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FOURTH FIVE-YEAR REVIEW REPORT FOR SINCLAIR REFINERY SUPERFUND SITE ALLEGANY COUNTY, NEW YORK

Prepared by

U.S. Environmental Protection Agency
Region 2
New York, NY

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Date

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LIST OF ABBREVIATIONS

ARCO	Atlantic Richfield Company
AS/SVE	Air sparging/soil vapor extraction
CELA	Central Elevated Landfill Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended
CIC	Community Involvement Coordinator
EPA	Environmental Protection Agency
ESD	Explanation of Significant Differences
FS	Feasibility Study
LNAPL	Light non-aqueous phase liquid
MCL	Maximum Contaminant Level
NPL	National Priorities List
NYSDEC	New York State Department of Environmental Conservation
O&M	Operation and Maintenance
OU	Operable Unit
PPM	Parts per million
RAO	Remedial Action Objective
RI	Remedial Investigation
ROD	Record of Decision
RPM	Remedial Project Manager
SLA	South Landfill Area
SVI	Soil Vapor Intrusion
UAO	Unilateral Administrative Order

EXECUTIVE SUMMARY

This is the fourth five-year review for the Sinclair Refinery site, located in the Village and Town of Wellsville, Allegany County, New York. The site is being addressed in two operable units (OUs). OU1 consists of the landfill remediation and river rechannelization and has been completed. OU2 consists of the surface soils, sediments, and groundwater at the former refinery. The soils and sediment work has been completed, while the groundwater remedy is ongoing.

Based upon its review of all relevant data, including the two Records of Decision (RODs) and Explanation of Significant Differences (ESD), investigation reports, design reports, progress monitoring and operation and maintenance reports, five-year review reports, and the recently conducted site inspection, the U.S. Environmental Protection Agency (EPA) concludes that the actions taken at the Sinclair Refinery site currently protect human health and the environment. Long-term protectiveness will be achieved upon the implementation of easements/covenants at nine site properties.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Sinclair Refinery		
EPA ID: NYD980535215		
Region: 2	**State:** NY	**City/County:** Wellsville/Allegany

SITE STATUS	
NPL Status: Final	
Multiple OUs? Yes	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: EPA **If "Other Federal Agency" was selected above, enter Agency name:** Click here to enter text.
Author name (Federal or State Project Manager): Michael J. Negrelli
Author affiliation: EPA
Review period: 10/01/2007 – 9/30/2012
Date of site inspection: 6/13/2012
Type of review: Statutory
Review number: 4
Triggering action date: 9/26/2007
Due date *(five years after triggering action date)*: 9/26/2012

The table below is for the purpose of the summary form and associated data entry and does not replace the two tables required in Section VIII and IX by the FYR guidance. Instead, data entry in this section should match information in Section VII and IX of the FYR report.

Issues/Recommendations

OU(s) without Issues/Recommendations Identified in the Five-Year Review:
OU1

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 02	Issue Category: Institutional Controls			
	Issue: Institutional controls not yet implemented at nine properties.			
	Recommendation: Implement remaining institutional controls.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA/State	12/31/2013

To add additional issues/recommendations here, copy and paste the above table as many times as necessary to document all issues/recommendations identified in the FYR report.

Protectiveness Statement(s)
Include each individual OU protectiveness determination and statement. If you need to add more protectiveness determinations and statements for additional OUs, copy and paste the table below as many times as necessary to complete for each OU evaluated in the FYR report.

Operable Unit: 01	*Protectiveness Determination:* Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The implemented remedy for OU1 of the Sinclair Refinery Superfund site protects human health and the environment. There are no exposure pathways that could result in unacceptable risks and none are expected, as long as the Site use does not change and the implemented engineered and institutional controls are properly operated, monitored, and maintained.		

Operable Unit: 02	*Protectiveness Determination:* Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The implemented remedy for OU2 of the Sinclair Refinery Superfund site protects human health and the environment in the short-term. In order for the remedy to be protective in the long-term, environmental easements/covenants need to be implemented at nine properties.		

Sitewide Protectiveness Statement (if applicable)	
For sites that have achieved construction completion, enter a sitewide protectiveness determination and statement.	
Protectiveness Determination: Short-term Protective	*Addendum Due Date (if applicable):* Click here to enter date.
Protectiveness Statement: The implemented remedy for the Sinclair Refinery Superfund site protects human health and the environment in the short-term. In order for the remedy to be protective in the long-term, environmental easements/covenants need to be implemented at nine properties.	

I. Introduction

This five-year review was conducted by Michael Negrelli, U.S. Environmental Protection Agency (EPA) Remedial Project Manager (RPM). This review was conducted pursuant to Section 121(c) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, 42 U.S.C. Section 9601, et seq., and 40 C.F.R. 300.430(f)(4)(ii) and in accordance with the Comprehensive Five-Year Review Guidance, OSWER Directive 9355.7-03B-P (June 2001). The purpose of a five-year review is to ensure that implemented remedies protect public health and the environment and that they function as intended by the decision documents. This document will become part of the site file.

In accordance with Section 1.3.3 of the Five-Year Review Guidance, this fourth five-year review is triggered by the signing date of the previous Five-Year Review Report. The five-year review is required because, following the completion of the remedial actions for the site, hazardous substance, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure. This five-year review is being conducted as a statutory requirement. The previous Five-Year Review Report was signed by EPA on September 26, 2007. A site inspection for this five-year review was held on June 13, 2012.

This site is being addressed in two operable units (OUs). OU1 consists of the landfill remediation and river rechannelization and has been completed. OU2 consists of the surface soils, sediments, and groundwater at the former refinery. The soils and sediment work has been completed, while the groundwater remedy is ongoing.

II. Site Chronology

Table 1, appended to this report, summarizes site-related events from discovery to construction completion.

III. Background

Physical Characteristics

The Sinclair Refinery site is situated between the Genesee River and South Brooklyn Avenue, one-half mile south of downtown Wellsville, in Allegany County, New York. The northerly flowing Genesee River forms the eastern and southern boundaries of the site, South Brooklyn Avenue forms the western boundary, and an old refinery access road forms the northern boundary. The site consists of two areas: a 90-acre refinery area and a 10-acre landfill area. A 14-acre tank farm, located approximately one-quarter mile west of the site, was investigated as part of the remedial investigation and found to have no contaminants of concern and is no longer

considered part of the site. All of the response actions are limited to the 100 acres of the refinery and landfill. A general site map is included as Figure 1.

Geology/Hydrogeology

The refinery area is characterized by generally flat land sloping gently towards the Genesee River. Site geology is dominated by fluvial and glacial sediments, which are highly variable unconsolidated deposits composed of sands, clays, and gravel. Fill material is also present in site soils, similarly composed of sands, clays, and gravel. Within the unconsolidated deposits beneath the site are at least three hydrogeologic units: an upper aquifer comprised of recent fluvial deposits, an aquitard comprised of glaciolacustrine clay, and a poorly defined lower aquifer comprised of glacial sands. Depths to the glaciolacustrine clay layer at the refinery range on average between 15 and 30 feet from the surface and average depth to the water table ranges between 5 and 10 feet from the surface. Groundwater flow at the site is generally to the north and east, discharging directly into the Genesee River. The Genesee River is a local source of drinking water, and the intake for the Village of Wellsville municipal water supply is located approximately one-quarter mile upstream of the site. Water on the site is supplied by the Village municipal system.

The area where the site is located also contains a man-made wetland area referred to as the main drainage swale. This wetland habitat was created as a result of the construction of a dike to prevent the Genesee River from eroding portions of the site. The Genesee River is also an important ecological resource for the State of New York, as well as being the primary drinking water source for the Village of Wellsville.

Land and Resource Use

When refinery operations ceased in 1958 as the result of a fire, the Sinclair Refining Company transferred the majority of the site property to the Village of Wellsville, which, in turn, conveyed some of the parcels to various companies and other entities. Currently, five companies and the State University of New York at Alfred's Wellsville Campus occupy the site. About 30 structures exist on-site, made of either brick or corrugated aluminum and steel frame construction. Other site features include a storm water sewer system, a sanitary sewer system, the main drainage swale, and a shallow drainage swale running perpendicular to the river near the site's north boundary. Features at the landfill portion of the site include a capped landfill and a recently built flood-control dike.

As previously mentioned, the site is located one-half mile south of downtown Wellsville, a village with a population of about 5,200. Additionally, approximately 500 people use the buildings located on the site on a daily basis. Site usage is considered active and the site is expected to continue to be actively used.

History of Contamination

The refinery was built in 1901 for the processing of Pennsylvania grade crude oil. The Sinclair

Refining Company purchased the refinery in 1919 and operated it through 1958, when a fire halted operations. In 1969, the Sinclair Refining Company merged with the Atlantic Richfield Company (ARCO). During the operating history of the refinery, the company manufactured products such as heavy oils and grease for lubrication applications, light oil for fuel, naphtha, gasolines, aniline, lighter fluid and paraffin. Additionally, a Wellsville, Addison and Galeton railroad line and spurs passed through the site which serviced the refinery. Also during Sinclair's refinery operations, tetraethyl lead sludge generated in the refinery process was temporarily buried in pits within the refinery area. The sludge was then oxidized or burned, causing the creation of lead oxide. The burned sludges were eventually reburied within the landfill located along the southernmost portion of the site. Other wastes generated during the course of the refinery operations included tank sludges from a solvent plant, sludges from an oil separator, acids, pesticides, waste oil and heavy metals. While these wastes were primarily disposed of in the landfill located at the site, manufacturing and waste handling operations at the time also led to the contamination of the refinery surface soils, subsurface soils and groundwater.

Initial Response

In 1981, debris from the Sinclair landfill was reported to have washed into the Genesee River due to erosion. Reports from the community and site inspections conducted by the New York State Department of Environmental Conservation (NYSDEC) indicated that the site warranted proposal for the National Priorities List (NPL). In September 1983, the Sinclair Refinery site was placed on the NPL.

In 1983, EPA and NYSDEC signed a cooperative agreement that identified NYSDEC as the lead agency responsible for overseeing the remedial cleanup activities at the site. In 1984, NYSDEC initiated a Remedial Investigation/Feasibility Study (RI/FS) to determine the nature and extent of contamination at the site and evaluate alternatives for the long-term remediation of the landfill portion of the site. In 1985, EPA authorized an initial remedial measure at the site, consisting of the relocation of the surface water intake for the Village of Wellsville's public water supply. The intake was moved to a location one-quarter of a mile upstream from the site in order to eliminate the possibility of landfill wastes contaminating the Village's drinking water supply. The relocation of the drinking water intake was completed in the Spring of 1988. In 1987, EPA took over lead agency status from NYSDEC following a work stoppage due to a contract dispute between NYSDEC and its contractor.

Enforcement Activities

Since EPA took over lead agency status in 1987, EPA and ARCO have entered into a number of agreements allowing ARCO to carry out the required work under EPA oversight. In 1988, EPA and ARCO entered into a judicial Consent Decree, which was entered with the U.S. District Court for the Western District of New York on May 19, 1989 ("1989 Consent Decree"), to perform the remedial design and remedial action for OU1. These activities (river channelization, landfill consolidation, landfill cap construction) were successfully completed between 1992 and 1994. Additionally, ARCO agreed to perform the OU2 RI/FS as memorialized in an Administrative Consent Order issued by the EPA on July 28, 1988. The RI/FS was successfully

completed in 1991 upon EPA's issuance of the OU2 ROD.

Following the selection of the OU2 remedy in the 1991 ROD, EPA sought to negotiate a Consent Decree with ARCO for the performance of the remedial design and remedial action for OU2. In order for ARCO to expedite the remedy selected for the refinery surface soils and enable most of the excavated material to be placed under the landfill cap before its closure, ARCO requested that EPA issue a Unilateral Administrative Order (UAO) for the remedial design and remedial action of the refinery surface soils (UAO1). UAO1 was issued by EPA on May 1, 1992, and the remedial action was successfully completed in 1994. EPA and ARCO were ultimately unable to negotiate a Consent Decree for the groundwater remedy and consequently EPA issued a second UAO to ARCO on September 8, 1992 for the remedial design and remedial action of the groundwater portion of the remedy (UAO2). Subsequently, in 1993, ARCO petitioned EPA to implement an air sparging/soil vapor extraction (AS/SVE) remedy with a smaller pumping and treatment component of the remedy called for in the OU2 ROD, claiming the AS/SVE system would be as effective in meeting ROD performance standards and less costly. EPA agreed to allow ARCO to pursue this proposal as a site-wide pilot program with the caveat that if monitoring data collected during the implementation of the AS/SVE system could not demonstrate the effectiveness of the system in achieving the cleanup goals of the ROD, then another program to meet those cleanup goals would have to be implemented by ARCO. This phased approach to groundwater remediation was memorialized in a February 28, 1994 letter from EPA to ARCO. ARCO has provided EPA with monitoring data since the Phase 1 systems began operating. The monitoring data are discussed in more detail below. Following EPA's review of the Phase 1 monitoring data over an approximate seven-year period, EPA determined that the Phase 1 remedy was ultimately ineffective in meeting the cleanup goals of the OU2 ROD and that a Phase 2 program, focused on the extraction and treatment of groundwater, needed to be implemented. EPA issued a letter to ARCO on September 19, 2002 to memorialize this determination. ARCO's implementation of Phase 2 is discussed below.

Since the OU2 work was performed pursuant to unilateral orders, EPA negotiated a judicial Consent Decree with ARCO to recover outstanding past costs and future oversight costs. The judicial Consent Decree was entered by the Court on May 11, 2004. Under the Consent Decree, ARCO paid the United States $1,834,712 in past costs and interest and agreed to pay the Government's future oversight costs under a three tiered approach tied to the phase of the project with an oversight cost cap diminishing as the work shifts from the completion of construction of the remedial action to operation and maintenance oversight.

Basis for Taking Action

For purposes of investigation and remediation, the Sinclair Refinery site is being addressed in two distinct operable units. OU1, which consists of the 10-acre landfill portion of the site, (formerly consisting of the Central Elevated Landfill Area (CELA), the South Landfill Area (SLA), and the area between the two landfills) and OU2, which consists of the 90-acre former refinery.

The OU1 RI/FS identified the following wastes deposited in the landfill: cloth filters used for straining oil; sludges from an oil/water separator; tank sludges from the solvent plant; off-specification products; oil-soaked soils and sludges (deposited daily); burnt Fullers Earth (used for filtering); tank sludges (deposited weekly); acid spills; cinders and ash from the coal-fired boiler plant; tetraethyl lead; pesticides; waste oil; and heavy metals.

A public health threat analysis (i.e., risk assessment) was performed as part of the RI/FS. The results indicated that although the landfill wastes did not generate a substantial amount of leachate and did not appear to be migrating readily from the landfill area, the landfill area as a whole must be considered a serious potential source of contamination by virtue of the hazardous substances deposited there. The most significant threat from the landfill was determined to be from flooding or failure of the landfill slopes; failure of the landfill into the Genesee River would have a serious negative impact on public health and the environment. Additionally, the potential for localized organic compound vaporization was found to be a potential contaminant migration mechanism, and thereby a potential threat to the local population.

The OU1 ROD had also called for remedial alternatives addressing the refinery portion of the site to be evaluated as part of a supplemental (OU2) RI/FS. ARCO agreed to perform the OU2 RI/FS as memorialized in an Administrative Consent Order issued by the EPA on July 28, 1988. The results of the OU2 RI/FS identified volatile and semi-volatile organic compounds and metals as contaminants of concern in the refinery area. Sampling and analysis of the surface soils indicated the presence of arsenic and lead above action levels selected for the site. Sampling and analysis of subsurface soils indicated the presence of volatile and semi-volatile organic compounds and arsenic and lead as well, but at levels lower than that found in the surface soils. Sampling and analysis of the groundwater in the refinery area indicated three plumes (the northern, central, and southern plumes) in the shallow aquifer with levels of benzene, toluene, ethylbenzene, xylene, nitrobenzene, naphthalene, arsenic, chromium and lead above action levels selected for the site.

A risk assessment was performed as part of the RI/FS and several potential exposure pathways were evaluated. The risk assessment assumed current and future land use as industrial. The greatest risk factor was attributed to the inhalation of fugitive dust, primarily due to arsenic found in site surface soils. Consequently, a risk-based arsenic cleanup number was generated (25 parts per million (ppm)). Additionally, EPA guidance for establishing lead cleanup levels in soil at superfund sites indicated that 1000 ppm would be a protective cleanup level based on current and anticipated future land use, which is industrial. Finally, although the shallow aquifer at the site is not a current drinking water source, the aquifer is designated by New York State as a potential source of potable water, thereby making it subject to cleanup levels established by federal and State laws and regulations (i.e., maximum contaminant levels (MCLs) and ambient water quality standards).

To support the 2009 Explanation of Significant Differences (ESD), a focused human health and ecological risk assessment was conducted for soils and sediments on-site. An ecological risk analysis was performed to determine potential impacts to native species of the swale

environment. Accordingly, the main drainage swale exhibited some limited areas of arsenic contamination that would likely cause adverse impacts to native biota. Also, a human health risk analysis was performed following the river investigation using the analytical samples taken of the soil media from the river bank. The results of this analysis established a potential future non-cancer health risk to construction workers on the river bank.

IV. Remedial Actions

Remedy Selection

As a result of the OU1 RI/FS, EPA selected a cleanup plan for the landfill portion of the site which was embodied in a September 26, 1985 Record of Decision (ROD) for OU1. The ROD outlined the remedial action objectives (RAOs) to address the risks to public health and the environment identified in the RI/FS. The RAOs for OU1 include:

* Maintenance of a safe, uncontaminated drinking water supply for the Village of Wellsville;

* Protection of Genesee River water quality and associated uses (potable water supply, fishing, recreation) from contaminant releases;

* Protection of local groundwater, which discharges to the Genesee River, from contaminant migration;

* Prevention of direct contact between humans and animals with contaminated site materials, including soil and leachate;

* Avoidance of site inundation from increased river flow associated with a 100-year storm event; and

* Avoidance of site erosion from a 100-year storm event.

To meet the RAOs for OU1, the remedial actions identified in the 1985 ROD included:

* the partial channelization of the Genesee River to protect the landfill from erosion and flooding;

* the removal and disposal of drums from the surface of the CELA;

* the excavation of the SLA and its consolidation onto the CELA, and backfilling of the excavated area with clean fill;

* the construction of a cap over the consolidated landfill; and

* the construction of a fence around the consolidated landfill.

ARCO agreed to implement the remedial actions, with modifications to the original plan for partial channelization of the Genesee River. This agreement was memorialized in a judicial Consent Decree which was signed by the United States and ARCO and entered with the U.S. District Court for the Western District of New York on May 19, 1989.

Subsequently, the required work was organized into three separate remedial actions, namely: the partial channelization of the Genesee River (completed in 1992); the drum removal, excavation, consolidation, and backfilling of the SLA (completed in 1992); and the capping and fencing of the consolidated landfill (completed in 1994).

As a result of the OU2 RI/FS, EPA selected a remedy for the second operable unit in a ROD (OU2 ROD) signed on September 30, 1991. The ROD outlined the RAOs to address the risks to public health and the environment identified in the RI/FS. The RAOs for OU2 include:

* A cleanup level for arsenic in site surface soils of 25 ppm, determined to be protective of human health and the environment based on the site risk assessment;

* A cleanup level for lead in site surface soils of 1000 ppm, determined to be protective of human health and the environment based on EPA guidance and current site land use; and

* A cleanup level for groundwater as established by state and federal regulations for a groundwater aquifer designated as a potential drinking water source.

The remedial actions selected in the ROD included:

* The excavation of surface soils exceeding the remedial cleanup criteria for arsenic (25 ppm) and lead (1000 ppm) to a depth of one foot, followed by confirmatory sampling and backfilling with clean fill. Excavated soils would then be treated as necessary to comply with applicable regulations prior to consolidation into the on-site landfill prior to closure;

* Long-term monitoring of surface water, groundwater, and soil-gas to track potential contaminant migration from the subsurface soils;

* Treatment of contaminated groundwater with the goal of achieving applicable or relevant and appropriate requirements (ARARs). Contaminated groundwater would be extracted, treated, and discharged either directly to the Genesee River or via the Publically Owned Treatment Works; and

* Institutional controls in the form of local zoning ordinances would be recommended to account for any construction activity that would alter present site use or otherwise open

an exposure pathway to subsurface soils. If such construction activity were to occur, an evaluation of the impacts of the proposed construction in regard to site contamination and exposure pathways would be reviewed and evaluated by EPA and New York State.

UAOs for Remedial Design and Remedial Action were issued by EPA to ARCO on May 1, 1992 and September 8, 1992 for the OU2 work, which was organized into two separate remedial actions. These consisted of the surface soils excavation and disposal as the first remedial action, completed in 1994, and the monitoring and groundwater remediation components as the second remedial action, which was completed in 2012.

In August 2009, EPA issued an ESD which documented modifications to the OU2 pumping and treatment groundwater remedy, referred in subsequent sections as "Phase 2-1." The modified Phase 2-1 remedy included the installation and operation of a groundwater collection trench to intercept the impacted groundwater from the aquifer and prevent the migration of contaminants into the Genesee River. The groundwater in the intercept trench would be conveyed by pumps to a constructed wetland at the southern end of the site where the contamination is treated by natural processes. The system would be subject to long term monitoring and maintenance.

The ESD also identified further soil and sediment removal and backfill actions to address light non-aqueous phase liquid (LNAPL) contamination on surface water bodies associated with the site. Sediments would be excavated in two identified areas: the deep sediment area and shallow sediment area. In addition, soils on the Genesee River bank where LNAPL was visually observed would be subject to excavation and backfilling. Finally, impacted soils and sediment on the western embankment of the main drainage swale would also be excavated and backfilled. These construction activities, and the placement of excavated soil and sediment into the CELA and its restoration, are referred in subsequent sections as "Phase 2-2."

The ESD also modified the institutional controls in the OU2 ROD. The goals set forth in the OU2 ROD would be implemented through proprietary institutional controls in the form of environmental easements/restrictive covenants to be placed on all properties at the site.

Remedy Implementation

Genesee River - Partial Channelization

The remedial action for partial channelization of the Genesee River was carried out in accordance with the requirements of the 1989 Consent Decree. The components of this phase of the remediation included the following:

* Protection of the consolidated landfill from bank erosion and flood inundation during floods up to a 100-year event on the Genesee River;

* Protection of the east bank, from an existing sheet pile weir to approximately 2000 feet from the existing riprap upstream of the weir; and

* Improvement of river flow conditions approaching the weir located downstream from the landfill.

The design to accomplish this work was approved by EPA on February 21, 1990 and construction commenced on July 24, 1990. The work was carried out by ARCO's contractor and overseen by the U.S. Army Corps of Engineers through an interagency agreement with EPA. EPA performed a final inspection of the construction on October 3, 1991; the remedial action was completed upon EPA's approval of the Remedial Action Report on March 27, 1992.

South Landfill Area Excavation and Consolidation

The remedial action for the SLA was implemented in accordance with the 1989 Consent Decree, and consisted of the following:

* Excavation and consolidation of the wastes from the 2.3-acre SLA onto the 9.2-acre CELA;

* Filling the excavated area with clean fill from an off-site source; and

* Placement of a temporary cover over the portion of the CELA which received waste from the SLA, pending the final remediation of the CELA.

The design to accomplish this work was approved by EPA on September 26, 1990 and construction commenced on October 15, 1990. The excavation was completed in November 1990, but backfilling of the excavated area was suspended due to the onset of the winter season and completed the following year. The work was carried out by ARCO's contractor and overseen by the U.S. Army Corps of Engineers through an interagency agreement. EPA performed a final inspection of the construction on October 3, 1991; the remedial action was completed upon EPA's approval of the Remedial Action Report on March 27, 1992.

Landfill Capping

The remedial action for the capping of the consolidated landfill was also carried out in accordance with the requirements of the 1989 Consent Decree. The objectives of this phase of the remediation included the following:

* Removal of drums from the landfill, with empty drums shredded and placed over the surface of the waste and drums with contents being disposed of off-site;

* Construction of a soil-bentonite cutoff wall around the landfill perimeter;

* Stabilization of soft sludge wastes within the landfill;

* Regrading of the landfill;

* Construction of a geosynthetic and soil cap over the landfill surface to be tied in to the soil-bentonite cutoff wall;

* Construction of a passive gas vent system within the cap;

* Installation of monitoring wells around the landfill, piezometers within the landfill, and pipe sleeves within the landfill cap for possible future access; and

* Installation of a permanent security fence around the capped landfill.

The design to accomplish this work was approved by EPA on December 6, 1991 and construction commenced in June 1992. The work was carried out by ARCO's contractor and overseen by the U.S. Army Corps of Engineers through an interagency agreement. EPA performed a final inspection of the construction on July 8, 1993; the remedial action was completed upon EPA's approval of the Remedial Action Report on January 28, 1994.

Surface Soils Excavation and Disposal

The remedial action for the refinery surface soils excavation was implemented in accordance with UAO1. The objectives of the remedial action consisted of the following:

* Excavation of refinery surface soils exhibiting concentrations above 1000 ppm of lead and 25 ppm of arsenic to a depth of one foot below surface;

* Consolidation of the excavated soils into the landfill prior to closure;

* Filling the excavated area with 6 inches of clean soil and 6 inches of topsoil; and

* Revegetation of the disturbed areas.

The design to accomplish this work was approved by EPA on May 29, 1992 and construction commenced on July 8, 1992. The work was completed in early 1994, necessitating some of the excavated soil to be disposed of at an approved off-site facility. The work was carried out by ARCO's contractor and overseen by the U.S. Army Corps of Engineers through an interagency agreement. EPA performed a final inspection of the construction on May 10, 1994; the remedial action was completed upon EPA's approval of the Remedial Action Report on November 23, 1994.

Groundwater Remediation - Phase 1

The OU2 ROD called for the pumping and treatment of contaminated groundwater at the site with the goal of achieving drinking water standards. EPA issued UAO2 to ARCO for the remedial design and remedial action of this remedy. In late 1993, ARCO approached EPA with a proposal to implement an air sparging/soil vapor extraction (AS/SVE) remedy, which would essentially remediate the subsurface sources of groundwater contamination at the site, with a

smaller component of pumping and treatment, claiming these systems would be as effective in meeting the OU2 ROD performance standards and less costly. EPA agreed to allow ARCO to pursue this proposal as a site-wide pilot program (Phase 1) with the caveat that if monitoring data collected during the implementation of the AS/SVE system could not demonstrate the effectiveness of the system in achieving the cleanup goals of the ROD, then another program to meet those cleanup goals would have to be implemented by ARCO (Phase 2). This phased approach to the groundwater remediation was memorialized in a February 28, 1994 letter from EPA to ARCO. In 1995, ARCO began Phase 1 at the site which essentially applied AS/SVE to the southern and central plumes at the site and a limited pumping and treatment component (three recovery wells) at the downgradient edge of the northern plume. After a failed attempt to apply AS/SVE at the upgradient portion of the northern plume, an AS/SVE system was later added further downgradient in a more geologically suitable location.

ARCO provided EPA with continuous monitoring data since the systems began operating. After the Phase 1 system operated for a number of years, the results of the monitoring data indicated that AS/SVE was not an effective technology in meeting drinking water standards in the groundwater plumes at the site. Although the systems implemented by ARCO effectively removed large quantities (approximately 150,000 pounds) of subsurface contamination from the subsurface soils that become seasonally saturated with a rising and falling water table, the systems had little, if any, effect on the groundwater plumes. Conversely, the limited pumping and treatment that was carried out at the site under Phase 1 appeared to be an effective means of reducing contaminant levels in the groundwater aquifer, and monitoring results showed the area of the plumes nearest to the recovery wells to be at or near MCLs. In September 2002, EPA notified ARCO by letter that the Phase 1 program had not met the performance standards of the OU2 ROD and that a Phase 2 program, based on the original pumping and treatment remedy from the OU2 ROD, needed to be implemented.

Groundwater Remediation - Phase 2

Following EPA's notification in 2002 that a Phase 2 groundwater remedy needed to be implemented, ARCO initiated remedial design activities. Following the submission of the Phase 2 Pre-Final Design Report for OU-2 in November 2005, a decision was made to separate the Phase 2 remediation into two separate portions, Phase 2-1 and Phase 2-2, so that some elements of the remedial design could be expedited while other elements were evaluated by the regulatory agencies. The following sections describe the aspects of the Phase 2-1 and Phase 2-2 remedial work. The use of innovative technologies became an integral part of the Phase 2 groundwater remediation, and EPA published an ESD in August 2009 to document how these technologies varied from the original pumping and treatment remedy outlined in the OU2 ROD.

OU-2 Phase 2-1: Groundwater Collection and Treatment

Phase 2-1 is the remedial action for the refinery groundwater and was implemented in accordance with UAO2. The objectives of the remedial action for Phase 2-1 consisted of the following:

- Installation of a Groundwater Collection System consisting of a 3,300 ft long collection trench;
- Installation of eight manholes in the collection trench to house pumping systems to transfer groundwater to the wetland treatment system;
- Installation of a conveyance system to transfer groundwater to the wetland treatment system; and
- Installation of the components of the wetland treatment system.

The design to accomplish this work was approved by EPA in March 2007. Construction began in July 2007 and was completed in September 2008. The work was performed by contractors employed by ARCO and overseen by Camp Dresser McKee (CDM; now dba CDM-Smith) as oversight contractor to EPA. The NYSDEC also provided oversight of the construction.

The Phase 2-1 remedy consists of a 3,300 foot long collection trench running the entire length of the site, tied into clay and designed to intercept the contaminated groundwater of the shallow aquifer. An in-trench pumping system conveys the contaminated groundwater to a constructed wetland treatment system at the southern end of the site. Components of the wetland treatment system include a sedimentation pond and sludge drying beds to collect solids and metals, and a sequence of surface flow wetlands, vertical flow wetlands, and a cascade aerator to remove VOCs and SVOCs. Discharge occurs at a single monitored outfall at the head of the main drainage swale with monthly compliance monitoring conducted to meet the terms of a New York State regulated permit. EPA's evaluation of the design of the system indicated that it was an effective and innovative approach to groundwater remediation. In its August 2009 ESD, EPA notified the public that the approach was essentially the same as the pumping and treatment remedy outlined in the OU2 ROD but at less cost. The collection trench with subsurface pumps served the same function as the series of pumping wells described in the ROD and the elements of the wetland treatment system provided the same functions as a central collection tank, solid removals step, air stripping, and carbon adsorption which would be incorporated into a water treatment plant. Additionally, this use of innovative technologies is a decidedly greener remedy.

The system became operational in December 2008 and during the initial six months of operation modifications and improvements were made. These included: connection of the manholes to the spare conveyance line; replacement of the conveyance line connections with wye connections; installation of cleanouts; installation of ultrasonic flow meters; the repair of surface flow aeration lines; and the installation of an air emission biofilter at the cascade aerator. The system has been operating continuously since the modifications were completed.

EPA performed a final inspection of construction of the Phase 2-1 remedy on July 14, 2011. At this time a Remedial Action Report prepared by ARCO's contractor is under agency review.

OU-2 Phase 2-2: Sediment and Soil Excavation

Phase 2-2 is the remedial action to mitigate residual LNAPL contamination in subsurface riverbank soils and riverbed and main drainage swale sediment which would seasonally seep

onto the surface of the Genesee River and surface water in the main drainage swale. Following the initial appearance of these sheens, ARCO implemented an interim remedy that involved the placement of collection booms and adsorbent pads. The Phase 2-2 remedial action mitigates the seeps through a permanent remedy. This remedial action was implemented in accordance with the additional work provisions of UAO2. The objectives of the remedial action for Phase 2-2 consisted of the following:

- Removal and restoration of impacted sediments from the main drainage swale;
- Installation of a mid-slope sheet pile wall along the Genesee River for structural support;
- Removal of impacted bank soils and sediment from the Genesee River followed by restoration;
- On-site disposal of excavated soils/sediments in a new cell on the CELA;
- Installation of a water level control berm in the main drainage swale to aid groundwater capture and mitigate groundwater seeps; and
- Final site restoration consisting of a public recreational trail along the top of the riverbank and CELA restoration using wildflowers and native grass species.

The design to accomplish this work was approved by EPA in April 2009. In its August 2009 ESD, EPA notified the public that the Phase 2-2 work in the Genesee River and main drainage swale was an expansion of the excavation and removal parameters for impacted soil established in the OU2 ROD. The OU2 ROD also provided for impacted soils to be disposed of in the CELA.

The work for Phase 2-2 began in September 2008. The Genesee River and main drainage swale excavation work was completed in 2010 and restoration of the recreational trail was completed in early 2011. A ribbon-cutting ceremony reopening the trail to public use, along with a final construction inspection conducted by EPA, was conducted on July 14, 2011. Final restoration of the CELA was completed in June 2012. The work was performed by contractors employed by ARCO and overseen by CDM (now dba CDM-Smith) as oversight contractor to EPA. The NYSDEC also provided oversight of the construction. At this time, a Remedial Action Report prepared by ARCO's contractor is under agency review.

Operation and Maintenance, Monitoring, and Institutional Controls

Landfill

Routine operation and maintenance (O&M) of the OU1 remedy has been ongoing since the completion of the remedial action in 1994. Annual reports are provided to EPA for review. O&M activities include quarterly inspections of the landfill cap and associated systems and annual subsidence surveys and groundwater monitoring events. Typical maintenance activities have included mowing the vegetation on the cap surface and removing overgrowth around well heads and the riprap on the riverbank. Eroded topsoil on the cap is replaced and reseeded as needed. Review of the annual reports and inspections during site visits indicate that all systems are operating efficiently. There is also access controls in place for OU1 in the form of a security

fence which is being maintained to prevent unauthorized access to the landfill. In addition, there is a restrictive covenant tied to the deed for the 10-acre parcel containing the landfill. The covenant provides for: no excavation, operation or parking of vehicles, or any activity that would otherwise disturb the facilities on the premises; access to the site for maintenance by ARCO; and the owner will notify ARCO if any party or event disturbs the facilities.

In November 2011, ARCO submitted an updated draft O&M Plan for the site. The overall purpose of this updated O&M Plan is to combine inspection and maintenance activities in a single document for both OU1 and OU2. The draft O&M Plan considered activities to be performed in four areas of the site including:

- CELA O&M Requirements
- Groundwater Collection Trench O&M Requirements
- Wetland Treatment System O&M Requirements
- River Channel and Swale O&M Requirements

As part of the CELA reuse and restoration program (Phase 2-2), certain O&M activities have been modified and are described in the draft O&M Plan. For example, CELA restoration work included using wildflowers and native grass species, eliminating the need for mowing of the landfill cap. Also as part of the restoration work, limited public access is provided via short pathways connected to the recreational trail that runs through the site, and informational plaques have been installed for the public's edification regarding the site history and remediation.

EPA has reviewed and provided comment on the draft O&M Plan and it is expected that the O&M Plan will be finalized sometime in 2012.

Groundwater Collection and Treatment

Prior to the construction and implementation of the groundwater collection trench and wetland treatment system, the groundwater remedy for OU2 included a very limited groundwater extraction well and a wastewater treatment plant system (Phase 1). During this period, a local company, On-Site Health and Safety Services, Inc., was contracted by ARCO to monitor and maintain the remedial systems. In addition to performing activities related to the groundwater treatment system, daily site inspections were performed including visual monitoring of the river surface for LNAPL. Monitoring wells were sampled annually and the analyzed data presented to EPA in an annual report. This report was used to show general trends over time of the effects of the remedial systems on site contamination. Monitoring of these systems led to the determination that Phase 1 was not effective in meeting the groundwater cleanup goals and that Phase 2 be implemented. In addition to constructing the groundwater collection trench and wetland treatment system, Phase 2 also removed the LNAPL sources from the riverbank and riverbed and main drainage swale. OU2 O&M activities now include the Phase 2 work, replacing the Phase 1 activities.

The Phase 2-1 wetland treatment system became operational in December 2008. At that time,

the Phase 1 groundwater extraction wells and wastewater treatment system was terminated and decommissioned. Modifications were made to optimize the Phase 2-1 system during the initial six months and the system has operated continuously since June 2009. The system is shut down for two weeks in June of each year for iron solids removal from the sedimentation pond. Approximately 188,000,000 gallons of water have been treated since system start-up. In 2008, NYSDEC issued interim reporting limits for a new permitted outfall from the wetland treatment system. Since its issuance, several extensions of the interim draft permit have been granted to ARCO in order to optimize the efficiency of the wetland treatment system. During this time period,VOCs have been treated to permit limits and SVOCs have been treated to permit limits with occasional exceptions in winter months. At this time, ARCO is continuing to optimize the treatment system such that discharge limits are met consistently year round. It is expected that a final permit will be issued in June 2013.

Additionally, since the initiation of the Phase 2-1 groundwater treatment system, ARCO has conducted a performance-based groundwater monitoring (PBGM) program to ensure that an inward gradient is maintained by the groundwater collection trench. The PBGM program includes taking regular water level measurements from piezometers on the upgradient and downgradient side of the trench to confirm the inward gradient, establishing that groundwater does not migrate beyond the trench to the Genesee River. Water quality samples are also taken and analyzed from the manholes associated with the pumps in the trench to monitor contaminant levels in the influent entering the wetland treatment system. Further, manhole groundwater sampling and analysis is representative of site-wide upgradient groundwater quality; once constituent levels begin to diminish in the manhole samples, upgradient groundwater samples will be taken and analyzed to confirm that contaminant levels are diminishing in the aquifer. Once a trend is established, ARCO will present the regulatory agencies with a Contingency Measure Plan and/or Long-term Management Measure Plan in accordance with the terms of the UAO, establishing the groundwork for completion. The PBGM program will be continued as an element of the comprehensive site O&M Plan expected to be finalized in 2012.

In addition to groundwater, the OU2 ROD also called for the long-term monitoring of surface water and soil gas to track any potential contaminant migration from the subsurface soils. The surface water monitoring directly led to the Phase 2-2 work to mitigate LNAPL outbreaks on the surface water of the Genesee River and main drainage swale. As described above, this work was completed in 2010. O&M activities associated with the river and swale systems include continued visual inspection particularly for signs of erosion or sloughing and effecting repairs as needed. LNAPL outbreaks have not been documented since the remedial activities concluded; however, monitoring will continue to include the recording of any outbreaks as part of the inspection process. These O&M activities and potential corrective actions are outlined in the comprehensive site O&M Plan. Additionally, the site O&M Plan will include groundwater quality monitoring in select wells between the trench and the river as an additional measure to ensure that Genesee River water quality is protected from contaminant releases.

With respect to soil gas monitoring, a soil gas survey was carried out in 1993, in which EPA surveyed the buildings on-site with the New York State Department of Health. Only one

building at the site was found to have a basement which would potentially be impacted by soil gas. The building is owned by the State University of New York. The basement of this building is a boiler room, consisting of a boiler and mechanical heat conveyance devices and no further action was considered necessary. Furthermore, as part of an agency wide initiative to investigate the potential for soil vapor intrusion on all superfund sites, in 2009, outreach was made to all of the entities occupying the site offering EPA's services in conducting air monitoring in their facilities. Each entity declined to participate, citing that indoor air monitoring was routinely conducted at their facilities under OSHA guidelines.

Institutional Control Implementation

The OU2 ROD also specified that institutional controls (ICs), in the form of local zoning ordinances, would be recommended to account for any construction activity that would alter present site use, particularly with respect to opening an exposure pathway to subsurface soils and to prevent groundwater usage until such time as ambient water quality standards are met in the aquifer. In its 2009 ESD, EPA modified the IC goals set forth in the OU2 ROD such that they are to be implemented through proprietary ICs in the form of environmental easements/restrictive covenants to be placed on all properties at the site. A total of 10 properties are impacted. In 2011, ARCO conveyed the property containing the CELA and wetland treatment system to SUNY Alfred with restrictions on groundwater use, as well as restrictions to ensure that the integrity of the remedial systems in place is maintained and that any future use of the property is done in accordance with a site management plan, which, among other things, will address residual subsurface soil contamination and potential vapor mitigation issues for any structures which may be constructed on the property. The deed restrictions also prevent the property from being used for residential purposes, including single or multi-family dwellings or rental units, child or elder care facilities, nursing homes or hospices, hotels or motels, medical or dental facilities, a church, an elementary or high school, entertainment or recreational facility, or a hospital. In addition, ARCO became the grantee to an Environmental Protection Easement and Declaration of Restrictive Covenants ("easement/covenant") on property already owned by SUNY Alfred which provided for the same restrictions discussed above. The site management plan is under development and an initial draft is expected to be completed in 2012. For the remaining nine separately owned parcels, ARCO has contacted the land owners and generally discussed the same types of engineering and institutional controls as the completed easement/covenant. The easements/covenants for these nine properties are expected to be signed and recorded no later than 2013. No problems are anticipated as all land owners at the site understand that the shallow aquifer zone is known to be contaminated and the Village of Wellsville supplies the entire site with water services, thus the groundwater is not used as a potable water source. Further, ARCO reports that the land owners are in agreement that distilling any environmental exposure requirements into generic and easily understandable land use and building restrictions would be prudent.

V. Progress Since the Last Review

The previous five-year review conducted by EPA in 2007 concluded that the implemented

actions for OU1 and OU2 protect human health in the short-term because exposure pathways for site contaminants are limited by current site groundwater use and controlled by the engineered, access, and institutional controls that are currently in place. Long-term human health protectiveness will be achieved when the final OU2 remedy is implemented and the final site institutional controls are selected and implemented. The 2007 report found that, for the most part, the implemented remedy protects the environment, although there were some concerns raised by unanticipated LNAPL releases and some high arsenic concentrations in the benthic environment. Consequently, the 2007 report concluded that it was not evident that the selected remedy was fully protective of the environment. Additional measures were to be implemented as part of the OU2 groundwater remedy to address these concerns. EPA would then decide on the adequacy of those measures and its determination would be made in either an addendum to the Five-Year Review Report or an ESD to the OU2 ROD.

The 2007 Five-Year Review Report included the following recommendations and follow-up actions with respect to the on-going remedial action:

- Complete the design and construction of the Phase 2 (OU2 ROD) groundwater remedy;
- Any changes in the final remedy may require an appropriate EPA decision document;
- Implement institutional controls for OU2 subsurface soils and groundwater;
- Conduct vapor intrusion evaluation and recommend mitigation measures, if necessary; and
- Conduct vapor intrusion evaluation and recommend where appropriate that new building construction on the site include vapor mitigation measures, if necessary.

In the five years since the last review, EPA has directed and overseen ARCO's efforts to meet these goals. In 2008, construction of the Phase 2-1 groundwater remedy was completed. Phase 2-1 included the groundwater collection trench and wetland treatment system. In 2009, the Final Design Report for OU2 Phase 2-2 was approved by EPA. This phase involved additional remedial measures to address LNAPL impacts in soils and sediments in the Genesee River and main drainage swale sediments. Construction involved the excavation of impacted materials and disposal of the materials in a new cell designed on the existing CELA and backfilling the excavated zones. During 2009-2010, approximately 27,000 cubic yards of impacted soils and sediments from site remedial work were disposed of on-site. Also, a permanent mid-slope sheet pile wall was installed along the river to stabilize the embankment and aid in groundwater containment.

In 2008, the PBGM program was developed and approved by EPA to monitor the effectiveness of the groundwater collection system in conveying contaminated groundwater to the wetland treatment system and prevent the migration of groundwater to the Genesee River. This program as well as the modified OU1 (CELA) O&M activities, maintenance and monitoring of the wetland treatment system, and maintenance and monitoring of the Genesee River and main drainage swale are included in a site-wide O&M Plan drafted in 2011. This O&M Plan provides the blueprint for ongoing site activities now that the remedial actions have been completed. The

O&M Plan will be completed in 2012. Additionally a Remedial Action Report will be completed in 2012, documenting the completion of the OU2 remedy.

In August 2009, EPA published the ESD for the OU2 Phase 2 groundwater remedy. This ESD provided for the modification of a traditional pump and treat groundwater remedy to an innovative collection trench and wetland treatment system. The ESD also expanded the soils removal portion of the OU2 remedy to include impacted soils and sediments of the Genesee River and main drainage swale to address the seasonal LNAPL outbreaks. Finally, the 2009 ESD modified the ICs called for in the OU2 ROD from local zoning ordinances to environmental easements/restrictive covenants on all properties comprising the site.

As discussed above, the implementation of ICs has at this time been achieved for two of the separately owned parcels comprising the site through deed restrictions and a separate easement/covenant. The easement/covenant will be the model for the remaining nine property parcels which are expected to be executed and recorded by 2013. A site management plan is also under development and an initial draft is expected to be completed in 2012.

In 2009, EPA contacted the site occupants offering EPA's services in conducting a vapor intrusion investigation in their facilities. Each entity declined to participate, citing that indoor air monitoring was routinely conducted at their facilities under OSHA guidelines. However, the site management plan will include a requirement that new building construction at the site include a vapor intrusion evaluation and that vapor mitigation measures, if necessary, will be included in the building design. The site management plan is under development.

Data collected during the five-year period since the last review included operations and maintenance data contained in the annual reports for OU1 O&M activities. Other data collected during the five-year period since the last review included the OU2 hydraulic data contained in two PBGM monitoring reports, dated January 2010 and July 2011, providing an evaluation of the performance of the groundwater collection trench. Additionally, annual groundwater quality monitoring reports were provided in 2007, 2008, and 2009 as interim reports to provide a summary of groundwater quality as the OU2 Phase 1 groundwater remedy was replaced by Phase 2. The Phase 2 groundwater quality data were collected from collection trench manholes monthly from October 2010 through March 2012 and provide a representation of site-wide groundwater quality. Finally, monthly data are collected and provided in letter report format to meet the requirements of the permitted outfall at the head of the main drainage swale, representing post-treatment effluent. Further detail on the data review process is supplied in Section VI., below.

Based upon the completion of the OU2 remedy and the undertaking of operation and maintenance of the remedial systems and review of the data collected, protection of human health and the environment has been achieved since the last five-year review. The remaining activities to be completed include the filing of ICs on the remaining property parcels, the finalization of the site O&M Plan, and the completion of the site management plan. These final activities should be completed in 2012 and 2013.

VI. Five-Year Review Process

Five-Year Review Team

Michael Negrelli, EPA Remedial Project Manager (RPM), prepared the Five-Year Review Report. The five-year review team also included Marian Olsen, human health risk assessor, Michael Clemetson, ecological risk assessor, Edward Modica, hydrogeologist, Michael Basile, community involvement coordinator (CIC), Carol Berns, site attorney, and Pietro Mannino, Section Chief. NYSDEC and ARCO have also provided information necessary for this review.

Community Notification and Involvement

The EPA CIC for the Sinclair Refinery site, Michael Basile, published a notice in the *Wellsville Reporter*, a local newspaper, in May 2012, notifying the community of the initiation of the five-year review process. The notice indicated that EPA would be conducting a five-year review of the remedy for the site to ensure that the implemented remedy remains protective of human health and the environment and is functioning as designed. It was also indicated that once the five-year review was completed, the Five-Year Review Report would be made available in the local site repository. The notice, which includes the RPM's mailing address, email address, and telephone number, solicits public comments or questions related to the five-year review process or to the site.

Document Review

The following documents, data, and information were reviewed in completing the five-year review:

- OU1 Record of Decision, EPA, September 1985;
- OU2 Record of Decision, EPA, September 1991;
- Explanation of Significant Differences, EPA, August 2009;
- EPA WasteLAN database;
- Final Design Report - Phase II-1 Remediation at OU2, ARCO, March 2007;
- Final Design Report – Phase II-2 Remediation at OU2, ARCO, March 2009;
- 2007 - 2010 Annual Reports of Operation and Maintenance Activities - OU1, April 2008 – September 2011;
- OU2 Phase 1 Groundwater Monitoring, ARCO, June 2007, December 2008 and October 2009 sample events;
- OU2 Phase 2 Manhole Monitoring, ARCO, October 2010 – March 2012 sample events;
- Performance Based Groundwater Monitoring Reports, ARCO, January 2010 and July 2011;

- Monthly Effluent Sampling Analysis Reports, January 2009 through July 2012;
- Draft Operation & Maintenance Plan, ARCO, November 2011;
- Environmental Protection Easement and Declaration of Restrictive Covenants granted by SUNY Alfred to ARCO on July 7, 2011;
- Deed conveying property from ARCO to SUNY Alfred dated July 7, 2011;
- Sinclair Refinery Site Five-Year Review Reports, September 1997, September 2002 and September 2007; and
- EPA Comprehensive Five-Year Review Guidance, June 2001.

Data Review

Data collected during the five year period since the last review included operations and maintenance data contained in the annual reports for OU1 O&M activities. The type of data collected and transcribed in these reports include inspection results, settlement plate survey results, groundwater, slurry wall, and LNAPL elevation/thickness measurements, groundwater quality analysis, gas vent and storm water evaluations, soil pH and agronomic testing results, and a summary of maintenance activities performed.

Groundwater quality monitoring performed under OU1 includes annual sampling and analysis of the eleven wells outside the slurry wall forming the perimeter of the CELA. Results indicate that VOC and SVOC levels remain below MCLs in these wells and the few samples where metals exceeded the MCL indicated either stable or decreasing concentration trends. Semi-annual groundwater elevation monitoring data indicate that water levels within the CELA have remained stable and are consistently more than one foot below the top of the slurry wall. The review of these data indicates that the OU1 remedy is performing as intended in accordance with design specifications.

Other data collected during the five year period since the last review included the hydraulic data contained in two PBGM monitoring reports, dated January 2010 and July 2011, providing an evaluation of the performance of the groundwater collection trench. The hydraulic data was collected from piezometers located on either side of the collection trench. Groundwater elevations demonstrate that an inward gradient is achieved by the trench, achieving the desired result of capturing site groundwater from either side of the trench as designed. Other hydraulic data contained in the reports include manhole pump rates and efficiency results and water level control berm groundwater flow paths. These data, too, support that the Phase 2-1 groundwater system is operating as designed.

Additionally, annual groundwater quality monitoring reports were provided in 2007, 2008, and 2009 as interim reports to provide a summary of groundwater quality as the Phase 1 groundwater remedy was replaced by Phase 2. Beginning in 2010, when the Phase 2 groundwater remedy was activated, groundwater quality data was obtained by analyzing samples taken from the manholes in the groundwater collection trench. These data were collected monthly from October

2010 through March 2012 and provide a representation of site-wide groundwater quality while also representing influent to the wetland treatment system. An analysis of BTEX and arsenic levels in groundwater from the monitoring wells used in the interim (Phase 1) reports and continuing through BTEX and arsenic analysis performed in the manholes (Phase 2), representing the period from the last five-year review to the current one, do not show any discernible trends. BTEX and arsenic levels rose, declined, or remained constant during the period. This was likely the result of fluctuations in the water table over the period enabling discrete introductions of contaminants from the vadose zone, albeit in concentrations lower than before the Phase 1 AS/SVE was implemented. Additionally, active groundwater treatment did not begin site-wide until Phase 2 was initiated in late 2008, and it is expected to take a significant amount of time before groundwater constituent trends are revealed. Results are provided in Table 2 provides a summary of groundwater quality data collected from 2007 through 2011 in both monitoring wells (Phase 1) and manholes (Phase 2).

Finally, monthly data are collected and provided in letter report format to meet the requirements of the permitted outfall at the head of the main drainage swale, representing post-treatment effluent. The parameters are established in the discharge permit and include physical (flow rates, pH, suspended solids) as well as chemical (site constituents of concern, including VOCs, SVOCs, and metals) characteristics. These monthly results confirm the effective treatment of groundwater by the wetland treatment system and that the system is operating as designed.

Site Inspection

Michael Basile, CIC, conducted a site inspection on June 13, 2012, accompanied by Maurice Moore of the NYSDEC. The inspection was carried out along with representatives of ARCO. No interviews were conducted. During the site inspection, there were no problems or deviations observed with respect to the ongoing operation and maintenance activities.

VII. Technical Assessment

Question A: Is the remedy functioning as intended by the decision documents?

The landfill cap, drainage system, and monitoring wells are intact and in good repair. The landfill and associated systems are inspected routinely and actions are taken where and when appropriate in accordance with the O&M manual. Groundwater quality monitoring performed under OU1 indicate that VOC and SVOC levels in the wells along the outside perimeter of the landfill remain below MCLs and the few samples where metals exceeded the MCL indicated either stable or decreasing concentration trends. Groundwater elevation monitoring data indicate that water levels within the landfill have remained stable and are consistently more than one foot below the top of the slurry wall. Modifications to the OU1 O&M manual are to be incorporated into the site-wide O&M Plan, a draft of which has been delivered and commented upon by the regulatory agencies. The modifications account for the restoration of the CELA surface using wildflowers and native grass species, eliminating the need for mowing of the landfill cap. Also

as part of the restoration work, limited public access is provided via short pathways connected to the recreational trail that runs through the site, and informational plaques have been installed for the public's edification regarding the site history and remediation. The site-wide O&M Plan is expected to be finalized in 2012.

The 1991 ROD called for excavation and disposal of surface soils exceeding remedial cleanup criteria for arsenic and lead, extraction/treatment of contaminated site groundwater, and monitoring of surface water, groundwater, groundwater seeps, and indigenous biota residing in the main drainage swale. The soil excavation and disposal component of the remedy was completed in 1994 and resulted in the removal of 15,000 cubic yards of contaminated soils, most of which were placed under the landfill cap. Post-excavation sampling confirmed that potential exposure to arsenic and lead in surface soils has been mitigated in accordance with the decision document and design specifications. Additionally, subsurface contamination remaining beneath building foundations and parking lots at the site will be accounted for in institutional controls to be implemented this year that will ensure proper handling and disposal of wastes should impacted subsurface soils be disturbed.

A Phase 1 groundwater treatment remedy was initiated in 1993. The Phase 1 groundwater remedy involved an air sparging and soil vapor extraction operation that was to be implemented on a trial basis along with a limited groundwater pumping and treatment component. Although the remedy resulted in the removal of 160,000 lbs of petroleum hydrocarbons, EPA determined that ARARs were not being met following a performance evaluation of the remedy system in 2002. Consequently, Phase 1 was terminated in 2003 and the design of a Phase 2-1 groundwater remedy, consisting of site-wide extraction and treatment of contaminated groundwater, began. The groundwater treatment system was further modified, as per an ESD completed in 2009, to provide for a site-long groundwater collection trench and engineered wetlands as a treatment facility. Construction of the system was completed in 2008 and the system has since been operational.

The groundwater treatment system in place consists of a collection trench that intercepts impacted groundwater from the glacial drift aquifer at the site and prevents migration of contaminated water to the Genesee River by creating a groundwater divide between the trench and the river. Site-wide groundwater capture is maintained by pumping the trench from sumps in eight manholes. There are numerous piezometers installed adjacent to the trench and thirteen staff gauges installed along the river that are used to continually monitor the hydraulics of the system. Pumping manholes and wells are also used to monitor the quality of collected groundwater. The intercepted groundwater is conveyed to a constructed wetlands located at the southern end of the site, where contaminated water is treated by natural processes. The constructed wetlands duplicates the functions of solids removal, air stripping, and carbon adsorption that are provided by devices used in more conventional water treatment facilities.

Based on the last several years of water-level data from the site, the system appears to function properly. Hydraulic gradients are maintained toward the trench. Pumping in the trench is sufficiently adequate to maintain capture on both sides of the trench. Water quality data from

monitoring wells and manholes show various concentrations of VOCs, SVOCs, *and metals with* no discernible trends yet apparent. This is expected to change over time, with declining chemical concentrations expected as the Phase 2 groundwater system operates over time. Review of effluent data from the point source permitted outfall meets the discharge criteria, supporting that the wetland treatment system effectively treats the groundwater as intended.

The site remedy also includes a source control component to address discrete areas of LNAPL located in the riverbank and riverbed, and along the embankment of main drainage swale that were identified by monitoring and subsequent supplemental investigations during the 2001-2003 period.

A Phase 2-2 program was designed and completed in the spring of 2009 that was used to mitigate sediment and soil contamination through removal of LNAPL contaminated material from the riverbank, riverbed, and main drainage swale. This work was completed in 2010. Monitoring of the river channel and main drainage swale are included in the comprehensive O&M Plan for the site and will begin once the plan has been finalized later this year.

Environmental restrictions have been placed on two of the site properties. Nine remaining property parcels are subject to environmental easements/covenants. Property owners have been contacted and the restrictions are expected to be put in place by 2013.

Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?

There have been no changes in the physical conditions of the site over the past five years that would change the protectiveness of the remedy. Four companies and the State University of New York at Alfred's Wellsville Campus occupy the site. The site includes approximately 30 structures made of either brick or corrugated aluminum and steel frame construction. The landfill portion of the site is capped. The property is zoned industrial and the property zoning is not expected to change.

The site was separated into two operable units. OU1 included the remediation of the landfill portion of the site (September 26, 1985 ROD) and partial channelization of the Genesee River to protect the landfill from erosion and flooding. OU2 (September 30, 1991 ROD) included the excavation of surface soils based on arsenic and lead contamination and pumping and treatment of contaminated site groundwater. The remediation goals were 25 ppm for arsenic and 1000 ppm for lead based on industrial land use (further discussed under the "Soil" section, below) and the federal and state MCLs for groundwater contaminants.

Risk Assessment Evaluation

At the time of the ROD for OU1, the procedures, guidance, and policies regarding human health risk assessment were under development. The ROD for OU1 identified elevated levels of lead and arsenic in the pools atop the landfill and in the main drainage swale and suggested that

surface water runoff may transport the metals to these local depressions and possibly to the Genesee River. The most significant threat from the landfill was determined to be from flooding or failure of the landfill slopes; failure of the landfill into the Genesee River would have a serious negative impact on public health and the environment. Additionally, the potential for localized organic compound vaporization was found to be a potential contaminant migration mechanism, and thereby a potential threat to the local population. This information served as the human health risk assessment.

The risk assessment for OU2 was conducted in 1991. The assessment evaluated the following potential exposures: (1) inhalation of fugitive dust; (2) inhalation of volatile emissions from subsurface soil; (3) ingestion of surface water (predicted two different ways); (4) ingestion of surface soil; (5) ingestion of former tank farm surface soil; and (6) ingestion of subsurface soil. Risks were quantified for each of these scenarios for the following receptors: (1) adults on-site and in Wellsville; (2) children on-site; (3) excavation workers on-site; and (4) children on the off-site former tank farm and in Wellsville.

Soil

The OU1 remediation included removal and disposal of drums; excavation; and backfilling. Other activities included the construction of a cap over the consolidated landfill, and installation of a fence around the landfill. OU1 was completed in 1994. Current ongoing O&M activities are designed to maintain the cap and limit access to the property. The combination of the removal of contaminated soils, installation of a cap over the landfill, assignment of designated walking areas, and the ongoing O&M provide effective barriers to exposure to contaminated soils. A site-wide O&M Plan has been drafted to consolidate OU1 and OU2 O&M activities. This plan is expected to be completed in 2012.

The OU2 remedial actions were designed to address contaminated areas of the refinery where surface soils were found to contain elevated concentrations of lead and arsenic (i.e., former tetraethyl lead sludge pits; former railroad tracks). The remediation included excavation of surface soils exceeding the remedial cleanup criteria for arsenic and lead (described above) and their consolidation into the landfill prior to closure. In 2011, an environmental easement/restrictive covenant was filed on the property encompassing the CELA and wetland treatment system. The easement/covenant includes restricting groundwater use and ensures that the integrity of the remedial systems that are in place are maintained and that any future use of the property is done in accordance with a site management plan, which will address such issues as residual subsurface soil contamination and potential vapor mitigation measures for any structures that may be constructed on the property. This IC will be the model for the remaining nine property parcels; the ICs for these properties are expected to be completed and filed in 2013. A site management plan is also under development and the initial draft is expected to be completed in 2012.

The combination of landfill cap and institutional controls to further prevent exposures indicate that the remedial actions are protective. At the current time, EPA is evaluating the toxicity of

arsenic through the Integrated Risk Information System process that provides EPA's consensus toxicity values. The Agency is currently evaluating lead through the Lead Technical Review workgroup; however the remedial actions taken at the site to address lead and arsenic are interrupting potential direct contact exposures.

Using current arsenic toxicity values and outdoor worker exposure assumptions, the concentration of arsenic associated with a non-cancer HI = 1 is 26 ppm and the concentration associated with a cancer risk of 10-6 is 1.6 mg/kg. The original remedial action objective of 25 mg/kg for arsenic is below the HI = 1 and within the risk range of 10^{-4} to 10^{-6} established under the National Contingency Plan. The land use assumed in the original risk assessment and the current land use is industrial. The remedy is protective of exposures under the outdoor worker scenario for industrial land use and the remedy is therefore protective of potential exposures to a college student with exposures for a shorter time frame than an outdoor worker (i.e., 180 days/year for 4 years for the college student compared to 225 days/year for a period of 25 years for the adult outdoor worker).

The soil lead level for industrial properties in 1991 was 1,000 mg/kg. Subsequently, EPA's Lead Toxicity Review Workgroup recommended a value of 800 mg/kg for industrial properties. The combination of the removal of the contaminated soils at concentration greater than 1,000 mg/kg at the portion of the site addressed by this remedial action, and backfilled with certified clean fill to the depth of the excavation (one foot), has reduced average concentrations to below the current recommendation of 800 mg/kg.

As such, review of the toxicity data for arsenic and lead indicate that the remediation goals remain protective based on current toxicity data for these chemicals under an industrial land use and the remedial actions taken at the site to interrupt exposures.

Groundwater

Groundwater contamination is being addressed under OU2. The goal of the program is to meet drinking water standards. The Genesee River is a local source of drinking water, and the intake for the Village of Wellsville municipal water supply is located approximately one-quarter mile upstream of the site and is therefore not impacted by the site. The groundwater at the site is classified as a potable source (Class GA) but drinking water on the site is supplied by the Village municipal system.

The Applicable or Relevant and Appropriate Requirements for groundwater cleanup include EPA's MCLs and New York State's groundwater quality standards. The OU2 Phase 1 Progress Monitoring Groundwater Data and OU2 Phase 2 Manhole Monitoring Groundwater Data were used to evaluate the contaminant concentrations in groundwater to appropriate standards.

At the current time,the groundwater at the site is not being used as a drinking water source for ingestion as the Village supplies the entire site with water services and therefore the exposure pathway has been interrupted. In addition, specific restrictions were placed in the environmental

easement on the SUNY Alfred property as well as the deed conveying property to SUNY Alfred to prevent the use of site groundwater unless approved by EPA. The easements for the remaining nine properties contain the same restrictions.

The 1991 ROD established the federal MCLs and NYSDEC Class GA groundwater standards as the cleanup criteria for site groundwater. Since the ROD was issued, the MCL for arsenic was changed from 50 micrograms per liter (µg/l) to 10 µg/l as acknowledged in the 2002 and 2007 Five-Year Review Reports. The toxicity values for several of the chemicals of concern in groundwater were updated since the 2007 five-year review including: 1,1,1-trichloroethane, cis-1,2-dichloroethene, and nitrobenzene. Table 3 provides a comparison of the federal MCLs, including the new value for arsenic, and NYSDEC Class GA groundwater standards to Regional Screening Levels for residential consumption of drinking water. As shown in Table 3, the MCLs and NYSDEC Class GA concentrations remain within the risk range. Chemicals that are being updated through the Integrated Risk Information System, EPA's consensus toxicity system, include arsenic and ethylbenzene. The EPA MCLs and NYSDEC Class GA groundwater standards remain protective.

Additionally, the environmental easement/restrictive covenant and restrictions in the deed already in place and the remaining easements/covenants to be put in place, all contain the following restrictions with respect to groundwater use: "Grantor shall not extract, pump, consume, expose, excavate, or otherwise use groundwater, including but not limited to the installation of groundwater wells or the use of groundwater for potable or other uses, except for such groundwater testing, monitoring, sampling, and/or other corrective actions (including the installation of monitoring or remedial wells) required or approved by EPA, and any Governmental entity with jurisdiction over such matters." Once these easements/covenants are in place site-wide, expected in 2013, the protectiveness of the remedy will be ensured.

Soil Vapor Intrusion.

Soil vapor intrusion (SVI) was evaluated in the previous Five-Year Review Report. As a result of that analysis, in 2009, EPA contacted the site occupants offering EPA's services in conducting a vapor intrusion investigation in their facilities. Each entity declined to participate, citing that indoor air monitoring was routinely conducted at their facilities under OSHA guidelines. In accordance with EPA SVI guidance, SVI requirements are waived if facilities conduct regular OSHA air monitoring. However, the comprehensive site management plan will include a requirement that new building construction at the site include a vapor intrusion evaluation and that vapor mitigation measures, if necessary, will be included in the building design. The site management plan is under development and an initial draft is expected to be complete by 2012.

Overall, based on the past remedial actions including the capping of the landfill that prevents potential exposure to soils and ongoing groundwater treatment and monitoring at the site and the use of public water supplies as the drinking water source, the remedy remains protective under the industrial scenario.

Ecological Risk Assessment Evaluation

The remedy has eliminated exposure to ecological receptors by controlling the source of contamination. The soil pathway was addressed by a 1992 Administrative Order through excavation and disposal beneath the landfill cap. The 2009 ESD involves a groundwater collection trench which intercepts impacted groundwater and pumps it to an engineered wetland treatment system. Additionally, sediment removal was conducted in the Genesee River and the main drainage swale as part of the ESD. As per the draft O&M Plan, the groundwater treatment system along with the main drainage swale and Genesee River will be included in a monitoring program.

An ecological risk assessment was conducted as part of the 2004 main drainage swale investigation and provided data to assist in the development of the cleanup levels in the Phase 2-2 remedial design. Although the exposure assumptions and toxicity assessment conducted for the 2004 investigation may not necessarily reflect the current ecological risk assessment methodology, the remedy is protective of ecological resources as contaminated sediments and soil were dredged/excavated and contained within a secure covered landfill. Further, as the groundwater treatment system is functioning as intended, the contaminant pathway to the Genesee River and the main drainage swale has been removed.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

No human health or ecological risks have been identified, and no weather–related events have affected the protectiveness of the remedy. No other information has come to light that could call into question the protectiveness of the remedy.

VIII. Recommendations and Follow-up Actions

Table 4, appended to this report, summarizes the recommendations and follow-up actions stemming from this five-year review.

IX. Protectiveness Statement

The implemented remedy for OU1 at the Sinclair Refinery site protects human health and the environment. There are no exposure pathways that could result in unacceptable risks and none are expected provided that site use does not change and the implemented engineered and institutional controls are properly operated, monitored, and maintained.

The implemented remedy for OU2 at the Sinclair Refinery site protects human health and the environment in the short term. In order for the OU2 remedy to be protective in the long-term,

environmental easements/covenants need to be implemented at the remaining nine properties. Steps to achieve this have been initiated and are expected to be completed no later than 2013.

X. Next Five-Year Review

The next five-year review for the Sinclair Refinery site should be completed by September 2017.

APPENDICES

Table 1: Chronology of Site Events	
Event	**Date**
Debris from landfill first reported in Genesee River	1981
Village, County, and State take steps to mitigate erosion of the landfill from Genesee River flood waters	1983
Site placed on National Priorities List (NPL)	1983
Record of Decision (ROD) for OU1	1985
Relocation of Village water supply intake completed	1988
Remedial Investigation/Feasibility Study started for OU2	1988
OU1 Consent Decree between EPA, ARCO entered with court	1989
Remedial Investigation/Feasibility Study completed for OU2	1991
Record of Decision for OU2	1991
EPA issues administrative order to ARCO for OU2 Remedial Action - Surface Soils	1992
EPA issues administrative order to ARCO for OU2 Remedial Action - Groundwater	1992
Remedial Action for River Channelization portion of OU1 completed	1992
Remedial Action for Landfill Consolidation portion of OU1 completed	1992
Remedial Action for Landfill Capping portion of OU1 completed	1994
Remedial Action for OU2 completed - Surface Soil Remediation	1994

Removal Action completed - Valley Steel property, soils	1995
Removal Action completed - Valley Steel property, drums	1995
Removal Action completed - Sinclair oil/water separator and powerhouse	1995
Remedial Design for Phase 1 groundwater remedy portion of OU2 completed	1995
Remedial Action for Phase 1 groundwater remedy portion of OU2 completed	1995
Long-Term Remedial Action for Phase 1 groundwater remedy portion of OU2 started	1996
EPA issues first Five-Year Review Report	1997
EPA issues second Five-Year Review Report	2002
Long-Term Remedial Action for Phase 1 groundwater remedy completed	2003
Remedial Design for Phase 2 groundwater remedy portion of OU2 started	2003
Supplemental OU2 - Phase 2 groundwater investigation completed	2004
Remedial Design for Phase 2 groundwater remedy portion of OU2 completed	2007
EPA issues third Five-Year Review Report	2007
Remedial Action (construction) for Phase 2-1 groundwater remedy portion of OU2 completed	2008
Remedial Action (construction) for Phase 2-2 LNAPL mitigation measures of OU2 completed	2010
Deed with restrictive covenants for landfill and wetland property and environmental easement/restrictive covenant on SUNY Alfred property filed	2011
Site-wide O&M Plan completed	2012*

Draft Site Management Plan completed	2012*
Easements filed on remaining property parcels	2013*

* projected

Table 2. Groundwater Quality Trend Analysis 2007-2011

Sampling Event	Well MW-78	Well OW-1	Well MW-70	Well MW-71			Well MW-55
June 2007	Total BTEX: 9 ppb Arsenic: 42 ppb	BTEX: 30 ppb Arsenic: 53 ppb	BTEX: 186 ppb Arsenic: 41 ppb	BTEX: ND Arsenic: 8 ppb			BTEX: 84 ppb Arsenic: 54 ppb
December 2008	BTEX: 19 ppb Arsenic: 68 ppb	BTEX: 3 ppb Arsenic: 101 ppb	BTEX: 62 ppb Arsenic: 37 ppb	BTEX: ND Arsenic: 10 ppb			BTEX: 10 ppb Arsenic: 43 ppb
October 2009	BTEX: 12 ppb Arsenic: 48 ppb	BTEX: ND Arsenic: 2 ppb	BTEX: 17 ppb Arsenic: 41 ppb	BTEX: ND Arsenic: 8 ppb			BTEX: 50 ppb Arsenic: 69 ppb
	Manhole A	Manhole B	Manhole C	Manhole D	Manhole E	Manhole F	Manhole G
October 2010	BTEX: 2 ppb Arsenic: 16 ppb	BTEX: 35 ppb Arsenic: 180 ppb	BTEX: 163 ppb Arsenic: 38 ppb	BTEX: ND Arsenic: 16 ppb	BTEX: ND Arsenic: 43 ppb	BTEX: 10 ppb Arsenic: 62 ppb	BTEX: 86 ppb Arsenic: 64 ppb
October 2011	BTEX: 59 ppb Arsenic: 193 ppb	BTEX: 41 ppb Arsenic: 120 ppb	BTEX: 70 ppb Arsenic: 69 ppb	BTEX: ND Arsenic: 20 ppb	BTEX: ND Arsenic: 50 ppb	BTEX: 12 ppb Arsenic: 60 ppb	BTEX: 27 ppb Arsenic: 40 ppb

Note: Manhole sampling replaced well sampling in 2010; columns pair the manhole with the nearest monitoring well.

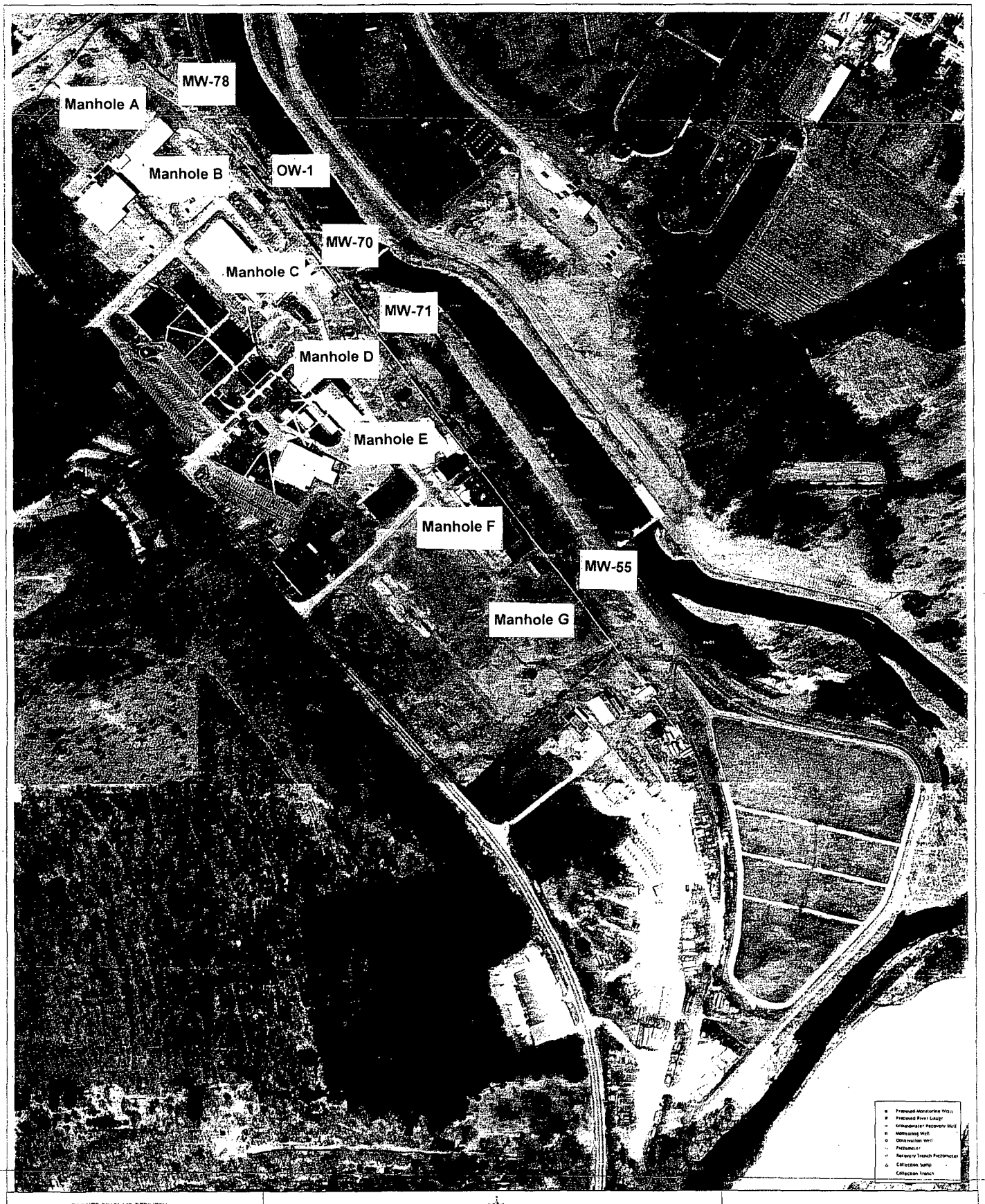
Table 3. Comparison of MCL and NYSDEC Class GW Standard to Risk Based Concentrations.					
Chemical	EPA MCL (ug/l)	NYSDEC Class GW Standard (ug/l)	Concentration Associated with Risk of 10^{-6} (ug/l)	Concentration Associated with Non-Cancer HI = 1 (ug/l)	Conclusion Regarding MCL or NYSDEC Class GW.
Benzene	5	1	0.39	29	Within risk range
Toluene	1,000	5 ((based on principal organic contaminant standard for groundwater)		860	Within risk range.
Ethylbenzene	700	5 (based on principal organic contaminant standard for groundwater)	1.3	670	Within risk range.
Xylenes	10,000	5 (based on principal organic contaminant standard for groundwater)		190	Within risk range.
1,1,1,-trichloroethane	200	5		7,500	Below risk range.
1,1-dichloroethane	NA	5	2.4	2,900	Within risk range.
Cis-1,2 dichloroethene	70	5		28	Below risk range.
Vinyl chloride	2	2	0.015	36	Within risk range.
Aniline	5	5 (based on principal organic contaminant standard for groundwater)	12	110	Below risk range.
Nitrobenzene	NA	0.4	0.12	11	Within risk range.
Arsenic	50 - *updated in 2006 to 10	25	0.045	4.7	Within risk range based on updated MCL.

Table 4: Recommendations and Follow-up Actions

Issue	Recommendation and Follow-up Actions	Party Responsible	Oversight Agency	Milestone Date	Affects Protectiveness (Y/N)
ICs on remaining site properties (9 total) not filed	Finalize remaining ICs and file in County Clerk's Office	ARCO	EPA	December 2013	Current: N Future: Y

FIGURES

Figure 1



FORMER SINCLAIR REFINERY
WELLSVILLE, NY

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Sinclair Refinery Site Map