approximately 16.9 acres, with a total height of 28 feet from its base elevation. FMC had previously proposed a CAMU with a maximum height of 35 feet. In response to comments from the community, FMC lowered the proposed CAMU height to 28 feet.

If a CAMU is designated (i.e., approved) for disposal of remediation waste from the CMS Study Area currently being evaluated, FMC may propose and request approval, in the future, to increase the height of the CAMU to a maximum height of 35 feet as part of a CMS for other FMC study areas situated south of Pearson/Stone Roads (e.g., Tributary One and Flood Plain South of Pearson/Stone Roads). However, the 35-foot height is not proposed as part of this current CMS.

After placing the final cover atop the CAMU, the ground surface of the CAMU would be vegetated with a variety of low-maintenance grasses and shrubs. Trees would be planted at select locations along the perimeter to achieve an appearance consistent with the open, rural, and natural character of the surrounding area. Figures 4-2 through 4-4 show the simulated aerial view and other simulated views of the proposed CAMU.

The placement and management of soils in the CAMU would be performed in accordance with design plans and procedures that will be approved by Agencies. Prior to approval by the Agencies, the design plans and associated procedures and support documents will be subjected to public comment and review.

4.5.2 Off-Site Disposal at a Permitted Commercial Landfill

The off-Site disposal options considered in this CMS is described in detail in Attachment D-2 of Appendix D, and is summarized below.

Off-Site Commercial Landfill

The off-Site disposal option consists of disposal at a commercial landfill with beneficial reuse as daily landfill cover (to the extent the landfill operator has the need). The receiving off-Site commercial landfill would be permitted to accept non-hazardous remediation wastes in accordance with applicable rules and regulations (e.g., 6NYCRR Part 360). Ten commercial landfills have been identified in Western New York (Attachment D-2) that are within approximately 100 miles of Middleport that could potentially accept the non-hazardous remediation soil and other remediation wastes generated during implementation of a corrective measure. The closest landfill is located approximately 30 miles from Middleport, and a total of four landfills are located within approximately 50 miles of Middleport. It should be noted however, that there are numerous additional commercial landfills located beyond the 100 mile radius, both within and outside of New York State that could potentially accept these non-hazardous remediation wastes.

Non-hazardous remediation waste beneficially reused as daily landfill cover, would conserve landfill airspace (used for remediation waste) and save on use of other soil/cover resources. The receiving commercial landfill may reuse all, none, or some of the remediation soils for landfill cover. The commercial landfill facility will determine the amount of any FMC-related remediation waste that could be used for landfill cover based on various factors, including the landfill needs and the landfill permit requirements. Throughout the course of remediation, the ability to beneficially reuse remediation soil for daily cover may change based on landfill needs at the particular time.

Material not beneficially reused for landfill cover would be disposed in the commercial landfill as non-hazardous solid waste. Reuse of the remediation waste as cover may provide a reduced cost compared to disposal at a commercial landfill. For the purposes of this CMS, FMC and the Agencies agreed to use of the assumption that 25 percent of FMC remediation wastes would be beneficially reused as daily landfill cover material and 75 percent would be disposed of as non-hazardous solid waste (reference Item No. 2 in the Enclosure to NYSDEC's letter to FMC dated December 2, 2010; copy provided in Attachment D-1B).

Truck Transportation

The remediation waste may be transported by truck directly or indirectly (through use of a temporary remediation waste staging area) to the appropriate commercial landfill. Direct loading of larger trucks (e.g., 30 ton capacity) at the excavation sites for transport to the commercial landfill may not be practicable or implementable and therefore, for purposes of this CMS use of a temporary staging area located on the eastern portion of the FMC Facility has been assumed. Remediation waste would be transported from excavation areas to the temporary staging area by a smaller truck. Remediation wastes accumulated in the staging area would be subsequently loaded into appropriately sized trucks for transport to the commercial landfill. Truck transport of the remediation waste would follow a truck route(s) to commercial landfill(s) that would be established during the CMI phase. Transport of the remediation waste from the FMC Facility to the commercial landfill would likely follow State Route 31 and not Village Streets.

Rail Transportation

Rail transportation may be accomplished by direct loading of rail containers (e.g., intermodals) at the excavation areas which would then be transported to the FMC Facility to be directly loaded on rail cars or temporarily staged at the facility until rail cars become available for transport. However, moving the intermodal containers would require resolution of certain logistics, including size of rail containers, physical constraints of the excavation areas, and need for specialized cranes and other equipment to move the intermodals. Alternatively, excavated remediation wastes can be initially transported by truck to a temporary staging area (i.e., temporary stockpile) located on the FMC Facility with subsequent transfer to railcars.

Rail transport of remediation wastes to the appropriate commercial landfill would occur from the FMC Facility utilizing the Falls Road Railroad mainline (owned by Genesee Valley Transportation). The FMC Facility has a rail switch to provide access to the on-Site rail spurs. Rail transport would not create additional local road traffic. However, as discussed in Attachment D-2, there is currently only one local landfill (approximately 33 miles from Middleport) that can receive remediation wastes by rail but there are limitations at this landfill on container types and number of daily shipments. There are numerous other commercial landfill facilities within the country that will accept waste by rail, either directly or via truck transfer.

After consultation with its technical experts and logistics providers, FMC understands that rail transport of remediation wastes to off-Site commercial landfills is typically used for long-distance transport of material or special circumstances (e.g., limited transportation routes or facilities suitable for treatment/disposal of a

hazardous waste) that require rail transport. It is FMC's opinion that there is no advantage of transport by rail over transport by truck at this time based on the following considerations:

- **More local options for truck transportation** - Middleport is proximate to 10 existing commercial landfills, shown on Figure D2-2 (ranging from approximately 30 miles to 108 miles), which accept remediation waste via truck transport and Middleport is proximate to one existing landfill identified that presently provides rail service. Among the 10 commercial disposal facilities identified within approximately 100 miles of Middleport, there are four facilities located within approximately 50 miles of Middleport. The facility that accepts rail is 33 miles from Middleport and it also accepts transport by truck.

- **Greater flexibility for local truck transportation** - Use of trucking provides greater flexibility in off-Site disposal options through the potential use of more than one local landfill facility for disposal. Use of several local disposal facilities may provide FMC an opportunity to maximize beneficial reuse as daily cover by distributing the soil to facilities in accordance with their need for cover soils. Use of rail transport to non-local landfill facilities (beyond the 100 mile radius) may provide additional disposal options with respect to the additional commercial landfills with direct rail service and equipment to handle either gondolas or intermodal containers. There is, however, limited ability to change routes in the event of a rail line repair and the need for multiple rail carriers/interchanges may increase the possibility of service disruptions and other delays.

- **Greater flexibility at the commercial landfill for trucks** - Each of the 10 landfills identified in western New York all accept remediation wastes via truck. The only local landfill facility with direct rail service is limited to receiving waste by rail in 100-ton gondola railcars (i.e., does not accept intermodal rail containers). Furthermore, this facility restricts the number of rail cars per day due to physical constraints with unloading operations. However, there are a number of other commercial landfill facilities within the United States that will accept waste by rail, directly via gondola car or intermodal container.

- **Rail transport is not cost effective for short transport distances -** Based on other remediation projects that FMC's consultants have been involved in and recent (February/March 2011) consultation with the remedial waste management firm Site Waste Logistics, Inc., FMC understands that although rail transport is often more economical than truck transport over longer distances (e.g., greater than approximately 300 miles) it is not cost effective for short transport distances.

Accordingly, the disposal evaluations presented in this CMS focus on the truck transport of remediation waste in making detailed comparisons between CMA options.

The actual details for remediation waste disposal, including landfill(s), mode(s) of transport (truck or truck/rail), amounts of remediation waste used as daily cover, and remediation waste staging methods used during implementation of a corrective measure would be determined during the CMI phase and presented in the CMI work plan subject to review and approval by the Agencies. These details would depend on a variety

of considerations, and could vary from current conditions (e.g., landfill capacity and permit status, need/requirements for landfill cover material, available rail service and logistics, fuel costs, disposal costs).

4.5.3 Disposal Options included in the CMAs

For the purposes of this CMS, the following two disposal options have been included in the CMAs for further evaluation:

- **On-Site Disposal Option** - Placement and permanent management of non-hazardous soil and other remediation wastes in a CAMU with a total height of 28 feet from its base elevation

- **Off-Site Disposal Option** - For the purposes of this CMS, the off-Site disposal option assumes that 25% of remediation waste would be beneficially reused as landfill cover material and 75% of the remediation waste would be disposed in a local commercial landfill as non-hazardous solid waste. The actual amount or percentage of remediation waste, if any, that could be beneficially reused as daily cover may vary during the CMI based on contractual agreements with the commercial landfill facility or facilities. For the purpose of detailed comparison of CMAs, the off-Site disposal option presented in this CMS focus on the truck transport of remediation waste since, in FMC's opinion, rail transport offers no advantage over truck transport at this time. However, conceptual evaluation of rail transport has been included in this CMS (see Appendix D). During the CMI, FMC may elect to use rail transport for some or all remediation wastes and/or may elect to use non-local commercial landfill facilities with transportation by truck, if determined to be appropriate.

As discussed in Section 4.5.2, the CAMU, if approved, could also be used for the disposal of any remediation wastes associated with other FMC study areas situated south of Pearson/Stone Roads (e.g., Tributary One and Flood Plain South of Pearson/Stone Roads). Therefore, the CAMU will be evaluated in this CMS based on its potential use in the CMAs considered for the Suspected Air Deposition and Culvert 105 study areas and for other FMC study areas south of Pearson/Stone Roads. However, since the excavation requirements (if any) of other remediation projects are indeterminable at this time (pending the findings of future corrective measures studies), this CAMU will also be evaluated assuming that it will be utilized to its full design capacity.

5. Detailed Descriptions of Corrective Measures Alternatives

This section identifies and describes the CMAs that are evaluated in this Draft CMS Report. The CMAs were developed consistent with the approved CMS Work Plan, and the Agencies' directives regarding the 2010 Draft CMS Report (see Section 1.2).

5.1 Identification of Alternatives

CMAs were developed incorporating the following corrective measures technologies identified and discussed in Section 4 of this report: no further action; institutional controls; monitoring and maintenance; soil excavation and placement in the proposed CAMU or off-Site disposal/beneficial reuse at a commercial landfill; buried pipe removal/replacement; soil tilling/blending; and tree preservation measures.

Using these technology options, CMAs 1 through 8 were developed for further evaluation (see Tables 5-1, 5-1a and 5-1b). With the exception of CMA 1 (No Further Action), each of the CMAs include some amount of excavation and disposal of remedial soils, with use of soil blending/tilling to minimize the amount of soil removal/disposal and methods to preserve trees in excavation areas where appropriate. The CMAs differ by post-remediation soil arsenic goals, how the Culvert 105 buried pipe is addressed, and how the non-ICM area of the Roy-Hart School property is addressed. These key differences are summarized as follows:

- **Post-Remediation Soil Arsenic Goals:** CMAs 3, 6A, 6B, 7A, 7B have different post-remediation arsenic goals (e.g., average and/or maximum soil arsenic levels) for different anticipated future property usages (see Appendix C), while CMAs 2, 4, 5, and 8 have goals that are applied regardless of property usage. Post-remediation soil arsenic goals are higher for non-residential land usages, and institutional controls would be implemented on properties remediated to non-residential post-remediation soil arsenic goals. Post-remediation goals are not applicable to CMA 1 (No Further Action).

- **Culvert 105:** Culvert 105 is the Village of Middleport's stormwater conveyance system. The Culvert 105 begins at the FMC-owned North Railroad, runs approximately 1.3 miles northward through a series of open ditches and buried pipe, and discharges into Tributary One, north of the Village of Middleport sanitary wastewater treatment plant. Appendix E describes Culvert 105, past FMC remedial activities associated with Culvert 105 and ongoing inspection, monitoring and maintenance being performed by FMC for the remediated sections of Culvert 105. Open ditch sections of Culvert 105 will be remediated to meet CMA-specific post-remediation soil arsenic goals for CMAs 2 through 8. CMAs 2 though 7B include soil remediation along buried pipe sections of Culvert 105 and replacement of the pipe, to meet the CMA-specific post-remediation soil arsenic goals. The estimated area for remediation along Culvert 105 for the CMAs 2 through 7B does not extend into prior ICM areas or unsampled properties/areas. For CMAs 2 through 7B, buried sections of Culvert 105 that would not be remediated based on existing soil data collected near the buried pipe would remain as is (i.e., buried pipe sections of Culvert 105 would not be replaced unless removal of soil surrounding the pipe is warranted) and institutional controls would be established. As discussed in Appendix E, monitoring of surface water and sediment quality within the new buried pipe sections of Culvert 105 (installed as part of the 2007-2008 Early

Actions) has not identified any elevated concentrations of arsenic or other FMC-related constituents. Institutional controls would include use restriction of the area of the property traversed by the buried Culvert 105 pipe and/or establishment of a Soil Management Plan for ground intrusive activities associated with any future repair/maintenance of unremediated buried Culvert 105 pipe that may be performed by the Village of Middleport. CMA 8 assumes that soil remediation and pipe removal/replacement would be required along the entire length of Culvert 105 buried pipe (including three unsampled properties and seven public streets crossed by the culvert, but not including areas previously remediated under ICMs and the section of the pipe that passes beneath the Erie Canal). For all CMAs, where Culvert 105 is to be remediated, the culvert would be replaced in-kind (either as a buried pipe or open ditch) along the existing alignment. It should be noted that the actual portions of Culvert 105 buried pipe expected to be remediated will be determined during the CMI phase, which will occur after selection of the final corrective measure(s) by the Agencies.

- **Non-ICM Area of the Roy-Hart School Property**: For the Roy-Hart School property, the human health risk assessment presented herein includes a site-specific risk evaluation that confirms the Agencies' conclusion presented by letter dated May 26, 2000 after completing the ICM in 1999, that "the Agencies have determined that the entire school yard is suitable for both athletic and non-athletic uses by all school children, in terms of their exposure to known school yard soil arsenic levels." The Agencies subsequently reaffirmed this determination by letter dated November 3, 2009. No further action for the non-ICM area of the Roy-Hart School property was included in three CMAs (CMAs 1, 4, and 5). Three other CMAs (CMAs 3, 6A, and 7A) included use of institutional controls to address the non-ICM area of the Roy-Hart School property, which would consist of further evaluation/action of the non-ICM area if the use of the Roy-Hart School property changes to residential. The remaining CMAs (CMAs 2, 6B, 7B, and 8) included remediation of the non-ICM area of the Roy-Hart School property to meet the CMA-specific post-remediation soil arsenic goals.

CMAs Developed

- Alternative 1 (also referred to as CMA 1) – No Further Action

- Alternative 2 (also referred to as CMA 2) – Remediation of soil with arsenic concentrations above 20 mg/kg on each property, including the non-ICM area of the Roy-Hart School property. Appropriate institutional controls (as described above) would be established on properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 3 (also referred to as CMA 3) – Remediation of soil on residential properties to a post-remediation average arsenic concentration of 20 mg/kg on each property with a maximum residential property soil arsenic concentration of 40 mg/kg. Post-remediation soil arsenic goals would be higher for nonresidential land usages. Appropriate institutional controls would be established on the following properties: a) the non-ICM area of the Roy-Hart School property; b) properties remediated to non-residential post-remediation soil arsenic goals; and c) properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 4 (also referred to as CMA 4) – Remediation to a post-remediation average arsenic concentration of 30 mg/kg with a maximum concentration of 60 mg/kg. No further action would be implemented on the non-ICM area of the Roy-Hart School property. Appropriate institutional controls (as described above) would be established on properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 5 (also referred to as CMA 5) – Remediation to a post-remediation average arsenic concentration of 40 mg/kg on each property and a maximum concentration of 80 mg/kg. No further action would be implemented on the non-ICM area of the Roy-Hart School property. Appropriate institutional controls (as described above) would be established on properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 6A (also referred to as CMA 6A) – Remediation of soil on residential, public, and institutional properties to a post-remediation average arsenic concentration of 20 mg/kg on each property with a maximum residential, public, institutional property soil arsenic concentration of 35 mg/kg. Soil remediation levels would be higher for other land usages. Soil remediation of the non-ICM portion of the Roy-Hart School property would not be performed. Appropriate institutional controls would be established on the following properties: a) non-ICM area of the Roy-Hart School property; b) properties remediated to post-remediation soil arsenic goals for agricultural, commercial, industrial, railroad and utility land usages; and c) properties with buried pipe sections of Culvert 105 that are not replaced.

- Alternative 6B (also referred to as CMA 6B) – Same as CMA 6A, except that CMA 6B includes remediation of the non-ICM portion of the Roy-Hart School property to the post-remediation soil arsenic cleanup goals for residential and public/institutional properties (20 mg/kg average and a maximum of 35 mg/kg). No institutional controls would be established for the non-ICM portion of the Roy-Hart School property.

- Alternative 7A (also referred to as CMA 7A) – Same as CMA 6A, except that CMA 7A will have a maximum post remediation soil arsenic cleanup level of 30 mg/kg for residential and public/institutional properties.

- Alternative 7B (also referred to as CMA 7B) – Same as CMA 7A, except that CMA 7B includes remediation of the non-ICM portion of the Roy-Hart School property to the post-remediation soil arsenic cleanup goals for residential and public/institutional properties (20 mg/kg average and a maximum of 30 mg/kg). No institutional controls would be established for the non-ICM portion of the Roy-Hart School property.

- Alternative 8 (also referred to as CMA 8) – Remediation of all properties, including the non-ICM portion of the Roy-Hart School property, but excluding the Wooded Parcel, to a post-remediation average arsenic concentration of 20 mg/kg and a maximum concentration of 30 mg/kg for each property. CMA 8 also includes removal/replacement of all remaining buried pipe portions of the Culvert 105 buried pipe.

5.2 Description of Alternatives

Descriptions of the CMAs are presented by describing the common elements of the CMAs, and then identifying the specific, distinguishing features for each CMA. The CMAs include the following common elements:

- **Continued implementation of the Site Management Plan for the Wooded Parcel** – The Wooded Parcel was remediated in 2007-2008, deed restrictions were recorded for the property, and inspection, monitoring and maintenance activities were implemented under an Agencies'-approved Site Management Plan beginning in 2008. Alternatives 1 through 8 assume that the existing 2-foot thick engineered soil cover and reconstructed sections of Culvert 105 (constructed as part of the 2007-2008 Early actions described in Section 3.1.5) will remain, and that no further remedial action is needed to address the soil underlying the soil cover or the sections of Culvert 105 that were not replaced in 2007-2008. The remedial systems at the Wooded Parcel and the property use restrictions established in the deed restrictions will limit long-term human exposures to any soil underlying the soil cover system. Continued implementation of the Site Management Plan will maintain the integrity of the engineered soil cover system constructed in 2007-2008 and provide for long-term inspection, monitoring and maintenance of the systems constructed in 2007-2008. (Note: In January 2011, FMC provided the Agencies with its legal analysis of the Wooded Parcel deed restrictions which indicate that these restrictions cannot be unilaterally removed by the current or any future owner of this parcel. However, if as a result of the ongoing Agencies' review, the permanency of these restrictions cannot be confirmed to the Agencies' satisfaction, other remedial options for this parcel may need to be evaluated [i.e., other than no further action]).

- **No Further Action for Previously Remediated Properties** – No further action for 31 properties remediated during the 2003 ICM and the 2007-2008 Early Actions for which the property owners received letters from the Agencies stating that no use restrictions were required and that no further sampling or other actions are needed. The 31 remediated properties include the 14 west residential properties and the associated public ROWs (A1A, A1B, A1C, A1D, A1E, A1F, A1G, A1H, A1I, A1J, A1K, A1L, A1M, A1N) and the section of buried storm sewer remediated during the 2003 ICM; 12 P-Block Properties (P1, P2, P3, P4, P5, P6, P7, P8, P9, P11, P12, P13) remediated during the 2007-2008 Early Actions; and five properties north of the Erie Canal and traversed by Culvert 105 that were remediated during the 2007-2008 Early Actions (AA1, AB6, AC3, AC2 and AC1). The post-remediation soil arsenic concentrations on these 31 remediated properties ranged up to 31.7 mg/kg, with average soil arsenic concentrations for each property ranging from 4.7mg/kg to 18.6 mg/kg. There are a few sample locations on these ICM properties where arsenic concentrations in the remaining soils exceeded 20 mg/kg and only one location exceeded 30 mg/kg. These occurrences were determined by the Agencies to be generally minimal and were allowed to remain by the Agencies based on property specific considerations. As stated in the Agencies' letters, the arsenic concentrations in the remaining soil at the remediated properties were consistent with area residential background concentrations and normal sampling and data variability (refer to Section 3.1). Properties AB5 and AC4 were also remediated as part of the 2007-2008 Early Actions and the property owners received letters from the

Agencies stating that no use restrictions were required and that no further sampling or other actions are needed except to potentially address soils along buried Culvert 105 pipe. Remediation (removal and replacement) of unremediated buried pipe sections of Culvert 105 traversing Properties AB5 and AC4 would therefore be required under CMA 8 (as discussed in Section 5.1), and may be required under the other CMAs based on the results of any future soil sampling performed as part of the CMI design phase.

- **Remediation to CMA-Specific Post-Remediation Soil Arsenic Goals –** To achieve specific post-remediation soil arsenic concentrations, Alternatives 2 through 8 would involve soil excavation and removal using conventional construction equipment. Where appropriate, excavation may be supplemented with or replaced with in-place soil tilling/blending. For example, soil tilling/blending may be appropriate for properties that are: 1) relatively flat, open, and undeveloped; 2) the soil arsenic concentrations are sufficiently low enough to achieve the alternative specific soil arsenic remediation concentrations; 3) soil arsenic concentrations are higher at the surface and lower in the shallow subsurface; and 4) there are no subsurface or overhead features (e.g., utilities) that would preclude the use of the machinery needed to perform the soil tilling/blending. The use of soil tilling/blending would be considered during the design of the CMI phase, which will occur after selection of the final corrective measure(s) by the Agencies. For the purposes of the CMS, it is assumed that all soil targeted for remediation under CMAs 2 through 8 will be excavated and removed.

- **Remediation Waste Disposal Options** – As discussed in Section 4.5 and Appendix D, on-Site and off-Site waste disposal options will be included in the detailed evaluation of the CMAs. Excavated soil would be loaded into trucks and transported to and placed in the CAMU (to be located at the eastern portion of the FMC Facility and designed as described in Appendix D), or transported directly or indirectly (use of a temporary on-Site staging area) by truck or rail to appropriate off-Site commercial landfills for disposal or beneficial reuse. The detailed evaluation of the CMAs in this CMS, including development of cost estimates, the off-Site disposal option assumes that remediation waste will be transported to local commercial landfill facilities via truck, and that 25% of the remediation waste will be beneficially reused as landfill cover material and 75% of the remediation waste will be disposed as non-hazardous solid waste.

- **Property Restoration** – Placement of backfill (clean fill soil and top soil, as appropriate) to original grade where soils are excavated. Imported fill used to restore excavated areas will meet chemical and geotechnical criteria to be specified in the remedial design that will be reviewed/approved by the Agencies. As with the Early Actions, topsoil may need to be amended with leaf compost (or other suitable material) to meet project specifications for total organic content. Lawns would be restored by seeding or placement of sod.

- **Tree Preservation** – As discussed in Section 4.3, opportunities to preserve trees will be identified in consultation with the property owner and a qualified local arborist relying on site-specific information during the CMI, after the Agencies select the final corrective measures and soil cleanup goals for the study area. The property owner will have the final decision on whether their property will be remediated and on preservation of trees on their property. During the CMI design phase, FMC will provide the

property owner with information needed to make an informed decision concerning tree preservation and FMC's recommendation regarding the viability of preserving the tree(s) within the remediation area during the CMI design phase.

- **Property-Specific Features within the Remediation Area** – Landscaping features, sidewalks, driveways, and other property-specific features (e.g., pools, sheds, fences, etc.), will be replaced in-kind where removal is necessary. The need for removal of any property-specific features will be determined during the design of the CMI phase, in consultation with the affected property owners and the Agencies.

- **Culvert 105 Remediation** –Where soil around Culvert 105 is to be removed, the culvert would be replaced in-kind (either as buried pipe or open ditch) along the existing alignment. Section 5.1 describes the remediation along the buried pipe sections of Culvert 105 for the CMAs. CMAs 2 through 7B included remediation of buried pipe sections of Culvert 105 to meet the CMA-specific post-remediation soil arsenic goals. CMA 8 assumes that remediation along the entire length of the Culvert 105 buried pipe sections that were not previously installed as part of previous ICMs.

- **Institutional Controls** – Use of institutional controls (see note at end of this bullet) to: 1) require further evaluation/action by FMC if the use of the property changes; and/or 2) address intrusive activities that may be conducted on a property using a Site or Soil Management Plan. Institutional controls would be implemented for the following properties within the CMS Study Areas:

    - Properties with buried pipe sections of Culvert 105 that are not removed and replaced, but not including areas previously remediated under ICMs and the section of the pipe that passes beneath the Erie Canal (CMAs 2 through 7B)

    - Properties remediated to non-residential post-remediation soil arsenic goals (CMA 3) or non-residential/public/institutional post-remediation soil arsenic goals (CMAs 6A, 6B, 7A, and 7B)

    - Non-ICM area of the Roy-Hart School property for CMAs 3, 6A and 7A

As noted in the first bullet of this subsection, legal mechanisms (i.e., deed restrictions) for the Wooded Parcel have been recorded and there is an Agencies'-approved Site Management Plan in association with the remediation completed by FMC in 2007-2008. Each of the CMAs includes continued implementation of the Site Management Plan for the Wooded Parcel. (Note: In January 2011, FMC provided the Agencies with its legal analysis of the Wooded Parcel deed restrictions which indicate that these restrictions cannot be unilaterally removed by the current or any future owner of this parcel. However, if as a result of the ongoing Agencies' review, the permanency of these restrictions cannot be confirmed to the Agencies' satisfaction, other remedial options for this parcel may need to be evaluated [i.e., other than no further action]).

- **Remedial Design and Pre-design Activities** – A remedial design would be required as part of the CMI phase to provide technical drawings, plans and specifications, as well as other project specific plans (e.g., Community Participation Plan, Health and Safety Plan, Remedial Construction Implementation Schedule, Traffic Control Plan, Air Monitoring and Dust Control Plan, Erosion and Sedimentation Control Plan, Property-Specific Remediation Work Scopes and Safety Analyses, etc.) necessary to implement the CMI construction activities. Pre-design activities necessary to support the remedial design and specific determination of the feasibility/appropriateness of implementing soil tilling/blending and/or tree preservation measures on a specific property would also be conducted. Potential examples of required pre-design information include additional soil sampling and analysis, identification of any structural limitations and utilities, results of a tree survey, property boundary and surface topographic survey, and an inventory/documentation of non-permanent features on each property (pools, sheds, fences, utilities, etc).

Sections 5.3 through 5.12 further discuss Alternatives 1 through 8, including the following distinguishing features of each alternative:

a. Soil arsenic concentration post-remediation goals.

b. Properties to be remediated, including the number of properties that would require soil remediation and/or institutional controls under each alternative. The CMS evaluated data for 229 properties within the CMS Study Areas.

c. Estimated volume of soil to be remediated under each alternative and summary of the basis for the estimate, with details provided in Appendix H. The estimated volumes of soil for each of the CMAs were determined using a consistent approach based on existing, available data. The actual design limits and volumes of soil expected to be remediated will be determined during the CMI phase, which will occur after selection of the final corrective measures by the Agencies.

d. Estimated lineal feet of Culvert 105 buried pipe to be replaced under each alternative and summary of the basis for the estimate, with details provided in Appendix H. Estimated Culvert 105 buried pipe to be replaced is based on available data for CMAs 2 through 7B, CMA 8 assumed that the entire buried portion will be removed. The actual portions of Culvert 105 buried pipe expected to be remediated will be determined during the CMI phase.

e. Estimated post-remediation soil arsenic concentrations for the purposes of comparison to CMA-specific post-remediation average arsenic concentration goals. To calculate the post-remediation soil arsenic concentration for each property the soil sample points identified for remediation were replaced with an estimated backfill arsenic concentration of 5 mg/kg to calculate the post-remediation average. The actual post-remediation average arsenic concentrations on each property will depend on actual backfill arsenic concentrations determined from sampling results that would be obtained during the CMI phase.

f. Long-term operations, maintenance, and monitoring (OM&M) activities.

g. Design and implementation activities.

h. Estimated costs for implementation of the CMAs, including capital costs (e.g., soil remediation, Culvert 105 buried pipe replacement), engineering/administrative costs (e.g., preparation of design plans, construction management, public communication activities), and OM&M costs (e.g., verify institutional controls, monitor and maintain the proposed CAMU).

i. Estimated time (number of construction seasons) for completing the remediation. The estimated construction duration is primarily based on the total number/types of properties to be remediated and the estimated amount of soil to be removed, as well as FMC's experience obtained during the 2003 and 2007 remediation on residential properties in Middleport. This experience was used in the CMS to estimate the amount of soil that may be removed during an assumed construction season (May to November). The estimated number of construction seasons presented in this CMS will be re-estimated during the CMI planning stage and may be more or less than the estimated duration presented herein. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule.

Tables 5-1a summarizes the results (e.g., number of properties to be remediated, estimated soil volumes and lineal feet of Culvert 105 buried pipe to be remediated, and number of properties requiring institutional controls) associated with implementation of the CMAs. Appendix H presents the results on a property-specific basis and describes the methods used to estimate the extent of remediation required under each CMA. Figure 5-1 depicts Alternative 1 (No Further Action). The properties identified for future remediation in Alternatives 2 through 8 are colored green on Figures 5-2 through 5-8, respectively.

5.3 Alternative 1

Alternative 1 or CMA 1 (No Further Action) involves no additional remedial actions beyond what has already been completed. As discussed in Section 3, FMC previously conducted remedial activities within the CMS Study Areas to address arsenic-containing soils. These remedial activities involved excavating approximately 80,000 cubic yards of soil from 36 properties within the CMS Study Areas, with average arsenic concentrations in excavated soil ranging from 50 to 201 mg/kg during the various remedial actions. The soil excavated from the remediated properties was replaced with clean fill/soil and the excavated soil was placed within the ESI Fill Area at the FMC Facility, per Agencies'-approved plans. Figure 5-1 depicts the No Further Action Alternative.

Subsequent to the 2007-2008 Early Action remedial activities, inspection, maintenance and monitoring activities were initiated at the Wooded Parcel and Margaret Droman Park and a deed restriction was implemented at the Wooded Parcel. Costs associated with continued implementation of these OM&M activities under this alternative would be low, and are presented in Table 5-4 and detailed in Appendix I.

5.4 Alternative 2

5.4.1 Alternative 2 Soil Arsenic Post-Remediation Goal

Alternative 2 provides for remediation of soils (excluding the Wooded Parcel) that contain arsenic at concentrations greater than 20 mg/kg. Under this alternative, any soil containing arsenic above 20 mg/kg (except for the properties noted below) would be targeted for remediation regardless of the average arsenic concentration in soil measured on the property (i.e., Alternative 2 requires that the arsenic post-remediation goal be met on a "point by point" basis). The Agencies have suggested that some limited flexibility in the application of the 20 mg/kg cleanup goal may be applied on a case-by-case basis during the CMI (subject to approval of the Agencies. However, for the purposes of the CMS only, this maximum goal was applied at all points under CMA 2.

The Agencies requested FMC to evaluate a soil arsenic cleanup number of 20 mg/kg on a point by point basis. The Agencies previously represented 20 mg/kg as generally being the upper limit of the local background soil arsenic concentration for residential properties. As stated in the Agencies' September 1, 2009 Responsiveness Summary on RFI Report Volumes I, II and IV, "[t]he arsenic concentration value of 20 parts per million (ppm) represents both the 95th percentile of the residential background arsenic data and the weighted 95th percentile of the entire background data set from all the Middleport property types." Tables 5-2 and 5-3 present the background soil arsenic data collected from Gasport in 2001-2003 and the Middleport soil arsenic background concentrations estimated using the Gasport data and Middleport property type/usage weighting factors. As shown in Table 5-3, the 95th percentile of the weighted data set were calculated to be 19 mg/kg (excluding potential outliers) and 22 mg/kg (including potential outliers) using property type/usage factors specified in the 2001 Gasport Work Plan.

5.4.2 Properties to be Remediated under Alternative 2

Implementation of Alternative 2 to attain 20 mg/kg arsenic in soil on a point by point basis would require remediation of 181 properties, including the non-ICM area of the Roy-Hart School property. These properties are colored green on Figure 5-2. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation.

Under Alternative 2, no further action would be required at the Wooded Parcel or at the 31 previously remediated properties (see Section 5.2). Institutional controls would be maintained for Wooded Parcel.

Under Alternative 2, a total of 11 properties would require implementation of institutional controls to address maintenance and/or disturbance of sections of Culvert 105 buried pipe that are not removed and replaced.

5.4.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 2 was estimated as described in Appendix H, based on the following criteria:

- Soil with arsenic concentrations greater than 20 mg/kg would be remediated.

- Any soils overlying samples greater than 20 mg/kg would be remediated.

- The area associated with a sample point to be remediated was estimated on a property-specific basis by extending the limits of remediation to the next adjacent (or closest) sample points on that property that met the post-remediation goal ("point-to-point"), or to the property line if no sample exists in that direction.

- The vertical extent of soil to be remediated was estimated as the deepest depth of the sample points identified to be remediated at each location. If the vertical extent could not be bounded by the available data at a particular location (i.e., the deepest sample was identified to be remediated), and deeper sample points were available at the next adjacent sample points, then it was assumed that the soil to be remediated extended to a depth dictated by the next adjacent sampling points.

- The extent of remediation along Culvert 105 associated with a transect sampling location identified for remediation was extended both upstream and downstream, to the next closest Culvert 105 sampling transect where the soil levels were below the post-remediation maximum concentration goal. The estimated extent along Culvert 105 was not extended into prior ICM areas or un-sampled properties/areas.

The estimated volume of soil to be remediated under Alternative 2 is approximately 228,000 cubic yards from an approximate total area of 127 acres, and approximately 1,325 lineal feet of buried pipe sections of Culvert 105 would be removed and replaced. Appendix H provides figures that depict the proposed horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be removed and replaced under Alternative 2.

5.4.4 Estimated Post-Remediation Arsenic Concentrations in Soils

As a result of implementing Alternative 2, the highest average post-remediation soil arsenic concentration at any of the 181 properties to be remediated would be 7 mg/kg (as estimated based on all existing soil data from each property to be remediated within the CMS Study Areas). Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 2 are provided in Appendix H.

On a community-wide basis, after implementation of Alternative 2 the average soil arsenic concentration in the CMS Study Areas would be approximately 7 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.4.5 Design and Implementation of Alternative 2

The CMI phase consists of the design and implementation of the selected CMA. During the remedial design, FMC representatives would visit the affected property owners to discuss the nature of the project and project schedule, to provide contact information and any information on the associated activities, and execute necessary access agreements.

As discussed in Section 5.2, pre-design activities would be necessary to support the preparation of remedial design documents. The remedial design drawings and plans would be submitted to the Agencies for review and approval.

Using the remedial design, FMC would secure a qualified contractor(s) to implement the remedial activities. Remedial construction start-up activities would begin after receipt of the Agencies approval of the remedial design documents. The construction start-up activities would include (but would not be limited to):

- Revision of the construction schedule
- Submittal of contract-required plans and information
- Mobilization of equipment, materials, and personnel necessary to complete the remediation at a specific number of properties based on the remediation schedule
- Identify and pre-qualify potential sources of imported backfill materials to verify that the materials meet chemical and geotechnical criteria to be specified in the remedial design
- Establish project field offices and equipment/material storage areas
- Locate and mark all underground and overhead utilities and other relevant site features scheduled to remain within or adjacent to the works areas
- Conduct a walk-through of each property to be remediated to inspect and document existing conditions
- Conduct a survey (using a New York State-licensed surveyor) to document pre-remediation elevations, establish survey control, and mark the remediation limits and property boundaries
- Construct a temporary staging area(s) for remediation wastes to facilitate off-Site disposal at a commercial landfill
- Upgrade or construct haul roads (as necessary) at the remedial work areas and in and around the CAMU, or to the temporary staging area(s) used for offsite disposal at a commercial landfill
- Install erosion and sedimentation controls

- Conduct baseline air monitoring
- Establish site security

Soil excavation would generally be conducted using conventional construction equipment, loaded into dump trucks, and transported to and placed in the CAMU or transported directly or indirectly (with use of a temporary staging area) by truck or rail to appropriate off-Site commercial landfills for disposal or beneficial reuse. Details for placement in the CAMU (e.g., consolidation, interim cover requirements, etc.) and for off-Site disposal (e.g., temporary staging methods, maintenance of staging areas, trucking routes, etc.) would be conducted in accordance with the Agencies approved plans. Characterization sampling of remediation wastes may be required to: 1) confirm that the wastes are non-hazardous and can be placed in the CAMU; 2) confirm compliance with the requirements of the receiving commercial landfill; or 3) determine whether offsite treatment may be needed.

Soil tilling/blending, if determined to be appropriate/feasible during the remedial design, would also be implemented using conventional equipment from the construction or agricultural industries (e.g., blending with a soil mixing head attached to an excavator or a roto-tiller combined with mechanical soil turnover). Throughout the remedial construction activities air monitoring would be conducted in accordance with a Community Air Monitoring Plan, and erosion and sedimentation control measures would be implemented and maintained, as necessary.

As part of the remedial design activities, opportunities to preserve trees will be identified in consultation with the property owner and a qualified local arborist relying on site-specific information. The property owner will have the final decision on whether their property will be remediated and on preservation of trees on their property. If tree preservation is not possible based on the vertical and horizontal extent of excavation required to meet the post-remediation soil concentrations goals, then the property owner will be informed of the issues related to leaving contaminant levels in soil above the soil cleanup goals.

In FMC's opinion, limited excavation (i.e., maximum depth of 6 inches) using either mechanical methods or pneumatic pressure would present the best opportunity to preserve selected trees, and the determination of whether a tree can or cannot be preserved would depend primarily on these four factors:

1. Would limited (or no) excavation be permissible and still allow attainment of the soil remediation goals?
2. The vertical and horizontal extent of soil removal required to achieve the soil remediation goals.
3. Property-specific factors (i.e., soil characteristics and owner input).
4. Tree-specific factors (i.e., tree species, age, health, stability, location, and condition).

CMA 2 is unique among the CMAs in that the extent of remediation is based strictly on a 20 mg/kg soil arsenic concentration goal applied on a point-by-point basis. There is no post-remediation average soil arsenic concentration goal (i.e., no averaging). Although the CMS determined extent of remediation for CMA 2 is based strictly on the 20 mg/kg soil arsenic concentration criterion within each given property, some limited flexibility in the application of this concentration may be employed on a case-by-case basis during the CMI with the approval of the Agencies. Therefore, where arsenic concentrations exceed 20 mg/kg within the protected root zone, there may be some opportunity to preserve the tree and the tree will not have to be removed to attain the post-remediation goal.

5.4.6 Cost and Timing of Alternative 2

The total estimated cost for implementation of Alternative 2 is approximately $58.0 million for the CAMU disposal option and approximately $68.7 million for the off-Site commercial landfill disposal option. The estimated costs for Alternative 2 are summarized in Table 5-4 and detailed in Appendix I. The estimated costs include the establishment of appropriate institutional controls (as described in Section 5.1) on the Wooded Parcel and properties with buried pipe sections of Culvert 105 that are not replaced.

For CMA 2, ten full construction seasons (typically a construction season is from May to November) are estimated to be required to complete the CMI field activities for either disposal option, assuming a considerable and manageable level of effort during each construction season. The estimated construction duration is primarily based on the number of properties to be remediated (181) and the estimated amount of soil to be removed (228,000 cubic yards), as well as FMC's experience obtained during the 2003 and 2007 remediation on residential properties in Middleport. The large number of residential properties (169) to be remediated under this alternative, the extent of remediation required on the large properties (e.g., non-ICM area of the Roy-Hart School), and the associated implementation considerations (e.g., working hour restrictions and labor intensive excavation in the vicinity of utilities or other relative site features scheduled to remain within or adjacent to the work areas) contributed significantly to the estimated construction duration. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule, and would consider (for example) sequencing the work from one complete residential block to another to minimize overall disruption to the community and potential safety concerns.

5.5 Alternative 3

5.5.1 Alternative 3 Soil Arsenic Post-Remediation Goals

Alternative 3 provides for attainment of post-remediation average and maximum soil arsenic concentrations on individual properties based on anticipated future property usages (as determined by FMC) depicted on Figure 3-3 (excluding the non-ICM area of the Roy-Hart School property and the Wooded Parcel). Both the post-remediation average and maximum concentrations would be required to be attained for both surface soils and for soils at all depths. Soil remediation of the non-ICM Areas of the Roy-Hart School property would not be performed under CMA 3. CMA 3 includes establishment of institutional controls on properties

that are not remediated to the residential soil arsenic cleanup goals. The institutional controls (legal mechanisms) would consist of further evaluation/action if the land use changes to residential on the following properties: a) the non-ICM area of the Roy-Hart School property and b) properties remediated to non-residential post-remediation soil arsenic goals. In addition, appropriate institutional controls (as described above) would be established on properties with buried pipe sections of Culvert 105 that are not removed and replaced.

Post-remediation soil arsenic concentrations for Alternative 3 are land-use specific and are as follows:

Land Use	CMA 3 Post-Remediation Soil Arsenic Cleanup Goals	
	Average	Maximum
Residential	20 mg/kg	40 mg/kg
Public/Institutional	30 mg/kg	60 mg/kg
Agricultural, Commercial	40 mg/kg	80 mg/kg
Industrial, Railroad, Utility	40 mg/kg	80 mg/kg

CMA 3 incorporates the local background concentration as a post–remediation average soil arsenic goal for residential properties. As stated in Section 5.4.1, the Agencies have represented 20 mg/kg as generally being the upper limit of the local background soil arsenic concentration for residential properties, and have also requested that FMC incorporate the local background concentration into one or more CMAs as an average soil arsenic remediation level with a maximum single point concentration.

CMA 3 also incorporates various soil arsenic remediation levels based on reasonably anticipated future land uses (as determined by FMC). For CMA 3, the maximum soil arsenic concentration for residential properties of 40 mg/kg was derived from the 95th percentile of the weighted background soil data set using revised Middleport property type/usage weighting factors. FMC revised the Middleport property type/usage weighting factors using information obtained from eight additional aerial photos that provided new information on historic land use in the Middleport study areas. As shown on Table 5-3, the 95th percentile of the weighted data set was calculated to be 39 mg/kg (excluding potential outliers) and 40 mg/kg (including potential outliers) using the revised property type/usage weighting factors and calculation methods specified in the 2001 Gasport Work Plan. Appendix 6b of RFI Report Volume I presents the new aerial photos and summarizes the calculation of the revised land use weighting factors. While in FMC's opinion based on consultation with its experts, these revisions to Middleport type/usage weighting factors used to derive these statistical values are considered to be appropriate, the Agencies do not accept and have not approved these revisions, and consider the originally calculated values presented in the 2003 Gasport Background Study Report as the appropriate values.

For agricultural, commercial, industrial, railroad and utility land usages, CMA 3 utilizes a post-remediation average soil arsenic concentration of 40 mg/kg derived from the 95th percentile of the weighted data set calculated using FMC's revised property type/usage weighting factors and calculation methods specified in

the 2001 Gasport Work Plan. The maximum soil arsenic concentration of 80 mg/kg utilized for CMA 3 was derived from the 98th percentile of weighted background soil data set using revised Middleport property type/usage weighting factors proposed by FMC.

For public/institutional land usages, CMA 3 utilizes a post-remediation soil arsenic concentration of 30 mg/kg (average) and 60 mg/kg (maximum) which are intermediate between the values used for residential (20 mg/kg on average, 40 mg/kg as a maximum) and agricultural/commercial/industrial/railroad/utility land uses (40 mg/kg on average, 80 mg/kg as a maximum).

5.5.2 Properties to be Remediated under Alternative 3

Implementation of Alternative 3 to attain the post-remediation soil arsenic concentrations identified in Section 5.5.1 (above) would require remediation of 152 properties. These properties are colored green on Figure 5-3. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation. The 152 properties consist of the following land usages: 145 residential and 7 non-residential (2 institutional, 1 commercial, 1 industrial, 1 utility, and 2 agricultural).

Under Alternative 3, no further action would be required for the Wooded Parcel and the 31 previously remediated properties (see Section 5.2). Institutional controls would be maintained for the Wooded Parcel. Institutional controls would also be implemented on a total of 12 non-residential properties, including the non-ICM area of the Roy-Hart School property. If the property use changes in the future to residential for any of these properties remediated to non-residential post-remediation soil arsenic goals, then further evaluation and, if necessary, remediation would be performed. Under this Alternative, a total of 13 properties would require implementation of institutional controls for maintenance and/or disturbance of sections of Culvert 105 buried pipe that are not removed and replaced.

5.5.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 3 was estimated as described in Appendix H, based on the following guidelines:

- Soil with arsenic concentrations greater than the land-use specific maximum concentration would be remediated.

- Any soils overlying samples greater than the land-use specific maximum concentration would be remediated.

- Additional soil and associated soil sample data were identified for remediation and replacement with backfill, as necessary, to achieve land-use based average concentrations on each property. The soil sample points identified for remediation were replaced with an estimated backfill arsenic concentration of 5 mg/kg for calculation of post-remediation average (both surface soil and all soil at any depth) for the

purposes of comparison to Alternative 3 post-remediation soil arsenic goals. The actual post-remediation average arsenic concentrations on each property will depend on actual backfill arsenic concentrations determined from sampling results. In deciding which additional soil sample point to remediate to achieve the property average concentration, preference was given to the highest concentrations that were either at the ground surface or that were adjacent to another sample point identified for remediation. If two such sample points exhibited similar concentrations, then preference was given to ease of remediation (e.g., access to the street).

- The area associated with a sample point to be remediated was estimated on a property-specific basis by extending the limits of remediation to the next adjacent (or closest) sample points on that property that met the post-remediation goal ("point-to-point"), or to the property line if no sample exists in that direction.

- The vertical extent of soil to be remediated was estimated as the deepest depth of the sample points identified to be remediated at each location. If the vertical extent could not be bounded by the available data at a particular location (i.e., the deepest sample was identified to be remediated), and deeper sample points were available at the next adjacent sample points, then it was assumed that the soil to be remediated extended to a depth dictated by the next adjacent sampling points.

- The extent of remediation along Culvert 105 associated with a transect sampling location identified for remediation was extended both upstream and downstream, to the next closest Culvert 105 sampling transect where the soil levels were below the post-remediation maximum concentration goal. The estimated extent along Culvert 105 was not extended into prior ICM area or un-sampled properties/areas.

The estimated volume of soil which would be remediated under Alternative 3 is approximately 69,000 cubic yards from an approximate total area of 50 acres, and approximately 1,185 lineal feet of buried sections of Culvert 105 would be removed and replaced. Appendix H provides figures that depict the proposed horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be removed and replaced under Alternative 3.

5.5.4 Estimated Post-Remediation Arsenic Concentrations in Soils

For Alternative 3, the post-remediation arsenic concentrations at any property within the CMS Study Areas would be at or lower than the specified Alternative 3 soil arsenic remediation goals. After removal of the soil identified for remediation under Alternative 3, the average soil arsenic concentration (all depths) on the 152 properties identified for remediation is estimated to be 16 mg/kg. The post-remediation average soil arsenic concentrations (all depths) are 15 mg/kg, 21 mg/kg, 26 mg/kg, and 13 mg/kg for residential, public/institutional, agricultural/commercial, and industrial/railroad/utility properties, respectively, after implementation of CMA 3. Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 3 are provided in Appendix H.

On a community-wide basis, after implementation of Alternative 3 the average soil arsenic concentration in the CMS Study Areas would be 14 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.5.5 Design and Implementation of Alternative 3

Implementation of Alternative 3 includes the same general steps described in Section 5.4.5 for Alternative 2.

The use of average post-remediation soil arsenic goals under CMA 3 provides a better opportunity for tree preservation than the limited flexibility that may be employed on a case-by-case basis when the extent of remediation is based strictly on a maximum post-remediation goal (CMA 2). For example, on a residential property for CMA 3, soil within the protected root zone of a tree with arsenic concentrations at 40 mg/kg or less could be left undisturbed if the property average post-remediation soil arsenic concentration is 20 mg/kg or less. In this case, the average post-remediation soil arsenic concentration of 20 mg/kg could be achieved through remediation of soil outside of the protected root zone of the tree. On properties where the owner wants to preserve a tree or trees, consideration would be given during the CMI phase to remediation of soil associated with sample locations outside of the designated trees to achieve the average soil arsenic concentration.

5.5.6 Cost and Timing of Alternative 3

The total estimated cost for implementation of Alternative 3 is approximately $23.6 million for the CAMU disposal option and approximately $27.4 million for the offsite commercial landfill disposal option (Table 5-4). The estimated costs for Alternative 2 are summarized in Table 5-4 and detailed in Appendix I.

For CMA 3, five full construction seasons (typically a construction season is from May to November) are estimated to be required to complete the CMI field activities for either disposal option, assuming a considerable and manageable level of effort during each construction season. The estimated construction duration is primarily based on the number of properties to be remediated (152) and the estimated amount of soil to be removed (69,000 cubic yards), as well as FMC's experience obtained during the 2003 and 2007 remediation on residential properties in Middleport. The large number of residential properties (145) to be remediated under this alternative and the associated implementation considerations (e.g., working hour restrictions and labor intensive excavation in the vicinity of utilities or other relative site features scheduled to remain within or adjacent to the work areas) contributed significantly to the estimated construction duration. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule, and would consider (for example) sequencing the work from one complete residential block to another to minimize overall disruption to the community and potential safety concerns.

5.6 Alternative 4

5.6.1 Alternative 4 Soil Arsenic Post-Remediation Goals

Similar to Alternative 3, Alternative 4 provides for attainment of a post-remediation average soil arsenic concentration on individual properties with a specified maximum concentration. However, the post-remediation concentrations for Alternative 4 do not vary with land use. Alternative 4 would remediate properties to attain a post-remediation average concentration of 30 mg/kg on each property with a maximum concentration of 60 mg/kg, excluding the non-ICM area of the Roy-Hart School Property where no further action would be implemented.

See Section 5.5.1 for an explanation of the basis for the post-remediation average and maximum soil arsenic concentrations.

5.6.2 Properties to be Remediated under Alternative 4

Implementation of Alternative 4 to attain the post-remediation soil arsenic goals would require remediation of 86 properties. These properties are colored green on Figure 5-4. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation.

Under Alternative 4, no further action would be required for the non-ICM area of the Roy-Hart School property, the Wooded Parcel, and the 31 previously remediated properties (see Section 5.2). Institutional controls would be maintained for the Wooded Parcel. Under this Alternative, a total of 14 properties would require implementation of institutional controls for maintenance and/or disturbance of sections of Culvert 105 buried pipe that are not removed and replaced.

5.6.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 4 was estimated as described in Appendix H, based on the same guidelines presented in Section 5.5.3 for Alternative 3 except for the differences in the post-remediation goals.

The estimated volume of soil which would be remediated under Alternative 4 is approximately 38,000 cubic yards from an approximate total area of 26 acres, and approximately 900 lineal feet of buried sections of Culvert 105 would be removed and replaced. Appendix H provides figures that depict the proposed horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be removed and replaced under Alternative 4.

5.6.4 Estimated Post-Remediation Arsenic Concentrations in Soils

For Alternative 4, the post-remediation arsenic concentrations at any remediated property within the CMS Study Areas would be at or lower than the specified Alternative 4 soil arsenic remediation goals. After removal of the soil identified for remediation under Alternative 4, the average soil arsenic concentration (all depths) on the 86 properties identified for remediation is estimated to be 21 mg/kg. The post-remediation average soil arsenic concentrations (all depths) are 21 mg/kg, 21 mg/kg, 24 mg/kg, and 16 mg/kg for residential, public/institutional, agricultural/commercial, and industrial/railroad/utility properties, respectively, after implementation of CMA 4. Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 4 are provided in Appendix H.

On a community-wide basis, after implementation of Alternative 4 the average soil arsenic concentration in the CMS Study Areas would be 17 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.6.5 Design and Implementation of Alternative 4

Implementation of Alternative 4 includes the same general steps described in Section 5.4.5 for Alternative 2.

The use of average concentrations for post-remediation concentrations provides opportunity for tree preservation. Soil containing 60 mg/kg or less arsenic could be left undisturbed in the protected root zone of a tree if the property-wide post-remediation average soil arsenic concentration of 30 mg/kg or less could be achieved through remediation of soil outside the protected root zone of the tree. On properties where the owner wants to preserve a tree or trees, consideration would be given during the CMI phase to remediation of soil associated with sample locations outside of the designated trees to achieve the average soil arsenic concentration.

5.6.6 Cost and Timing of Alternative 4

The total estimated cost for implementation of Alternative 4 is approximately $13.3 million for the CAMU disposal option and approximately $15.3 million for the offsite commercial landfill disposal option (Table 5-4). The estimated costs for Alternative 2 are summarized in Table 5-4 and detailed in Appendix I.

For CMA 4, three full construction seasons (typically a construction season is from May to November) are estimated to be required to complete the CMI field activities for either disposal option, assuming a considerable and manageable level of effort during each construction season. The estimated construction duration is primarily based on the number of properties to be remediated (86) and the estimated amount of soil to be removed (38,000 cubic yards), as well as FMC's experience obtained during the 2003 and 2007 remediation on residential properties in Middleport. The large number of residential properties (78) to be remediated under this alternative and the associated implementation considerations (e.g., working hour

restrictions and labor intensive excavation in the vicinity of utilities or other relative site features scheduled to remain within or adjacent to the work areas) contributed significantly to the estimated construction duration. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule, and would consider (for example) sequencing the work from one complete residential block to another to minimize overall disruption to the community and potential safety concerns.

5.7 Alternative 5

5.7.1 Alternative 5 Soil Arsenic Post-Remediation Goals

Similar to Alternative 4, Alternative 5 provides for attainment of a post-remediation average soil arsenic concentration on individual properties with a specified maximum concentration that does not vary with land use. Alternative 5 would remediate properties to attain a post-remediation average concentration of 40 mg/kg on each property with a maximum concentration of 80 mg/kg, excluding the non-ICM area of the Roy-Hart School Property where no further action would be implemented.

See Section 5.5.1 for an explanation of the basis for the post-remediation average and maximum soil arsenic concentrations.

5.7.2 Properties to be Remediated under Alternative 5

Implementation of Alternative 5 to attain the post-remediation soil arsenic goals identified would require remediation of 48 properties. These properties are colored green on Figure 5-5. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation.

Under Alternative 5, no further action would be required for the non-ICM area of the Roy-Hart School property, the Wooded Parcel, and the 31 previously remediated properties (see Section 5.2). Institutional controls would be maintained for the Wooded Parcel. Under this Alternative, a total of 14 properties would require implementation of institutional controls for maintenance and/or disturbance of buried sections of Culvert 105 buried pipe that are not removed and replaced.

5.7.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 4 was estimated as described in Appendix H, based on the same guidelines presented in Section 5.5.3 for Alternative 3 except for the differences in the post-remediation goals.

The estimated volume of soil which would be remediated under Alternative 5 is approximately 28,000 cubic yards from an approximate total area of 18 acres, and approximately 900 lineal feet of buried sections of Culvert 105 would be removed and replaced. Appendix H provides figures that depict the proposed

horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be removed and replaced under Alternative 5.

5.7.4 Estimated Post-Remediation Arsenic Concentrations in Soils

For Alternative 5, the post-remediation arsenic concentrations at any remediated property within the CMS Study Areas would be at or lower than the specified Alternative 5 soil arsenic remediation goals. After removal of the soil identified for remediation under Alternative 5, the average soil arsenic concentration (all depths) on the 48 properties identified for remediation is estimated to be 22 mg/kg. The post-remediation average soil arsenic concentrations (all depths) are 22 mg/kg, 21 mg/kg, 27 mg/kg, and 15 mg/kg for residential, public/institutional, agricultural/commercial, and industrial/railroad/utility properties, respectively, after implementation of CMA 5. Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 5 are provided in Appendix H.

On a community-wide basis, after implementation of Alternative 5 the average soil arsenic concentration in the CMS Study Areas would be 18 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.7.5 Design and Implementation of Alternative 5

Implementation of Alternative 5 includes the same general steps described in Section 5.4.5 for Alternative 2.

The use of average concentrations for post-remediation concentrations provides opportunity for tree preservation. Soil containing 80 mg/kg or less arsenic could be left undisturbed in the protected root zone of a tree if the property-wide post-remediation average soil arsenic level of 40 mg/kg or less could be achieved through remediation of soil outside the protected root zone of the tree.

5.7.6 Cost and Timing of Alternative 5

The total estimated cost for implementation of Alternative 5 is approximately $9.8 million for the CAMU disposal option and approximately $11.3 million for the offsite commercial landfill disposal option (Table 5-4). The estimated costs for Alternative 5 are summarized in Table 5-4 and detailed in Appendix I.

The estimated construction duration is 2 full construction seasons based on the number of properties to be remediated (48 total, of which 42 are residential) and the estimated amount of soil to be removed (28,000 cubic yards), as well as FMC's experience obtained during previous remedial activities. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule.

5.8 Alternative 6A

5.8.1 Alternative 6A Soil Arsenic Post-Remediation Goals

Similar to Alternative 3, Alternative 6A provides for attainment of post-remediation average and maximum soil arsenic concentrations on individual properties based on anticipated future property usages (as determined by FMC) depicted on Figure 3-3 (excluding the non-ICM area of the Roy-Hart School property and the Wooded Parcel). Both the post-remediation average and maximum concentrations would be required to be attained for both surface soils and soils at all depths. Remediation of soil properties based on land use to the following post-remediation averages and maximum soil arsenic concentrations:

Land Use	CMA 6A Post-Remediation Soil Arsenic Cleanup Goals	
	Average	Maximum
Residential	20 mg/kg	35 mg/kg
Public/Institutional	20 mg/kg	35 mg/kg
Agricultural, Commercial	30 mg/kg	50 mg/kg
Industrial, Railroad, Utility	40 mg/kg	80 mg/kg

Soil remediation of the non-ICM portion of the Roy-Hart School property would not be performed under CMA 6A.

CMA 6A includes establishment of institutional controls on properties that are not remediated to the residential and public/institutional soil arsenic cleanup goals. It should be noted that CMA 6A cleanup goals for public/institutional land uses are the same as those for residential properties. Therefore, institutional controls would not be required for properties remediated to post-remediation soil arsenic goals for public/institutional land usages. The institutional controls would consist of further evaluation/action if the land use changes to residential on the following properties: a) the non-ICM area of the Roy-Hart School property and b) properties remediated to post-remediation soil arsenic goals for agricultural, commercial, industrial, railroad and utility land usages. Appropriate institutional controls (as described above) would be established on properties with buried pipe sections of Culvert 105 that are not replaced.

Alternative 6A incorporates the local background concentration as a post-remediation average soil arsenic goal for residential, public, and institutional properties. As stated in Section 5.4.1, the Agencies have represented 20 mg/kg as generally being the upper limit of the local background soil arsenic concentration for residential properties, and have also requested that FMC incorporate the local background concentration into one or more CMAs as an average soil arsenic remediation level with a maximum single point concentration. The Alternative 6A maximum soil arsenic concentration for residential, public, and institutional properties (35 mg/kg) is between the maximum concentrations for residential properties in Alternative 2 (20 mg/kg) and Alternative 3 (40 mg/kg).

For industrial, railroad and utility land usages, CMA 6A utilizes a post-remediation average soil arsenic concentration of 40 mg/kg derived from the 95th percentile of the weighted data set calculated using FMC's revised property type/usage weighting factors and calculation methods specified in the 2001 Gasport Work Plan. The maximum soil arsenic concentration of 80 mg/kg utilized for CMA 6A was derived from the 98th percentile of weighted background soil data set using revised Middleport property type/usage weighting factors proposed by FMC.

CMA 6A utilizes a post-remediation soil arsenic concentration of 30 mg/kg (average) and 50 mg/kg (maximum) for agricultural and commercial which are intermediate between the values used for residential (20 mg/kg on average, 35 mg/kg as a maximum) and industrial/railroad/utility land uses (40 mg/kg on average, 80 mg/kg as a maximum). It should also be noted that CMA 6A post-remediation soil arsenic average of 30 mg/kg is less that the maximum background soil arsenic concentration (32.8 mg/kg) detected on commercial and industrial properties.

5.8.2 Properties to be Remediated under Alternative 6A

Implementation of Alternative 6A to attain the post-remediation soil arsenic concentrations identified in Section 5.8.1 (above) would require remediation of 157 properties. These properties are colored green on Figure 5-6a. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation. The 157 properties consist of the following land usages: 149 residential and 8 non-residential (3 institutional, 1 commercial, 1 industrial, 1 utility, and 2 agricultural). Soil remediation of the non-ICM Areas of the Roy-Hart School property would not be performed under CMA 6A

Under this Alternative, institutional controls would be implemented on a total of nine non-residential properties that are remediated to the soil arsenic cleanup goals for agricultural, commercial, industrial, railroad and utility properties, and the non-ICM area of the Roy-Hart School property. If the property use changes in the future to residential for any of these nine properties, then further evaluation and if necessary remediation would be performed.

Under this Alternative, a total of 13 properties would require implementation of institutional controls for maintenance and/or disturbance of buried sections of Culvert 105 buried pipe that is not replaced.

Under Alternative 6A, no further action would be required for the Wooded Parcel and the 31 previously remediated properties (see Section 5.2). Institutional controls would be maintained for the Wooded Parcel.

5.8.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 6A was estimated as described in Appendix H, based on the same guidelines presented in Section 5.5.3 for CMA 3.

The estimated volume of soil which would be remediated under Alternative 6A is approximately 85,000 cubic yards from an approximate total area of 62 acres, and approximately 1,185 lineal feet of buried sections of Culvert 105 would be removed and replaced. Appendix H provides figures that depict the proposed horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be removed and replaced under Alternative 6A.

5.8.4 Estimated Post-Remediation Arsenic Concentrations in Soils

For Alternative 6A, the post-remediation arsenic concentrations at any remediated property within the CMS Study Areas would be at or lower than the specified Alternative 6A soil arsenic remediation goals. After removal of the soil identified for remediation under Alternative 6A, the average soil arsenic concentration (all depths) on the 157 properties identified for remediation is estimated to be 14 mg/kg. The post-remediation average soil arsenic concentrations (all depths) are 14 mg/kg, 11 mg/kg, 23 mg/kg, and 13 mg/kg for residential, public/institutional, agricultural/commercial, and industrial/railroad/utility properties, respectively, after implementation of CMA 6A. Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 6A are provided in Appendix H

On a community-wide basis, after implementation of Alternative 6A the average soil arsenic concentration in the CMS Study Areas would be 13 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.8.5 Design and Implementation of Alternative 6A

Implementation of Alternative 6A includes the same general steps described in Section 5.4.5 for Alternative 2.

As with the other CMAs which incorporate average post-remediation soil arsenic goals, Alternative 6A provides a better opportunity for tree preservation than the limited flexibility that may be employed on a case-by-case basis when the extent of remediation is based strictly on a maximum post-remediation goal (CMA 2).

5.8.6 Cost and Timing of Alternative 6A

The total estimated cost for implementation of Alternative 6A is approximately $26.7 million for the CAMU disposal option and approximately $31.3 million for the offsite commercial landfill disposal option (Table 5-4). The estimated costs for Alternative 6A are summarized in Table 5-4 and detailed in Appendix I.

For Alternative 6A, six full construction seasons (typically a construction season is from May to November) are estimated to be required to complete the CMI field activities for either disposal option, assuming a considerable and manageable level of effort during each construction season. The estimated construction

duration is primarily based on the number of properties to be remediated (157) and the estimated amount of soil to be removed (85,000 cubic yards), as well as FMC's experience obtained during the 2003 and 2007 remediation on residential properties in Middleport. The large number of residential properties (149) to be remediated under this alternative and the associated implementation considerations (e.g., working hour restrictions and labor intensive excavation in the vicinity of utilities or other relative site features scheduled to remain within or adjacent to the work areas) contributed significantly to the estimated construction duration. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule, and would consider (for example) sequencing the work from one complete residential block to another to minimize overall disruption to the community and potential safety concerns.

5.9 Alternative 6B

5.9.1 Alternative 6B Soil Arsenic Post-Remediation Goals

Alternative 6B is the same as Alternative 6A, except that CMA 6B includes remediation of the non-ICM portion of the Roy-Hart School property to the post remediation soil arsenic cleanup goals for public/institutional properties (20 mg/kg average and a maximum of 35 mg/kg). It should be noted that CMAs 6A and 6B cleanup goals for public/institutional land uses are the same as those for residential properties. Therefore, institutional controls will not be required for the non-ICM portion of the Roy-Hart School property remediated under CMA 6B.

5.9.2 Properties to be Remediated under Alternative 6B

The same 157 properties identified for Alternative 6A, plus the non-ICM area of the Roy-Hart School Property, for a total of 158 properties that would be remediated under Alternative 6B. These properties are colored green on Figure 5-6b. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation. The 158 properties consist of the following land usages: 149 residential and 9 non-residential (4 institutional, 1 commercial, 1 industrial, 1 utility, and 2 agricultural).

Under Alternative 6B, institutional controls would be implemented on a total of eight non-residential properties that are remediated to the soil arsenic cleanup goals for agricultural, commercial, industrial, railroad and utility properties. If the property use changes in the future to residential for any of these eight properties, then further evaluation and if necessary remediation would be performed.

A total of 13 properties would require implementation of institutional controls under Alternative 6B (same as Alternative 6A) for maintenance and/or disturbance of buried sections of Culvert 105 buried pipe that are not removed and replaced.

5.9.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 6A was estimated as described in Appendix H, based on the same guidelines presented in Section 5.5.3 for CMA 3.

The estimated volume of soil which would be remediated under Alternative 6B is approximately 98,000 cubic yards from an approximate total area of 73 acres, and approximately 1,185 lineal feet of buried sections of Culvert 105 would be removed and replaced. Appendix H provides figures that depict the proposed horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be replaced under Alternative 6B.

5.9.4 Estimated Post-Remediation Arsenic Concentrations in Soils

For Alternative 6B, the post-remediation arsenic concentrations at any remediated property within the CMS Study Areas would be at or lower than the specified Alternative 6B soil arsenic remediation goals. After removal of the soil identified for remediation under Alternative 6B, the average soil arsenic concentration (all depths) on the 158 properties identified for remediation is estimated to be 14 mg/kg. The post-remediation average soil arsenic concentrations (all depths) are 14 mg/kg, 11 mg/kg, 23 mg/kg, 13 mg/kg, and 9 mg/kg for residential properties, public/institutional properties, agricultural/commercial properties, industrial/railroad/utility properties, and the non-ICM area of the Roy-Hart School property, respectively, after implementation of CMA 6B. Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 6B are provided in Appendix H.

On a community-wide basis, after implementation of Alternative 6B the average soil arsenic concentration in the CMS Study Areas would be 12.7 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.9.5 Design and Implementation of Alternative 6B

Implementation of Alternative 6B includes the same general steps described in Section 5.4.5 for Alternative 2. The opportunities for tree preservation under Alternative 6B are the same as those for Alternative 6A.

5.9.6 Cost and Timing of Alternative 6B

The total estimated cost for implementation of Alternative 6B is approximately $29.9 million for the CAMU disposal option and approximately $35.2 million for the offsite commercial landfill disposal option (Table 5-4). The estimated costs for Alternative 6B are summarized in Table 5-4 and detailed in Appendix I.

The estimated timing for Alternative 6B is the same as Alternative 6A - six full construction seasons for either disposal option. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule.

5.10 Alternative 7A

5.10.1 Alternative 7A Soil Arsenic Post-Remediation Goals

Alternative 7A provides for attainment of post-remediation average and maximum soil arsenic concentrations on individual properties based on future anticipated property usages (as determined by FMC) depicted on Figure 3-3 (excluding the non-ICM area of the Roy-Hart School property and the Wooded Parcel). Both the post-remediation average and maximum concentrations would be required to be attained for both surface soils and for soils at all depths.

Remediation of soil properties based on land use to the following post-remediation averages and maximum soil arsenic concentrations:

Land Use	CMA 7A Post-Remediation Soil Arsenic Cleanup Goals	
	Average	Maximum
Residential	20 mg/kg	30 mg/kg
Public/Institutional	20 mg/kg	30 mg/kg
Agricultural, Commercial	30 mg/kg	50 mg/kg
Industrial, Railroad, Utility	40 mg/kg	80 mg/kg

Soil remediation of the non-ICM Areas of the Roy-Hart School property would not be performed under CMA 7A.

CMA 7A includes establishment of institutional controls on properties that are not remediated to the residential and public/institutional soil arsenic cleanup goals. It should be noted that CMA 7A cleanup goals for public/institutional land uses are the same as those for residential properties. Therefore, institutional controls would not be required for properties remediated to post-remediation soil arsenic goals for public/institutional land usages. The institutional controls would consist of further evaluation/action if the land use changes to residential on the following properties: a) the non-ICM area of the Roy-Hart School property and b) properties remediated to post-remediation soil arsenic goals for agricultural, commercial, industrial, railroad and utility land usages. Appropriate institutional controls (as described above) would be established on properties with buried pipe sections of Culvert 105 that are not removed and replaced.

Alternative 7A incorporates the local background concentration as a post-remediation average soil arsenic goal for residential, public, and institutional properties (see Section 5.8.1). The Alternative 7A maximum soil arsenic concentration for residential, public, and institutional properties (30 mg/kg) is intermediate between the concentrations used for residential properties in Alternative 2 (20 mg/kg) and Alternative 3 (40 mg/kg). It

should also be noted that CMA 7A post-remediation soil arsenic maximum of 30 mg/kg is less that the maximum background soil arsenic concentration (32.8 mg/kg) detected on commercial and industrial properties. See Section 5.8.1 for an explanation of the basis for the other post-remediation average and maximum soil arsenic concentrations.

5.10.2 Properties to be Remediated under Alternative 7A

Implementation of Alternative 7A to attain the post-remediation soil arsenic concentrations identified in Section 5.10.1 (above) would require remediation of 164 properties. These properties are colored green on Figure 5-7a. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation. The 164 properties consist of the following land usages: 156 residential and 8 non-residential (3 institutional, 1 commercial, 1 industrial, 1 utility, and 2 agricultural). Soil remediation of the non-ICM portion of the Roy-Hart School property would not be performed under CMA 7A

Under this Alternative, institutional controls would be implemented on a total of nine agricultural, commercial, industrial, railroad and utility properties, and the non-ICM area of the Roy-Hart School property. If the property use changes in the future to residential for any of these nine properties, then further evaluation and if necessary remediation would be performed.

Under this Alternative, a total of 13 properties would require implementation of institutional controls for maintenance and/or disturbance of buried sections of Culvert 105 buried pipe that is not replaced.

Under Alternative 7A, no further action would be required for the Wooded Parcel and the 31 previously remediated properties (see Section 5.2). Institutional controls would be maintained for the Wooded Parcel.

5.10.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 7A was estimated as described in Appendix H, based on the same guidelines presented in Section 5.5.3 for Alternative 3.

The estimated volume of soil which would be remediated under Alternative 7A is approximately 101,000 cubic yards from an approximate total area of 71 acres, and approximately 1,185 lineal feet of buried sections of Culvert 105 would be removed and replaced. Appendix H provides figures that depict the proposed horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be removed and replaced under Alternative 7A.

5.10.4 Estimated Post-Remediation Arsenic Concentrations in Soils

For Alternative 7A, the post-remediation arsenic concentrations at any remediated property within the CMS Study Areas would be at or lower than the specified Alternative 7A soil arsenic remediation goals. After removal of the soil identified for remediation under Alternative 7A, the average soil arsenic concentration (all

depths) on the 164 properties identified for remediation is estimated to be 12 mg/kg. The post-remediation average soil arsenic concentrations (all depths) are 12 mg/kg, 10 mg/kg, 22 mg/kg, and 13 mg/kg for residential, public/institutional, agricultural/commercial, and industrial/railroad/utility properties, respectively, after implementation of CMA 7A. Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 7A are provided in Appendix H

On a community-wide basis, after implementation of Alternative 7A the average soil arsenic concentration in the CMS Study Areas would be 12 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.10.5 Design and Implementation of Alternative 7A

Implementation of Alternative 7A includes the same general steps described in Section 5.4.5 for Alternative 2.

As with the other CMAs which incorporate average post-remediation soil arsenic goals, CMA 7A provides a better opportunity for tree preservation than the limited flexibility that may be employed on a case-by-case basis when the extent of remediation is based strictly on a maximum post-remediation goal (CMA 2).

5.10.6 Cost and Timing of Alternative 7A

The total estimated cost for implementation of Alternative 7A is approximately $30.2 million for the CAMU disposal option and approximately $35.7 million for the offsite commercial landfill disposal option (Table 5-4). The estimated costs for Alternative 7A are summarized in Table 5-4 and detailed in Appendix I.

For Alternative 7A, seven full construction seasons (typically a construction season is from May to November) are estimated to be required to complete the CMI field activities for either disposal option, assuming a considerable and manageable level of effort during each construction season. The estimated construction duration is primarily based on the number of properties to be remediated (164) and the estimated amount of soil to be removed (101,000 cubic yards), as well as FMC's experience obtained during the 2003 and 2007 remediation on residential properties in Middleport. The large number of residential properties (156) to be remediated under this alternative and the associated implementation considerations (e.g., working hour restrictions and labor intensive excavation in the vicinity of utilities or other relative site features scheduled to remain within or adjacent to the work areas) contributed significantly to the estimated construction duration. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule, and would consider (for example) sequencing the work from one complete residential block to another to minimize overall disruption to the community and potential safety concerns.

5.11 Alternative 7B

5.11.1 Alternative 7B Soil Arsenic Post-Remediation Goals

Alternative 7B is the same as Alternative 7A, except that CMA 7B includes remediation of the non-ICM portion of the Roy-Hart School property to the post remediation soil arsenic cleanup goals for public/institutional properties (20 mg/kg average and a maximum of 30 mg/kg). It should be noted that CMAs 7A and 7B cleanup goals for public/institutional land uses are the same as those for residential properties. Therefore, institutional controls will not be required for the non-ICM portion of the Roy-Hart School property remediated under CMA 7B.

5.11.2 Properties to be Remediated under Alternative 7B

The same 164 properties identified for Alternative 7A, plus the non-ICM area of the Roy-Hart School Property, for a total of 165 properties to be remediated under Alternative 7B. These properties are colored green on Figure 5-7b. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation. The 165 properties consist of the following land usages: 156 residential and 9 non-residential (4 institutional, 1 commercial, 1 industrial, 1 utility, and 2 agricultural).

Under Alternative 7B, institutional controls would be implemented on a total of eight non-residential properties that are remediated to the soil arsenic cleanup goals for agricultural, commercial, industrial, railroad and utility properties. If the property use changes in the future to residential for any of these eight properties, then further evaluation and if necessary remediation would be performed.

A total of 13 properties would require implementation of institutional controls under Alternative 7B (same as Alternative 7B) for maintenance and/or disturbance of buried sections of Culvert 105 buried pipe that is not replaced.

5.11.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 7B was estimated based on the guidelines presented in Section 5.5.3 for Alternative 3.

The estimated volume of soil which would be remediated under Alternative 7B is approximately 119,000 cubic yards from an approximate total area of 85 acres, and approximately 1,185 lineal feet of buried sections of Culvert 105 would be removed and replaced. Appendix H provides figures that depict the proposed horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be removed and replaced under Alternative 7B.

5.11.4 Estimated Post-Remediation Arsenic Concentrations in Soils

For Alternative 7B, the post-remediation arsenic concentrations at any remediated property within the CMS Study Areas would be at or lower than the specified Alternative 7B soil arsenic remediation goals. After removal of the soil identified for remediation under Alternative 7B, the average soil arsenic concentration (all depths) on the 165 properties identified for remediation is estimated to be 12 mg/kg. The post-remediation average soil arsenic concentrations (all depths) are 12 mg/kg, 10 mg/kg, 22 mg/kg, 13 mg/kg, and 7 mg/kg for residential properties, public/institutional properties, agricultural/commercial properties, industrial/railroad/utility properties, and the non-ICM area of the Roy-Hart School property, respectively, after implementation of CMA 7B. Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 7B are provided in Appendix H.

On a community-wide basis, after implementation of Alternative 7B the average soil arsenic concentration in the CMS Study Areas would be 11 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.11.5 Design and Implementation of Alternative 7B

Implementation of Alternative 7B includes the same general steps described in Section 5.4.5 for Alternative 2. The opportunities for tree preservation under Alternative 7B are the same as those for Alternative 7A.

5.11.6 Cost and Timing of Alternative 7B

The total estimated cost for implementation of Alternative 7B is approximately $34.5 million for the CAMU disposal option and approximately $40.9 million for the offsite commercial landfill disposal option (Table 5-4). The estimated costs for Alternative 7B are summarized in Table 5-4 and detailed in Appendix I.

The estimated timing for Alternative 7B is the same as Alternative 7A - seven full construction seasons for either disposal option. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule, and would consider (for example) sequencing the work from one complete residential block to another to minimize overall disruption to the community and potential safety concerns.

5.12 Alternative 8

5.12.1 Alternative 8 Soil Arsenic Post-Remediation Goal

Similar to Alternatives 2, 4, and 5, the post-remediation concentrations for Alternative 8 do not vary with land use. Alternative 8 would remediate properties, including the non-ICM area of the Roy-Hart School property, to attain a post-remediation average concentration of 20 mg/kg on each property (and in a different manner

for large properties as detailed below and in Appendix H) with a maximum concentration of 30 mg/kg. See Section 5.10.1 for an explanation of the basis for the post-remediation average and maximum soil arsenic concentrations.

Alternative 8 is unique among the other alternatives relative to remediation of the buried pipe sections of Culvert 105. For Alternative 8, it was assumed that soil remediation would be required along the entire length of Culvert 105 buried pipe (including three unsampled properties and seven public streets crossed by the culvert, not including areas previously remediated under ICMs and the section of the pipe that passes beneath the Erie Canal), regardless of the absence of subsurface data or if existing sampling data met the post-remediation soil arsenic goals. Alternative 8 is based on the Agencies' assumption that FMC-related constituents may have potentially impacted soil surrounding all buried pipe sections of Culvert 105 (except for sections replaced during the 2007-2008 Early Actions) due to historical leakage through numerous documented pipe defects (i.e., frequent cracks, breaks, etc.) and/or from deposits in open ditch sections that may have pre-dated pipe installation along sections of Culvert 105.

For CMA 8, in addition to calculating averages on a property-wide basis, averages were also developed for sampling grid sub-areas at eight large properties (R1a-north, R1a-south, R1b, R1d, AD1, AE1, AF1 and non-ICM area of the Roy-Hart School Property), as discussed in Appendix H. For the purposes of estimating soil remediation volume and extent, it was assumed that CMA 8 would remediate the eight large properties to attain a post-remediation average of 20 mg/kg within each grid sub-area.

5.12.2 Properties to be Remediated under Alternative 8

Implementation of Alternative 8 to attain the post-remediation soil arsenic goals would require remediation of 179 properties. These properties are colored green on Figure 5-8. It should be noted that the area and depth of soil remediation are not depicted on the figure and that only a portion of the property may require soil remediation.

Under Alternative 8, no further action would be required for the Wooded Parcel, and the 31 previously remediated properties (see Section 5.2). Institutional controls would be maintained for the Wooded Parcel.

Under Alternative 8, no properties would require institutional controls (except for continuation of those established for the Wooded Parcel) because the entire Culvert 105 buried pipe would be removed and replaced, and all properties would be remediated to residential post-remediation soil arsenic concentrations. (Note: In January 2011, FMC provided the Agencies with its legal analysis of the Wooded Parcel deed restrictions which indicate that these restrictions cannot be unilaterally removed by the current or any future owner of this parcel. However, if as a result of the ongoing Agencies' review, the permanency of these restrictions cannot be confirmed to the Agencies' satisfaction, other remedial options for this parcel may need to be evaluated [i.e., other than no further action]).

5.12.3 Extent and Volume of Soil to be Remediated

The extent and volume of soil to be remediated under Alternative 8 was estimated based on the guidelines summarized below. These guidelines are the same as those presented in Section 5.5.3 for Alternative 3 except for the differences in the post-remediation goals, differences in the way arsenic concentration averages were derived for large properties and the remediation of buried pipe sections of Culvert 105.

Under CMA 8, the estimated extent and volume of soil to be remediated on the eight large properties were based on the comparison of the post-remediation average clean-up goal of 20 mg/kg to the soil arsenic averages calculated for each of the grid sub-areas. The estimated volume of soil which would be remediated under Alternative 8 is approximately 162,000 cubic yards from an approximate total area of 104 acres, and approximately 3,025 lineal feet of buried sections of Culvert 105 (crossing beneath seven public streets) would be removed and replaced. Appendix H provides figures that depict the proposed horizontal and vertical extent of soil remediation and the portions of Culvert 105 buried pipe proposed to be replaced under Alternative 8.

5.12.4 Estimated Post-Remediation Arsenic Concentrations in Soils

For Alternative 8, the post-remediation arsenic concentrations at any remediated property within the CMS Study Areas would be at or lower than an average concentration of 20 mg/kg on each property (and in a different manner for large properties as previously described) and less than the maximum concentration of 30 mg/kg. After removal of the soil identified for remediation under Alternative 8, the average soil arsenic concentration (all depths) on the 179 properties identified for remediation is estimated to be 11 mg/kg. The post-remediation average soil arsenic concentrations (all depths) are 12 mg/kg, 10 mg/kg, 10 mg/kg, 10 mg/kg, and 7 mg/kg for residential properties, public/institutional properties, agricultural/commercial properties, industrial/railroad/utility properties, and the non-ICM area of the Roy-Hart School property, respectively, after implementation of CMA 8. Data tables that summarize the expected post-remediation soil arsenic concentrations for properties identified for remediation under Alternative 8 are provided in Appendix H.

On a community-wide basis, after implementation of Alternative 8 the average soil arsenic concentration in the CMS Study Areas would be 11 mg/kg. This average includes data within the upper 12 inches from all properties within the Suspected Air Deposition and Culvert 105 Study Areas (properties colored green and yellow on Figure 1-1). The community-wide average soil concentrations were used by FMC for the purposes of evaluating the CMAs.

5.12.5 Design and Implementation of Alternative 8

Implementation of Alternative 8 includes the same general steps described in Section 5.4.5 for Alternative 2, with the additional steps required to design and implement complete removal and replacement the buried pipe sections of Culvert 105. Close coordination with the Village of Middleport would be required, particularly for those portions of the buried Culvert 105 pipe that cross seven public streets.

The use of average post-remediation soil arsenic goals under CMA 8 provides a better opportunity for tree preservation than the limited flexibility that may be employed on a case-by-case basis when the extent of remediation is based strictly on a maximum post-remediation goal (CMA 2). On properties where the owner wants to preserve a tree or trees, consideration would be given during the CMI phase to remediation of soil associated with sample locations outside of the designated trees to achieve the average soil arsenic concentration.

5.12.6 Cost and Timing of Alternative 8

The total estimated cost for implementation of Alternative 8 is approximately $42.9 million for the CAMU disposal option and approximately $50.9 million for the offsite commercial landfill disposal option (Table 5-4). The estimated costs for Alternative 8 are summarized in Table 5-4 and detailed in Appendix I.

For CMA 8, eight full construction seasons (typically a construction season is from May to November) are estimated to be required to complete the CMI field activities for either disposal option, assuming a considerable and manageable level of effort during each construction season. The estimated construction duration is primarily based on the number of properties to be remediated (179) and the estimated amount of soil to be removed (162,000 cubic yards), as well as FMC's experience obtained during the 2003 and 2007 remediation on residential properties in Middleport. The large number of residential properties (170) to be remediated under this alternative and the associated implementation considerations (e.g., working hour restrictions and labor intensive excavation in the vicinity of utilities or other relative site features scheduled to remain within or adjacent to the work areas) contributed significantly to the estimated construction duration. The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule, and would consider (for example) sequencing the work from one complete residential block to another to minimize overall disruption to the community and potential safety concerns.

6. FMC's Risk Assessment

As indicated in Section 1.3, potential human health and environmental risks are two of the seven criteria to be used in the evaluation of CMAs. Accordingly, site-specific human health and ecological risk assessments are used to evaluate the degree to which a corrective measure would protect human health and the environment and achieve target risks. A Human Health Risk Assessment and an Ecological Risk Summary have been prepared on behalf of FMC by ENVIRON and Integral Consulting Inc. (Integral). These documents are provided in Appendix F and Appendix G, respectively, and are summarized below by ENVIRON and Integral. The evaluation methods and conclusions of the human health and ecological risk assessments presented herein are those of FMC and its consultants.

6.1 Summary of FMC's Human Health Risk Analyses

One of the corrective action objectives is to "protect human health and the environment relative to FMC-related contamination." Human health risk analyses were used to evaluate the degree to which various CMAs would achieve this objective with respect to protection of human health. These analyses are used for the comparative evaluation of CMAs with respect to the human health criteria.

6.1.1 Approach

Based on screening for constituents of concern (COC), arsenic was the only COC carried forward in the risk analyses. While other constituents (lead, other metals, and chlorinated pesticides) have been detected during the various sampling events at locations within the study areas, these constituents are not considered constituents of potential concern for the CMS based on their low frequency of detection, low concentrations, infrequent occurrence above screening levels, and/or occurrence due to natural conditions or non-site-related activities.

The risk analyses were conducted for both cancer and non-cancer health effects and focused on soil (i.e., exposures via soil and house dust), which is the primary exposure medium for arsenic potentially associated with FMC. Within the Air Deposition Study Area and the Culvert 105 Study Area north of the Erie Canal, risks for various CMAs were quantified for child and adult Middleport residents. Additional risk analyses were conducted for non-residential exposures for areas traversed by Culvert 105, for the Wooded Parcel, and for the Roy-Hart School property. Within the Culvert 105 Study Area and Wooded Parcel, risks were quantified for utility workers digging trenches along the culvert or utility lines. Within the Roy-Hart School property, risks were quantified for middle school and high school children. The risk estimates for residents are considered protective of commercial and industrial workers, who would be expected to have lower exposures to soil than would residents. For the risk analyses, two types of risk calculation approaches described in USEPA guidance were used: 1) deterministic risk assessment, and 2) probabilistic risk assessment. Deterministic risk assessment uses point estimates of exposure and toxicity parameters to calculate a point estimate of hypothetical risk. Both central tendency exposure (CTE) and reasonable maximum exposure (RME) estimates were calculated. In probabilistic risk assessment, probability distributions are assigned for one or more exposure parameters to yield a probability distribution for estimated exposure. From the exposure probability distribution, central and upper-bound values

representing exposures at approximately the 50th and 95th percentiles of the distribution are selected to represent the CTE and RME, respectively.

A deterministic approach was used initially to assess each of the receptor scenarios, at first using default assumptions and then progressing to incorporate site-specific exposure assumptions. For residential exposures to surface soils in the Air Deposition Study Area and the Culvert 105 Study Area North of the Erie Canal, the two stages of deterministic risk analyses (default and site-specific analyses) were followed by site-specific probabilistic analyses. The combination of deterministic and probabilistic risk analysis methods was used to provide a comprehensive analysis of risk that relies on the best available scientific approach and the available site-specific data (local weather data, oral and dermal bioavailability studies, a biomonitoring study, results of a community survey and soil and dust data) in the detailed analyses.

Except for the culvert transects, arsenic concentrations in subsurface soils are generally lower than in surface soils, so for the residential scenario it is protective to focus the evaluation on surface soils. For surface soils, an analysis of background arsenic conditions was conducted. For surface soils, data collected during a study in Gasport in 2001-2003 were used as an indicator of soil arsenic concentrations that would be present in Middleport in the absence of the FMC facility. In this analysis, Gasport soil arsenic concentrations for each land use type were combined with Middleport land use data to estimate soil arsenic concentrations that would be present if there were no impact from the FMC facility. The resultant soil arsenic concentrations are termed “background” conditions. Comparison with background conditions is a critical measure of the potential risk reduction associated with remedial actions that might be undertaken. This risk difference relative to background conditions is termed the “incremental” risk. For residential scenarios, both total and incremental excess lifetime cancer risks are provided in the HHRA (see Appendix F).

6.1.2 Excess Lifetime Cancer Risk Results

A cancer risk estimate is characterized as the excess probability that an individual will develop cancer during his or her lifetime due to exposure to site-related chemicals. The term “excess” reflects the fact that the calculated risk is in addition to typical cancer incidence, i.e., the 1 in 3 (for men) or 1 in 4 (for women) risk of developing cancer during a lifetime. Because there are risks associated with both current CMS area and background conditions, comparison between CMS area and background conditions is a critical issue in understanding the potential risk reduction associated with any remedial actions that might be undertaken at the site. This risk difference is termed the “incremental” risk to reflect the risks currently present in the study areas above background conditions. For residential scenarios, both total and incremental excess lifetime cancer risks are provided.

Cancer risks are evaluated in the context of EPA’s acceptable excess risk range of $1x10^{-6}$ to $1x10^{-4}$ (40 CFR § 300.430[e][2][A][2]). A $1x10^{-4}$ cancer risk means a “one-in-ten-thousand excess cancer risk,” or one additional incidence of cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions assumed in the HHRA.

For the Air Deposition Study Area and the Culvert 105 Study Area north of the Erie Canal, excess lifetime cancer risks were calculated for a residential exposure scenario, including exposures during childhood. For the Culvert 105 Study Area and the Wooded Parcel, cancer risks were calculated for a utility worker scenario. For all scenarios, risks were evaluated for background conditions, concentrations that existed prior to the ICMs (pre-ICM), current concentrations (CMA 1), and CMAs 2 through 8.

For the Air Deposition Study Area, total CTE and RME excess lifetime cancer risks calculated by all three methods (default deterministic, site-specific deterministic, and site-specific probabilistic) for all the CMAs are within or below the acceptable risk range of $1x10^{-6}$ to $1x10^{-4}$ (Table 6-1a). The CTE and RME incremental excess lifetime cancer risks (i.e., the difference between site risk and background risk) for CMAs 2 through 8 are all less than or equal to $1x10^{-5}$ (Table 6-1b).

For the Culvert 105 Study Area north of the Erie Canal, total CTE and RME excess lifetime cancer risks for CMAs 2 through 8 are all within or below the acceptable risk range (Table 6-2a). Incremental risks greater than zero could be calculated for only pre-ICM and current conditions because all other CMAs resulted in risks lower than background, with the exception of the CTE site-specific probabilistic estimate for CMA 5 ($1x10^{-8}$) (Table 6-2b). The CTE and RME incremental excess lifetime cancer risks for pre-ICM and current conditions are all within or below EPA's acceptable risk range.

Figures 6-1 and 6-2 show the total excess lifetime cancer risk distributions produced by the probabilistic risk evaluation for the Air Deposition Study Area and the Culvert 105 Study Area north of the Erie Canal, respectively. The 95th percentiles, shown for three distributions by long dashed lines, were used to identify RME risk results and the 50th percentiles, shown by short dashed lines, were used to identify CTE results.

Excess lifetime cancer risks for utility workers in the Culvert 105 Study Area and the Wooded Parcel are below EPA's acceptable risk range for all conditions evaluated.

A schoolchild scenario was also evaluated using the site-specific deterministic method to compare potential cancer risks for a child attending the Roy-Hart school under the various CMAs. This scenario focused on exposures during middle and high school years. The cancer risks were below or within the acceptable risk range of $1x10^{-6}$ to $1x10^{-4}$ for all CMAs, and cancer risks under CMAs that do not include additional remediation at the school were only slightly higher than those under CMAs that do include additional remediation at the school. These results confirm the conclusion of the Agencies that after the school yard remediation in 1999-2000, "[t]he entire school yard is suitable for both athletic and non-athletic uses by all school children, in terms of their exposure to known school yard soil arsenic levels." (NYSDEC et al. 2000). Based on the findings of this assessment that the human health risks to school age children at the school property are generally similar under all of the CMAs, and would not significantly decrease relative to current conditions, it is FMC's conclusion that further remediation of the school property is not supported on the grounds of reduction of risk to human health.

6.1.3 Noncancer Risk Results

For the Air Deposition Study Area and the Culvert 105 Study Area north of the Erie Canal, noncancer risks for residents were calculated for both an adult plus child scenario (i.e., chronic exposure) and a child-only scenario (i.e., subchronic exposure). Noncancer risks were also calculated for utility workers in the Culvert 105 Study Area and the Wooded Parcel. For all scenarios, noncancer risks were evaluated for background conditions, concentrations that existed prior to the ICMs (pre-ICM), current concentrations (CMA 1), and CMAs 2 through 8.

CTE and RME noncancer risks for all scenarios, including residents and utility workers, are below the target level of 1 for all conditions evaluated, indicating no concern for noncancer health effects.

6.1.4 Arsenic Exposure from Sources Other Than Soil

Additional perspective on the risk reduction that might be associated with the CMAs was provided by comparison of exposure to soil arsenic with exposure to inorganic arsenic from other natural sources such as diet and drinking water. Arsenic is naturally present in most foods and in drinking water, and is widely distributed in the environment from many natural and anthropogenic sources. Studies of background exposures to arsenic in the U.S. have found that exposures are dominated by intakes from drinking water and diet, and that intakes via incidental ingestion of soil and inhalation of air contribute a negligible amount to total exposure.

In most communities, arsenic from soil accounts for less than 1 percent of inorganic arsenic exposure in U.S. adults (Meacher et al. 2002; Boyce et al. 2008). RME intakes calculated in this HHRA are lower (by a factor of at least 20) than the 95th percentile arsenic intakes from diet and drinking water reported for typical U.S. residents.

A comprehensive arsenic exposure and biomonitoring study was sponsored by FMC and conducted by Exponent with oversight of an independent scientific review panel during 2003 in Middleport. This biomonitoring study found no significant relationships between urinary arsenic and arsenic in soil in Middleport. Arsenic present in soil is expected to contribute only a small fraction of the total inorganic arsenic exposure.

6.1.5 Human Health Risk Assessment Uncertainty

Risk assessments predict the likelihood of health effects in a population, but do not directly measure the occurrence of health effects. The predicted risks are based on many assumptions about the ways in which people come into contact with chemicals in the environment. Although many of these assumptions are based on general scientific studies or site-specific data, uncertainty remains regarding how well the available data reflect the ways residents are actually exposed to chemicals. The degree of confidence in the results of a risk assessment depends on how closely the data and assumptions used match actual conditions.

This HHRA included a detailed uncertainty assessment that qualitatively evaluated sources of variability and uncertainty for each step of the risk assessment process. An uncertainty analysis is needed to understand the reliability of risk estimates to support risk management decision-making. Underestimation of risks may result in people not being adequately protected from adverse health effects, while overestimation of risks can cause needless disruption and resource allocation.

Each source of uncertainty was evaluated in terms of whether it would tend to over- or underestimate risks and the relative magnitude of the uncertainty associated with that factor. A sensitivity analysis was also conducted to quantitatively assess uncertainty and variability for selected critical assumptions. In general, where uncertainties exist, conservative parameters, assumptions, and methodologies were used to enhance the likelihood that potential exposures and risks would not be underestimated.

The confidence in the risk characterization for arsenic in Middleport soil is enhanced by the three approaches used to estimate exposures, starting with deterministic analyses that employ EPA default exposure assumptions, and then incorporating the results of studies conducted in Middleport and updated literature evaluations into site-specific deterministic and probabilistic analyses. These analyses have reduced the level of uncertainty for many factors. One current source of uncertainty is in the arsenic oral cancer slope factor (CSF). EPA has proposed a draft CSF, not used in this HHRA, that suggests arsenic cancer potency is greater than indicated by the current EPA-approved CSF. This is a controversial subject, and is currently unresolved. Many scientists disagree with EPA's proposed draft assessment, and believe risks from low dose arsenic exposures are much lower than EPA's draft estimates.

6.1.6 Summary of FMC's Human Health Risk Assessment Conclusions

All RME estimated excess lifetime cancer risks for the Air Deposition Study Area and the Culvert 105 Study Area north of the Erie Canal residential scenarios are within or below the acceptable risk range. Incorporation of site-specific exposure assumptions representative of Middleport yielded deterministic risk estimates that are approximately one-tenth of the risk estimates using EPA's standard default assumptions. RME probabilistic risk estimates are about half of the site-specific deterministic risk estimates.

The risk analyses for the residential scenario demonstrate that for the Air Deposition Study Area and the Culvert 105 Study Area north of the Erie Canal there is little difference in excess lifetime cancer risks among all the CMAs, including current conditions. Furthermore, when incorporating site-specific assumptions, the incremental risks between background and CMAs 2 through 8 for the Air Deposition Study Area are close to or less than one-in-a-million. For the Culvert 105 Study Area north of the Erie Canal, there are no RME incremental risks above background for CMAs 2 through 8.

Based on these residential scenario risk analyses, all CMAs are similar on a risk basis. Risks to utility workers in the Culvert 105 Study Area and the Wooded Parcel are below a level that would trigger remedial action, and risks associated with attending school in Middleport were not found to be elevated. These conclusions are based on FMC's evaluation of human health risks performed consistent with EPA risk assessment guidance and do not necessarily represent the opinions of NYSDEC, USEPA, or the NYSDOH.

Due to the fact that there are many other sources of exposure to inorganic arsenic, FMC's HHRA demonstrates that all of the alternative CMAs produce negligible reductions in arsenic exposure. Consequently, human health risk reduction should not be considered by FMC to be the primary factor in the determination of the FMC recommended CMA. Further, FMC considers the differences among all of the CMAs in terms of reduction of human health risk to be very small.

Appendix F presents the HHRA in its entirety, including a detailed presentation of all assumptions, methodologies, supporting data/site-specific studies, exposure point and risk calculations, and uncertainty analysis.

6.2 Summary of FMC's Ecological Risk Evaluation

As directed by the Agencies, the CMS also evaluated the ecological risks associated with the various CMS alternatives in the Culvert 105 Study Area north of Sleeper Street. Two Culvert 105 reaches (see Figure 3-1) have been identified in this area:

- Reach C2: Three properties are traversed in this reach - AD1, AE1, and AF1. The below-ground portions of the culvert are located predominantly in the northern (downstream) and southern (upstream) portions of Reach C2, and traverse land used for residential purposes. Culvert 105 is an open ditch between these areas, traversing wooded areas and areas occupied by residences. The total length of open ditch in Reach C2 is approximately 650 feet of a total reach length of approximately 1,650 feet.

- Reach C3: Seven properties are traversed in this reach - AG1, AH1, AH2, AI1, AJ1, AJ2, and AK1. This reach includes approximately 1,870 feet of open ditch that traverses wooded areas, landscaped areas of residential properties, agricultural properties and the Village of Middleport wastewater treatment plant.

A third reach of Culvert 105, Reach C1, is located south of Sleeper Street and was not evaluated in this ecological assessment principally because (1) open ditch portions of Reach C1 had undergone soil removal and culvert pipe installation as part of the 2007 Early Action remedial work; the culvert in this reach is now entirely underground and thus not accessible to ecological receptors; and (3) the properties in this reach are developed, with maintained lawns.

Reach C2 and the lower portion of Reach C3 are both bounded by developed residential properties with well maintained open areas (i.e., lawns) or small wooded areas. The ecological community of Reach C2 of the culvert area is likely very limited. Maintained lawn areas do not characteristically support diverse or robust ecological communities. The land area in the upper portion of Reach C3 is undeveloped and wooded, with a few agricultural properties in the vicinity. This area has more natural ecological communities and could support native wildlife. However, the relatively small size of these areas likely limits the overall value to the larger community. The Village of Middleport Wastewater Treatment Plant is also located in the upper portion of Reach C3. The open ditch portion of the culvert in this area includes both engineered materials (e.g., rip-rap) and settled solids. The latter, when present, is a sandy-silt to sandy-gravel. Surface

water flow is intermittently present in the open ditch sections, which receive runoff during and immediately after major rain events and during thaws, and are dry during most of the year.

Details regarding the residual ecological risk evaluation that was performed for Reaches C2 and C3 CMS alternatives are presented in Appendix G.

6.2.1 Approach

Based on screening for COC, arsenic was the only COC carried forward in the Human Health Risk Assessment (HHRA) risk analyses (Appendix F), and this constituent is considered the primary COC in the ecological evaluation. Lead and chlorinated pesticides were also detected in some samples collected from the study areas and are additionally considered in the ecological evaluation. A two step process was used to assess potential ecological risks for this area. First, the observed results were compared to relevant ecological screening benchmarks under the various CMAs. Second, the ecological significance of these results under each of the CMAs was evaluated.

The analytical results for Reaches C2 and C3 sediments and soils that were reported in Volume IV of the RFI Report were used for this assessment. Consistent with that document, the soil and sediment results were combined together for this assessment. As discussed in the RFI Report, the soil present within the open ditch sections did not meet the regulatory definition of sediment provided in the NYSDEC guidance (NYSDEC, 1999) for evaluation of potential ecological impacts and therefore was evaluated as soil, not sediment. The intermittent flow conditions in the open ditch in these reaches will preclude the establishment of benthic communities typically anticipated with aquatic systems, and therefore, consideration of these habitats as terrestrial (i.e., soil) is appropriate. The average media concentrations were calculated for each of the CMAs and these values were compared to the screening benchmarks. The average values were used for these comparisons in lieu of individual sample results, because the average concentrations are more representative of potential exposures by ecological receptors.

The soil ecological benchmarks were used for evaluating the results. The NYSDEC ecological soil cleanup objective (SCO; from 6 NYCRR Part 375) value of 13 mg/kg was derived by NYSDEC and represents the background concentration of arsenic in rural soils of New York State. In the RFI Report, an arsenic concentration of 20 mg/kg was used for screening purposes as a reasonable estimate of the upper range of background soils in the Middleport area, based on prior field studies. As requested by the Agencies, both the state-wide and site-specific arsenic background soil concentrations are used in this ecological assessment. Additionally, toxicity-based Ecological Soil Screening Levels (EcoSSLs) developed by USEPA are used in the assessment. For arsenic in soils, the following EcoSSL values (USEPA 2005) are available:

- Plants: 18 mg/kg
- Avian wildlife: 43 mg/kg
- Mammalian wildlife: 46 mg/kg

Plants are the most sensitive receptor, although arsenic tolerance in plants is species-specific, and also related to arsenic speciation.

For a discussion of the identification of ecological benchmarks used to evaluate results for lead and the chlorinated pesticides detected with the greatest frequency, the DDT series (DDx), refer to Appendix G.

6.2.2 Ecological Assessment of CMAs

A total of 969 soil results for arsenic were available for this evaluation. This included samples collected from 15 depth intervals. Of these 969 results, there were 413 results that fell within the 0-6" depth interval representing surface soils. Some of the sample locations had results from multiple depths that fell within this interval (e.g., 0-3" and 3-6"). These were depth averaged for the calculation of average chemical concentrations for the surface soils. This depth interval was selected because it is ecologically relevant for herbaceous plants (with shallow roots) that may be consumed by herbivores, soil invertebrates that may be consumed by higher tropic level receptors, and depths where incidental contact may occur by these receptors. An evaluation of alternate depth intervals is presented in Appendix G.

Under CMA 1 (No Further Action), the average arsenic surface soil concentration for Reaches C2 and C3 is greater than the site-specific background (20 mg/kg), NYSDEC ecological SCO (13 mg/kg) and plant EcoSSL (18 mg/kg) values. This would imply that there would be impacts to the vegetation in this area; however, no impacts (e.g., weak plant growth) have been observed during any of the prior field investigations. For example, the open ditch portion of the culvert on Property AD1 was well vegetated (see RFI Volume IV, Appendix A, photograph number 15) even though the surface arsenic concentrations were above the conservative plant ecological benchmark (see Figure 3.5 of RFI Volume IV). The site-specific bioavailability assessment performed using site soils to support the HHRA showed that the arsenic can readily bind to iron oxides and iron sulfate. Therefore, the absence of any obvious stress on the native vegetation may be attributable to a reduction in the bioavailability of arsenic in these soils.

The average surface soil concentrations for arsenic, lead and the DDx pesticides under CMA 1 are also above the conservative screening level benchmarks for potential avian and mammalian receptors. The properties in Reach C2 have been observed to be well-maintained residential properties that would not support diverse or robust ecological communities; therefore, the application of the avian or mammalian screening benchmarks may not be fully relevant for this reach. The average arsenic surface soil concentration in Reach C3, which is undeveloped and wooded (and therefore represents better habitat for ecological receptors), is 42 mg/kg. This value is below the screening benchmarks for the avian and mammalian receptors (43 and 46 mg/kg, respectively). Like arsenic, the bioavailability of lead and the DDx pesticides is expected to be reduced in Middleport soils. Therefore, based on FMC's ecological analysis, these receptors are not at risk under the No Further Action Alternative in Reach C3. Collectively, the results of FMC's ecological risk evaluation for the No Further Action Alternative (CMA 1) suggest, in the opinion of FMC and its experts, that there would be (and are) negligible ecological risks for Reaches C2 and C3.

CMAs 2 through 8 are estimated to reduce the average arsenic surface soil concentrations to 6, 11, 16, 19, 9, 9, and 8 mg/kg (respectively) for Reaches C2 and C3. These concentrations are all near or below all of the arsenic screening ecological benchmarks. The remedial actions under CMAs 2 through 8 would also result in significant reductions in the concentrations of lead and the DDx pesticides in surface soil. Post-remediation average lead concentrations are estimated to fall within the observed range of site-specific background for CMAs 2 through 8. Post-remediation average DDx pesticide concentrations for CMAs 2, 3, 4, 6, 7 and 8 are estimated to be below avian and mammalian EcoSSLs for Reaches C2 and C3 combined, and near or below all ecological benchmarks for the undeveloped portion of Reach C3. Given that the risks under the No Further Action alternative are considered negligible based on FMC's ecological evaluation and that the post-remediation concentrations of COCs will be significantly reduced under CMAs 2 through 8, no remedial actions are needed to address potential ecological risks.

6.2.3 Summary of FMC's Ecological Risk Conclusions

FMC's ecological risk evaluation of the CMAs for Culvert 105 Reaches C2 and C3 was based on a comparison of the average concentrations of COCs (primarily arsenic) to conservative screening benchmarks, and also an assessment of the potential ecological resources in this area. The ecological community of the culvert area is very limited. The maintained lawn areas in Reach C2 and the upstream portion of Reach C3 do not support diverse or robust ecological communities. The northern wooded sections of Reach C3 have natural ecological communities that could support native wildlife, but the relatively small size of these areas limits their overall value to the larger ecological community.

The average arsenic concentrations under the No Further Action alternative (CMA 1) exceed the NYSDEC soil ecological benchmark and the EcoSSL developed for plants. However, the most sensitive ecological receptor is plants, and there is no evidence that the vegetative community has been adversely affected. In Reach C3, where the comparison of the arsenic concentrations in soil to the avian and mammalian screening benchmarks is relevant, the average arsenic concentrations are below these benchmark values. Soil concentrations of other COCs (primarily lead and DDx pesticides) are also not expected to impact the evaluated receptors because of the likely reduced bioavailability of these constituents in soil.

The results of FMC's ecological analysis suggest that potential ecological impacts related to arsenic, lead and pesticides are not likely. Although CMS Alternatives 2 through 8 would further reduce the residual arsenic, lead and pesticide concentrations, FMC's ecological evaluation indicates that remedial action based on the potential ecological risk in this area is not warranted. This conclusion is based on the absence of apparent impacts under the No Further Action alternative in combination with the reduced bioavailability of the compounds and the low detected levels (and detection frequencies) of pesticides in these soils. These conclusions are based on FMC's evaluation of ecological risks performed consistent with USEPA risk assessment guidance.[2]

[2] See bolded paragraph at the beginning of the Introduction Section.

7. FMC's Evaluation of Corrective Measures Alternatives

This section presents FMC's detailed evaluation of the CMAs identified and described in Section 5.

7.1 CMA Evaluation Criteria

The CMAs were evaluated by FMC based on the ability to meet the project-specific CAOs issued by the Agencies (provided in Appendix A) using the following criteria specified in the approved CMS Work Plan:

1. Community/Property Owner Acceptance
2. Technical
3. Environmental
4. Human Health
5. Institutional
6. Green Remediation Practices
7. Cost

The factors considered for each of these evaluation criteria, as specified in the CMS Work Plan, are summarized in Table 7-1 and described in the subsections below.

7.1.1 Community/Property Owner Acceptance

CMAs are to be evaluated based on the degree to which they are acceptable to the community and affected property owners. The CMS Study Areas consists of properties that are not owned by FMC. The community and affected property owners have previously requested that opportunities be provided for early involvement and input in FMC's RCRA environmental programs. Community participation is an ongoing process. As specified in the approved CMS Work Plan, community members and affected property owners and other stakeholders will be provided opportunities to discuss and comment on the CMS and associated documents. Community members are encouraged to participate in planned public participation activities (e.g., public meetings, information sessions, formal comment period, etc) associated with this Draft CMS Report. Community and property owner comments on the Draft CMS Report will be considered by the Agencies in the selection of corrective measures.

A majority of the CMS Study Areas consist of residential neighborhoods with streets that are lined with mature trees. Middleport is recognized by the NYSDEC as a Tree City USA Community.

Based on the input obtained from the community during public participation events leading up to the development of this Draft CMS Report and as specified in the CMS Work Plan, the community has sensitivities and concerns associated with any corrective measures within the community. The concerns include disruptions to residents and the community; public safety; overall effectiveness of the remedy; maintaining the character of the Village and neighborhoods (e.g., mature trees); human health concerns over exposure to soil contaminants; minimizing any restrictions on properties that may limit property usage, redevelopment or reuse; and the need for the Agencies to provide documentation that properties are acceptable for unrestricted use. Table 7-1 identifies specific community concerns that will be assessed in the CMA comparative evaluation.

As indicated above, community acceptance will continue to be evaluated throughout the CMS process and community concerns will be considered as the CMS process continues through selection and implementation of the corrective measures.

7.1.2 Technical

The technical criterion requires each CMA to be evaluated with respect to performance, reliability, implementability, and safety. The performance and reliability evaluation examines the effectiveness of the CMA in reducing unacceptable risks and its demonstrated ability to maintain that effectiveness over time. The implementability evaluation examines the engineering and construction related tasks necessary to carry out the corrective measure. The implementability evaluation typically covers permit requirements and other necessary approvals, equipment requirements, space and logistics considerations, and operation, maintenance and monitoring (OM&M) requirements. The safety evaluation examines potential safety risks to workers and community members during and after implementation of the CMA.

7.1.3 Environmental

The environmental criterion requires each CMA to be evaluated with respect to: 1) short-term adverse environmental impacts during construction; and 2) short-term and long-term beneficial and adverse impacts of the CMA on the environment, particularly in any environmentally sensitive areas.

7.1.4 Human Health

The human health criterion requires each CMA to be evaluated on the extent to which short- and long-term exposures to contaminants of concern are mitigated. The assessment includes an examination of how each CMA protects human health during corrective action implementation.

7.1.5 Institutional

The institutional criterion requires each CMA to be evaluated with respect to Federal, State and local standards, criteria or guidance relative to the design, operation and timing of each alternative.

7.1.6 Green Remediation Practices

The green remediation practices criterion requires each CMA to be evaluated for consistency with USEPA's and NYSDEC's Green Remediation concepts and strategies which consider the environmental consequences of remedial actions, including energy requirements, air emissions, material consumption, resource consumption and waste generation.

7.1.7 Cost

The cost criterion requires each CMA to be evaluated with respect to the capital, engineering, and any long-term costs (e.g., inspection, monitoring, and maintenance) associated with each CMA for both the CAMU and off-Site waste disposal options. These costs are summarized in Table 5-4 and detailed in Appendix I. The capital costs consist of two components: 1) direct cost expenditures for construction equipment, labor and materials to perform the remedial construction; and 2) indirect cost expenditures for engineering, financial, and other services that are not part of the actual construction but required to implement the corrective measure.

7.2 Summary of Differences between the CMAs

As described in Section 5, CMAs 2 through 8 have many similar elements, including the following two options for remediation waste disposal:

- Placement and permanent management of remediation wastes in a CAMU that would be located on the FMC Facility; and

- Off-Site disposal at a commercial landfill(s) with assumed temporary staging at the FMC Facility prior to transport to the landfill and assumed beneficial reuse of a portion (25%) of the remediation waste as daily landfill cover and disposal of the remainder (75%) as non-hazardous waste. The remediation waste would be transported to the commercial landfill(s) by truck or rail.

These remediation waste disposal options are evaluated in detail in Appendix D using the same seven evaluation criteria described above. Key findings of this evaluation are reiterated below where pertinent.

The major differences between Alternatives 2 through 8 are:

- the post-remediation soil arsenic goals (which determine the number of properties to be remediated);

- how the non-ICM area of the Roy Hart School Property is addressed;

- the volume and extent of soil to be remediated;

- the lineal footage of buried Culvert 105 pipe to be removed and replaced;

- the estimated duration of remediation;
- the post-remediation arsenic concentrations which would be present in soils after implementation of the corrective measure; and
- the number of properties requiring institutional controls.

The comparative evaluations presented in the following sections involve assessment of the extent to which these differences have beneficial or adverse effects on the CMA evaluation criteria. For example, a CMA which would remediate a greater number of properties and a higher volume of soil may require a longer time to implement, depending on the level of effort employed, and may cause more community disruption and greenhouse gas emissions than a CMA which would remediate fewer properties and less soil volume. On the other hand, a CMA which would remediate more properties and soil volume would result in lower post-remediation soil arsenic concentrations compared to a CMA which would remediate less soil.

7.2.1 Number of Properties to be Remediated

The previously completed remedial activities in the CMS Study Areas involved the removal of soil from 31 off-Site properties for which no further action is needed. The numbers of additional properties which would be remediated for each CMA are summarized as follows:

Alternative	1	2	3	4	5	6A	6B	7A	7B	8
Number of Additional Properties to be Remediated	0	181	152	86	48	157	158	164	165	179

7.2.2 Non-ICM Area of the Roy-Hart School Property

The previously completed remedial activities at the Roy-Hart School property involved the removal of approximately 41,200 cubic yards of soil. The human health risk assessment presented herein includes a site-specific risk evaluation that confirms the Agencies' conclusion presented by letter dated May 26, 2000 after completing the ICM in 1999, that "the Agencies have determined that the entire school yard is suitable for both athletic and non-athletic uses by all school children, in terms of their exposure to known school yard soil arsenic levels." The Agencies subsequently reaffirmed this determination by letter dated November 3, 2009.

Despite this determination, additional remediation of the Roy-Hart School property was evaluated in several CMAs. For the non-ICM area of the Roy-Hart School property, the corrective measures technologies included in each CMA are summarized as follows:

Alternative	Non-ICM Area of the Roy-Hart School Property	Estimated Additional Volume of Soil to be Remediated (cubic yards)
1	No Further Action	0
2	Remediation to Residential Post-Remediation Soil Arsenic Concentration	19,000
3	Institutional Controls: requiring further evaluation and remediation, if necessary, if property use changes in future to residential	0 (see Note)
4	No Further Action	0
5	No Further Action	0
6A	Institutional Controls: requiring further evaluation and remediation, if necessary, if property use changes in future to residential	0 (see Note)
6B	Remediation to Residential Post-Remediation Soil Arsenic Concentrations	13,500
7A	Institutional Controls: requiring further evaluation and remediation, if necessary, if property use changes in future to residential	0 (see Note)
7B	Remediation to Residential Post-Remediation Soil Arsenic Concentrations	18,000
8	Remediation to Residential Post-Remediation Soil Arsenic Concentrations	18,000
Note: If the property use changes in the future to residential, additional soil will be remediated if necessary.		

7.2.3 Estimated Volume and Extent of Soil to be Remediated

The previously completed remedial activities in the CMS Study Areas involved the removal of approximately 80,000 cubic yards of soil. The additional volumes and area of soil which would be remediated for each CMA are estimated as follows:

Alternative	1	2	3	4	5	6A	6B	7A	7B	8
Estimated Additional Volume of Soil to be Remediated (cubic yards)	0	228,000	69,000	38,000	28,000	85,000	98,000	101,000	119,000	162,000
Total Estimated Area of Soil to be Remediated (acres)	0	127	50	26	18	62	73	71	85	104

7.2.4 Estimated Lineal Footage of Buried Culvert 105 Pipe to be Removed and Replaced

The previously completed remedial activities in the CMS Study Areas involved the installation of approximately 1,110 lineal feet of Culvert 105 buried pipe. Estimated additional lineal footage of Culvert 105 buried pipe to be removed and replaced for each CMA are as follows:

Alternative	1	2	3	4	5	6A	6B	7A	7B	8
Estimated Additional Buried Culvert 105 Pipe to be Installed (lineal feet)	0	1,325	1,185	900	900	1,185	1,185	1,185	1,185	3,025

7.2.5 Estimated Duration of Remediation

The estimated duration of the remediation for each CMA is summarized as follows:

Alternative	1	2	3	4	5	6A	6B	7A	7B	8
Estimated Number of Construction Seasons (May to November) to Complete the Remediation	0	10	5	3	2	6	6	7	7	8
Note: The actual number of construction seasons for the selected CMA or CMAs would be determined during the CMI planning stage through an Agencies approved schedule, and would consider (for example) sequencing the work from one complete residential block to another to minimize overall disruption to the community and potential safety concerns.										

7.2.6 Post-Remediation Soil Arsenic Concentrations

Using the existing data set from the RFI and prior sampling programs, the post-remediation soil arsenic concentration distributions which would result from implementation of each CMA were estimated in this CMS by removing soil arsenic data at locations which would be remediated and replacing the data with a soil arsenic concentration representative of backfill soil (i.e., 5 mg/kg). The post-remediation average soil arsenic concentrations for each CMA are provided below, expressed as both: 1) the community-wide average (including both remediated and unremediated properties within the CMS Study Areas) and 2) as the average for properties to be remediated only.

Alternative	Post-Remediation Average Soil Arsenic Concentration (mg/kg)	
	Community-wide (0- to 12-inch sampled depths)	Properties to be Remediated (all sampled depths)
Pre-ICM	35	Not applicable
1	25	Not applicable
2	7	7
3	14	16
4	17	21
5	18	22
6A	13	14
6B	13	14
7A	12	12
7B	11	12
8	11	11

Notes:

1. The community-wide arsenic concentrations were used by FMC for the purposes of evaluating the CMAs.
2. Actual post-remediation average soil arsenic concentrations will depend on actual backfill arsenic concentrations determined from sampling results to obtained during the CMI.

7.2.7 Estimated Number of Properties Requiring Institutional Controls

The previously completed remedial activities in the CMS Study Areas included implementation of institutional controls for the Wooded Parcel. Estimated number of additional properties requiring institutional controls for each CMA is as follows:

Estimated Number of Additional Properties Requiring Institutional Controls	Alternative									
	1	2	3	4	5	6A	6B	7A	7B	8
Buried Culvert 105 Pipe	0	11	13	14	14	13	13	13	13	0
Remediated to Non-Residential Goals	0	0	11	0	0	8	8	8	8	0
Non-ICM Area of Roy-Hart School Property	0	0	1	0	0	1	0	1	0	0
Total	0	11	25	14	14	22	21	22	21	0

7.3 Community/Property Owner Acceptance

This criterion compares the alternatives based on the degree to which the CMAs are anticipated to address the community and property owners' concerns. One of the Agencies' CAOs is to "minimize disturbance and disruption of the community so that the character of the neighborhoods can be maintained."

Based on the community input received to date, residents are concerned with maintaining the community character, and in particular the tree coverage. Residents have also expressed a desire that their properties be made safe for use without restrictions (i.e., institutional controls). Since formal public comments on this Draft CMS Report have not yet been received, the evaluation presented herein is necessarily subjective based on general community input received to date during and before the CMS.[2]

CMA 1 (No Further Action) may be acceptable to portions of the community based on FMC's risk assessment results (current risks within acceptable risk range)[2], no disruption of the community, no property use restrictions, no change to the existing community character/setting and no destruction of mature trees. As described in Section 6.1, FMC's site specific human health risk assessment determined risks of current conditions to be below or within the acceptable risk range of $1x10^{-6}$ to $1x10^{-4}$. Further, the differences among all of the CMAs in terms of reducing human health risk from arsenic in soil were determined to be very small. However, there may be those in the community for whom any risk above background due to arsenic in soil may be perceived as an unacceptable condition or potential detriment to the community. Therefore, pending additional input, Community/Property Owner Acceptance for CMA 1 is considered moderate.

CMA 2 (remediate all soil above 20 mg/kg soil arsenic, point by point basis) may be unacceptable to portions of the community because CMA 2 will be highly disruptive to the community compared to all other CMAs. CMA 2 would require the largest amount of soil to be remediated (approximately 228,000 cubic yards on 181 properties, including the Roy-Hart School property), the greatest number of truck loads of remediation waste and backfill materials traversing the community (approximately 49,400 truck loads), and has the longest estimated duration (10 full construction seasons). In addition, CMA 2 would likely require the greatest amount of time to complete construction activities on any one property. There are fewer opportunities for tree preservation and soil tilling/blending with CMA 2 than any of the other CMAs, as CMA 2 is unique in that it does not include an average post-remediation soil arsenic concentration. Property use-restrictions would be required on 11 properties where Culvert 105 buried pipe is present.

[2] See bolded paragraph at the beginning of the Introduction Section.

Compared to the other CMAs, CMA 2 would offer the greatest reduction in potential human health risk due to arsenic in soil. However, based on the risk assessment performed by FMC's consultants (Integral Consulting, Inc. and ENVIRON), as discussed in Section 6.0 and Appendix F, all CMAs have human health risks within the acceptable risk range.[2] Furthermore, FMC's experts concluded that the actual estimated risk reductions for all CMAs including CMA 2 are small and the differences between the CMAs in terms of reduction of human health risks are negligible.

CMA 2 would reduce community-wide arsenic concentrations in surface soils (upper 12-inches) to an average of 7 mg/kg, which is well below the concentration (20 mg/kg) represented by the Agencies as generally being the upper limit of local background levels. Such a reduction may be viewed as unnecessary by portions of the community given the results of the human health risk assessment and the disruptive consequences and limiting factors noted above. Therefore, pending additional input, Community/Property Owner Acceptance for CMA 2 is considered to be unfavorable.

CMA 3 (remediate residential properties to post-remediation average at or below 20 mg/kg, with higher concentrations for non-residential properties) introduces a degree of flexibility with key implications for minimizing community disruption. For example, slightly higher soil arsenic concentrations (up to 40 mg/kg) could be left in place beneath trees and/or near utilities/obstructions for soil tilling/blending as long as an average of 20 mg/kg could be attained by remediation elsewhere on the property. The total number of properties to be remediated would be reduced from 181 (CMA 2) to 152 (CMA 3); however, the total number of properties requiring institutional controls would increase from 11 properties (CMA 2) to 25 properties (CMA 3). This increase is attributable to the properties remediated under CMA 3 to non-residential goals and the non-ICM portion of the Roy-Hart School property, which would be re-evaluated and remediated (if necessary) in the future if the property use changes to residential. The volume of soil to be remediated would be reduced from 228,000 cubic yards (CMA 2) to 69,000 cubic yards (CMA 3). The greater percentage reduction in soil volume for CMA 3 reflects greater opportunity to remediate only portions of properties compared to CMA 2. Implementation of CMA 3 would reduce the post-remediation community-wide average soil (upper 12 inches) arsenic concentration to 14 mg/kg. From a timing perspective, CMA 3 would require an estimated five full construction seasons to implement, which is a significant improvement over CMA 2, but still so long that it may engender community concerns. Overall, given that there would be less community disruption associated with CMA 3 (relative to CMA 2) with substantial reduction in soil arsenic concentrations, Community/Property Owner Acceptance for CMA 3 is considered to be moderate.

CMAs 4 and 5 differ from CMA 3 in the average soil arsenic remediation concentration goals specified (30 average/60 maximum for CMA 4 and 40 average/80 maximum for CMA 5), the remediation goals do not vary with land-use, and no further action would be implemented on the Roy-Hart School property. CMA 4 would remediate 86 properties over an estimated three full construction seasons and CMA 5 would remediate 48 properties over an estimated two full construction seasons. No further action would be

[2] See bolded paragraph at the beginning of the Introduction Section.

implemented at the Roy-Hart School property for CMAs 4 and 5 (and CMA 1) which does not address community concerns regarding potential future residential use of the property. Remediation goals are not land-use specific (i.e., properties remediated to residential goals) and therefore institutional controls would be required only for unremediated sections of Culvert 105 buried pipe. Accordingly, there would be less properties with restrictions under CMAs 4 and 5 (14 properties for either CMA) compared to CMA 3 (25 properties). The trade off for these CMAs would be less community disruption and shorter duration with a marginal increase in post-remediation community wide surface soil (upper 12-inches) average arsenic concentrations (17 mg/kg for CMA 4 and 18 mg/kg for CMA 5). CMAs 4 and 5 fall between CMA 1 and CMA 3 with respect to Community/Property Owner Acceptance. Therefore Community/Property Owner Acceptance for CMAs 4 and 5 are also considered to be moderate.

CMAs 6A through 7B are similar to CMA 3 in the use of maximum and average post-remediation goals that are land-use specific, but have incrementally lower remediation goals for certain property usages with corresponding increases in remediation. For each of these CMAs, the post-remediation average concentrations are the same for residential properties (at or below 20 mg/kg) and the maximum concentration for residential properties are higher for CMA 3 (40 mg/kg) than CMAs 6A and 6B (35 mg/kg) and CMAs 7A and 7B (30 mg/kg). These lower remediation goals result in the remediation of an additional 5 to 13 properties and an additional 16,000 to 50,000 cubic yards of soil compared to CMA 3, with a proportionate increase in the number of trucks traversing the community and in the estimated durations for CMA 3, CMAs 6A and 6B, and CMAs 7A and 7B of five, six, and seven full construction seasons, respectively. The resulting community-wide arsenic concentrations for CMAs 6A through 7B range from 11 to 13 mg/kg, compared to 14 mg/kg for CMA 3. The number of properties requiring institutional controls is also similar for CMA 3 (25 properties), CMA 6A (22 properties), CMA 6B (21 properties), CMA 7A (22 properties) and CMA 7B (21 properties). Overall, these CMAs are similar to CMA 3 with respect to this criterion, as described above. Therefore, Community/Property Owner Acceptance for CMAs 6A through 7B are also considered moderate.

CMA 8 is similar to CMAs 3, 6A, 6B, 7A, and 7B in that the average post-remediation soil concentration for residential is at or below 20 mg/kg, and similar to CMAs 4 and 5 in that the post-remediation soil arsenic concentration goals do not vary with land use. CMA 8 includes remediation of the non-ICM area of Roy-Hart School property. It is unique among the alternatives as it was assumed that remediation would be required along the length of Culvert 105 buried pipe, including seven public streets crossed by the culvert. Accordingly, only CMA 8 has no additional properties that would require implementation of institutional controls. CMA 8 would remediate 179 properties and approximately 162,000 cubic yards of soil, the second highest numbers of the 10 CMAs developed. Likewise, CMA 8 would require the second highest number of truck loads of remediation waste and backfill materials traversing the community (approximately 35,100 truck loads), and has the second longest estimated duration (8 full construction seasons). CMA 8 would reduce community-wide arsenic concentrations in surface soils (upper 12-inches) to an average of 11 mg/kg, which similar to that provided by CMAs 3, 6A, 6B, 7A, and 7B (range from 11 to 14 mg/kg) and is well below the concentration (20 mg/kg) represented by the Agencies as generally being the upper limit of local residential background levels. Similar to CMA 2, such a reduction may be viewed as unnecessary by the community when the disruptive consequences are considered in the context of negligible human health

risk reduction determined from the risk assessment performed by FMC's consultants (Integral Consulting, Inc. and ENVIRON) (see Section 6.0, Section 7.3 and Appendix F). Therefore, pending additional input, Community/Property Owner Acceptance for CMA 8 is considered to be unfavorable.

7.4 Technical

The technical criterion requires an evaluation of performance, reliability, implementability, and safety. The performance and reliability of each CMA is essentially the same, as all of the CMAs employ construction technologies that have been well demonstrated to be effective and reliable.[2]

Consequently, the primary consideration that differentiates the alternatives under this criterion is relative ease of implementation and potential short-term public and worker risks during construction (e.g., potential for injury due to operation of heavy equipment and trucks, increased traffic, and traffic disruption). These considerations and risks are proportional to the soil volumes to be addressed under each CMA.

CMA 1 is considered favorable for ease of implementation because no additional remedial activities are required. For the same reason, CMA 1 is also considered favorable with respect to the technical criterion, including safety considerations during construction (i.e., short-term).

CMA 2 is considered not favorable for implementation due primarily to the extensive amount of construction, traffic, and number of property access agreements required to address 228,000 cubic yards of soil on 181 properties. The potential for changes in property ownership over numerous construction seasons introduces another level of complexity. Another consideration that potentially limits implementability of CMA 2 is the local availability of suitable imported backfill materials. CMA 2 would be the least favorable with respect to short-term risks because of the increase in truck traffic (i.e., this alternative would require over 38,200 truck loads of remediation waste and imported fill), as well as traffic associated with construction workers, agency representatives and oversight personnel. Consequently, CMA 2 is also considered not favorable with respect to the technical criterion, including short-term safety considerations.

For CMAs 3 through 8, construction implementation considerations are proportionate to the number of properties and soil volumes to be remediated and would be intermediate between CMAs 1 and CMA 2. Likewise, CMAs 3 through 8 would all result in increased short-term risks associated with potential construction and traffic accidents compared to CMA 1, but risks would be lower than those for CMA 2. The potential for accidents would be lower as remediation concentrations are increased (e.g., CMA 5 would be associated with the lowest short-term risk and CMA 8 the highest). All would have short-term risks falling between those posed by CMA 1 and CMA 2. Each of the CMAs, except CMA 1 and CMA 8, require implementation of institutional controls on a number of properties (ranging from 11 to 25 properties), adding an administrative step to implementing these CMAs. The tradeoff for CMA 8 is larger volumes of soil to be

[2] See bolded paragraph at the beginning of the Introduction Section.

remediated and greater short-term safety considerations, with no institutional controls. Therefore, on balance, CMAs 3 through 8 are considered moderate with respect to the technical criterion. With respect to the short-term safety considerations, CMAs 3 through 7B are considered moderate and CMA 8 is considered unfavorable.

Table 7-2 summarizes the implementation considerations for each alternative, including estimated construction duration, additional number of properties and estimated soil volumes to be remediated, estimated truck loads required to transport remediation waste/backfill materials, estimated truck loads required to transport remediation waste to a commercial landfill, and estimated number of properties requiring institutional controls.

7.5 Environmental

This criterion requires an assessment of short and long-term beneficial and adverse impacts of each CMA and in particular any adverse effects on environmentally sensitive areas. As requested by the Agencies, FMC's ecological risk assessment focused on the section of Culvert 105 Study Area north of Sleeper Street since wildlife is expected to visit or inhabit this area. As documented in FMC's Ecological Risk Assessment (see Appendix G and Section 6.2), potential ecological impacts within the Culvert 105 Study Area north of Sleeper Street are not likely to occur as a result of Facility-related chemicals. Therefore, the primary considerations for this criterion are short- and long-term environmental impacts associated with implementing a CMA.[2] The potential for short- and long-term impacts of the CMA is proportionate to the extent and amount of soil to be addressed and corresponding ability of mitigative measures or engineering controls to be implemented during remedial construction (e.g., sedimentation and erosion controls) to remain effective. While mitigative measures during soil removal, soil tilling/blending, and culvert replacement within a stormwater conveyance system are well demonstrated to be effective if properly installed and maintained, the potential for adverse impacts remains proportional to the volume of soil addressed.

Additionally, there is an environmental benefit associated with preserving existing vegetation and mature trees. Therefore, the effects of the alternatives on trees and vegetation are considered environmental impacts. The following is FMC's assessment and rating of each CMA's environmental criterion.[2]

CMA 1 has no short-term or long-term environmental impact. It is considered favorable with respect to this criterion.

[2] See bolded paragraph at the beginning of the Introduction Section.

CMA 2 would have the most potential for adverse environmental impact, both during and as a result of implementation. As detailed above, sedimentation and erosion controls (including dust control) could be adequate to mitigate the short-term impacts. Regarding the longer term impacts, CMA 2 affords less flexibility for tree preservation than the other CMAs which include a post-remediation average soil concentration. Moreover, the environmental setting will be adversely impacted. CMA 2 is considered unfavorable with respect to environmental impact.

CMAs 3 through 8 would all require some degree of tree destruction but this would be less widespread than would occur for CMA 2. Environmental impacts would be lower as remediation concentrations are increased (e.g., CMA 5 would be associated with the least impacts and CMA 8 with the most). All would have impacts intermediate between CMA 1 and CMA 2; however, CMA 8 would be associated with environmental impacts that are more comparable to CMA 2 due to the relatively large volume of soil to be remediated. Accordingly, CMAs 3 through 7B are considered moderate with respect to this criterion, and CMA 8 is considered unfavorable.

7.6 Human Health

This criterion, similar to the environmental criterion, includes an evaluation of both potential short- and long-term exposures both during and after CMA implementation.

Short-term human health impacts of the CMAs are primarily related to potential wind and water dispersion of soil from excavation sites and stockpiles. These potential releases can be minimized using standard engineering controls and monitoring. Short term safety considerations associated with construction and traffic are discussed in Section 7.4, above.

The following is FMC's assessment and rating of each CMA's human health criterion.[2]

With respect to the long-term health risks, based on the results of FMC's site-specific risk assessments (see Section 6.0 and Appendix F), each of the CMAs is associated with a level of risk that is within or below the acceptable risk range as defined by the Agencies' CAOs. Moreover, the differences among all of the CMAs in terms of reducing human health risks are very small based on the risk assessment performed by FMC's consultants (Integral Consulting, Inc. and ENVIRON).[2]

The total excess lifetime cancer risk range among the CMAs is indicated by the difference between the alternative with the most excavation (CMA 2) and the alternative with the least excavation (current conditions or CMA 1), The CTE and RME risk estimates for the Air Deposition Study Area using site-specific deterministic methods (see Appendix F) are as follows:

[2] See bolded paragraph at the beginning of the Introduction Section.

	CTE	RME
CMA1	7.3E-07	7.5E-06
CMA2	7.3E-07	5.5E-06
Difference	2.1E-07	2.0E-06

This indicates the risk estimates associated with any of the CMAs in the Air Deposition Study Area differ by an amount less than or equal to 0.00000021 (CTE calculations). These risk differences are negligible, particularly when considered in the context that the inorganic arsenic exposure for the typical population is overwhelmingly associated with sources other than soil (such as food and drinking water).

The excess lifetime cancer risk estimates for the CMAs can be compared to background risks to obtain estimates of the reduction in human health risk which would be accomplished through implementation of each CMA, The range of risk reduction values is determined by comparison of CMA-1 with the background risk estimates. Using the site-specific deterministic CME and RME values for the Air Deposition Study Area, the range is as follows:

	CTE	RME
CMA1	7.3E-07	7.5E-06
Background	5.6E-07	5.9E-06
Difference	1.7E-07	1.6E-06

This indicates the risk reductions achieved by any of the CMAs would be less than or equal to 0.00000017 (CTE calculations). This is actually lower than the risk range between the CMAs due to the fact that CMA 2 requires remediation to post-remediation arsenic levels that are below background levels (i.e., CMA 2 risks are lower than the background risks).

Based on the risk assessment performed by FMC's consultants (Integral Consulting, Inc. and ENVIRON) (see Section 6.0 and Appendix F), the differences between the CMAs with respect to protection of human health are considered by FMC's experts to be very small and negligible compared to risks associated with arsenic ingestion from other sources (e.g., food and drinking water). All of the alternatives are therefore considered comparable with respect to potential long-term exposure and are rated as favorable with respect to the human health criterion.[2]

[2] See bolded paragraph at the beginning of the Introduction Section.

7.7 Institutional

The institutional criterion considers the effects of relevant federal, state and local standards, criteria, or guidance on the design, operation, and timing of each CMA. The standards, criteria and guidelines relevant to setting corrective action goals have been considered in developing and are synthesized in the Corrective Action Objectives (CAOs) issued by the Agencies. Therefore, this criterion also considers how each CMA fares in meeting the Agencies' CAOs (see Appendix A).

The Agencies' CAOs for the CMS Study Areas and relevant NYSDEC and USEPA regulations and guidance allow for the use of site-specific human health and environmental risk assessments. The CAOs expressly call for the reduction of human health lifetime excess cancer risks to within the range acceptable for residential communities (i.e., 10^{-4} to 10^{-6}) and non-cancer risks to a level also acceptable for residential communities (i.e., Hazard Index ≤ 1). Based on the results of FMC's human health and ecological risk assessments, each of the alternatives results in conditions within or below an acceptable level of long-term human health and environmental risks determined in accordance with the Agencies' CAOs. Therefore, all CMAs are comparable with respect to institutional concerns associated with long-term health risks.[2]

However, it should be noted that the Technical Support Document (TSD) associated with the derivation of New York State's Soil Cleanup Objectives (SCOs) indicates that health-risk based arsenic concentrations are often lower than New York State background soil arsenic concentrations. Accordingly, the soil arsenic SCOs (13 mg/kg for protection of ecological resources and 16 mg/kg for protection of human health) contained in 6NYCRR Part 375 were established using New York State rural background concentrations. Since the soil arsenic SCOs are below 20 mg/kg, which the Agencies have represented as generally being the upper limit of the local background arsenic concentration, a number of the CMAs use 20 mg/kg as a site-specific soil arsenic cleanup goal. However, a comparison of the soil arsenic SCOs to FMC estimated post-remediation arsenic concentrations on individual properties (Table H-2 in Appendix H) indicate that for certain CMAs, a number of properties are expected to achieve post-remediation soil arsenic concentrations that are at or below the arsenic SCOs.

The Agencies' CAOs include the following goal:

- "The Point of Departure", or starting point for corrective action risk-management decisions pertaining to arsenic in soil, is the site-specific residential background considering site-specific histories of use for current and reasonably anticipated future residential properties within these study areas."

[2] See bolded paragraph at the beginning of the Introduction Section.

This goal expresses the Agencies' preference for corrective measures for residential properties that would result in soil arsenic conditions that are similar to residential site-specific background concentrations. The Agencies have represented 20 mg/kg as generally being the upper limit of local background level for arsenic in soil for residential properties, and have advised residents (e.g., in the November 2009 letters) that levels above 20 mg/kg are considered "elevated". Therefore, it is expected that the Agencies would not be inclined to approve cleanup levels above 20 mg/kg for residential properties. All of the CMAs, except CMAs 1, 4 and 5 meet this goal on an average basis (i.e., post-remediation property averages would be below 20 mg/kg soil arsenic).

The following is FMC's assessment of each CMA's institutional criterion.[2]

CMAs 1, 4 and 5 do not achieve 20 mg/kg average soil arsenic concentrations on all properties, and therefore may be less likely to be accepted by the Agencies. Although average community-wide soil arsenic concentrations would be below 20 mg/kg for CMA 4 and CMA 5, not all individual residential properties would have average concentrations below 20 mg/kg. Consequently, these alternatives are considered to be not favorable with respect to the institutional criterion.

In the case of CMA 2, all properties would be remediated to 20 mg/kg or below with a resulting soil average for all remediated properties of 7 mg/kg. For CMAs 3 and 6A through 8, all residential properties would be remediated to 20 mg/kg or below on an average basis, with varying maximum concentrations. The resulting soil arsenic average for all remediated properties in the two study areas for these CMAs would range from 11 mg/kg (CMA 8) to 16 mg/kg (CMA 2).

CAO No. 1 requires corrective action decision-making to be based on site-specific data, including current and reasonably anticipated future land uses. CMAs 2 and 8 are inconsistent with CAO No. 1 because they apply putative residential background values for arsenic in soil to all properties in the Study Areas, including those which are not now and are not reasonably anticipated to be used for residential purposes.[2] However, CMA 8 employs criteria for all properties that allow for unrestricted use which is consistent with CAO 1A.

Action-specific standards, criteria and guidance would be identified, integrated into the design and met during implementation of each CMA (e.g., Village ordinances/requirements related to work hours and use of public roads). All CMAs are comparable with respect to compliance with such action-specific standards, criteria and guidance.

Therefore, CMAs 3 and 6A through 7B are considered by FMC to be favorable with respect to the institutional criteria; CMAs, 2 and 8 are considered "moderate" for this criteria.

[2] See bolded paragraph at the beginning of the Introduction Section.

7.8 Green Remediation Practices

This criterion was added to the evaluation of the CMAs at the request of the Middleport Community Input Group, is consistent with the Agencies' CAOs, and considers the environmental effects of the remedial actions and consistency with the NYSDEC's and USEPA's green remediation practices. The primary considerations for this criterion are 1) consumption of natural resources (soil and fuel), 2) extent of demolition and earth moving activities, 3) waste generation, and 4) greenhouse gas and other air emissions. Disposition of the remediation wastes is a key consideration under this criterion.

The following is FMC's assessment and rating of each CMA's green remediation practices criterion.[2]

CMA 1 is considered favorable with respect to this criterion because no further action would be required for the CMS Study Areas and therefore no wastes would be generated and no natural resources would be consumed.

CMA 2 is the least favorable CMA due to the extensive amount of soil to be excavated, the number of trees to be destroyed, the amount of clean fill (including topsoil) needed to replace excavated soil, the amount of fuel consumed for trucking and equipment, and the associated air emissions. Imported clean backfill soils represent a valuable resource that would be consumed by this alternative. CMA 2 is considered not favorable with respect to the green remediation criterion.

For CMAs 3, 4 and 5, these considerations are proportionate to the number of properties and soil volumes to be remediated. These CMAs would be associated with less than one-third of the resource utilization and air emissions than those associated with CMA 2. CMAs 3, 4 and 5 are considered moderate with respect to the green remediation practices criterion, except for disposal of remediation wastes in a commercial landfill for CMA 3 due the relatively larger amount of soil to be transported under this disposal option (see Appendix D for a detailed comparison of disposal options).

CMAs 6A through 8 utilize more resources and generate more air emissions than CMAs 3, 4 and 5 proportionate to the increasing number of properties and soil to be remediated, and truck loads/miles travelled for disposition of the remediation wastes. CMAs 6A through 7B are considered moderate by FMC for this criterion for disposal in the CAMU and unfavorable for disposal in a commercial landfill (see Appendix D), similar to CMAs 3, 4 and 5. CMA 8 is considered not favorable with respect to this criterion, similar to CMA 2.

[2] See bolded paragraph at the beginning of the Introduction Section.

7.9 Cost

The CMAs represent a wide range of costs, consistent with the number of properties and estimated soil volumes to be remediated, as well as the remediation waste disposal option selected. A detailed cost estimate for each alternative has been developed for both waste disposal options, and is presented in Appendix I and summarized in Table 5-4. The total estimated costs are presented in the table below. FMC's evaluation of CMA cost estimates is presented after the table.[2]

CMA	Estimated (Rounded) Total Cost (Capital and OM&M)	
	CAMU	Landfill (with 25% beneficial re-use)
1	$0.4M	$0.4M
2	$58.0M	$68.7M
3	$23.6M	$27.4M
4	$13.3M	$15.3M
5	$9.8M	$11.3M
6A	$26.7M	$31.3M
6B	$29.9M	$35.2M
7A	$30.2M	$35.7M
7B	$34.5M	$40.9M
8	$42.9M	$50.9M

The cost savings for disposal in the CAMU compared to the landfill increases proportionate to the volume of soil disposed. Approximately $10M would be saved utilizing the CAMU to its full design capacity (as required for implementation of CMA 2, see Table I-4 in Appendix I). The CAMU costs presented herein are based on utilizing the CAMU to its full design capacity because the CAMU, if approved, may be used for other FMC study areas situated south of Pearson/Stone Roads. It is therefore not appropriate for the cost reductions achievable with the CAMU to be solely evaluated based on its potential use in the remediation scenarios considered for the Suspected Air Deposition and Culvert 105 Study Areas. The potential value for use on other FMC Middleport remediation projects should also be considered in the evaluation of the waste disposal options for this CMS.

[2] See bolded paragraph at the beginning of the Introduction Section.

8. FMC's Justification and Recommendation of the Corrective Measures Alternative

This Draft CMS Report is FMC's work product. It was prepared by FMC's team of professionals and experts from inside and outside the company. FMC conferred with the Agencies in preparing the draft report, and attempted to address various comments provided by the Agencies on the draft report. However, FMC understands that the Agencies do not necessarily agree with or accept the various conclusions, determinations, assessments, assertions or judgments which are expressed by FMC throughout this draft report. Many of these instances where FMC has stated its opinion in this draft report are identified by specific text or by a footnote which references this paragraph so as to clearly differentiate such opinions from the factual information provided in the report.

This section of the Draft CMS Report presents FMC's recommended CMA for the Suspected Air Deposition and Culvert 105 Study Areas and justification for the recommended CMA. FMC's recommendation and justification are based on the detailed evaluation of alternatives by FMC using the CAOs and the evaluation criteria set forth in the approved CMS Work Plan.

Table 8-1 summarizes the comparative evaluation of alternatives presented in detail in Section 7 by FMC and Appendix D. Table 8-1 shows that all CMAs result in acceptable long-term human health risks (i.e., for all of the alternatives, 1 through 8, the estimated excess life-time cancer risks are within or below the range of 10^{-4} to 10^{-6}, and the non-cancer hazard indices are below the target value of 1).[3] As described in Section 7.6, there is very little difference in the amount of risk reduction achieved between the CMAs. All of the CMAs also result in acceptable ecological risks in the Culvert 105 area north of Sleeper Street, the area of focus requested by the Agencies based on the perception that this is the area where the presence of wildlife might be expected.[3] The CMAs differ more substantially with respect to the remaining evaluation criteria - i.e., community/property owner acceptance; technical effectiveness, performance, reliability, implementability and safety; the environmental impacts associated with CMA implementation; short-term human health risks associated with CMS implementation; institutional compliance; and adherence to green remediation practices.

The following is FMC's assessment of the CMAs in support of our recommended CMA.[3]

CMA 1 satisfies more evaluation criteria than any other CMA.[3] However, it does not satisfy the institutional compliance criterion because it is inconsistent with the CAO stating that the "point of departure," or starting point, for corrective action risk-management decisions pertaining to arsenic in soil with respect to residential properties is the site-specific residential background soil arsenic value(s).

[3] See bolded paragraph at the beginning of Section 8.

CMA 2 satisfies the institutional criterion in part because it adopts the most stringent application of the arsenic concentration (20 mg/kg) that the Agencies have represented as generally being the upper limit of local background level for residential properties. However, CMA 2 is not consistent with CAO No. 1 which requires corrective action decision-making to be based on site-specific data, including current and reasonably anticipated future land use(s).[3] CMA 2 applies a putative residential background value for arsenic in soil to all properties in the CMS Study Areas, including those which are not now and are not reasonably anticipated to be residential.[3] Moreover, in FMC's opinion, apart from very small differences in long-term human health and ecological risk reduction, CMA 2 compares unfavorably to all the other CMAs with respect to the remaining evaluation criteria.

CMAs 3 and 6A through 7B satisfy the institutional criteria and are consistent with the CAOs requiring the use of site-specific residential background for soil arsenic values as the point of departure for corrective action decision-making with respect to residential properties and allowing the use of alternative (higher) values for non-residential properties. These CMAs and CMA 8 were assessed by FMC as moderate for the community/property owner acceptance, technical, and environmental evaluation criteria.

CMA 8 is inconsistent with CAO No. 1 for the same reason that CMA 2 is inconsistent with that CAO.[3] CMA 8 applies putative residential background values for arsenic in soil to all properties in the CMS Study Areas, regardless of current and reasonably anticipated future use.[3] CMA 8 is therefore assessed by FMC as unfavorable for the institutional criteria. It is also assessed by FMC as unfavorable for the environmental and short-term safety criteria.

CMAs 4 and 5 do not satisfy the institutional criteria for the same reasons that CMA 1 does not.

CMAs 2 and 8 were assessed by FMC as unfavorable for the green remediation practices criterion, primarily due to the large amount of soil to be remediated and transported under either disposal option. Likewise, CMAs 3 and 6A through 7B were assessed by FMC as unfavorable for the off-Site disposal option, and as favorable for the CAMU disposal option due primarily to the relatively smaller amounts of soil to be remediated and truck loads of material to be transported.

The soil which would be generated by implementation of the CMAs is well-suited to disposal in an on-Site CAMU. The use of the CAMU would essentially entail the relocation of soils that pose no unacceptable human health or environmental risks at their current locations to an on-Site secure unit where they would also pose no unacceptable human health or environmental risks.[3] Considering this, and given the potential cost savings, greater flexibility during construction, lower resource utilization, lower potential for greenhouse gas and particulate emissions, and lower probability of traffic accidents associated with the CAMU option compared to off-Site disposal, FMC recommends use of the CAMU as the disposal option under all of the CMAs. The CAMU also has the added benefit of preserving off-Site commercial landfill space for its intended purpose (i.e., garbage and waste disposal) and is consistent with the industrial use of the property.

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[3] See bolded paragraph at the beginning of Section 8.

On the basis of the detailed evaluation and critical comparison of alternatives, FMC recommends CMA 3 as the preferred final corrective measure and use of a designated CAMU for disposal and management of the remediation waste.

9. References

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Tables

TABLE 3-1
SUMMARY OF PRIOR REMEDIAL ACTIVITIES COMPLETED BY FMC WITHIN THE CMS STUDY AREAS
DRAFT – MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK

Remedial Activity	Properties/Areas Within the CMS Study Areas Where Remedial Activities Conducted	Approximate Volume of Soil Excavated from CMS Study Areas (cubic yards)	Estimated Average Arsenic Concentration in Excavated Soil (mg/kg)	Estimated Post-Remediation Arsenic Concentration in Remediated Properties/Areas (mg/kg)	
				Average (mg/kg)	Maximum (mg/kg)
1996 Bleacher Area IRM	• Southern bleachers area of the Roy-Hart School Property	2,200	152	14.1	47.7
1999 Roy-Hart School ICM	• Athletic field area in the southern portion of the Roy-Hart School Property, and extending onto FMC-owned strip of land	39,000	55	6.3 (ICM portion within the school property only)	29.3 (ICM portion within the school property only)
2003 West Properties ICM	• 14 West residential properties along South Vernon Street and Main Street	15,000	94	5.5 to 8.8 (per property range of values; excludes right-of-ways)	9.2 to 23.8 (per property range of values; excludes right-of-ways)
2005 North Railroad Property Phase 1 ICM (see Notes 1 and 2)	• The southeastern portion of the Wooded Parcel, which is traversed by the North Ditch of the FMC-owned North Railroad Property, and along the southern property line of the Roy-Hart School Property abutting the North Railroad Property	300	201	All soil corresponding to the data points collected within the CMS Study Areas portion were removed during the remediation and replaced with backfill having arsenic concentrations of 1.1 to 7.0 mg/kg	
2007-2008 Early Actions (see Note 2)	• 12 P-Block residential properties	23,750	43	4.7 to 18.6 (per property range of values)	8.3 to 31.7 (per property range of values)
	• Wooded Parcel		67	21.3	79.1
	• Property AB-4 along Culvert 105 north of the Erie Canal		43	28.6	98.7
	• 7 other properties along Culvert 105 north of the Erie Canal		39	6.2 to 11.6 (per property range of values)	13.2 to 19.6 (per property range of values)
Overall Summary	**36 off-site properties within the CMS Study Areas**	**80,000**	**39 to 201 (range)**	**4.7 to 28.6 (range)**	**8.3 to 98.7 (range)**

Notes:
1. The FMC-owned North Railroad Property is not within the CMS Study Areas. Remedial activities at the North Railroad Property were performed immediately upstream of the inlet to Culvert 105, and extended onto the southeastern portion of the Wooded Parcel and along the southern boundary of the Roy-Hart School Property, both of which are within the CMS Study Areas. The total volume of soil excavated during the Phase 1 ICM was approximately 16,000 cubic yards, of which approximately 300 cubic yards was excavated from the Wooded Parcel.
2. Inspection, monitoring and maintenance activities are on-going at the North Railroad Property, Wooded Parcel and Margaret Droman Park (Culvert 105) under plans approved by the Agencies.

TABLE 5-1
IDENTIFICATION OF CORRECTIVE MEASURES ALTERNATIVES
DRAFT – MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK

Alternative	Post-Remediation Soil Arsenic Goals (1)		Non-ICM Area of Roy-Hart School Property
	Property Average	Property Maximum	
1	Not applicable – No Further Action	Not applicable – No Further Action	No Further Action
2	Not applicable – no average value	20 mg/kg	Included
3	20 mg/kg (residential) 30 mg/kg (public/institutional) (2) 40 mg/kg (agricultural, commercial, industrial, railroad, utility) (2)	40 mg/kg (residential) 60 mg/kg (public/institutional) (2) 80 mg/kg (agricultural, commercial, industrial, railroad, utility) (2)	Institutional Controls (3)
4	30 mg/kg	60 mg/kg	No Further Action
5	40 mg/kg	80 mg/kg	No Further Action
6A	20 mg/kg (residential, public, institutional) 30 mg/kg (agricultural, commercial) (2) 40 mg/kg (industrial, railroad, utility) (2)	35 mg/kg (residential, public, institutional) 50 mg/kg (agricultural, commercial) (2) 80 mg/kg (industrial, railroad, utility) (2)	Institutional Controls (3)
6B	20 mg/kg (residential, public, institutional) 30 mg/kg (agricultural, commercial) (2) 40 mg/kg (industrial, railroad, utility) (2)	35 mg/kg (residential, public, institutional) 50 mg/kg (agricultural, commercial) (2) 80 mg/kg (industrial, railroad, utility) (2)	Included
7A	20 mg/kg (residential, public, institutional) 30 mg/kg (agricultural, commercial) (2) 40 mg/kg (industrial, railroad, utility) (2)	30 mg/kg (residential, public, institutional) 50 mg/kg (agricultural, commercial) (2) 80 mg/kg (industrial, railroad, utility) (2)	Institutional Controls (3)
7B	20 mg/kg (residential, public, institutional) 30 mg/kg (agricultural, commercial) (2) 40 mg/kg (industrial, railroad, utility) (2)	30 mg/kg (residential, public, institutional) 50 mg/kg (agricultural, commercial) (2) 80 mg/kg (industrial, railroad, utility) (2)	Included
8	20 mg/kg	30 mg/kg	Included

Notes:
1. CMAs 3, 6A, 6B, 7A and 7B have different post-remediation soil arsenic goals for different property usages, while CMAs 1, 2, 4, 5 and 8 have goals that are applied regardless of property usage.
2. Includes use of legal mechanism; if the property use changes in the future, further evaluation, and if necessary remediation, will be performed.
3. Includes use of legal mechanism for the non-ICM area of the school property; further action to be performed if the use of the property changes to residential.

TABLE 5-1a
SUMMARY OF CORRECTIVE MEASURES ALTERNATIVES
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

		Alternative									
		1	**2**	**3**	**4**	**5**	**6A**	**6B**	**7A**	**7B**	**8**
a.	**Number of Properties To Be Remediated (see Note 1)**	0	181	152	86	48	157	158	164	165	179
b.	**Number of Properties Previously Remediated and No Further Action Needed**	31	31	31	31	31	31	31	31	31	31
c.	**Total Number of Properties Remediated**	**31**	**212**	**183**	**117**	**79**	**188**	**189**	**195**	**196**	**210**
d.	**Estimated Future Volume of Soil To Be Remediated (cubic yards) (see Note 2)**	0	228,000	69,000	38,000	28,000	85,000	98,000	101,000	119,000	162,000
e.	**Total Volume of Soil Remediated (cubic yards)**	**80,000**	**308,000**	**149,000**	**118,000**	**108,000**	**165,000**	**178,000**	**181,000**	**199,000**	**242,000**
f.	**Estimated Additional Length of Culvert 105 Buried Pipe to be Removed and Replaced as Part of Future Remediation (lineal feet) (see Note 3)**	0	1,325	1,185	900	900	1,185	1,185	1,185	1,185	3,025
g.	**Total Length of Culvert 105 Buried Pipe Replaced/Installed (lineal feet)**	**1,110**	**2,435**	**2,295**	**2,010**	**2,010**	**2,295**	**2,295**	**2,295**	**2,295**	**4,135**
h.	**Number of Properties Requiring Institutional Controls (see Notes 4 and 5)**	**0**	**11**	**25**	**14**	**14**	**22**	**21**	**22**	**21**	**0**

Notes:

1. The number of properties to be remediated is in addition to the 31 off-Site properties in the CMS Study Areas that were previously subject to remediation and where no further action is needed.
2. The estimated future volume of soil to be remediated is in addition to the approximately 80,000 cubic yards of soil removed from the CMS Study Areas during prior remedial actions.
3. Estimated length of Culvert 105 buried pipe to be replaced is in addition to the 1,110 lineal feet of Culvert 105 pipe that was replaced and/or installed in the CMS Study Areas during prior remedial actions.
4. Number of properties requiring institutional controls does not include the existing deed restrictions for the Wooded Parcel.
5. Refer to Table 5-1b for listing of property usages considered and number of properties requiring institutional controls for those usages.

TABLE 5-1b
PROPERTIES REQUIRING INSTITUTIONAL CONTROLS
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Number of Properties Requiring Institutional Controls										
Property Usage Considered (see Note 1)	**CMA 1**	**CMA 2**	**CMA 3**	**CMA 4**	**CMA 5**	**CMA 6A**	**CMA 6B**	**CMA 7A**	**CMA 7B**	**CMA 8**
Residential	0	8	10	11	11	10	10	10	10	0
Public, Institutional	0	2	5	2	2	2	2	2	2	0
Agricultural, Commercial	0	1	6	1	1	6	6	6	6	0
Industrial, Railroad, Utility	0	0	3	0	0	3	3	3	3	0
Non-ICM Area of Roy-Hart School Property	0	0	1	0	0	1	0	1	0	0
TOTAL	0	11	25	14	14	22	21	22	21	0

Note:
1. The identification of land usage is taken from Table H-2 in Appendix H of the Draft CMS Report.

TABLE 5-2a
SOIL ARSENIC DATA FROM 2001-2003 GASPORT BACKGROUND STUDY
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Property Group	Land Use Type	Property ID	Sample Location	Depth (inches)	Arsenic Concentration (mg/kg)				
					Primary	Duplicate	Agency Split	Other	Combined
Wooded-Agricultural	Crop Field	Ca	CA-1A	0-3	56.7				56.7
Wooded-Agricultural	Crop Field	Ca	CA-1B	0-3	4.9				4.9
Wooded-Agricultural	Crop Field	Ca	CA-2A	0-3	5.2				5.2
Wooded-Agricultural	Crop Field	Ca	CA-2B	0-3	4.1				4.1
Wooded-Agricultural	Crop Field	Ca	CA-3A	0-3	5	4.6			4.8
Wooded-Agricultural	Crop Field	Ca	CA-3B	0-3	3.5				3.5
Wooded-Agricultural	Crop Field	Ca	CA-4A	0-3	33.5		31.1		32.3
Wooded-Agricultural	Crop Field	Ca	CA-4B	0-3	7.1				7.1
Wooded-Agricultural	Crop Field	Cc	CC-1A	0-3	3.2				3.2
Wooded-Agricultural	Crop Field	Cc	CC-1B	0-3	3 J				3
Wooded-Agricultural	Crop Field	Cc	CC-2A	0-3	3.3		3.1		3.2
Wooded-Agricultural	Crop Field	Cc	CC-2B	0-3	2.9 J				2.9
Wooded-Agricultural	Crop Field	Cc	CC-3A	0-3	3.2				3.2
Wooded-Agricultural	Crop Field	Cc	CC-3B	0-3	2.3 J				2.3
Wooded-Agricultural	Crop Field	Cc	CC-4A	0-3	3.2				3.2
Wooded-Agricultural	Crop Field	Cc	CC-4B	0-3	4.4 J				4.4
Wooded-Agricultural	Crop Field	Cd	CD-1A	0-3	4.1		3.5		3.8
Wooded-Agricultural	Crop Field	Cd	CD-1B	0-3	5.1 J				5.1
Wooded-Agricultural	Crop Field	Cd	CD-2A	0-3	9.8				9.8
Wooded-Agricultural	Crop Field	Cd	CD-2B	0-3	11.9 J				11.9
Wooded-Agricultural	Crop Field	Cd	CD-3A	0-3	3.7				3.7
Wooded-Agricultural	Crop Field	Cd	CD-3B	0-3	4.4 J				4.4
Wooded-Agricultural	Crop Field	Cd	CD-4A	0-3	9.4				9.4
Wooded-Agricultural	Crop Field	Cd	CD-4B	0-3	8.4 J				8.4
Wooded-Agricultural	Crop Field	Ce	CE-1A	0-3	3.4				3.4
Wooded-Agricultural	Crop Field	Ce	CE-1B	0-3	4.7 J				4.7
Wooded-Agricultural	Crop Field	Ce	CE-2A	0-3	4.6				4.6
Wooded-Agricultural	Crop Field	Ce	CE-2B	0-3	3.4 J				3.4
Wooded-Agricultural	Crop Field	Ce	CE-3A	0-3	4.2				4.2
Wooded-Agricultural	Crop Field	Ce	CE-3B	0-3	4.1 J				4.1
Wooded-Agricultural	Crop Field	Ce	CE-4A	0-3	3.7		2.8		3.3
Wooded-Agricultural	Crop Field	Ce	CE-4B	0-3	4 J				4
Wooded-Agricultural	Crop Field	Ch	CH-1A	0-3	3.3				3.3
Wooded-Agricultural	Crop Field	Ch	CH-1B	0-3	5.3 J				5.3
Wooded-Agricultural	Crop Field	Ch	CH-2A	0-3	5.5				5.5
Wooded-Agricultural	Crop Field	Ch	CH-2B	0-3	36.9 J				36.9
Wooded-Agricultural	Crop Field	Ch	CH-3A	0-3	54.4		52.6		53.5
Wooded-Agricultural	Crop Field	Ch	CH-3B	0-3	5.3 J				5.3

TABLE 5-2a
SOIL ARSENIC DATA FROM 2001-2003 GASPORT BACKGROUND STUDY
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Property Group	Land Use Type	Property ID	Sample Location	Depth (inches)	Arsenic Concentration (mg/kg)				
					Primary	Duplicate	Agency Split	Other	Combined
Wooded-Agricultural	Crop Field	Ch	CH-4A	0-3	7.7				7.7
Wooded-Agricultural	Crop Field	Ch	CH-4B	0-3	3.3 J				3.3
Wooded-Agricultural	Wooded	Wd	WD-1A	0-3	6.9	6.9			6.9
Wooded-Agricultural	Wooded	Wd	WD-1B	0-3	3.3 J				3.3
Wooded-Agricultural	Wooded	Wd	WD-2A	0-3	7.9		7.3		7.6
Wooded-Agricultural	Wooded	Wd	WD-2B	0-3	6.7 J				6.7
Wooded-Agricultural	Wooded	Wd	WD-3A	0-3	8.8				8.8
Wooded-Agricultural	Wooded	Wd	WD-3B	0-3	8.1 J				8.1
Wooded-Agricultural	Wooded	Wd	WD-4A	0-3	5.1				5.1
Wooded-Agricultural	Wooded	Wd	WD-4B	0-3	7.2 J				7.2
Wooded-Agricultural	Wooded	We	WE-1A	0-3	4.2				4.2
Wooded-Agricultural	Wooded	We	WE-1B	0-3	4.7				4.7
Wooded-Agricultural	Wooded	We	WE-2A	0-3	5.2				5.2
Wooded-Agricultural	Wooded	We	WE-2B	0-3	3.2				3.2
Wooded-Agricultural	Wooded	We	WE-3A	0-3	4.7		3.8		4.3
Wooded-Agricultural	Wooded	We	WE-3B	0-3	4				4
Wooded-Agricultural	Wooded	We	WE-4A	0-3	3.7				3.7
Wooded-Agricultural	Wooded	We	WE-4B	0-3	3.4				3.4
Commercial-Industrial	Commercial	Bb	BB-1A	0-3	2.4 J	6.1 J	2.3	2.2	3.3
Commercial-Industrial	Commercial	Bb	BB-2A	0-3	4.6				4.6
Commercial-Industrial	Commercial	Bb	BB-3A	0-3	5.2				5.2
Commercial-Industrial	Commercial	Bf	BF-1A	0-3	7.5				7.5
Commercial-Industrial	Commercial	Bf	BF-2A	0-3	9.9		2.9		6.4
Commercial-Industrial	Commercial	Bf	BF-3A	0-3	13.2				13.2
Commercial-Industrial	Industrial	Ia	IA-1A	0-3	33.5	32.1			32.8
Commercial-Industrial	Industrial	Ia	IA-2A	0-3	26.1				26.1
Commercial-Industrial	Industrial	Ia	IA-3A	0-3	3.5		3.1		3.3
Commercial-Industrial	Industrial	Ib	IB-1A	0-3	12.5				12.5
Commercial-Industrial	Industrial	Ib	IB-2A	0-3	20.4		20.8		20.6
Commercial-Industrial	Industrial	Ib	IB-3A	0-3	4.9				4.9
Residential-Public	Residential	Ra	RA-1A	0-3	6.3				6.3
Residential-Public	Residential	Ra	RA-2A	0-3	17.4		12.5		15
Residential-Public	Residential	Ra	RA-3A	0-3	4.5				4.5
Residential-Public	Residential	Rb	RB-1A	0-3	16.7		3.5		10.1
Residential-Public	Residential	Rb	RB-2A	0-3	11.6				11.6
Residential-Public	Residential	Rb	RB-3A	0-3	12.8				12.8
Residential-Public	Residential	Rc	RC-1A	0-3	8.7		7.2		8
Residential-Public	Residential	Rc	RC-2A	0-3	9.5				9.5

TABLE 5-2a
SOIL ARSENIC DATA FROM 2001-2003 GASPORT BACKGROUND STUDY
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Property Group	Land Use Type	Property ID	Sample Location	Depth (inches)	Arsenic Concentration (mg/kg)				
					Primary	Duplicate	Agency Split	Other	Combined
Residential-Public	Residential	Rc	RC-3A	0-3	9.9				9.9
Residential-Public	Residential	Re	RE-1A	0-3	5.7				5.7
Residential-Public	Residential	Re	RE-2A	0-3	7.7				7.7
Residential-Public	Residential	Re	RE-3A	0-3	18.6		20.3		19.5
Residential-Public	Residential	Rf	RF-1A	0-3	14.7		14.3		14.5
Residential-Public	Residential	Rf	RF-2A	0-3	21.2				21.2
Residential-Public	Residential	Rf	RF-3A	0-3	14.5				14.5
Residential-Public	Residential	Rg	RG-1A	0-3	7.3				7.3
Residential-Public	Residential	Rg	RG-2A	0-3	5.6				5.6
Residential-Public	Residential	Rg	RG-3A	0-3	8		7.3		7.7
Residential-Public	Residential	Rh	RH-1A	0-3	4.6	3.9	4.2		4.2
Residential-Public	Residential	Rh	RH-2A	0-3	20.3 J				20.3
Residential-Public	Residential	Rh	RH-3A	0-3	9.1				9.1
Residential-Public	School	Sa	SA-1A	0-3	4.2	4.3	3.3	3.5	3.8
Residential-Public	School	Sa	SA-2A	0-3	3.3				3.3
Orchard	Orchard	Oa	OA-1A	0-3	14.7				14.7
Orchard	Orchard	Oa	OA-2A	0-3	8.8		8		8.4
Orchard	Orchard	Oa	OA-3A	0-3	27.8				27.8
Orchard	Orchard	Oa	OA-4A	0-3	10.4				10.4
Orchard	Orchard	Ob	OB-1A	0-3	3.8	3.7			3.8
Orchard	Orchard	Ob	OB-2A	0-3	40.4		45.9		43.2
Orchard	Orchard	Ob	OB-3A	0-3	4.6				4.6
Orchard	Orchard	Ob	OB-4A	0-3	3.1				3.1
Orchard	Orchard	Od	OD-1A	0-3	130	129	105		121
Orchard	Orchard	Od	OD-2A	0-3	81.9				81.9
Orchard	Orchard	Od	OD-3A	0-3	24.5				24.5
Orchard	Orchard	Od	OD-4A	0-3	56.3				56.3

Notes:
1. All samples collected in May 2002 during the Gasport Background Study.
2. Approximate locations of properties sampled shown on Figure 8.1b of RFI Report Volume II.
3. Results reported in *Development of Arsenic Background in Middleport Soil* (CRA 2003).
4. The combined result is the arithmetic average of all values reported for any primary field sample, field duplicate sample, Agency split sample, and additional other samples collected.
5. J = Associated value is estimated.
6. Table duplicated from Table 5.2a in RFI Report Volume II and Table 7.2a in RFI Report Volume IV.

TABLE 5-2b
SUMMARY OF SOIL ARSENIC CONCENTRATIONS BY PROPERTY TYPE/USAGE FROM 2001-2003 GASPORT BACKGROUND STUDY
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Major Property Type/Usage	Number of Samples	Arsenic Concentrations (mg/kg)				
		Range	Mean	95% UCL	95th Percentile	98th Percentile
Orchard Land (3 Orchards)	12	3.1 to 121.3	33.3	63.5	99.6	112.6
Wooded or Overgrown Land and Agricultural Crop Field Land (2 Wooded, 5 Crop Fields)						
Including 4 potential statistical outliers	56	3.1 to 56.7	7.9	14.2	33.5	51.8
Excluding 4 potential statistical outliers	52	3.1 to 11.9	5.0	5.5	9.1	9.8
Commercial and Industrial Land (2 Business and 2 Industrial Properties)	12	2.2 to 32.8	11.7	18.4	29.1	31.3
Residential and Public Land (7 Residential Properties, 1 School)	23	3.3 to 21.1	10.1	12.0	20.2	20.7

Notes:

1. 95% UCL = 95% Upper Confidence Limit on the Mean
2. The 2001-2003 Gasport Background Study generated total arsenic data for 103 surface soil samples (0- to 3-inch depth interval) collected from four major property types/usage groups. An analysis for potential statistical outliers identified four points in the wooded/overgrown/agricultural crop field land group.
3. Table duplicated from Table 5.2b in RFI Report Volume II and Table 7.2b in RFI Report Volume IV.

TABLE 5-3
SUMMARY OF ESTIMATED MIDDLEPORT SOIL ARSENIC BACKGROUND CONCENTRATIONS
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Property Type/Usage Weighting Factor Calculation Method[1]	Weighted Mean		95% UCL on Weighted Mean		95th Percentile		98th Percentile	
	Excluding Potential Outliers[2] N=99 (mg/kg)	Including Potential Outliers[3] N=103 (mg/kg)	Excluding Potential Outliers[2] N=99 (mg/kg)	Including Potential Outliers[3] N=103 (mg/kg)	Excluding Potential Outliers[2] N=99 (mg/kg)	Including Potential Outliers[3] N=103 (mg/kg)	Excluding Potential Outliers[2] N=99 (mg/kg)	Including Potential Outliers[3] N=103 (mg/kg)
2001 Gasport Work Plan[4, 5]	**8.1**	**9.7**	**8.7**	**12**	**19**	**22**	**28**	**30**
Updated 2001 Gasport Work Plan[6, 8]	13	14	19	19	39	40	76	75
Time-Weighted Alternative[7, 8]	9.3	11	13	14	23	25	40	41

See Notes on Page 2.

TABLE 5-3
SUMMARY OF ESTIMATED MIDDLEPORT SOIL ARSENIC BACKGROUND CONCENTRATIONS
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Notes:

1. The Middleport background soil arsenic concentrations presented in this table are statistical values that were calculated using property type/usage group weighting factors (i.e., percentages) derived for the Middleport study area. The property type/usage groups are defined in the NYSDEC document entitled "Program to Determine Extent of FMC-Related Arsenic Contamination in Middleport - Part A - Work Plan for Development of Arsenic Background in Middleport Soil" (Agencies, September 2001) [2001 Gasport Work Plan]. The statistical values are calculated based on the soil arsenic data for different property types/usages presented in the report entitled "Development of Arsenic Background in Middleport Soil" (CRA, February 2003) [2003 Gasport Background Study Report]; the data is also provided in Table 5.2b of RFI Report Volume II.
2. Calculated concentrations in this column are based on the 2003 Gasport Background Study data, excluding 4 potential outliers (total sample size = 99).
3. Calculated concentrations in this column are based on the 2003 Gasport Background Study data, including 4 potential outliers (total sample size = 103).
4. The 2001 Gasport Work Plan arsenic values were calculated using property type/usage group weighting factors specified in the 2001 Gasport Work Plan that are time-weighted, with cumulative orchard areas within two time periods (1931-1958 and 1968-1978), based on aerial photos provided in the Draft RCRA Facility Investigation (RFI) Report (CRA, January 1999) [1999 Draft RFI Report]. The calculated arsenic values are presented in the 2003 Gasport Background Study Report. No value was presented for the 98th percentile in the 2003 Gasport Background Study Report The 98th percentile values were subsequently added in early 2011 in response to the Agencies' comments on the Draft CMS Report.
5. The Agencies selected 20 mg/kg arsenic (based on the weighted 95th percentile of the 2003 Gasport Background Study soil data, using the 2001 Gasport Work Plan calculation method) as the delineation criterion for FMC-related arsenic in Middleport soils for the purposes of the RFI, with consideration given to other factors that could influence potential historical air deposition and stormwater flow.
6. The Updated 2001 Gasport Work Plan arsenic values were calculated using revised property type/usage group weighting factors. The revised property type/usage group weighting factors were calculated as specified in the 2001 Gasport Work Plan and are time-weighted, with cumulative orchard areas within two time periods (1931-1958 and 1968-1978), based on aerial photos provided in the 1999 Draft RFI Report and eight additional aerial photos. The revised property type/usage group weighting factors and the calculated arsenic values are presented in Appendix 6B of RFI Report Volume I.
7. The Time Weighted Alternative arsenic values were calculated using revised property type/usage group weighting factors. The revised property type/usage group weighting factors are time-weighted based on the individual dates of each aerial photo used. The aerial photos used include those provided in the 1999 Draft RFI Report and eight additional photos. The revised property type/usage group weighting factors and the calculated arsenic values are presented in Appendix 6B of RFI Report Volume I.
8. The Agencies have not accepted the statistical values from the Updated 2001 Work Plan or the Time-Weighted Alternative presented in the second and third rows, for reasons explained in the Agencies March 10, 2008 letter.
9. Table modified from Table 5.3 in RFI Report Volume II and Table 7.3 in RFI Report Volume IV. The only modification was the addition of the 98th percentile values (see Note 4).

TABLE 5-4
SUMMARY OF COST ESTIMATES FOR CORRECTIVE MEASURES ALTERNATIVES
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Description	Estimated Cost									
	Alternative 1	Alternative 2		Alternative 3		Alternative 4		Alternative 5	
A. Soil Remediation Capital Costs (Excluding T&D) Subtotal =	$ -	$ 37,328,730		$ 14,928,250		$ 8,177,900		$ 5,545,100	
B. Culvert 105 Buried Pipe Removal and Replacement Capital Costs Subtotal =	$ -	$ 338,850		$ 299,250		$ 236,400		$ 236,400	
C. Engineering and Coordination Costs Associated with Soil and Culvert 105 Buried Pipe Remediation Capital Items Subtotal =	$ -	$ 3,766,758		$ 1,522,750		$ 841,430		$ 578,150	
D. Transportation and Disposal Capital Costs		**CAMU**	**Landfill**	**CAMU**	**Landfill**	**CAMU**	**Landfill**	**CAMU**	**Landfill**
Subtotal =	$ -	$ 13,701,000	$ 25,762,500	$ 3,622,500	$ 7,762,500	$ 1,995,000	$ 4,275,000	$ 1,470,000	$ 3,150,000
E. OM&M Costs Subtotal =	$ 362,608	$ 2,814,632	$ 1,440,632	$ 3,226,663	$ 2,812,663	$ 1,962,639	$ 1,734,639	$ 1,902,639	$ 1,734,639
TOTAL ESTIMATED COST =	$ 362,608	$ 57,949,970	$ 68,637,470	$ 23,599,413	$ 27,325,413	$ 13,213,369	$ 15,265,369	$ 9,732,289	$ 11,244,289

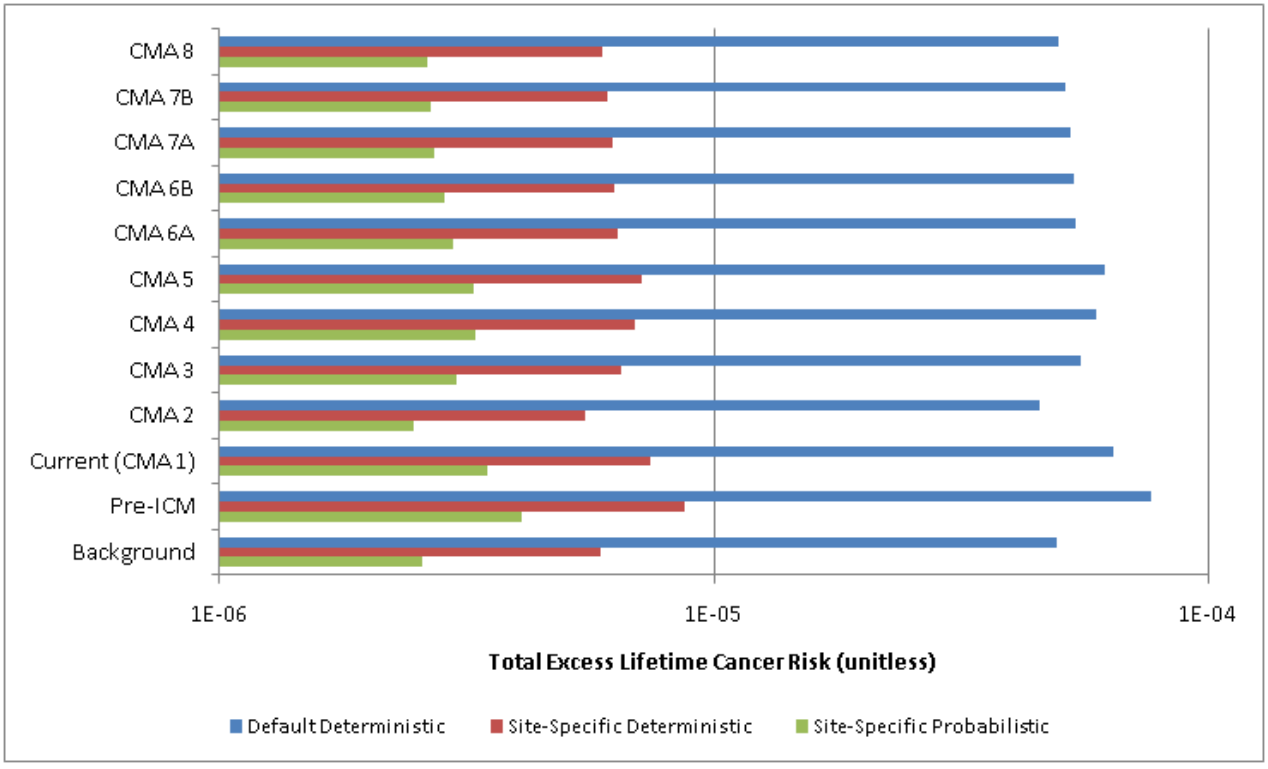
Description	Estimated Cost									
	Alternative 6A		Alternative 6B		Alternative 7A		Alternative 7B		Alternative 8	
A. Soil Remediation Capital Costs (Excluding T&D) Subtotal =	$ 17,149,050		$ 19,398,750		$ 19,475,700		$ 22,443,900		$ 28,537,400	
B. Culvert 105 Buried Pipe Removal and Replacement Capital Costs Subtotal =	$ 299,250		$ 299,250		$ 299,250		$ 299,250		$ 789,750	
C. Engineering and Coordination Cost Items Associated with Soil and Culvert 105 Buried Pipe Remediation Capital Items Subtotal =	$ 1,744,830		$ 1,969,800		$ 1,977,495		$ 2,274,315		$ 2,932,715	
D. Transportation and Disposal Capital Costs	**CAMU**	**Landfill**	**CAMU**	**Landfill**	**CAMU**	**Landfill**	**CAMU**	**Landfill**	**CAMU**	**Landfill**
Subtotal =	$ 4,462,500	$ 9,562,500	$ 5,145,000	$ 11,025,000	$ 5,302,500	$ 11,362,500	$ 6,339,000	$ 13,387,500	$ 9,241,500	$ 18,225,000
E. OM&M Costs Subtotal =	$ 3,028,657	$ 2,518,657	$ 3,008,655	$ 2,420,655	$ 3,124,657	$ 2,518,657	$ 3,134,655	$ 2,420,655	$ 1,334,608	$ 362,608
TOTAL ESTIMATED COST =	$ 26,684,287	$ 31,274,287	$ 29,821,455	$ 35,113,455	$ 30,179,602	$ 35,633,602	$ 34,491,120	$ 40,825,620	$ 42,835,973	$ 50,847,473

Notes:

1. Refer to Appendix I for a total breakdown of costs.
2. CAMU disposal costs assume Phase 1 portion of CAMU would be filled to capacity (169,350 tons or approximately 112,900 cy) followed by the Phase 2 area (172,500 tons or approximately 115,000 cy). If the CAMU is completely filled to capacity (both Phase 1 and Phase 2), then any remaining soil would be disposed of off-site at a commercial landfill. Based on this, CMA 2 requires landfill disposal to satisfy the disposal of soils exceeding the capacities of both the Phase I and Phase 2 CAMU.
3. CAMU cost represents $35/ton and $45/ton for placement in the Phase I and Phase 2 Areas, respectively.
4. Landfill cost represents 75% disposal in a commercial landfill as non-hazardous wastes at a cost of $80/ton and 25% beneficially reused as daily cover material at a commercial landfill at a cost of $60/ton.

TABLE 6-1a
TOTAL EXCESS LIFETIME CANCER RISKS (UNITLESS)
FOR SUSPECTED AIR DEPOSITION STUDY AREA
DRAFT – MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK

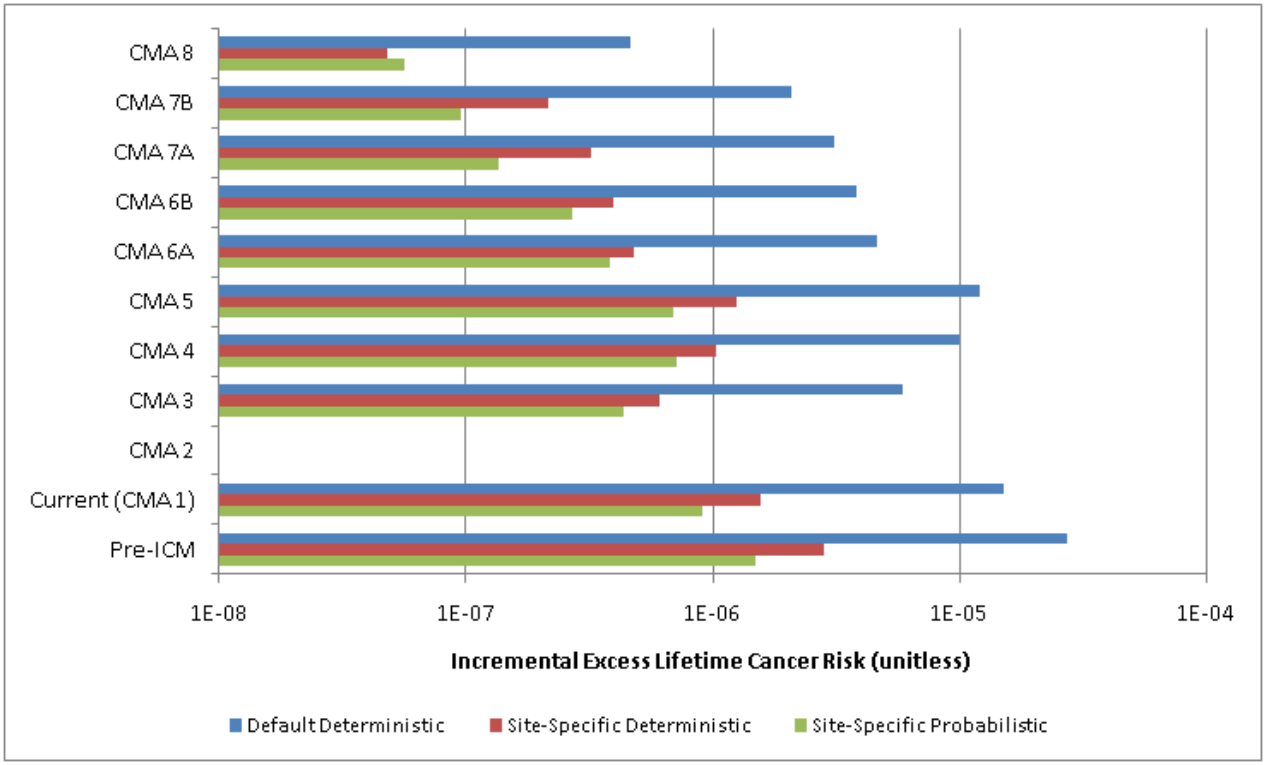
	CTE			RME		
	Default Deterministic	Site-Specific Deterministic	Site-Specific Probabilistic[a]	Default Deterministic	Site-Specific Deterministic	Site-Specific Probabilistic[a]
Background	6.2E-06	5.6E-07	4.2E-07	5.0E-05	5.9E-06	2.6E-06
Pre-ICM	9.7E-06	8.5E-07	7.1E-07	7.7E-05	8.7E-06	4.1E-06
Current (CMA 1)	8.3E-06	7.3E-07	6.1E-07	6.5E-05	7.5E-06	3.5E-06
CMA 2	5.7E-06	5.2E-07	3.8E-07	4.6E-05	5.5E-06	2.5E-06
CMA 3	7.0E-06	6.3E-07	4.9E-07	5.5E-05	6.5E-06	3.0E-06
CMA 4	7.6E-06	6.8E-07	5.7E-07	5.9E-05	6.9E-06	3.3E-06
CMA 5	7.9E-06	7.0E-07	6.0E-07	6.2E-05	7.2E-06	3.3E-06
CMA 6A	6.9E-06	6.2E-07	4.9E-07	5.4E-05	6.4E-06	3.0E-06
CMA 6B	6.7E-06	6.1E-07	4.9E-07	5.3E-05	6.3E-06	2.8E-06
CMA 7A	6.6E-06	6.0E-07	4.7E-07	5.3E-05	6.2E-06	2.7E-06
CMA 7B	6.5E-06	5.9E-07	4.5E-07	5.2E-05	6.1E-06	2.7E-06
CMA 8	6.3E-06	5.7E-07	4.4E-07	5.0E-05	5.9E-06	2.6E-06



Notes:
1. Total excess lifetime cancer risks calculated for adult plus child resident in the Air Deposition Study Area.
2. Calculations are for three different risk analysis methods, using both central tendency exposure (CTE) and reasonable maximum exposure (RME) values.
3. Chart shows RME values.

TABLE 6-1b
INCREMENTAL EXCESS LIFETIME CANCER RISKS (UNITLESS)
FOR SUSPECTED AIR DEPOSITION STUDY AREA
DRAFT –MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK

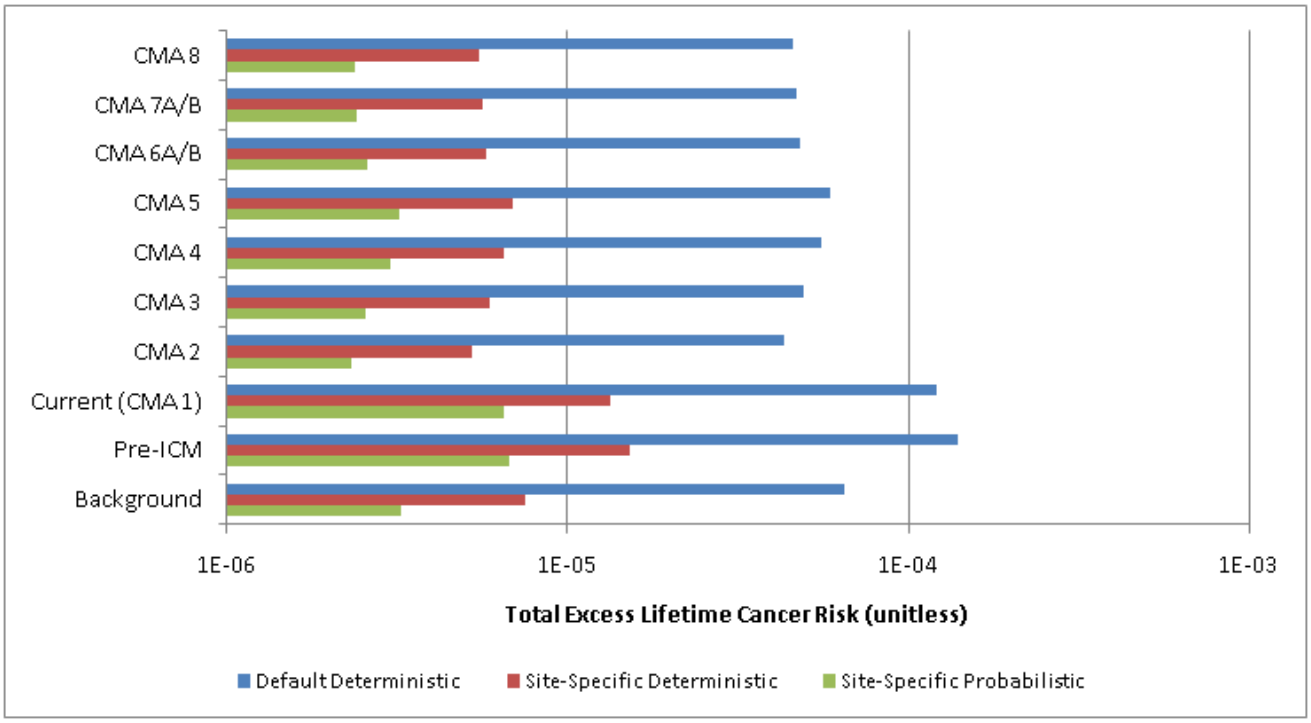
	CTE			RME		
	Default Deterministic	Site-Specific Deterministic	Site-Specific Probabilistic[a]	Default Deterministic	Site-Specific Deterministic	Site-Specific Probabilistic[a]
Pre-ICM	3.6E-06	2.8E-07	2.9E-07	2.7E-05	2.8E-06	1.5E-06
Current (CMA 1)	2.1E-06	1.7E-07	1.9E-07	1.5E-05	1.6E-06	9.1E-07
CMA 2	--	--	--	--	--	--
CMA 3	8.7E-07	7.0E-08	7.1E-08	5.9E-06	6.1E-07	4.3E-07
CMA 4	1.5E-06	1.2E-07	1.5E-07	9.9E-06	1.0E-06	7.2E-07
CMA 5	1.8E-06	1.4E-07	1.8E-07	1.2E-05	1.3E-06	6.9E-07
CMA 6A	7.0E-07	5.6E-08	7.5E-08	4.6E-06	4.8E-07	3.8E-07
CMA 6B	5.8E-07	4.6E-08	6.8E-08	3.8E-06	4.0E-07	2.7E-07
CMA 7A	4.7E-07	3.8E-08	5.3E-08	3.1E-06	3.2E-07	1.3E-07
CMA 7B	3.3E-07	2.7E-08	3.3E-08	2.1E-06	2.2E-07	9.6E-08
CMA 8	1.0E-07	8.4E-09	1.7E-08	4.6E-07	4.8E-08	5.6E-08



Notes:
1. Incremental excess lifetime cancer risks calculated for adult plus child resident in the Air Deposition Study Area.
2. Calculations are for three different risk analysis methods, using both central tendency exposure (CTE) and reasonable maximum exposure (RME) values.
3. Chart shows RME values.
4. Dashes (--) in table and missing bars in chart indicate that background risks are higher than site-related risks.

TABLE 6-2a
TOTAL EXCESS LIFETIME CANCER RISKS (UNITLESS)
FOR CULVERT 105 STUDY AREA NORTH OF THE ERIE CANAL
DRAFT – MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK

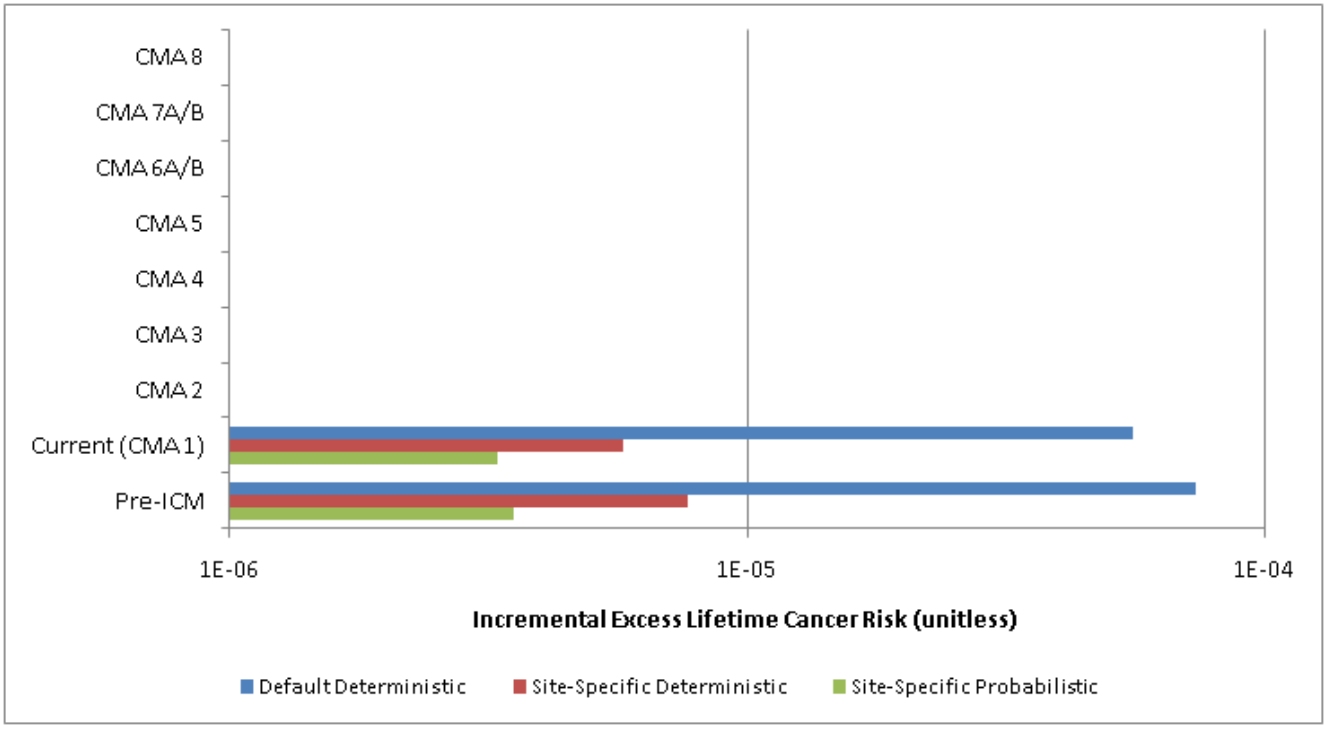
	CTE			RME		
	Default Deterministic	Site-Specific Deterministic	Site-Specific Probabilistic[a]	Default Deterministic	Site-Specific Deterministic	Site-Specific Probabilistic[a]
Background	7.3E-06	6.5E-07	4.6E-07	6.5E-05	7.5E-06	3.2E-06
Pre-ICM	1.5E-05	1.3E-06	9.1E-07	1.4E-04	1.5E-05	6.8E-06
Current (CMA 1)	1.4E-05	1.2E-06	8.0E-07	1.2E-04	1.3E-05	6.5E-06
CMA 2	5.3E-06	4.9E-07	3.5E-07	4.3E-05	5.2E-06	2.3E-06
CMA 3	5.9E-06	5.4E-07	3.8E-07	4.9E-05	5.9E-06	2.6E-06
CMA 4	6.6E-06	6.0E-07	4.5E-07	5.5E-05	6.5E-06	3.0E-06
CMA 5	7.1E-06	6.3E-07	4.7E-07	5.9E-05	6.9E-06	3.2E-06
CMA 6A/B	5.8E-06	5.3E-07	3.7E-07	4.8E-05	5.7E-06	2.6E-06
CMA 7A/B	5.7E-06	5.2E-07	3.7E-07	4.7E-05	5.7E-06	2.4E-06
CMA 8	5.6E-06	5.1E-07	3.6E-07	4.6E-05	5.5E-06	2.4E-06



Notes:
1. Total excess lifetime cancer risks calculated for adult plus child resident in the Air Deposition Study Area.
2. Calculations are for three different risk analysis methods, using both central tendency exposure (CTE) and reasonable maximum exposure (RME) values.
3. Chart shows RME values
4. Bars exceeding $1x10^{-4}$ are equal to $1x10^{-4}$ when rounded to one significant digit.

TABLE 6-2b
INCREMENTAL EXCESS LIFETIME CANCER RISKS (UNITLESS)
FOR CULVERT 105 STUDY AREA NORTH OF THE ERIE CANAL
DRAFT – MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK

	CTE			RME		
	Default Deterministic	Site-Specific Deterministic	Site-Specific Probabilistic[a]	Default Deterministic	Site-Specific Deterministic	Site-Specific Probabilistic[a]
Pre-ICM	7.6E-06	6.1E-07	4.5E-07	7.4E-05	7.7E-06	3.5E-06
Current (CMA 1)	6.4E-06	5.1E-07	3.4E-07	5.6E-05	5.8E-06	3.3E-06
CMA 2	--	--	--	--	--	--
CMA 3	--	--	--	--	--	--
CMA 4	--	--	--	--	--	--
CMA 5	--	--	1.2E-08	--	--	--
CMA 6A/B	--	--	--	--	--	--
CMA 7A/B	--	--	--	--	--	--
CMA 8	--	--	--	--	--	--



Notes:
1. Incremental excess lifetime cancer risks calculated for adult plus child resident in the Air Deposition Study Area.
2. Calculations are for three different risk analysis methods, using both central tendency exposure (CTE) and reasonable maximum exposure (RME) values.
3. Chart shows RME values.
4. Dashes (--) in table and missing bars in chart indicate that background risks are higher than site-related risks.
5. "0+E00" means that the site-related risks are equal to background risks.

TABLE 7-1
CORRECTIVE MEASURES ALTERNATIVES EVALUATION CRITERIA
DRAFT – MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK

Community/ Property Owner Acceptance	Technical	Environmental	Human Health	Institutional	Green Remediation Practices	Cost
• Public Safety • Health of Residents and Town/Village Workers • Noise, Traffic, and Disruption of Neighborhood • Preservation of Neighborhood Character/Setting (Impact due to Loss of Trees) • Tree Preservation • Public Image of Village • Institutional Controls (potential option for non-residential properties; achieve unrestricted use for residential properties) • Impact on Future Land Uses • Impact to Village Roads and Infrastructure • Property Values • Potential for Development or Reuse of Property and Adjacent Property • Remediation Schedule	• Effectiveness at Reducing Unacceptable Human Health Risk Levels (site-specific) • Ability to Maintain Effectiveness Over Time (Useful Life) • Demonstrated Effectiveness • Relative Ease of Implementation/ Construction • Short-Term Worker and Community Safety Risks During Implementation • Permits or Agreements Required • Equipment and Disposal Availability • Frequency and Complexity of Any Needed Post-Remediation Inspection, Monitoring and/or Maintenance	• Identify Pathways of Contamination Addressed (groundwater, surface water, ecological) • Short-Term Impacts to Environmentally Sensitive Areas (Erosion and Sedimentation Controls) • Long-Term Environmental Benefits (potential migration controlled)	• Mitigation of Potential Human Exposures for Current and Reasonably Anticipated Future Land Uses • Reduce and Manage Potential Human Health Risks Associated with FMC-related Contamination • Short-Term Health Risks During Implementation • Post-Remediation Arsenic Concentrations	• Federal, State, Local Standards, Criteria, and Guidance • Ordinances	• Increase Energy Efficiency • Reduce Greenhouse Gas and other Air Emissions • Minimize Demolition and Earth Moving Activities • Reduce Consumption of Natural Resources • Ecological and Soil Preservation • Conservation/ Efficient Use of Available Space at Offsite Commercial Disposal Facilities • Reduce Material Consumption and Waste Generation • Increase Reuse and Recycling of Materials • Minimize Effects to Land and Ecosystem • Foster Long-Term Environmental Stewardship	• Capital Costs of Construction • Costs of Engineering, Permitting, Reporting • Present Worth of Future Expenses (Annual Post-Remediation Inspection, Monitoring and Maintenance, if needed)

Note:
1. Evaluation Criteria provided in the CMS Work Plan.

TABLE 7-2
SUMMARY OF CORRECTIVE MEASURES ALTERNATIVES IMPLEMENTATION CONSIDERATIONS
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

		Alternative									
		1	**2**	**3**	**4**	**5**	**6A**	**6B**	**7A**	**7B**	**8**
	Number of Properties and Volume of Soil to be Remediated										
a.	**Number of Properties To Be Remediated (see Note 1)**	0	181	152	86	48	157	158	164	165	179
b.	**Estimated Volume of Soil To Be Remediated (cubic yards) (see Note 2)**	0	228,000	69,000	38,000	28,000	85,000	98,000	101,000	119,000	162,000
	Resulting Post-Remediation Soil Arsenic Concentrations and FMC's Conclusions Regarding Associated Risk to Human Health and the Environment										
c.	**Community-Wide Average Arsenic Concentration (see Note 3)**	25 mg/kg (no further action)	7 mg/kg (post-remediation)	14 mg/kg (post-remediation)	17 mg/kg (post-remediation)	18 mg/kg (post-remediation)	13 mg/kg (post-remediation)	13 mg/kg (post-remediation)	12 mg/kg (post-remediation)	11 mg/kg (post-remediation)	11 mg/kg (post-remediation)
d.	**Average Arsenic Concentration at All Properties to be Remediated (see Note 4)**	NA	7 mg/kg	16 mg/kg	21 mg/kg	22 mg/kg	14 mg/kg	14 mg/kg	12 mg/kg	12 mg/kg	11 mg/kg
e.	**Risk to Human Health and the Environment (see Note 5)**	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range	Within or Below Acceptable Risk Range
	Future Construction Duration										
f.	**Estimated Number of Construction Seasons (May to November) to Complete the Future Remediation (see Note 6)**	0	10	5	3	2	6	6	7	7	8
	Future Local Truck Traffic For Temporary Storage at the FMC Facility and/or Placement in the CAMU (see Note 7)										
g.	**Estimated Number of Future Dump Truck Loads Needed to Transport Soil to FMC Facility**	0	19,000	5,800	3,200	2,300	7,100	8,200	8,400	9,900	13,500
h.	**Estimated Number of Future Dump Truck Loads Needed to Import Backfill Material**	0	19,000	5,800	3,200	2,300	7,100	8,200	8,400	9,900	13,500
i.	**Total Number of Future Dump Truck Loads**	0	38,000	11,600	6,400	4,600	14,200	16,400	16,800	19,800	27,000
	Additional Future Truck Traffic for Off-Site Disposal/Beneficial Reuse of Soil at Commercial Landfill (see Note 8)										
j.	**Estimated Number of Soil Truck Loads Needed to Transport to Commercial Landfill**	0	11,400	3,450	1,900	1,400	4,250	4,900	5,050	5,950	8,100
k	**Minimum Number of Truck Miles to be Travelled to Commercial Landfill and Return to FMC Facility**	0	684,000	207,000	114,000	84,000	255,000	294,000	303,000	357,000	486,000

See Notes on Page 2.

TABLE 7-2
SUMMARY OF CORRECTIVE MEASURES ALTERNATIVES IMPLEMENTATION CONSIDERATIONS
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

Notes:

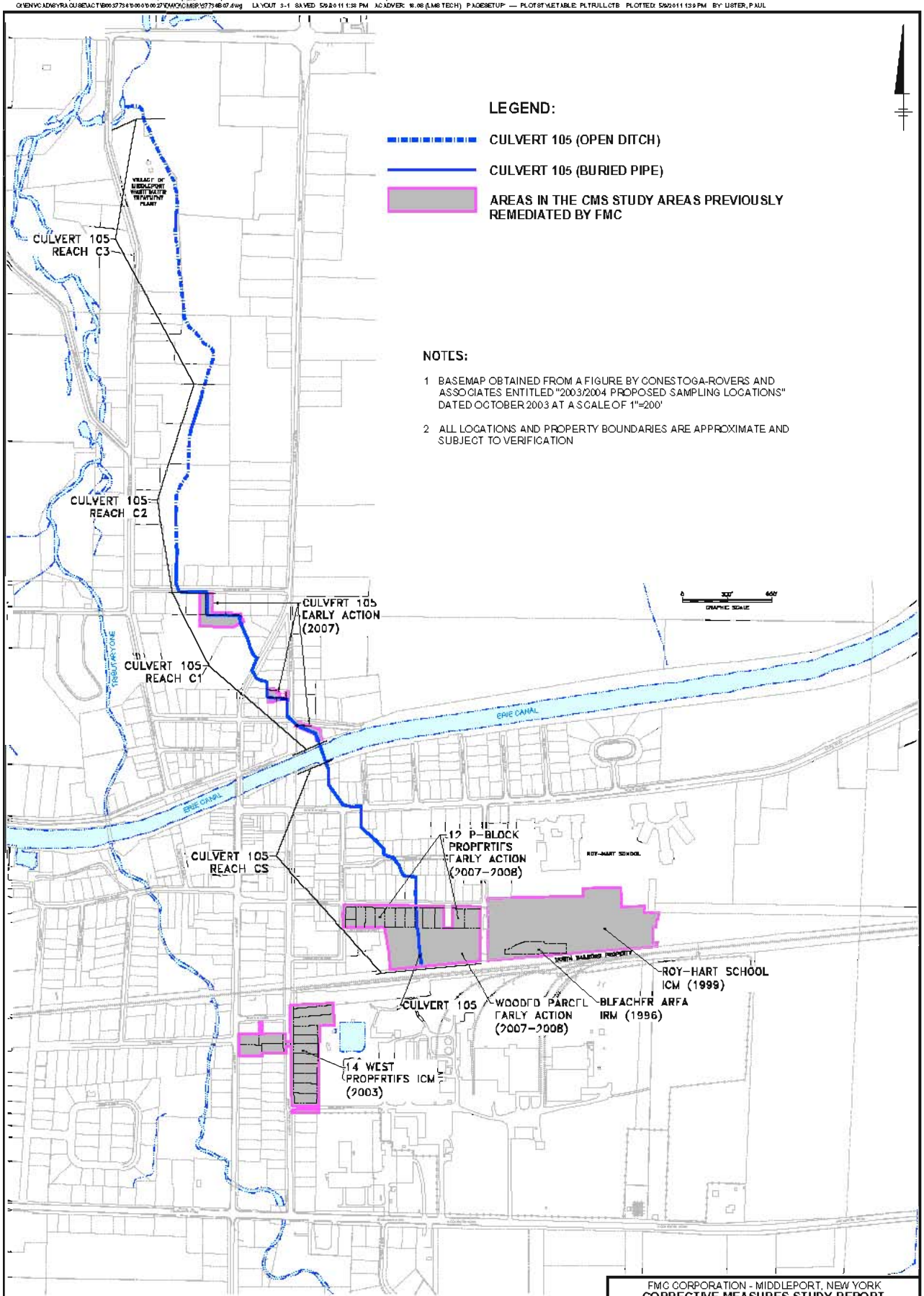
1. The number of properties to be remediated is in addition to the 31 off-Site properties in the CMS Study Areas that were previously subject to remediation and where no further action is needed.
2. The estimated volume of soil to be remediated is in addition to the approximately 80,000 cubic yards of soil removed from the CMS Study Areas during prior remedial actions.
3. Average arsenic concentration in 0- to 12-inch depth interval across all properties that are colored green or yellow on Figure 1-1. These community-wide concentrations were used in FMC's CMS for the purposes of evaluating the CMAs.
4. Average post-remediation soil arsenic concentration at properties to be remediated (all depths). Details provided in Appendix H.
5. For FMC's assessment of risk to human health and the environment, refer to Appendices F and G. The evaluation methods and conclusions of the human health and ecological risk assessments presented herein are those of FMC and its consultants.
6. The estimated number of construction seasons presented for each CMA in the above table is based on FMC's experience performing remediation on residential properties in Middleport in 2003 and 2007 and assumes a considerable and manageable level of effort during each construction season. The actual number of construction seasons for the selected CMA or CMAs will be determined during the CMI planning stage through an Agencies' approved schedule.
7. Estimated number of dump truck loads assumes 12 cubic yard truck capacity and transport of the entire estimated volume of soil to be remediated (Line Item 'b'). This volume of soil and the corresponding number of dump truck loads would be reduced if soil is remediated using in-place soil tilling/blending.
8. Additional future truck traffic for offsite disposal/beneficial reuse calculated based on transport of the entire volume of soil to be remediated (Line Item 'b') to the closest commercial landfill identified for potential disposal of FMC remediation waste (30 miles distant, see Attachment D-2), and return to the FMC Facility. 30-ton (20 cubic yards) capacity trucks assumed for off-site transport of soil to the commercial landfill.

TABLE 8-1
FMC'S RESULTS OF COMPARATIVE ANALYSIS OF CORRECTIVE MEASURES ALTERNATIVES
DRAFT - MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION - MIDDLEPORT, NEW YORK

	Evaluation Criteria		Alternatives									
			1	2	3	4	5	6A	6B	7A	7B	8
a.	Community / Property Owner Acceptance		◒	○	◒	◒	◒	◒	◒	◒	◒	○
b.	Technical		●	○	◒	◒	◒	◒	◒	◒	◒	◒
c.	Public and Worker Safety (Short-Term)		●	○	◒	◒	◒	◒	◒	◒	◒	○
d.	Environmental		●	○	◒	◒	◒	◒	◒	◒	◒	○
e.	Human Health		●	●	●	●	●	●	●	●	●	●
f.	Institutional		○	◒	●	○	○	●	●	●	●	◒
g.	Green Remediation Practices	CAMU	●	○	◒	◒	◒	◒	◒	◒	◒	○
		Landfill	●	○	○	◒	◒	○	○	○	○	○
h.	Total Estimated Cost	CAMU	$0.4 M	$58.0 M	$23.6 M	$13.3 M	$9.8 M	$26.7 M	$29.9 M	$30.2 M	$34.5 M	$42.9 M
		Landfill		$68.7 M	$27.4 M	$15.3 M	$11.3 M	$31.3 M	$35.2 M	$35.7 M	$40.9 M	$50.9 M
	Estimated Remediation to be Completed											
i.	Additional Properties To Be Remediated		0	181	152	86	48	157	158	164	165	179
j.	Estimated Volume of Soil To Be Remediated (cubic yards)		0	228,000	69,000	38,000	28,000	85,000	98,000	101,000	119,000	162,000
k.	Additional Length of Buried Culvert Pipe to be Removed and Replaced as Part of Future Remediation (lineal feet)		0	1,325	1,185	900	900	1,185	1,185	1,185	1,185	3,025
l.	Estimated Number of Construction Seasons (May to November) to Complete Future Remediation		0	10	5	3	2	6	6	7	7	8

● = favorable
◒ = moderate
○ = not favorable

Figures



FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

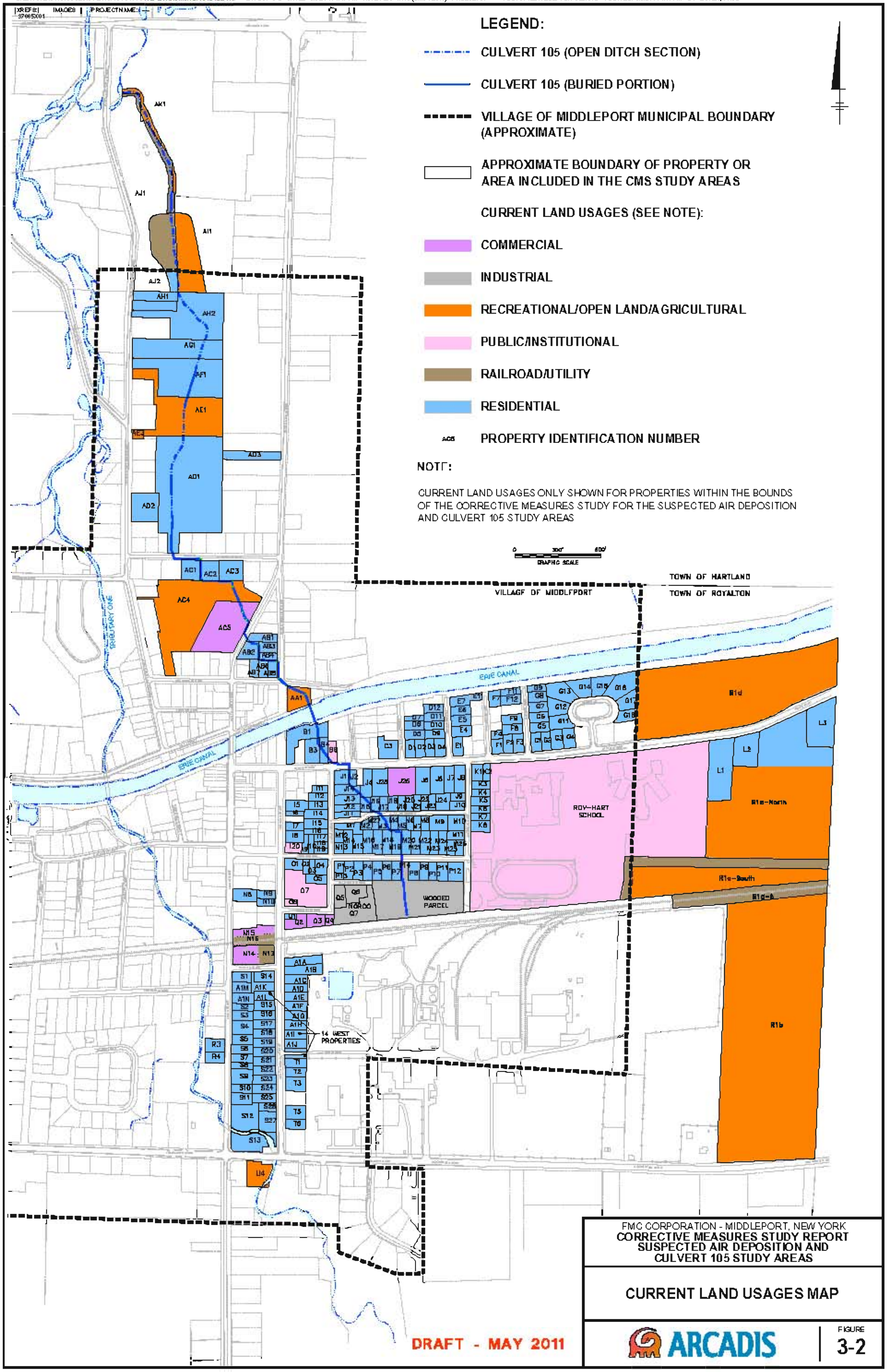
AREAS IN THE CMS STUDY AREAS PREVIOUSLY REMEDIATED BY FMC

DRAFT - MAY 2011

ARCADIS

FIGURE 3-1

CITY: SYRACUSE, NY GROUP: ENVCAD DB: P. LISTER LD: P. LISTER PM: D. WRIGHT LYR: ON=*;OFF=REF, (FRZ)



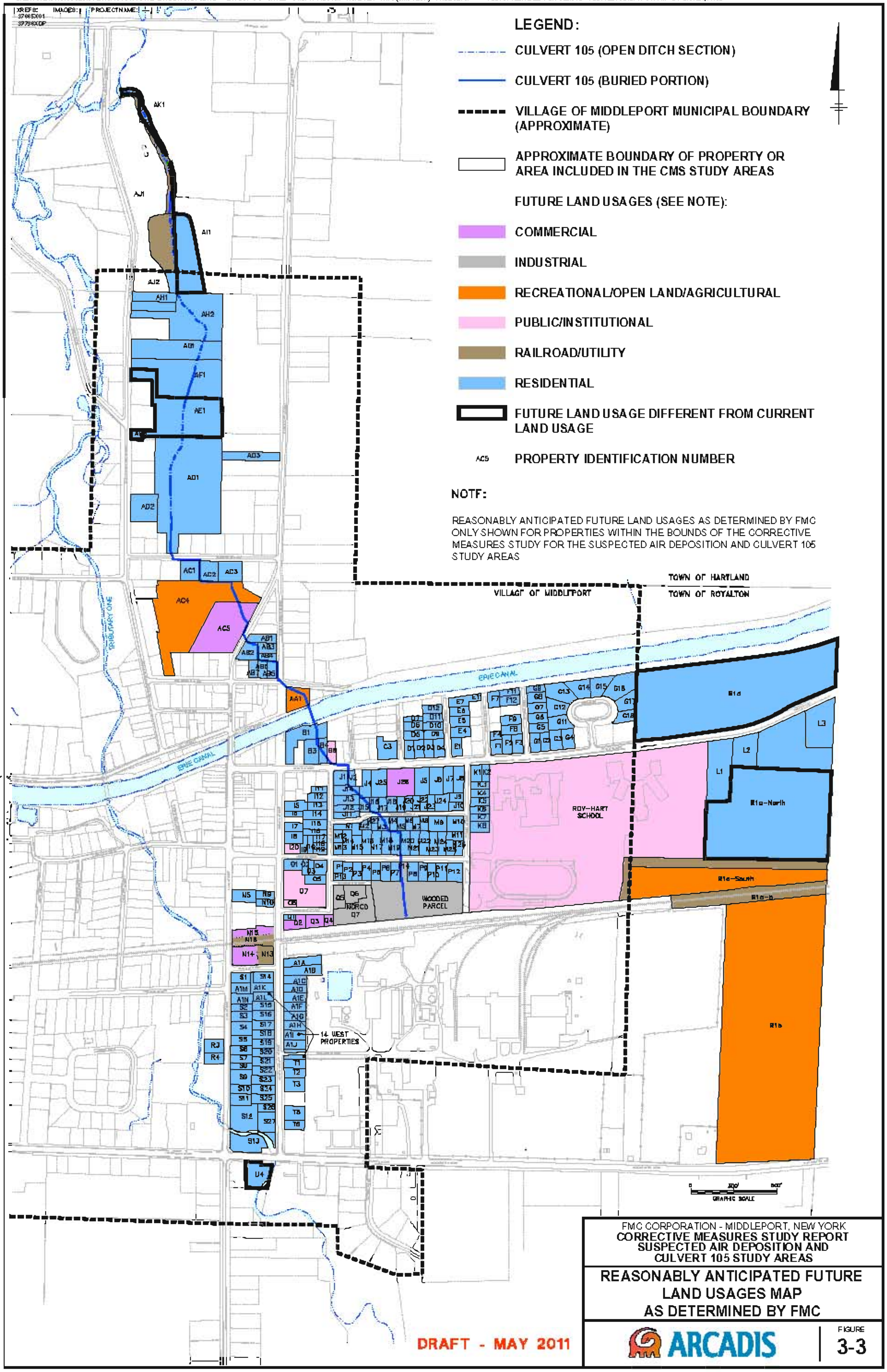
FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

CURRENT LAND USAGES MAP

ARCADIS

FIGURE 3-2

CITY: SYRACUSE, NY GROUP: ENVCAD DB: P LISTER LD: P LISTER PM: D WRIGHT LYR: ON=*;OFF=REF, (FRZ)
G:\ENVCAD\SYRACUSE\ACT\B0037736\0000\00027\DWG\37736B04.DWG LAYOUT: 3-3 SAVED: 4/4/2011 11:35 AM ACADVER: 18.0S (LMS TECH) PAGESETUP: --- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/9/2011 1:46 PM BY: LISTER, PAUL

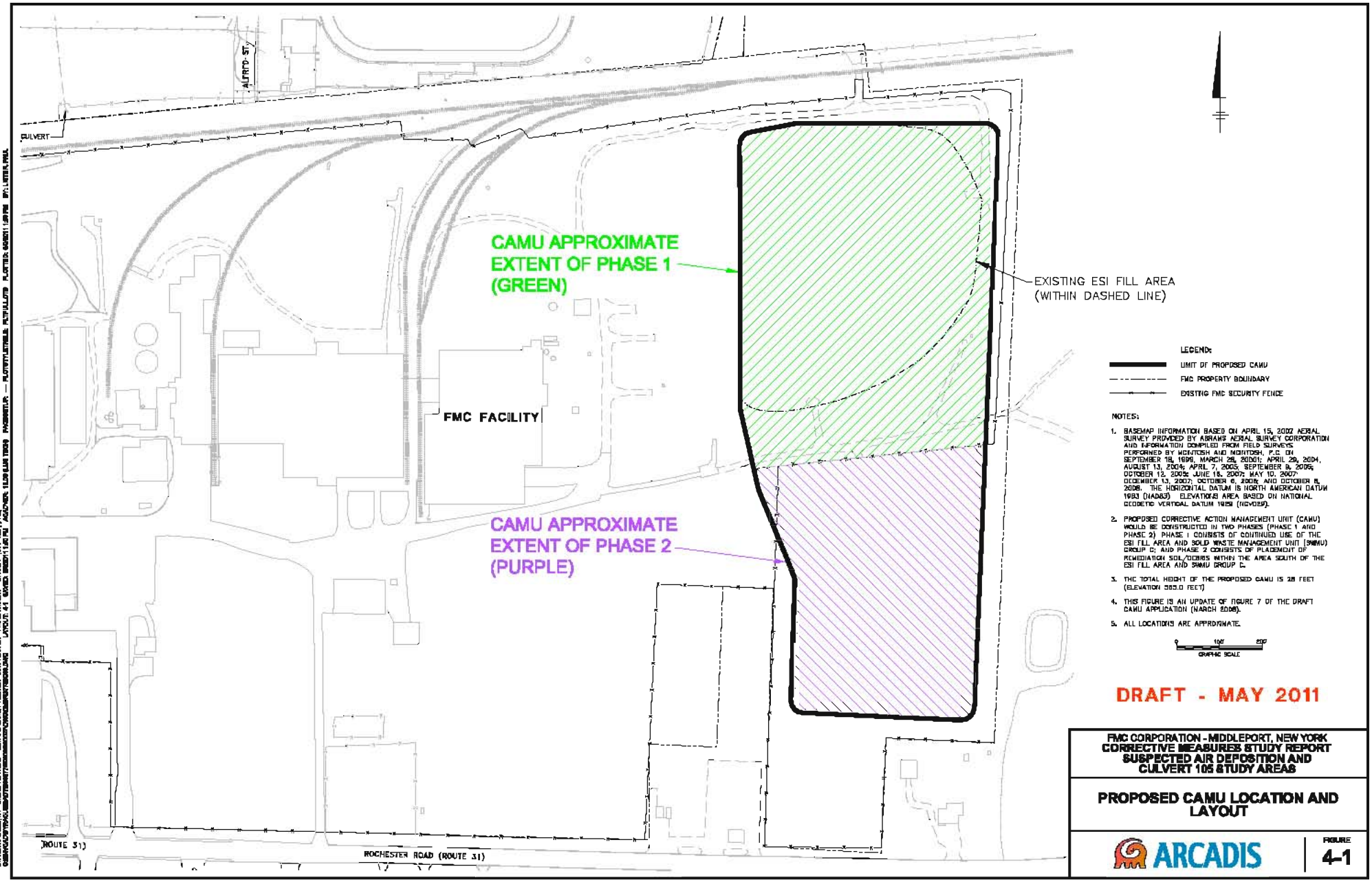


FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

REASONABLY ANTICIPATED FUTURE LAND USAGES MAP AS DETERMINED BY FMC

ARCADIS

FIGURE 3-3


ALFRD ST
CULVERT
CAMU APPROXIMATE EXTENT OF PHASE 1 (GREEN)
EXISTING ESI FILL AREA (WITHIN DASHED LINE)
FMC FACILITY
CAMU APPROXIMATE EXTENT OF PHASE 2 (PURPLE)
ROUTE 31
ROCHESTER ROAD (ROUTE 31)
LEGEND:
LIMIT OF PROPOSED CAMU
FMC PROPERTY BOUNDARY
EXISTING FMC SECURITY FENCE
NOTES:
1. BASEMAP INFORMATION BASED ON APRIL 15, 2002 AERIAL SURVEY PROVIDED BY ABRAMS AERIAL SURVEY CORPORATION AND INFORMATION COMPILED FROM FIELD SURVEYS PERFORMED BY MCINTOSH AND MCINTOSH, P.C. ON SEPTEMBER 18, 1998, MARCH 28, 2001; APRIL 29, 2004, AUGUST 13, 2004; APRIL 7, 2005, SEPTEMBER 9, 2005; OCTOBER 12, 2005; JUNE 15, 2007; MAY 10, 2007; DECEMBER 13, 2007; OCTOBER 6, 2008; AND OCTOBER 8, 2008. THE HORIZONTAL DATUM IS NORTH AMERICAN DATUM 1983 (NAD83). ELEVATIONS AREA BASED ON NATIONAL GEODETIC VERTICAL DATUM 1929 (NGVD29).
2. PROPOSED CORRECTIVE ACTION MANAGEMENT UNIT (CAMU) WOULD BE CONSTRUCTED IN TWO PHASES (PHASE 1 AND PHASE 2). PHASE 1 CONSISTS OF CONTINUED USE OF THE ESI FILL AREA AND SOLID WASTE MANAGEMENT UNIT (SWMU) GROUP C; AND PHASE 2 CONSISTS OF PLACEMENT OF REMEDIATION SOIL/DEBRIS WITHIN THE AREA SOUTH OF THE ESI FILL AREA AND SWMU GROUP C.
3. THE TOTAL HEIGHT OF THE PROPOSED CAMU IS 28 FEET (ELEVATION 585.0 FEET)
4. THIS FIGURE IS AN UPDATE OF FIGURE 7 OF THE DRAFT CAMU APPLICATION (MARCH 2008).
5. ALL LOCATIONS ARE APPROXIMATE.
GRAPHIC SCALE
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CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
PROPOSED CAMU LOCATION AND LAYOUT
ARCADIS
FIGURE 4-1

NOTES:

1. THE TOTAL HEIGHT OF THE PROPOSED CAMU IS 28 FEET (ELEVATION 565.0 FEET).
2. CAMU LANDSCAPING SHOWN IS CONCEPTUAL FOR THE PURPOSES OF THIS CMS. THE LANDSCAPING DESIGN WOULD BE PRESENTED IN THE REVISED CAMU APPLICATION THAT WILL BE SUBJECT TO PUBLIC REVIEW AND COMMENT. IN GENERAL, AFTER PLACING THE FINAL COVER ATOP THE CAMU, THE GROUND SURFACE OF THE CAMU WOULD BE VEGETATED WITH A VARIETY OF GRASSES AND SHRUBS. TREES WOULD ALSO BE PLANTED AT SELECT LOCATIONS ALONG THE PERIMETER TO ACHIEVE AN APPEARANCE CONSISTENT WITH THE OPEN, RURAL, AND NATURAL CHARACTER OF THE SURROUNDING AREA.

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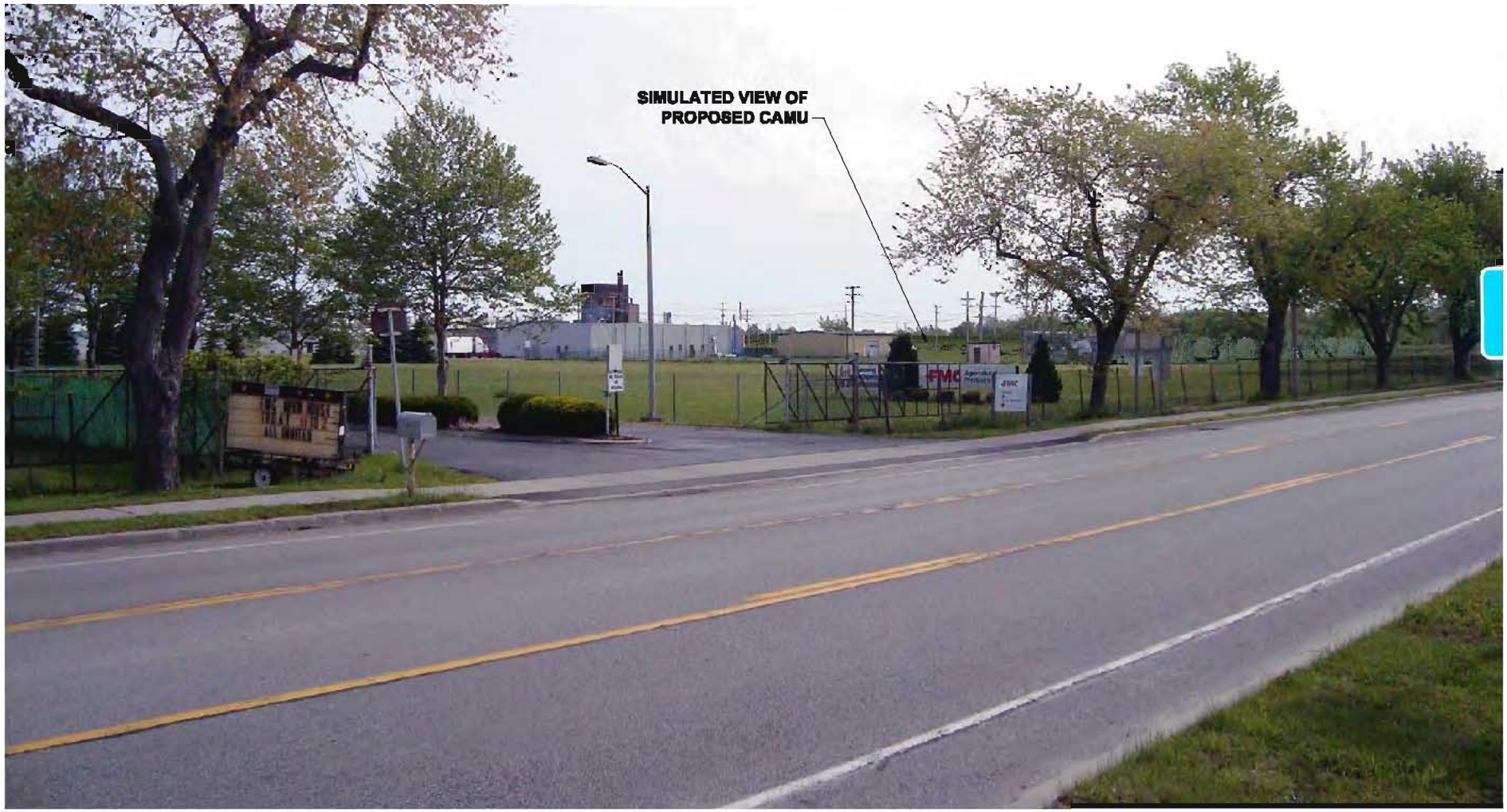
CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

SIMULATED AERIAL VIEW OF PROPOSED CAMU

ARCADIS

FIGURE 4-2



NOTE:

1. THE TOTAL HEIGHT OF THE PROPOSED CAMU IS 28 FEET (ELEVATION 565.0 FEET).

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SUSPECTED AIR DEPOSITION AND
CULVERT 105 STUDY AREAS

SIMULATED VIEW OF PROPOSED CAMU
LOOKING NORTHEAST FROM ROUTE 31
ENTRANCE

ARCADIS

FIGURE
4-3

NOTES:

1. THE TOTAL HEIGHT OF THE PROPOSED CAMU IS 29 FEET (ELEVATION 565.0 FEET).
2. AFTER PLACING THE FINAL COVER ATOP THE CAMU, THE GROUND SURFACE OF THE CAMU WOULD BE VEGETATED WITH A VARIETY OF GRASSES AND SHRUBS. TREES WOULD BE PLANTED AT SELECT LOCATIONS ALONG THE PERIMETER TO ACHIEVE AN APPEARANCE CONSISTENT WITH THE OPEN, RURAL, AND NATURAL CHARACTER OF THE SURROUNDING AREA.

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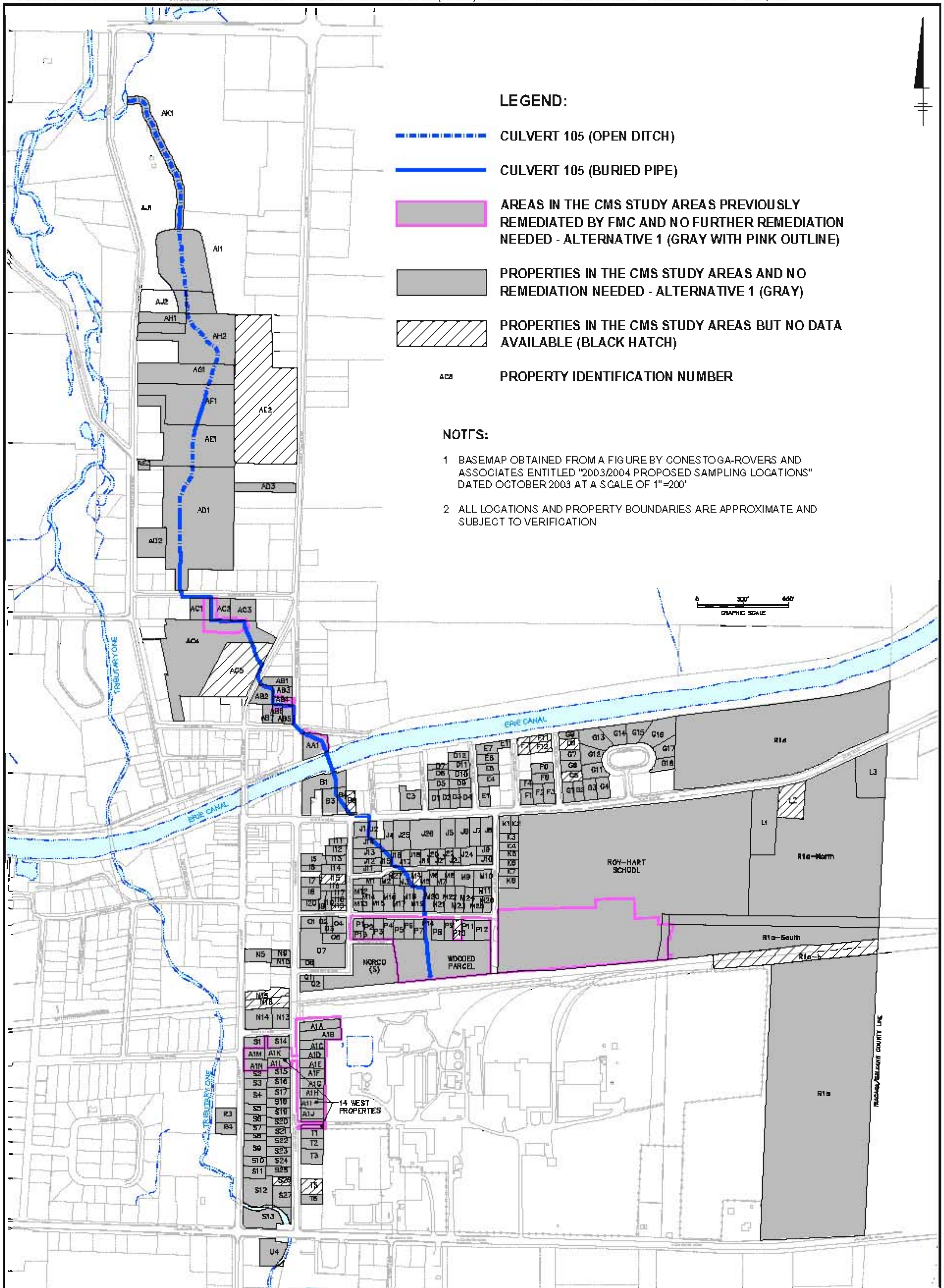
FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND
CULVERT 105 STUDY AREAS

SIMULATED VIEW OF PROPOSED CAMU LOOKING SOUTHEAST FROM ROY-HART SCHOOL NORTHERN BLEACHERS

ARCADIS

FIGURE
4-4



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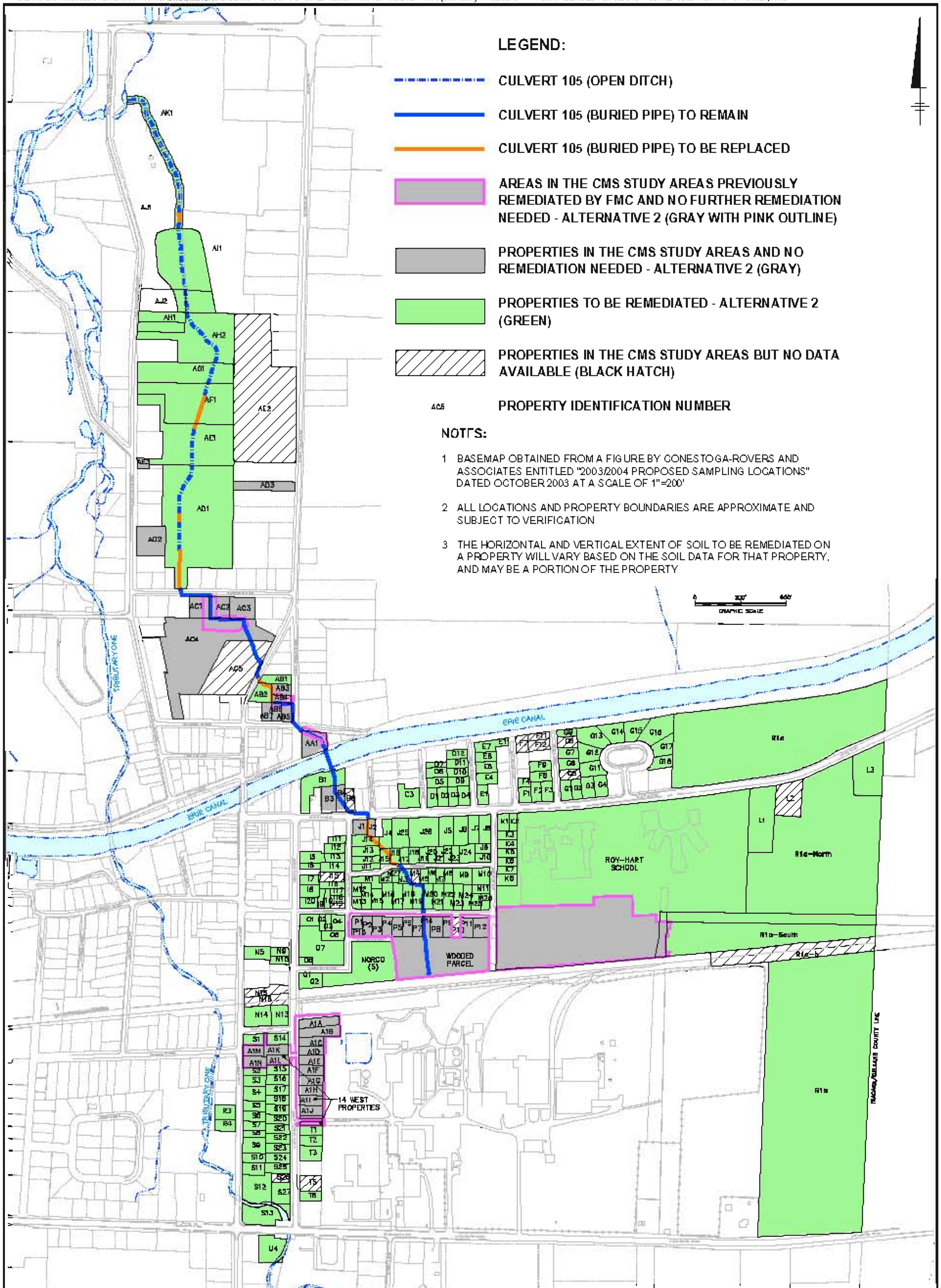
CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

ALTERNATIVE 1 - NO FURTHER ACTION

ARCADIS

FIGURE
5-1



LEGEND:

CULVERT 105 (OPEN DITCH)

CULVERT 105 (BURIED PIPE) TO REMAIN

CULVERT 105 (BURIED PIPE) TO BE REPLACED

AREAS IN THE CMS STUDY AREAS PREVIOUSLY REMEDIATED BY FMC AND NO FURTHER REMEDIATION NEEDED - ALTERNATIVE 2 (GRAY WITH PINK OUTLINE)

PROPERTIES IN THE CMS STUDY AREAS AND NO REMEDIATION NEEDED - ALTERNATIVE 2 (GRAY)

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 2 (GREEN)

PROPERTIES IN THE CMS STUDY AREAS BUT NO DATA AVAILABLE (BLACK HATCH)

AC5 PROPERTY IDENTIFICATION NUMBER

NOTES:

1. BASEMAP OBTAINED FROM A FIGURE BY CONESTOGA-ROVERS AND ASSOCIATES ENTITLED "2003/2004 PROPOSED SAMPLING LOCATIONS" DATED OCTOBER 2003 AT A SCALE OF 1"=200'
2. ALL LOCATIONS AND PROPERTY BOUNDARIES ARE APPROXIMATE AND SUBJECT TO VERIFICATION
3. THE HORIZONTAL AND VERTICAL EXTENT OF SOIL TO BE REMEDIATED ON A PROPERTY WILL VARY BASED ON THE SOIL DATA FOR THAT PROPERTY, AND MAY BE A PORTION OF THE PROPERTY

0 300' 600'
GRAPHIC SCALE

FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 2 (GREEN)

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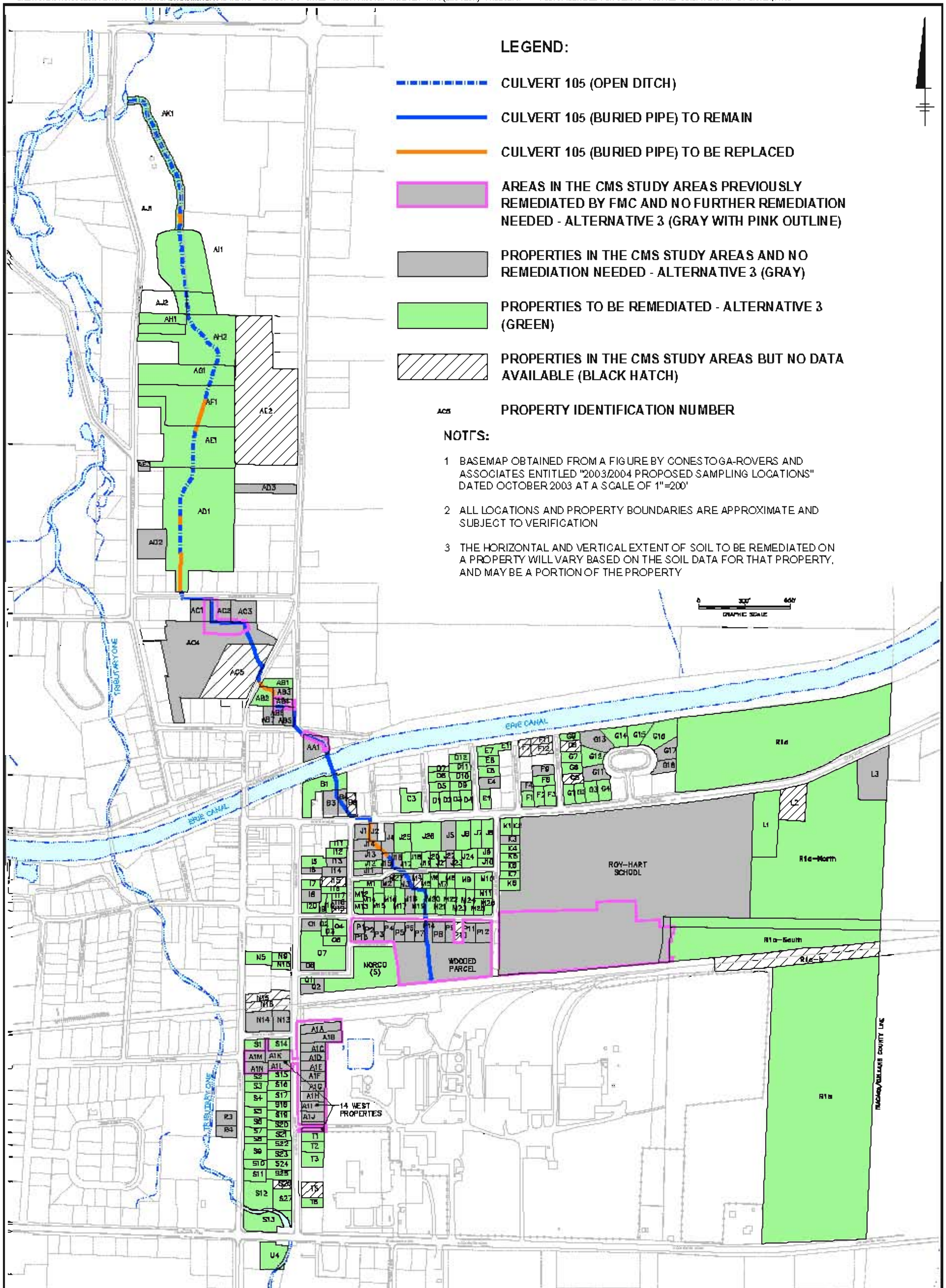
FIGURE
5-2

CITY: SYRACUSE, NY GROUP: ENVCAD DB: P. LISTER, G.STOWELL, P LISTER LD: P LISTER PM: D WRIGHT LYR: ON=*;OFF=REF, (FRZ)
G:\ENVCAD\SYRACUSE\ACT\B0037736\0000\00028\DWG\CMSR\377368-18.DWG LAYOUT: 5-3 SAVED: 4/26/2011 8:59 AM ACADVER: 18.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/9/2011 2:02 PM BY: LISTER, PAUL



LEGEND:

CULVERT 105 (OPEN DITCH)

CULVERT 105 (BURIED PIPE) TO REMAIN

CULVERT 105 (BURIED PIPE) TO BE REPLACED

AREAS IN THE CMS STUDY AREAS PREVIOUSLY REMEDIATED BY FMC AND NO FURTHER REMEDIATION NEEDED - ALTERNATIVE 3 (GRAY WITH PINK OUTLINE)

PROPERTIES IN THE CMS STUDY AREAS AND NO REMEDIATION NEEDED - ALTERNATIVE 3 (GRAY)

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 3 (GREEN)

PROPERTIES IN THE CMS STUDY AREAS BUT NO DATA AVAILABLE (BLACK HATCH)

AC5 PROPERTY IDENTIFICATION NUMBER

NOTES:

1. BASEMAP OBTAINED FROM A FIGURE BY CONESTOGA-ROVERS AND ASSOCIATES ENTITLED "2003/2004 PROPOSED SAMPLING LOCATIONS" DATED OCTOBER 2003 AT A SCALE OF 1"=200'
2. ALL LOCATIONS AND PROPERTY BOUNDARIES ARE APPROXIMATE AND SUBJECT TO VERIFICATION
3. THE HORIZONTAL AND VERTICAL EXTENT OF SOIL TO BE REMEDIATED ON A PROPERTY WILL VARY BASED ON THE SOIL DATA FOR THAT PROPERTY, AND MAY BE A PORTION OF THE PROPERTY

FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

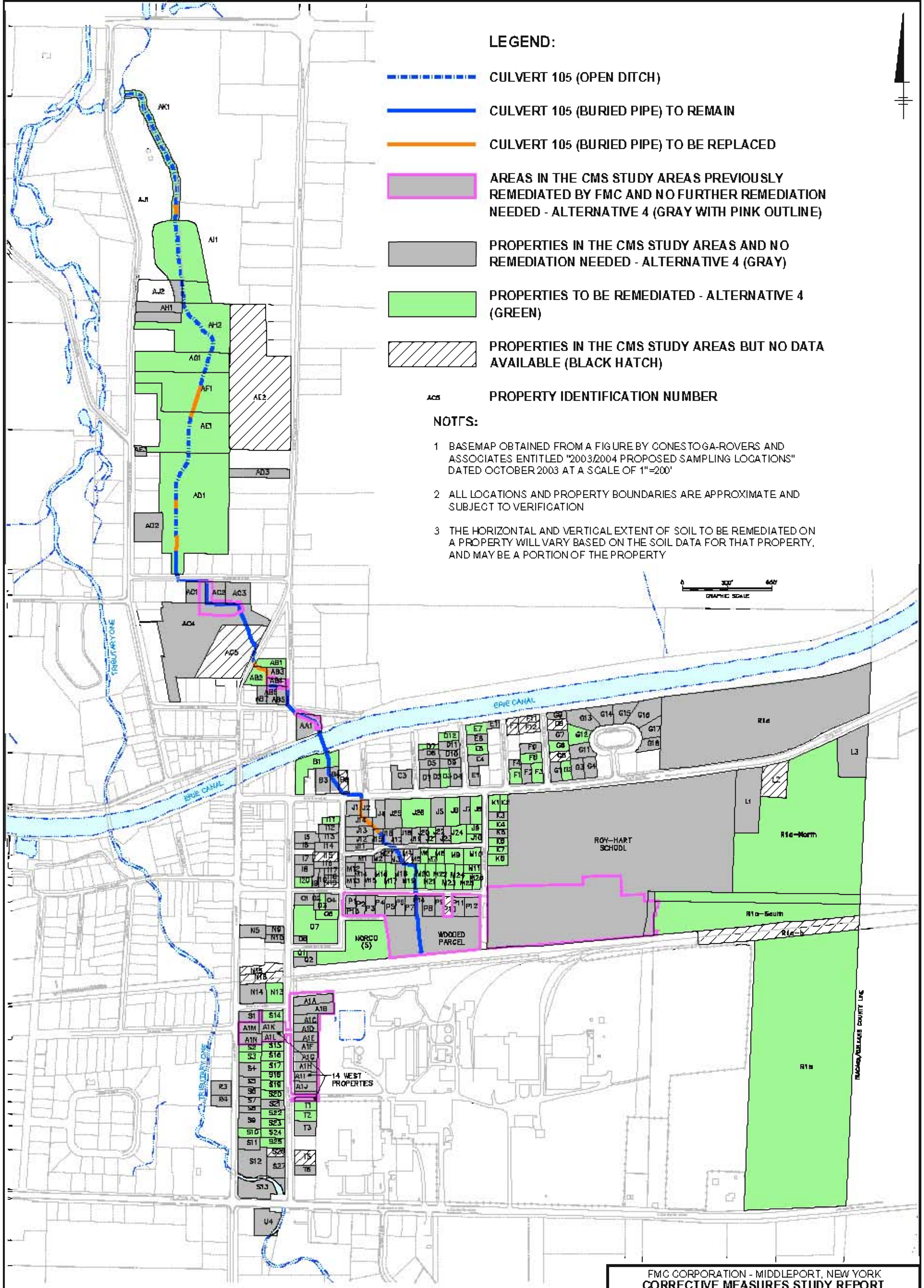
PROPERTIES TO BE REMEDIATED - ALTERNATIVE 3 (GREEN)

DRAFT - MAY 2011

ARCADIS

FIGURE **5-3**

CITY: SYRACUSE, NY GROUP: ENVCAD DB: P. LISTER, G.STOWELL, P LISTER LD: P LISTER PM: D WRIGHT LYR: ON=*;OFF=REF, (FRZ)
G:\ENVCAD\SYRACUSE\ACT\B0037736\0000\00028\DWG\CMSR\37736B17.DWG LAYOUT: 5-4 SAVED: 4/26/2011 8:59 AM ACADVER: 18.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/3/2011 2:08 PM BY: LISTER, PAUL



LEGEND:

- CULVERT 105 (OPEN DITCH)
- CULVERT 105 (BURIED PIPE) TO REMAIN
- CULVERT 105 (BURIED PIPE) TO BE REPLACED
- AREAS IN THE CMS STUDY AREAS PREVIOUSLY REMEDIATED BY FMC AND NO FURTHER REMEDIATION NEEDED - ALTERNATIVE 4 (GRAY WITH PINK OUTLINE)
- PROPERTIES IN THE CMS STUDY AREAS AND NO REMEDIATION NEEDED - ALTERNATIVE 4 (GRAY)
- PROPERTIES TO BE REMEDIATED - ALTERNATIVE 4 (GREEN)
- PROPERTIES IN THE CMS STUDY AREAS BUT NO DATA AVAILABLE (BLACK HATCH)
- AC5 PROPERTY IDENTIFICATION NUMBER

NOTES:

1. BASEMAP OBTAINED FROM A FIGURE BY CONESTOGA-ROVERS AND ASSOCIATES ENTITLED "2003/2004 PROPOSED SAMPLING LOCATIONS" DATED OCTOBER 2003 AT A SCALE OF 1"=200'
2. ALL LOCATIONS AND PROPERTY BOUNDARIES ARE APPROXIMATE AND SUBJECT TO VERIFICATION
3. THE HORIZONTAL AND VERTICAL EXTENT OF SOIL TO BE REMEDIATED ON A PROPERTY WILL VARY BASED ON THE SOIL DATA FOR THAT PROPERTY, AND MAY BE A PORTION OF THE PROPERTY

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CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 4 (GREEN)

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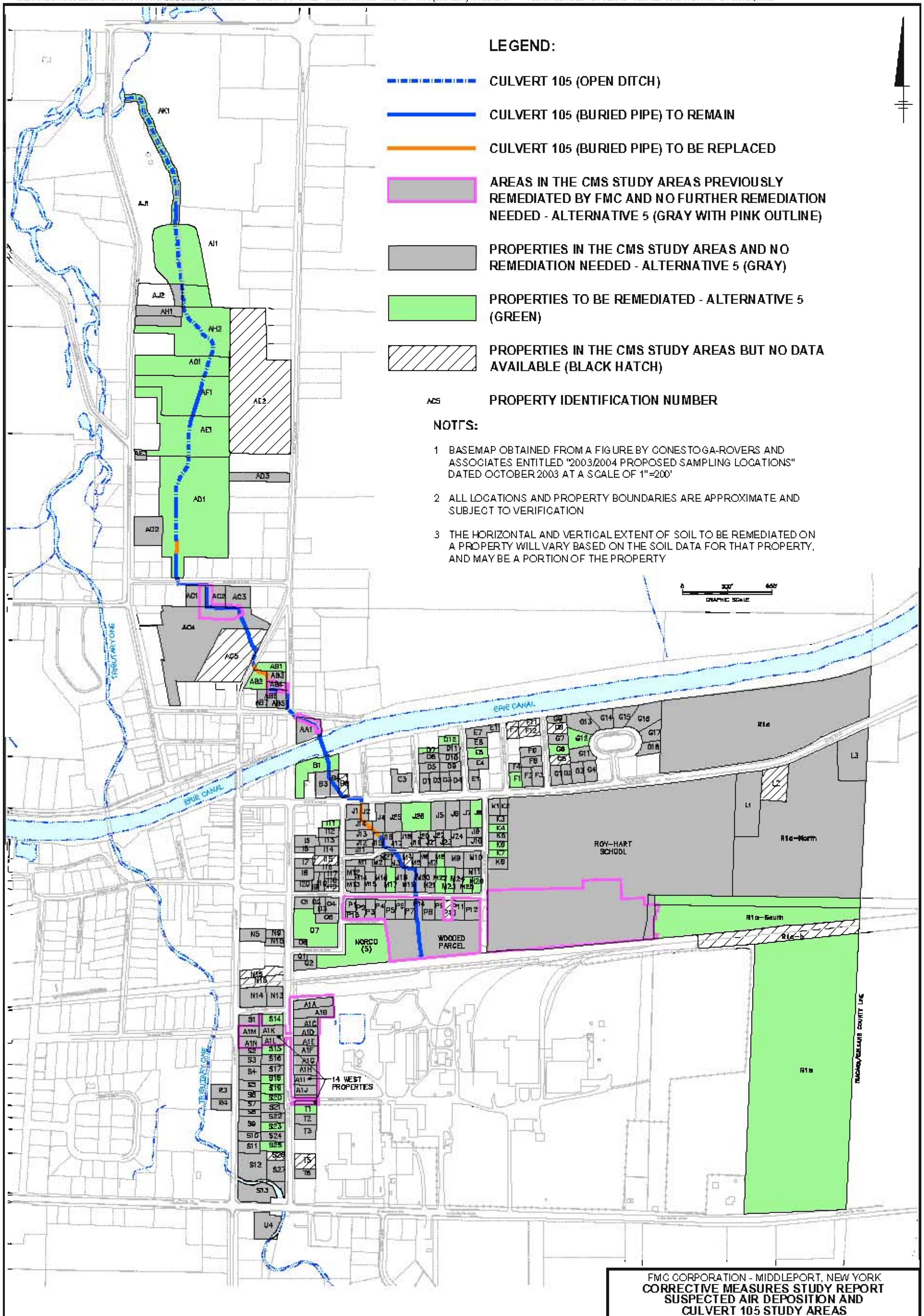
ARCADIS

FIGURE 5-4



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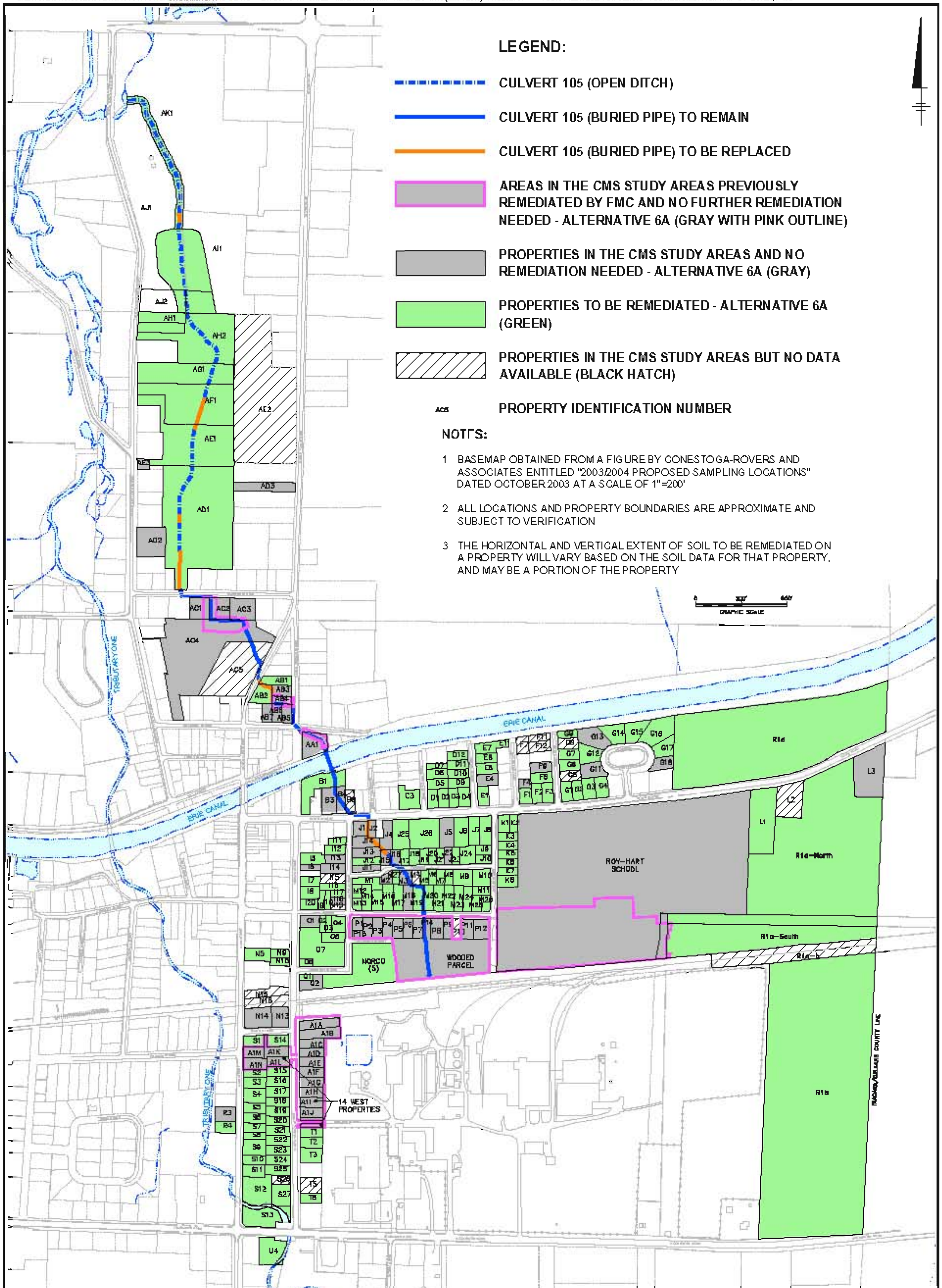
FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 5 (GREEN)

ARCADIS

FIGURE
5-5


LEGEND:
CULVERT 105 (OPEN DITCH)
CULVERT 105 (BURIED PIPE) TO REMAIN
CULVERT 105 (BURIED PIPE) TO BE REPLACED
AREAS IN THE CMS STUDY AREAS PREVIOUSLY REMEDIATED BY FMC AND NO FURTHER REMEDIATION NEEDED - ALTERNATIVE 6A (GRAY WITH PINK OUTLINE)
PROPERTIES IN THE CMS STUDY AREAS AND NO REMEDIATION NEEDED - ALTERNATIVE 6A (GRAY)
PROPERTIES TO BE REMEDIATED - ALTERNATIVE 6A (GREEN)
PROPERTIES IN THE CMS STUDY AREAS BUT NO DATA AVAILABLE (BLACK HATCH)
AC5 PROPERTY IDENTIFICATION NUMBER
NOTES:
1 BASEMAP OBTAINED FROM A FIGURE BY CONESTOGA-ROVERS AND ASSOCIATES ENTITLED "2003/2004 PROPOSED SAMPLING LOCATIONS" DATED OCTOBER 2003 AT A SCALE OF 1"=200'
2 ALL LOCATIONS AND PROPERTY BOUNDARIES ARE APPROXIMATE AND SUBJECT TO VERIFICATION
3 THE HORIZONTAL AND VERTICAL EXTENT OF SOIL TO BE REMEDIATED ON A PROPERTY WILL VARY BASED ON THE SOIL DATA FOR THAT PROPERTY, AND MAY BE A PORTION OF THE PROPERTY
0 300' 600'
GRAPHIC SCALE
ERIE CANAL
TRIBUTARY ONE
ROY-HART SCHOOL
WOODED PARCEL
NORCO (5)
14 WEST PROPERTIES
R1a-North
R1a-South
AK1
AJ1
AI1
AH1
AH2
AG1
AF1
AE1
AE2
AD1
AD2
AD3
AC1
AC2
AC3
AC4
AC5
AA1
L1
L2
L3
R1a

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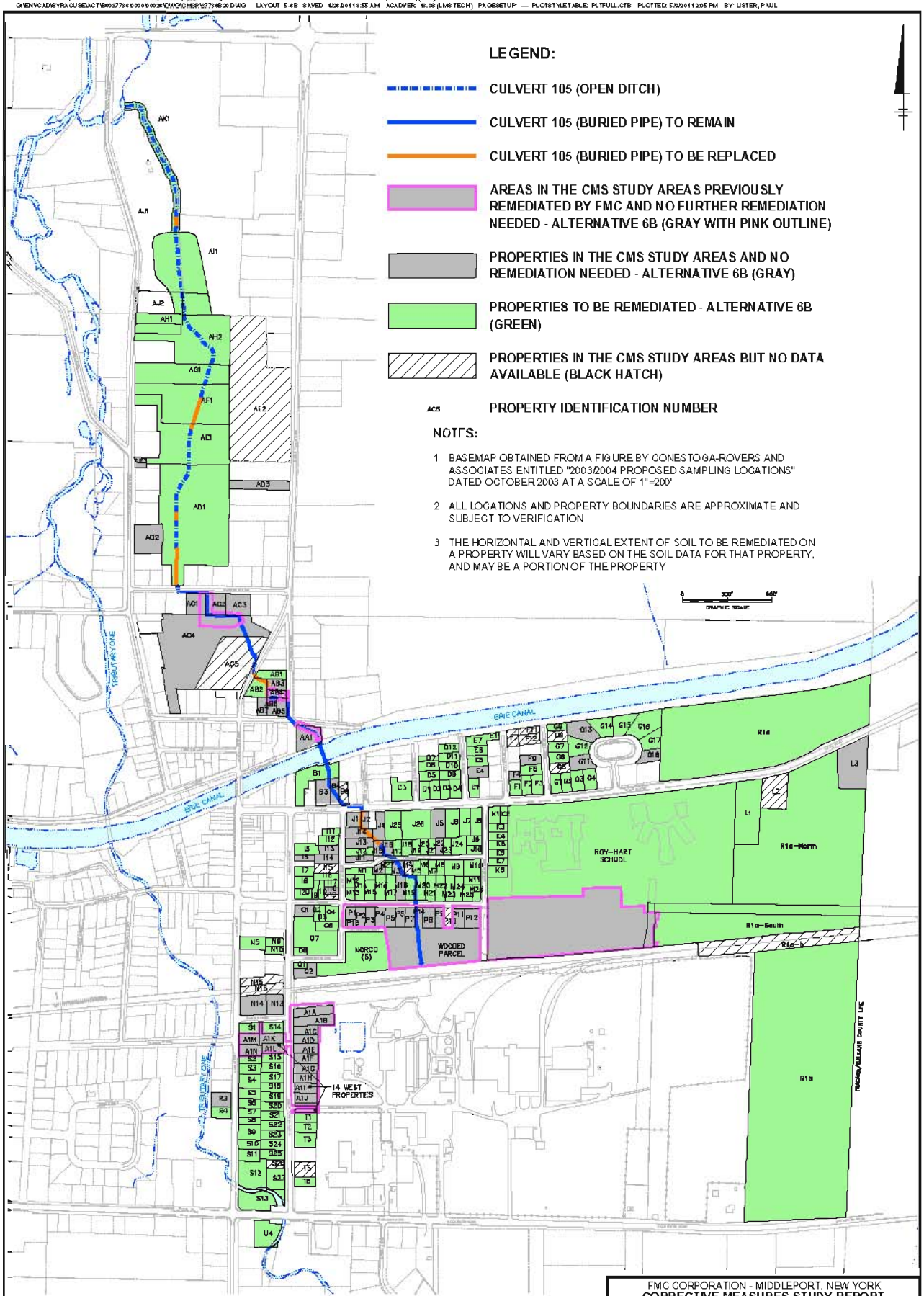
CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 6A (GREEN)

ARCADIS

FIGURE
5-6a



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CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 6B (GREEN)

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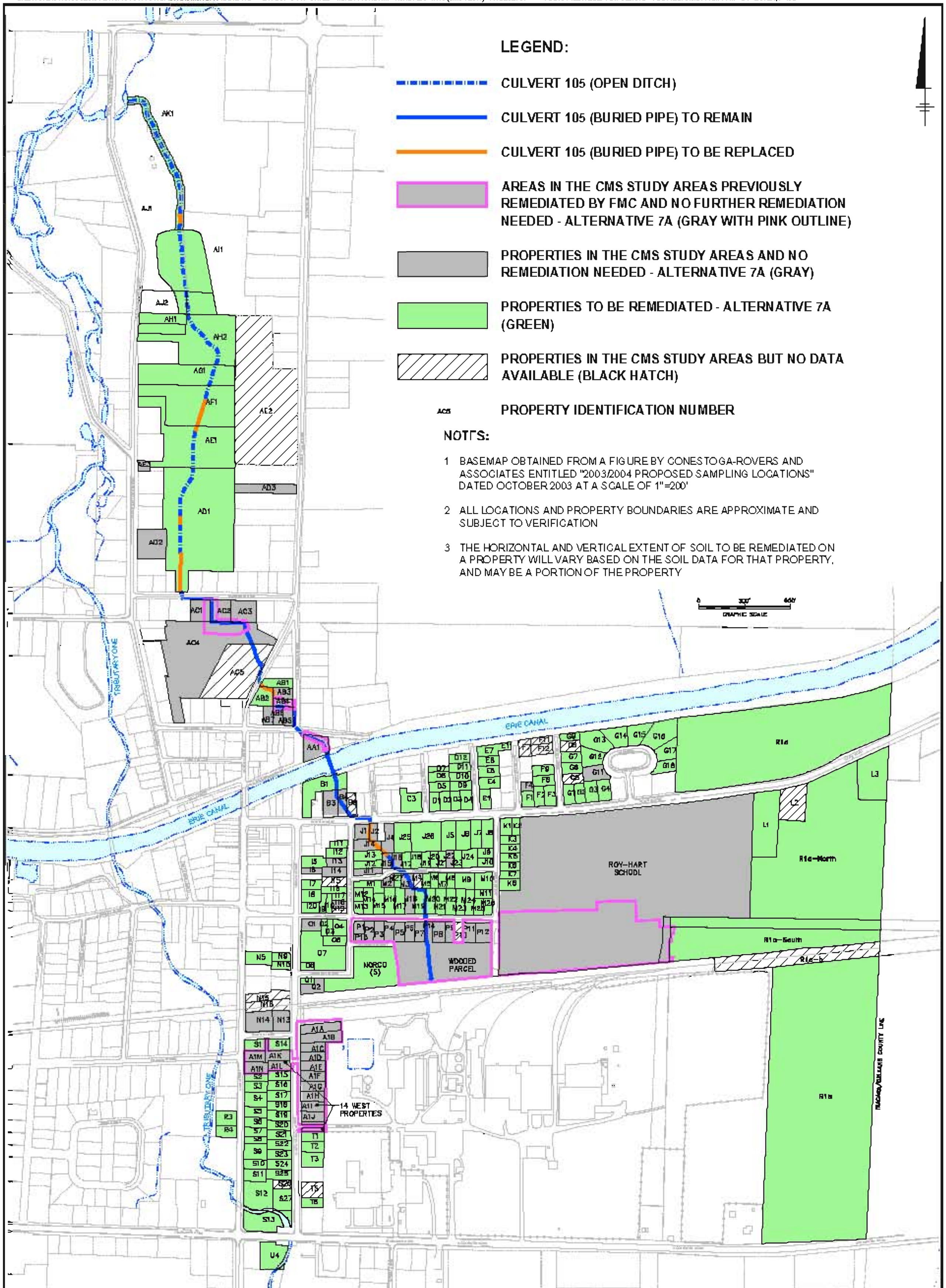
FIGURE
5-6b

CITY: SYRACUSE, NY GROUP: ENVCAD DB: P. LISTER, G.STOWELL, P LISTER LD: P LISTER PM: D WRIGHT LYR: ON=*;OFF=REF, (FRZ)



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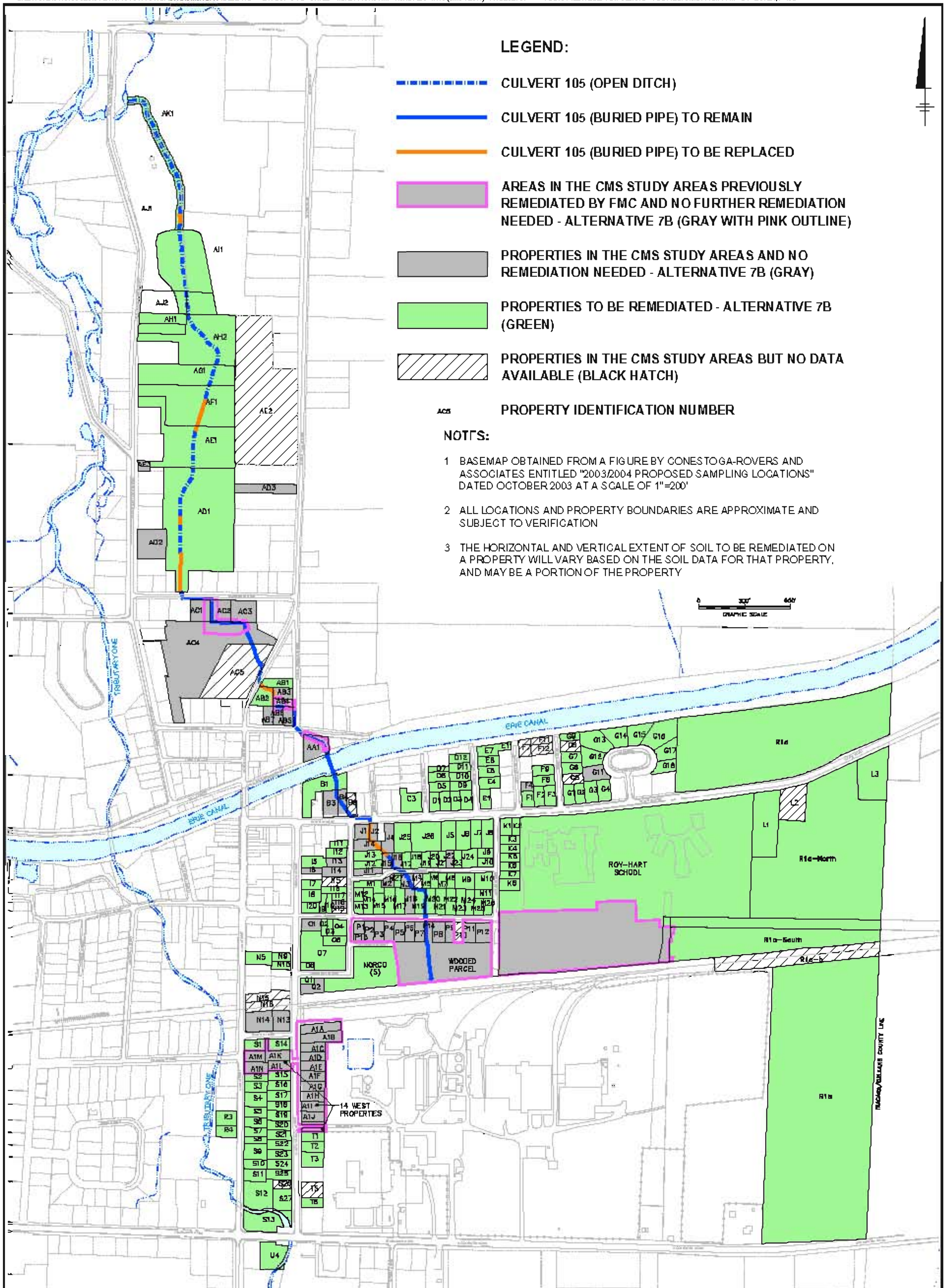
FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 7A (GREEN)

ARCADIS

FIGURE
5-7a

CITY: SYRACUSE, NY GROUP: ENVCAD DB: P. LISTER, G.STOWELL, P. LISTER LD: P. LISTER PM: D. WRIGHT LYR: ON=*;OFF=REF, (FRZ)
G:\ENVCAD\SYRACUSE\ACT\B0037736\0000\00026\DWG\CMSR\37736B22.DWG LAYOUT: 5-7B SAVED: 4/28/2011 9:05 AM ACADVER: 18.0S (LMS TECH) PAGESETUP: — PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 5/9/2011 2:06 PM BY: LISTER, PAUL



LEGEND:

CULVERT 105 (OPEN DITCH)

CULVERT 105 (BURIED PIPE) TO REMAIN

CULVERT 105 (BURIED PIPE) TO BE REPLACED

AREAS IN THE CMS STUDY AREAS PREVIOUSLY REMEDIATED BY FMC AND NO FURTHER REMEDIATION NEEDED - ALTERNATIVE 7B (GRAY WITH PINK OUTLINE)

PROPERTIES IN THE CMS STUDY AREAS AND NO REMEDIATION NEEDED - ALTERNATIVE 7B (GRAY)

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 7B (GREEN)

PROPERTIES IN THE CMS STUDY AREAS BUT NO DATA AVAILABLE (BLACK HATCH)

AC5 PROPERTY IDENTIFICATION NUMBER

NOTES:

1. BASEMAP OBTAINED FROM A FIGURE BY CONESTOGA-ROVERS AND ASSOCIATES ENTITLED "2003/2004 PROPOSED SAMPLING LOCATIONS" DATED OCTOBER 2003 AT A SCALE OF 1"=200'
2. ALL LOCATIONS AND PROPERTY BOUNDARIES ARE APPROXIMATE AND SUBJECT TO VERIFICATION
3. THE HORIZONTAL AND VERTICAL EXTENT OF SOIL TO BE REMEDIATED ON A PROPERTY WILL VARY BASED ON THE SOIL DATA FOR THAT PROPERTY, AND MAY BE A PORTION OF THE PROPERTY

0 300' 600'
GRAPHIC SCALE

FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 7B (GREEN)

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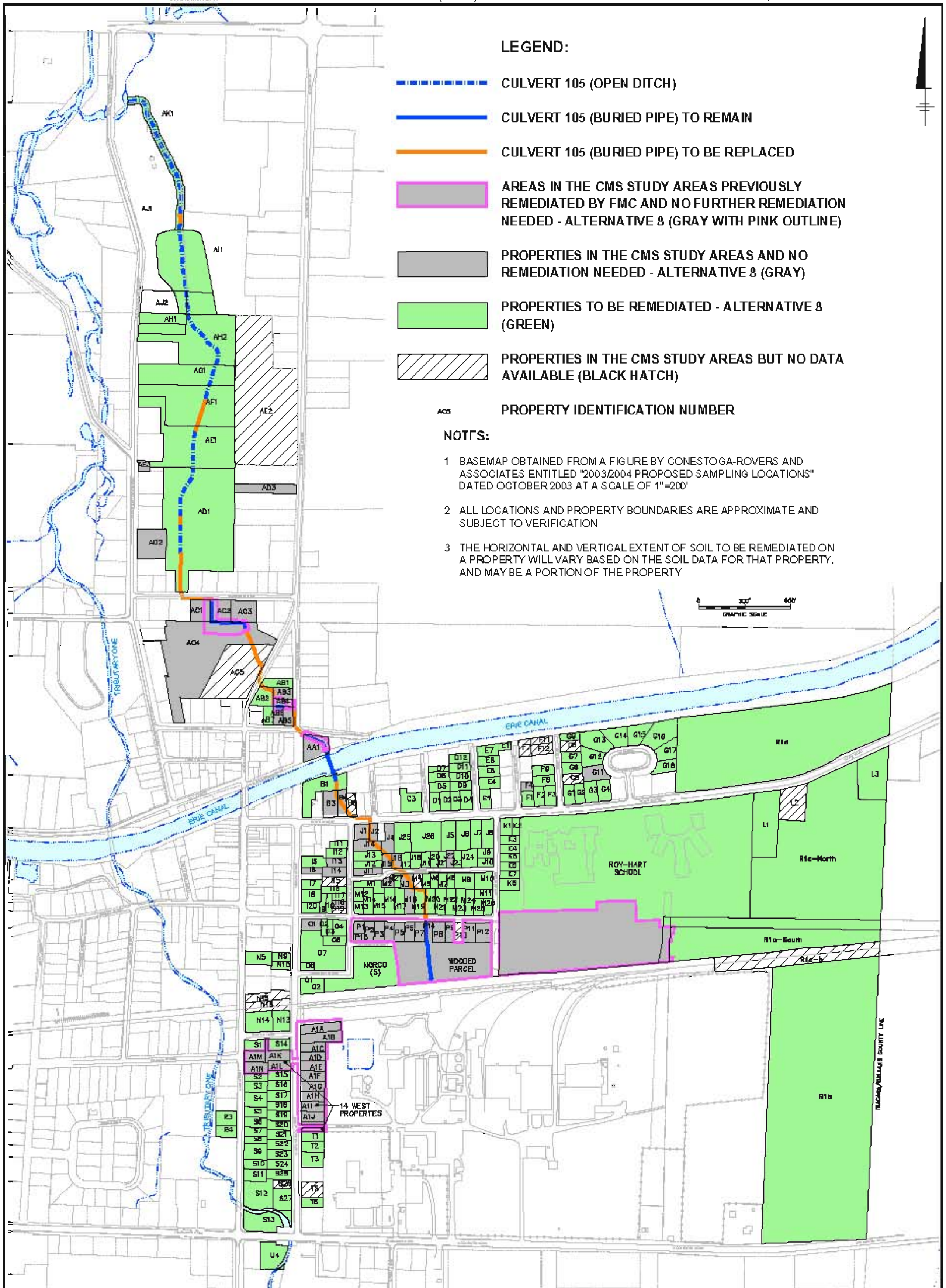
FIGURE
5-7b



FMC CORPORATION - MIDDLEPORT, NEW YORK
CORRECTIVE MEASURES STUDY REPORT
SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS

PROPERTIES TO BE REMEDIATED - ALTERNATIVE 8 (GREEN)

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FIGURE 5-8

FIGURE 6-1
TOTAL EXCESS LIFETIME CANCER RISK DISTRIBUTIONS FOR SUSPECTED AIR DEPOSITION STUDY AREA
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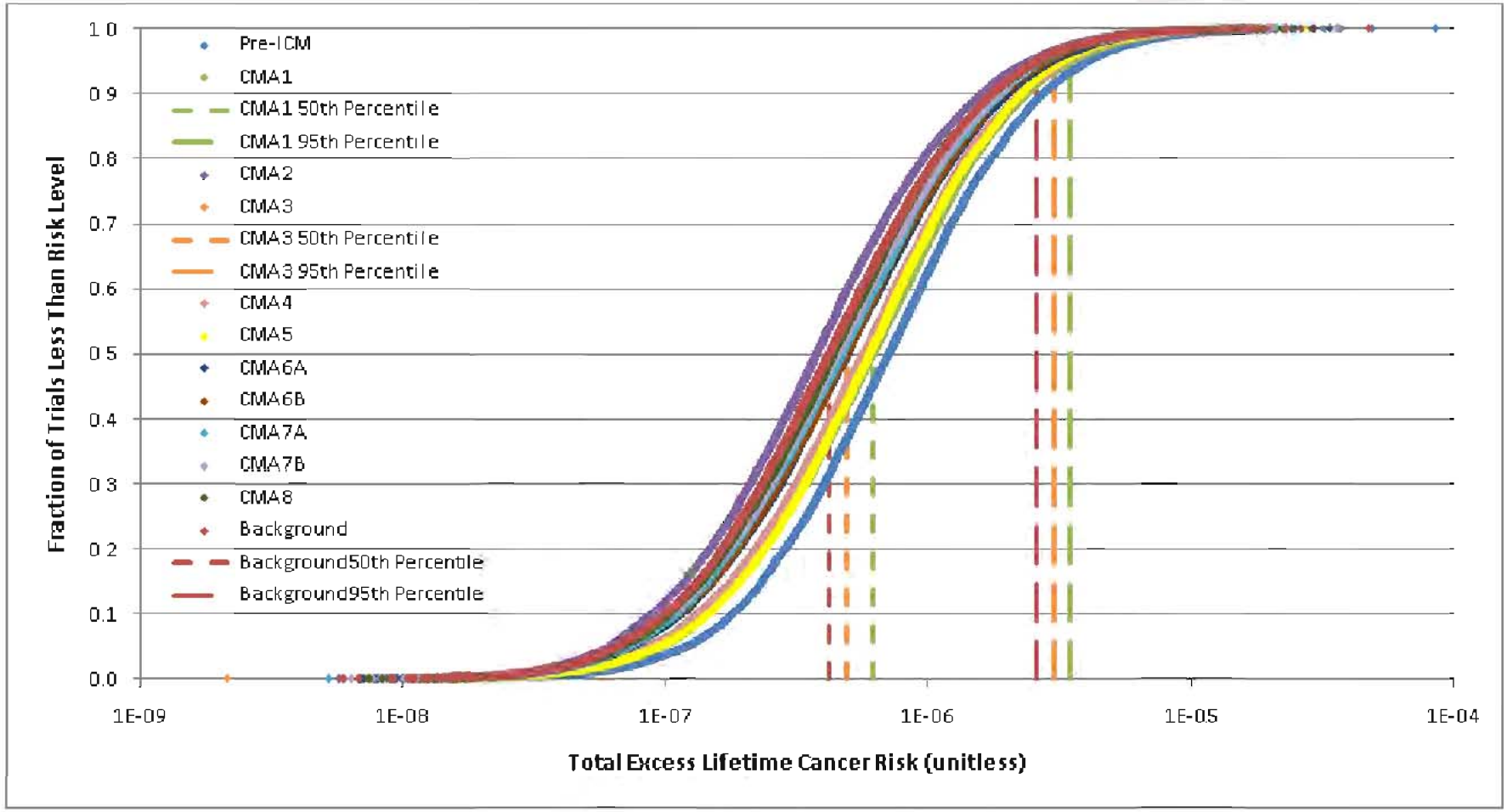
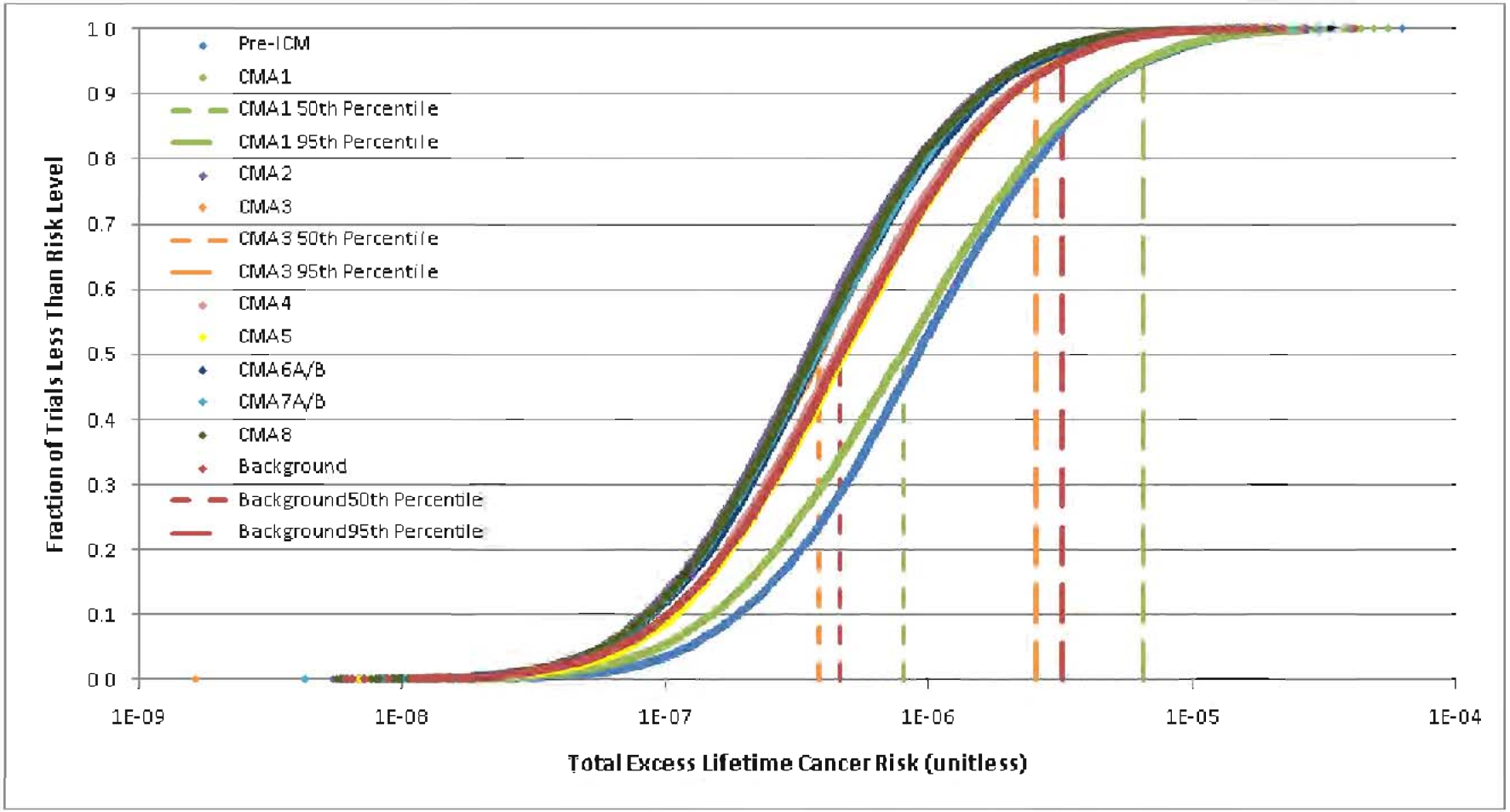
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK



Notes:
1. Calculated for adult plus child resident using probabilistic analysis method.
2. Does not include one pre-ICM simulation data point greater than $1x10^{-4}$ ($1.4x10^{-4}$).

FIGURE 6-2
TOTAL EXCESS LIFETIME CANCER RISK DISTRIBUTIONS FOR CULVERT 105 STUDY AREA NORTH OF THE ERIE CANAL
DRAFT – MAY 2011
CMS REPORT FOR SUSPECTED AIR DEPOSITION AND CULVERT 105 STUDY AREAS
FMC CORPORATION – MIDDLEPORT, NEW YORK



Notes:
1. Calculated for adult plus child resident using probabilistic analysis method.
2. Does not include one pre-ICM simulation data point greater than $1x10^{-4}$ ($1.1x10^{-4}$).