190696

# THIRD FIVE-YEAR REVIEW REPORT
# for
# CIBA-GEIGY CHEMICAL CORPORATION SUPERFUND SITE

## TOMS RIVER

## OCEAN COUNTY, NEW JERSEY

**PREPARED BY:**

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

**April 2013**

Approved by:

Walter E. Mugdan, Director
Emergency and Remedial Response Division

May 1, 2013
Date

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## TABLES AND FIGURES

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## EXECUTIVE SUMMARY

This is the third five-year review for the Ciba-Geigy Chemical Corporation Superfund (Ciba) Site. The Ciba Site is located in Toms River, Ocean County, New Jersey and is being addressed in two phases or operable units (OUs).

Operable Unit 1 (OU1) addresses groundwater contamination at the Site. A Record of Decision (ROD) for OU1 was signed on April 24, 1989 and modified by an Explanation of Significant Differences (ESD) on September 30, 1993. The OU1 remedy requires the pumping of contaminated groundwater; on-site treatment and recharge of treated groundwater; evaluation of the uncontaminated lower aquifer; monitoring of the Toms River water quality; and closure of the contaminated residential irrigation wells.

All contaminated residential irrigation wells were sealed by 1991. Full-scale operation of the on-site groundwater treatment plant began in March 1996. All sample results for the treated groundwater have been below the criteria established in the ROD and ESD. The local community is not affected by the contaminant plume since its drinking water is supplied by a municipal water system, and the Site does not pose an immediate threat to the surrounding community.

Operable Unit 2 (OU2) addresses remediation of contaminated soils and buried drums at the Ciba Site. A ROD for OU2 was signed on September 29, 2000. Remedial action activities included excavation and both off-site and on-site treatment of contaminated soil as well as removal and disposal of drums. Construction began in 2003 and was completed in 2010. The OU2 remedy will be protective of human health and the environment once institutional controls (ICs), such as deed restrictions, are in place.

The assessment of this five-year review found that the OU1 groundwater remedy was constructed in accordance with the requirements of the ROD and the remedy is protective of human health and the environment.

The OU2 source control remedy is protective of human health and the environment in the short term. In order for the remedy to be protective in the long term, deed restrictions need to be established.

## Five-Year Review Summary Form

| SITE IDENTIFICATION | | |
|---|---|---|
| **Site Name:** Ciba-Geigy Chemical Corporation | | |
| **EPA ID:** NJD001502517 | | |
| **Region:** 2 | **State:** NJ | **City/County:** Toms River, Ocean County |

| SITE STATUS | |
|---|---|
| **NPL Status:** Final | |
| **Multiple OUs?**<br>Yes | **Has the site achieved construction completion?**<br>Yes |

| REVIEW STATUS |
|---|
| **Lead agency:** EPA<br>**If "Other Federal Agency" was selected above, enter Agency name:** Click here to enter text. |
| **Author name (Federal or State Project Manager):** Diane Salkie |
| **Author affiliation:** EPA Region 2 |
| **Review period:** July 07, 2008 – March 11, 2013 |
| **Date of site inspection:** January 23, 2013 |
| **Type of review:** Statutory |
| **Review number:** 3 |
| **Triggering action date:** July 07, 2008 |
| **Due date *(five years after triggering action date)*:** July 07, 2013 |

**Five-Year Review Summary Form (continued)**

## Issues/Recommendations

| **OU(s) without Issues/Recommendations Identified in the Five-Year Review:** |
|---|
| 01 |
| **Issues and Recommendations Identified in the Five-Year Review:** |

| **OU(s):** OU2 | **Issue Category:** Institutional controls (ICs) | | | |
|---|---|---|---|---|
| | **Issue:** ICs not implemented. | | | |
| | **Recommendation:** Implement ICs. | | | |
| **Affect Current Protectiveness** | **Affect Future Protectiveness** | **Implementing Party** | **Oversight Party** | **Milestone Date** |
| No | Yes | PRP | EPA | 2016 |

## 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:* | *Protectiveness Determination:* | *Addendum Due Date (if applicable):* |
|---|---|---|
| OU 1 | Protective | |
| *Protectiveness Statement:* The OU1 remedy is protective of human health and the environment. | | |

| *Operable Unit:* | *Protectiveness Determination:* | *Addendum Due Date (if applicable):* |
|---|---|---|
| OU 2 | Short-term Protective | |
| *Protectiveness Statement:* The source control remedy at OU2 is protective of human health and the environment in the short term. In order for the remedy to be protective in the long term, deed restrictions need to be established. | | |

**Five-Year Review Summary Form (continued)**

| Sitewide Protectiveness Statement (if applicable) | |
|---|---|
| *For sites that have achieved construction completion, enter a sitewide protectiveness determination and statement.* | |
| | |
| *Protectiveness Determination:*<br>Short-term Protective | *Addendum Due Date (if applicable):*<br>Click here to enter date. |
| *Protectiveness Statement:*<br>The remedies at the Site are protective of human health and the environment in the short term. In order for the remedy to be protective in the long term, deed restrictions need to be established. | |

**Ciba-Geigy Chemical Corporation Superfund Site**
**Ocean County, New Jersey**
**Third Five-Year Review Report**

## I. Introduction

This is the third five-year review for the Ciba Site located in Toms River, Ocean County, New Jersey. This five-year review was conducted by the U.S. Environmental Protection Agency (EPA) remedial project manager (RPM), Diane Salkie. The five-year review was conducted pursuant to Section 121 (c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended and 40 CFR 300.430(f)(4)(ii), in accordance with the Comprehensive Five-Year Review Guidance, Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-03B-P (June 2001) and the updated Five-Year Review Summary Form, OSWER 9200.2-105 (December 2011). The purpose of five-year review is to ensure that implemented remedies are protective of human health and the environment and that they function as intended by the decision documents. This document will become part of the Site file.

The Site is being addressed in two phases or OUs, each covered by a ROD. OU1, which involves the extraction, treatment and on-site recharge of groundwater, is operational. OU2, which addresses contaminated material and buried drums in source areas on the Site, is complete. While the OU1 remedy is intended to restore the aquifer to drinking water standards, the OU2 remedy is intended to remediate/treat to levels that would be protective. In accordance with Section 1.4.1 of the comprehensive five-year review guidance, the last five-year review and subsequent five-year reviews for this Site are statutory. The triggering action for this review is the date of the last five-year review, July 07, 2008.

## II. Site Chronology

Table 1 summarizes pertinent site-related events.

## III. Site Background

Physical Characteristics

The Site is located in Toms River, Dover Township, Ocean County, New Jersey. The Site is situated on approximately 1,350 acres of land that are bordered on the east by the Toms River (see Figure 1). On-site structures include piping associated with the groundwater collection system, the groundwater treatment plant, and office facilities for remediation personnel.

Land and Resource Use

The seven uppermost geologic members underlying the Site in descending order are: the Upper Cohansey Member, Cohansey Yellow Clay, Primary Cohansey Member, Cohansey/Kirkwood Transitional Member, the Lower Cohansey Member, Upper Kirkwood Member and the Kirkwood Number 1 Member. At some locations, a perched water system is present in the Upper

Cohansey. This perched water system is referred to as the Upper Cohansey Aquifer. The perched water system can provide a pathway for movement of contaminants to lower geologic units. The Primary Cohansey Member is a water-bearing unit, referred to as the Primary Cohansey Aquifer, and is a source of drinking water in an area of New Jersey beyond the plume.

The Cohansey/Kirkwood Transitional Member can limit the movement of contaminants from the source areas to the Lower Cohansey Aquifer. Toward the north, the thickness of this unit begins to decrease until it eventually disappears entirely in the extreme northern portion of the Site. Contaminants have penetrated into this unit and have reached the Lower Cohansey Aquifer. The Upper Kirkwood Member is below the Lower Cohansey Aquifer and acts as an aquitard at the Site. Contamination has not penetrated into this unit or the Kirkwood Number 1 aquifer below.

The Site is situated on 1,350 acres. Approximately 320 of the 1,350 acres are developed and were used for manufacturing operations, waste treatment, disposal activities, and administrative and laboratory facilities. The remaining acreage is undeveloped and in its natural state. Of the 1,350 acres, 1,240 acres are Dover Township's largest single tract of industrially zoned land. In addition, 72 acres located in Manchester Township, were purchased by Ciba-Geigy after the Site was placed on the National Priorities List (NPL) and are not known to be associated with production or waste disposal. This parcel of land is zoned for residential use. Thirty-nine acres are in Dover Township and are zoned conservation-residential. Based on soil sampling, approximately 790 acres are outside the area requiring remediation and no restriction on their future use is necessary. Approximately 440 acres are within, or close to the remediation zone and are not appropriate for residential use. Finally, the waste management zone comprises 93 acres, the use of which is restricted to waste management activities. The entire facility area is fenced with restricted access and is currently only being used to carry out the Site remedy.

Residential neighborhoods, recreational areas, small commercial establishments and light industrial complexes are present near the Site. The commercial areas are situated primarily southwest of the Site. The area to the west is zoned for industrial use, light manufacturing and warehousing operations. A large recreational area, which includes several parks and the Toms River, is east of the Site. Residential areas exist along the northern and southeastern portions of the Site. Municipal water systems serve Dover Township and the surrounding communities. No residential or commercial drinking water wells are within the confines of the plume. Surface waters from the Toms River are not used as potable water.

History of Contamination

Production operations at the Site began in late 1952. At the time, the Site was owned by the Toms River Chemical Company, which was later merged into the Ciba-Geigy Corporation. From 1970 through 1981, the Site was jointly owned by Ciba-Geigy and Sandoz Corporation. In 1981, Sandoz transferred all interest to Ciba-Geigy. In 2008, Ciba-Geigy was purchased by BASF and all remedial activities are currently BASF's responsibility.

Manufacturing operations at the Site were related to the production of a variety of dyestuffs, pigments, epoxy resins and additives. The activities associated with the historical operations at

the Site have resulted in contamination of Site groundwater and the surface and subsurface soils in several on-site source areas (see Figure 1). These areas have been designated as source areas because they represent sources of contamination for the groundwater. Each source area has been categorized based on the activity that resulted in its contamination. The three major Site activities were production-related activities, wastewater treatment operations and solid waste disposal. The two major source areas associated with production operations are the Former South Dye Area (FSD) and the Building 108/ Underground Storage Tank Area. The FSD was the location of the initial manufacturing operations at the Site and operated from 1952 to 1984. Many solvents used in the manufacturing process were stored in underground storage tanks (USTs) west of Building 108. These tanks were removed in 1992.

During the entire period of Site operations, a wastewater treatment plant existed for the treatment and disposal of process wastewater. The major source areas associated with the wastewater treatment operations are the East and West Equalization Basins (EQ Basins) and the Backfilled Lagoon Area (BLA). The EQ Basins were each approximately three acres with a depth of 14 feet and an overall capacity of approximately 6.7 million gallons at their full operating capacity. The BLA consists of five unlined lagoons next to the Toms River that operated from about 1959 to 1977. The entire BLA area covered approximately seven acres and consisted of three wastewater treatment lagoons: Oxidation Lagoon, Settling Lagoon and Final Polishing Pond and two sludge drying lagoons: Northern and Southern.

Several solid waste disposal areas are known to have operated at different times during operations at the Site. The major areas associated with waste disposal are the Filtercake Disposal Area (FCD), Lime Sludge Disposal Area, Drum Disposal Area (DDA), Standpipe Burner Area and the Borrow/Compactor Area.

The FCD, which is approximately ten acres, was used for the disposal of wastewater sludges removed from wastewater treatment plant impoundments. The Trench Disposal Area, which is within the FCD, was used for the disposal of debris and trash, crushed drummed waste materials and miscellaneous bulk sludges. The Lime Sludge Disposal Area is approximately four acres and included three unlined pits. These pits were used for disposal of arsenic-containing wastes that were stabilized to prevent leaching.

The DDA is approximately five acres and was used for the disposal of solid waste from plant manufacturing activities. Three distinct subareas: the Non-Intact Drum Area, the Stacked Drum Area and the Iron Filings Area, have been identified within the DDA. The Non-Intact Drum Area was used for the disposal of crushed drummed wastes and debris. The Stacked Drum Area was used for the disposal of intact drums containing various wastes. The Iron Filings Area was used for the disposal of bulk iron oxide sludges. The Standpipe Burner Area is approximately 0.5 acre and partially overlaps the southern boundary of the DDA.

Historical plant records indicate that up to 250 gallons per week of laboratory solvents and solvent contaminated laboratory wastes were disposed of down the concrete pipes of the Standpipe Burner Area. The Borrow/Compactor Area encompasses approximately 25 acres. This area was used as a staging area for drummed waste shipped off-site for disposal.

Initial Response

During the late 1970's and early 1980's, in response to New Jersey Department of Environmental Protection (NJDEP) directives, Ciba-Geigy performed various closure activities and geohydrologic investigations at the Site. As early as 1979, there were reports of leakage of the double-lined active landfill and remedial measures were taken under the direction of the NJDEP Solid Waste Administration. In 1980, EPA completed an identification and preliminary assessment report of the Ciba-Geigy Site under the Potential Hazardous Waste Site Program. The Site was placed on the Superfund NPL in 1983. In 1984, EPA began a remedial investigation (RI) of the Site.

Basis for Taking Action

The sampling results were finalized in an initial RI report for the Site in 1988. The RI report concluded that contaminated source areas on Site resulted in groundwater contamination. Based on this investigation, EPA defined the following OUs:

- OU1 - pertaining to groundwater; and
- OU2 - pertaining to known or suspected source areas.

EPA focused on identifying a remedy for groundwater contamination (OU1) first as part of a multi-phase remedy for the Site. This decision was made because the nature and extent of contamination was better understood in the groundwater than in the source areas. Also, the groundwater remedy would more quickly address potential public health concerns by preventing further off-site migration of groundwater contaminants. During the OU2 RI, which was finalized in 1994, additional samples were collected in the potential Site source areas. These data were supplemented by the OU2 feasibility study (FS), which was completed in 1999. These investigations found that seven source areas continued releasing contamination to the groundwater and were impacting groundwater quality. The OU2 RI and subsequent risk assessment also found that one source area, the FCD, presented a direct contact risk under a potential on-site worker future use scenario.

A Public Health Evaluation (PHE) in the 1989 OU1 ROD found that the cancer risks to the future resident consuming groundwater from the site were $1 \times 10^{-2}$ (one in 100) and the noncancer Hazard Index (HI) was 40 (which is 40 times greater than the goal of protection of an HI = 1) if no action were taken. Other routes of exposure such as dermal contact and inhalation were within the risk range of $1 \times 10^{-4}$ (cancer risk of 1 in 10,000) to $1 \times 10^{-6}$ (cancer risk of 1 in 1,000,000) and the noncancer HI was less than 1. Cancer risks and noncancer HI for recreational exposures to surface water in the Toms River, sediments in the marshland, and inhalation of air from the river or wetland were within or below the risk range and the noncancer HI was less than 1.

Contamination from the source areas penetrated through the upper five geologic layers to the Lower Cohansey Aquifer. The groundwater plume in the Primary Cohansey extends off-site toward the Toms River. The OU1 ROD PHE identified the following indicator chemicals in groundwater: arsenic, barium, benzene, cadmium, chlorobenzene, chloroform, 1,2-dichloroethane, nickel, tetrachloroethene, 1,2,4-trichlorobenzene and trichloroethene.

The OU2 ROD developed a list of 12 contaminants of concern (COCs) to characterize the nature and extent of contamination: arsenic, chlorobenzene, 2-chlorotoluene, 1,2-dichlorobenzene, lead, mercury, naphthalene, nitrobenzene, tetrachloroethene, 1,2,4-trichlorobenzene, trichloroethene and 1,2,3-trichloropropane. The COCs were chosen based on the following criteria: they pose the greatest potential risk to human health and the environment; they are found in the highest concentrations in the source areas and groundwater at the Site; and/or they are most likely to move from the source areas to the groundwater.

The OU2 ROD evaluated potential risks from exposure to the FCD. The risk for the future worker from ingestion were an HI = 1.2 that slightly exceeds the noncancer goal of protection of an HI = 1 and a cancer risk of $1.1 \times 10^{-4}$ from inhalation. The risk for the residential adults from ingestion of groundwater were $3 \times 10^{-4}$ and the noncancer HI = 11. The future risks to the child were $2.9 \times 10^{-4}$ and the noncancer HI = 92. The OU2 ROD also evaluated potential risks to construction workers from exposure to the FCD. The noncancer hazards to the future construction were an HI = 9.2, that exceeds the goal of protection of an HI = 1. The COCs were arsenic and mercury.

In 1994, EPA completed a Wetlands Characterization and Ecological Assessment to evaluate potential risks to the environment associated with Site contaminants. The wetlands along the Toms River, including the Marshland Area and the river itself, represent the most likely pathway for ecological impacts related to the Site. The ecological assessment concluded that there were no adverse impacts to terrestrial and aquatic biota in these areas.

## IV. Remedial Actions

Remedy Selection

On April 24, 1989, EPA issued a ROD for OU1 describing the selected groundwater remedy. The major remedial objectives of the OU1 ROD are: mitigation of the effects of groundwater contamination on public health and the environment and restoration of the upper sand aquifer to drinking water standards. The major components of this remedy included:

- sealing of contaminated irrigation wells;
- installation of a groundwater extraction and treatment system in a portion of the existing on-site wastewater treatment plan; and
- discharge of treated groundwater to the Toms River.

In accordance with the ROD, irrigation wells near the Site were decommissioned and well restrictions (based on Ocean County Board of Health regulations) were imposed that restrict

installation of domestic wells in the plume.

After EPA issued the 1989 ROD, public concerns related to the proposed discharge to the Toms River resulted in continued investigation and public involvement to develop an alternate discharge point for treated groundwater. On September 30, 1993, after conducting a technical review of the groundwater recharge proposal submitted by Ciba-Geigy Corporation, EPA issued an ESD. The ESD eliminated the discharge to the Toms River and called for the on-site recharge of treated groundwater. The ESD also established appropriate standards for discharging the treated water, see Table 3. The primary remedial action objective of the OU1 ROD and ESD is aquifer restoration.

On September 29, 2000, EPA issued a ROD for OU2 describing the selected remedy for the on-site source areas. The remedial action objectives of the OU2 ROD are to:

- address the potential risks associated with direct contact with surface soils, and
- shorten the time frame for the OU1 groundwater remedy to achieve the groundwater restoration goals established in the 1993 ESD.

The remedy includes the following major components:

- on-site ex-situ bioremediation of approximately 145,000 cubic yards of contaminated material from the source areas;
- excavation and off-site disposal of approximately 35,000 drums from the DDA and 5000 $yds^3$ of soils not suited for bioremediation;
- installation of caps and slurry walls in areas of the Site where the Cohansey Yellow Clay is present. This perched water management system will prevent the movement of contaminants from the clay into the underlying Primary Cohansey Aquifer. The cap in the FCD will also address the potential direct contact risks associated with the surface soils in this area;
- installation of an in-situ bioremediation system in the EQ Basins to address contamination below the groundwater table;
- establishment of deed restrictions to regulate the use of certain areas of the Site and to prevent intrusive activities in capped areas;
- optimization of the groundwater extraction and recharge system implemented as part of OU1; and
- appropriate environmental monitoring to ensure the effectiveness of the selected remedy.

Remedy Implementation

OU 1 In 1993, a consent decree (CD) was lodged between EPA and Ciba-Geigy Corporation, which allowed Ciba-Geigy to design, construct and operate the groundwater extraction, treatment and recharge systems. All work was conducted with EPA oversight. The design criteria for the extraction, treatment and recharge systems included: extracting between 2.5 and 4.0 million gallons per day (MGD) of contaminated groundwater from the Upper, Primary and Lower Cohansey aquifers; treating the contaminated groundwater to meet the standards specified

in the ESD (see Table 3); recharging 100% of the treated groundwater into the ground within the property boundaries of the Toms River Site; locating recharge areas away from source areas of contamination; recharging groundwater to prevent the horizontal or vertical movement of groundwater contaminants beyond the capture zones of the extraction wells; and preventing the movement of recharged or contaminated groundwater under residential areas of Pine Lake Park.

The groundwater extraction system includes 37 (originally 43) pumping wells designed to extract a maximum of four MGD of contaminated groundwater. Currently, the total nominal flow of the system is about 1.7 MGD. The basic technologies used in the groundwater treatment process, in order, are: 1) powdered activated carbon treatment (PACT7); 2) clarification and separation of the sludge/carbon from the PACT7 effluent; and 3) granular activated carbon (GAC) adsorption. The systems became fully operational in March 1996. Figures 5-1 and 5-2 demonstrate the reduction in influent concentrations and Figure 5-3 shows contaminant mass removed over time.

Recharge was originally directed to one of three recharge areas: the Northeast Recharge Area (NERA), Mideast Recharge Area (MERA) or the Southeast Recharge Area (SERA); see Figure 3-2. Before recharge began, a decision was made to direct all recharge water to the three recharge points within the NERA to eliminate potential for treated water to enter a public water supply well that is located across the Toms River, south of the NERA. The SERA was eliminated from use. After operating for several years, recharge within the NERA was altered to direct more treated water to the southernmost of the three NERA recharge points. Groundwater electrical conductance is recorded at wells in the NERA to track groundwater recharge movement and prevent it from moving to the Pine Lake Park community located northwest of NERA. In 2000, an increase in conductance was found in one well and was remediated by discharging to the southern third of the NERA and using the MERA for 9 percent of the flow.

OU 2 The design of the OU2 source area remedy was completed in summer 2003 and on-site construction began in October 2003. Construction activities consisted of erection of pre-engineered buildings for the ex-situ treatment system, an air emissions treatment system, a shed to house the aboveground components of the in situ treatment system, excavation of contaminated soil from the source areas and installation of landfill caps and slurry walls at the DDA/FCD/FSD soil depository, see Figure 2.

The OU2 ROD and FS identified a number of discrete, pre-determined volumes at each of the source areas. The identified volumes of soil, called source blocks, were calculated using fate and transport and groundwater flow models. The source blocks determined the amount of soil to be removed from each source area and treated in the ex-situ treatment system. Modeling was also used to determine the amount of treatment required for the soil. Treatment end-point concentrations were determined for each COC in the source blocks by testing the soil using the synthetic precipitation leaching procedure. Once all end-point concentrations were reached within a source block, the treated soil was placed under a landfill cap in the DDA/FCD/FSD soil depository. Excavation and backfilling was conducted so that backfill of treated soil was not placed near the areas that required further excavation so that commingling of treated and untreated material did not occur. The OU2 ROD required installation of impermeable caps and

slurry walls in the three source areas (DDA/FCD/FSD) underlain by clay, to prevent movement of contaminants from the clay into the Primary Cohansey aquifer. Ciba-Geigy used this perched water management system to redirect the flow of groundwater in the Upper Cohansey around the source areas.

The first phase of the source area cleanup involved the removal of buried drums from the DDA source area. The drum removal phase began on December 9, 2003, and was completed on November 22, 2004. A total of 47,055 drums were removed and sent off-site for disposal. A total of 126,435 cubic yards of soil were excavated from the DDA, treated from July 2004 to March 4, 2010, and backfilled in place. Excavation at the FCD began in July 2004 and was completed in March 2010. Approximately 52,646 cubic yards of soil were excavated, treated and backfilled in place.

Remediation of the EQ Basins included excavation and ex-situ treatment of contaminated soil as well as in-situ treatment of soil in the saturated zone which could not be effectively excavated. A total of 31,313 cubic yards of soil were removed from the basins from July 2004 to April 2008, treated ex-situ and placed in the Site depository. In-situ treatment was implemented in two phases. Phase 1 installation consisted of a single extraction well and single injection well, and operated from 2004 through 2006. Phase 2 involved the installation of additional injection wells and extraction wells, and a horizontal infiltration gallery. Phase 2 operation began in June 2007. In 2009, one additional injection well was installed. Groundwater from the area is pumped from the extraction wells, oxygenated and then re-injected to stimulate aerobic, biological treatment of contamination in the saturated zone.

The BLA remediation included excavation and ex-situ treatment of contaminated soil. Excavation work began in July 2004 and was completed in April 2007. A total of 34,328 cubic yards of soil were removed treated and placed in the Site depository. The FSD consisted of several buildings which produced dyes and pigments from 1952 to 1984. The buildings were demolished before the design of the OU2 remedy. Remediation of the source area included excavation and ex-situ treatment of contaminated soil beginning in August 2005 and reaching completion in July 2008. A total of 4,597 cubic yards of soil were removed, treated and placed in the DDA/FCD/FSD depository. Remediation of soils under former Building 108 was completed in February of 2007. As a result of this action, 463 cubic yards of soil were removed, treated and placed in the Site depository. The last source area to be remediated was the BCA. Excavation work at the BCA began in November 2008 and was completed in July 2010. A total of 46,180 cubic yards of contaminated soil were removed, treated and placed in the Site depository. Before the ex-situ treatment facility was demolished, samples of the concrete floors and the secondary treatment pad were collected in accordance with an EPA approved decommissioning plan. The treatment building material, which consisted mostly of metal, was disassembled, decontaminated and recycled. The nonmetal material was disposed off-site as nonhazardous waste. EPA allowed the concrete and asphalt rubble to be milled, blended and used at the DDA/FCD/FSD depositional area for road material. Decommissioning was completed on November 4, 2010. A PCOR was signed in September 2012, documenting that all on-site construction was completed.

System Operations/Operations and Maintenance (O&M)

The groundwater extraction, recharge and treatment system (GERS) is currently operated by BASF and their contractor, Brown and Caldwell. The OU1 CD required Ciba-Geigy (and now BASF) to perform periodic sampling to determine the effectiveness of the OU1 extraction and recharge system in capturing the groundwater plume. The requirements of this sampling effort are provided in the Long-Term Monitoring Plan (LTMP) and involve the collection of on-site groundwater samples and water level measurements. The LTMP incorporates the following monitoring programs: the Site-Wide Monitoring Program to monitor groundwater and the GERS; the Toms River Monitoring Program for monitoring surface water of the Toms River; and the NERA monitoring as discussed earlier. A Wetlands Monitoring Program was in place from development in 1994 until 2002 when EPA eliminated the requirement because no changes were recorded. Sulfate trends are used to monitor the potential vertical movement of contamination into the Kirkwood Number 1 member.

LTMP Annual reports have been submitted from 2005 through 2011. The initial report for 2005/2006 indicated that the capture envelope when compared with the design capture envelope, as defined in *"The Groundwater Extraction System for Ciba-Geigy's Toms River Plant: Locations and Rates for Groundwater Extraction and On-Site Aquifer Recharge"* report prepared by Environ Corporation, had degraded in some parts of the groundwater contaminant plume. This was due to the inability of individual wells to reach design pumping capacity because of iron fouling in the wells and piping. BASF currently addresses the iron fouling issue by using a deposit control agent, FeREMEDE™ which is designed to prevent precipitation and deposition of metal oxides. Figures 5-1 and 5-2 demonstrate the reduction in influent concentrations and Figure 5-3 shows contaminant mass removed over time. The effluent continues to meet standard requirements specified in the ESD, see Table 3.

In 2011, of the 37 wells that comprise the groundwater extraction system, 17 achieved less than 75% of the design rate. In addition, 24 pumps were replaced and three wells were redeveloped in 2011 due to iron. However, compared to 2009 and 2010, the number of pumps replaced and wells redeveloped in 2011 have decreased due to more efficient chemical cleaning procedures (61 pumps replaced and nine wells redeveloped in 2009; 41 pumps replaced and three wells redeveloped in 2010). While the extraction wells have shown difficulty in achieving design specifications due mostly to iron fouling, the system has achieved its goal of reducing and containing contaminated groundwater as shown through groundwater and Toms River monitoring.

The Toms River Monitoring Program is in place to evaluate whether the GERS is effective at capturing volatile organic compound (VOC) contaminated groundwater before it discharges to the Toms River, located to the East of the Site. There are two monitoring locations denoted, TR-1 which is located upstream of the Site and TR-5, downstream of the Site. The NERA Monitoring program evaluates changes to flow patterns from recharged groundwater by monitoring groundwater hydraulics and water quality in the northeast portion of the Site. The goal is to prevent recharge water from entering the residential community of Pine Lake Park.

To monitor the performance of the OU2 Remedial Action Perched Water Management system of slurry walls and caps, an OU-2 Long-Term Monitoring Plan was developed. The plan's objectives are as follows:

- ensure groundwater quality improves according to modeling expectations,
- ensure capture of contaminated groundwater is maintained by OU1 remedy,
- ensure system of slurry walls and caps are effective in addressing potential mass flux from Cohansey yellow Clay to the Primary Cohansey,
- ensure that the caps in the FSD, FCD and DDA maintain integrity, and
- ensure institutional controls implemented during the remedial action remain effective.

The O&M costs can be found as Table 5.

The OU1 ROD required sealing of contaminated residential irrigation wells in the Cardinal Drive area. Drinking water in the area of the Site is provided by supply wells that are owned by the United Water Company. In 2001, NJDEP approved a CEA restricting the installation of new wells into the Cohansey and Kirwood aquifers in the vicinity of the Site. The OU2 ROD requires restrictions on the property deed to prevent any intrusive activities in the capped areas of the Site. The OU2 ROD contained three conceptual future land use areas for the Site based on anticipated conditions following remedy implementation: unrestricted use area, restricted waste management area, and restricted commercial/industrial/recreational use area.

Unrestricted use Area – This area had no known industrial activity. This area which is currently locally zoned as commercial/industrial, requires no land use restrictions.

Restricted Waste Management Area - This area which includes the footprint of the groundwater treatment facilities, DDA, Standpipe Burner Area, Lime Sludge Disposal Area, FCD and industrial landfill, requires land use restrictions to prevent any intrusive activities in the capped areas of the Site.

Restricted Commercial/Industrial/Recreational Area – This area which includes the historical industrial production areas requires land use restrictions to prevent the construction of residential structures.

The deed restriction for the property to ensure future land use, consistent with the OU2 ROD, is expected to be implemented by 2016.

**V. Progress Since the Last Five-Year Review**

During 2008, the remedies at the Site were under construction. The five-year review concluded that the remedies were expected to be protective upon completion. In the interim, all exposure pathways were under control. No issues or recommendations were identified.

As stated earlier, BASF purchased Ciba-Geigy in 2008, therefore all progress since then has been under the direction of BASF and their contractor, Brown and Caldwell.

In May 2011, BASF submitted a Draft Remedial Process Optimization Evaluation Report to optimize the groundwater remedy at the Site. The report addresses the OU2 ROD requirement for optimization of the GERS as well as optimization of the remaining source, the EQ Basins.

At the EQ Basins, the unsaturated zone materials were excavated and treated, while an aerobic in-situ bioremediation system was installed to address the remaining contamination in the saturated zone. The total COC concentrations in the extracted groundwater decreased by a factor of two; however, they remain at levels on the order of 10,000 ppb. The EQ Basins remain the last recognized source at the Site. During the Remedial Process Optimization (RPO) evaluation, it was determined that the effectiveness could be enhanced by switching from an aerobic to an anaerobic method. In 2012, EPA approved a work plan to characterize the EQ Basin in which BASF proposes to: define the nature and extent of contamination further; define groundwater flow behavior; develop a conceptual site model; and collect samples for an in-situ bioremediation bench-scale study. The characterization is projected to begin in 2013.

The GERS optimization plan was presented to EPA in a Basis of Design report which was approved by EPA in 2012. These upgrades will include removing PACT7 and utilizing a packed tower system. To address the elevated iron issue, an iron oxidation tank with caustic addition will be used prior to treatment. A cloth filter and polymer addition will be used for solids and precipitated iron removal. A sludge thickening agent will concentrate solids in the backwash stream. Existing liquid-phase granular activated carbon units will be retained for effluent polishing. The equipment will be housed in a single building and the groundwater extraction and recharge system will remain. Treatment objectives as defined by the Site ESD (see Table 3) will remain unchanged and effluent will continue to be recharged to Site groundwater. The new, sustainable upgrades will reduce cost, electrical usage, powdered carbon waste and the carbon footprint as well as improve safety of the Site operators. BASF has approved the bid and projects the upgrade will begin in the spring of 2013.

## VI. Five-Year Review Process

Administrative Components

The five-year review team consisted of Diane Salkie (RPM), Marian Olsen (human health risk assessor), Michael Clemetson (ecological risk assessor), Edward Modica (hydrogeologist), and Patricia Seppi (Community Involvement Coordinator or CIC) of EPA.

Community Notification and Involvement

The EPA CIC for the Ciba-Geigy Site, Patricia Seppi, published a notice in the *Toms River Times*, the local newspaper, on March 13, 2013, notifying the community of the initiation of the five-year review process. The notice indicated that EPA would be conducting a five-year review for the Site to ensure that the implemented remedy remains protective of human health and the environment and is functioning as designed. It was indicated that once the five-year review is completed, the results will be made available in the local Site repository. In addition, the notice

included the RPM's address and telephone number for questions related to the five-year review process or the Site.

Document Review

Table 2 provides a list of documents reviewed. The LTMP Annual report and Site-Wide Monitoring Reports listed have been published for the Site since 1997. These reports evaluate the effectiveness of the GERS in controlling the groundwater plume and recommend potential improvements as needed. The LTMP reports cover groundwater, surface waters and wetlands areas in and around the Site and is conducted to measure cleanup progress and to ensure that public health and the environment continue to be protected. The effluent from the groundwater treatment plant is also monitored by BASF and EPA to ensure that treated water meets the requirements set forth in the 1989 ROD and the ESD. BASF's monitoring results are reported to EPA quarterly in the Quarterly Compliance Reports.

Data Review

The LTMP incorporates the following monitoring programs: the Site-Wide Monitoring Program to monitor groundwater and the GERS; the Toms River Monitoring Program for monitoring surface water of the Toms River; and the Northeast Recharge Area monitoring. The LTMP requires groundwater monitoring in several off-site areas to determine the impact of the groundwater extraction, treatment and recharge systems in protecting these areas. Off-site monitoring is done primarily in two areas; in the parkland east of the Toms River and in the Oak Ridge Area, a residential subdivision south of the Site. Portions of these areas have been impacted by the contaminant plume, which comprises all groundwater that exceeds the standards from Table 2 of the ESD, (Table 3 in this document). The off-site monitoring results, which are presented in the LTMP Annual reports, show a reduction in chemical concentrations in areas impacted by the plume and indicate that the system has been effective in preventing the migration of the plume. A comparison of the 2011 data with the 1995-1996 data indicates both a reduction in contaminant concentrations and in the number of COCs detected that exceed groundwater restoration standards. Overall, analysis of groundwater monitoring data indicates that the groundwater remedy is functioning as designed in order to attain eventually the more stringent of the federal and/or State MCLs established in the 1993 ESD. See Attachment 1 for example wells demonstrating decreasing trends.

The 2011 LTMP annual report, released in August 2012, includes the first round of sampling from wells located downgradient of the OU2 remediated sources. The report concludes that the treatment system consistently meets performance criteria. Since this is the first year of sampling the OU2 source wells, no trends can be assessed.

Due to a recent study indicating a possible correlation between the presence of 1,4-dioxane in TCE-contaminated groundwater plumes, BASF analyzed the GERS influent sample for 1,4-dioxane in February 2013. There was no 1,4-dioxane found at a detection level of 0.9 µg/L in the influent sample.

The Toms River has been sampled repeatedly in the past to determine the impact of the Site on river quality. Surface water, sediment and toxicity samples have been collected in the river. Based on the results of these samples, it was determined that river quality was not negatively affecting environmental receptors. Although site-related chemicals have been detected in the river, concentrations have been below surface water and drinking water standards. As a requirement of the LTMP, the Toms River is currently monitored semiannually in two locations, upstream and downstream of the Site. In 2011, no VOCs were detected in the surface water samples. Aluminum and nickel were found at similar levels upstream and downstream in 2011 and in previous years (refer to Figure 9-2).

The 2011 groundwater monitoring results from along the Site's northern border supports the conclusion that no treated water from the recharge areas has migrated under Pine Lake Park residential area.

The Wetlands Monitoring Program was developed to assess the effects of the GERS on the adjacent wetlands. First implemented in 1994, the program was modified in 1997 and 1998, before it was discontinued in 2002. The 1994 plan included five permanent plots in the NERA, and seven permanent plots within the SERA. Plots were placed in locations most likely to indicate the potential impacts of the extraction and recharge on wetlands, on the transition between wetlands and uplands, and on the uplands immediately downgradient of the discharge points. The approach was meant to focus on the ecologically important wetland functions and parameters that are sensitive to change. Wetlands monitoring was completed in 2002.

Air monitors were operational at the Site from April 2003 until the completion of OU2 source removal in 2010. Monitoring occurred in the work zone, near-source, and at the Site perimeter; four different monitors were used at the perimeter stations. There were no exceedances of the particulate action level at the perimeter of the Site. One elevated reading, due to operator error, was measured since 2003. Particulates have not been an issue in the near-field areas or work zone. Total VOCs were measured with part per billion (ppb) level photoionization detectors. No action levels were exceeded at the perimeter of the Site. Summa canisters were used to measure low levels of VOCs in the air and the results were compared to the long-term action levels for the Site. There were no multiple day exceedances recorded by the Summa monitors.

During 2007-2008, EPA conducted a residential vapor intrusion study in the residential area where low levels of VOCs are present off-site in the shallow groundwater aquifer. Twenty-seven residences were tested and the results indicated that there are no contaminants present at levels of concern in any of the residences tested. Results from the testing have been provided to the respective property owners.

Site Inspection

A Site inspection was performed on January 23, 2013. See Table 4 for a list of attendees. BASF and their contractors provided the attendees with presentations summarizing activities over the past five years as well as an update of current conditions and future plans. The team toured the current and future groundwater treatment plant, NERA, OU2 caps and the EQ Basins. They also

drove through additional portions of the Site allowing for visual inspections of fencing and monitoring wells. No issues or concerns were discovered during the inspection.

Interviews

EPA conducted interviews during the five-year review inspection with BASF's project manager and O&M manager during the Site visit. There were no issues or concerns reported during the interviews. The O&M costs for the past five years can be found as Table 5.

## VII. Technical Assessment

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

Yes. Analysis of data over the past five years indicates that the groundwater treatment system has consistently met the treatment standards provided in the 1989 ROD and 1993 ESD. The Pine Lake Park residential areas have not been impacted by the contaminant plume or treated recharge water. Actions such as the fencing around the Site and the continuous security activities are in place to interrupt exposures to potential trespassers. The effectiveness of the extraction, treatment and recharge system is continually monitored through groundwater, river and effluent sampling.

Analysis of groundwater monitoring data indicates that the groundwater remedy is functioning as designed in order to attain the more stringent of the federal and/or state MCLs in the future as specified in the 1993 ESD. These actions have reduced the amount of contamination in the environment (e.g., groundwater) and are functioning as intended to interrupt unacceptable direct exposure to Site contaminants.

The OU2 remedy addressing soil contamination was completed in 2012. This remedy addressed the direct contact exposure through caps and prevents contamination from spreading from the clay into the Primary Cohansey aquifer through the installation of slurry walls. Groundwater monitoring is in place to ensure the remedy is functioning as designed.

A CEA has been established to prevent the use of groundwater. Consistent with the OU2 ROD, appropriate deed restrictions and ICs will be put in place or maintained to protect human health based on potential land use.

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

There have been no changes in the physical conditions at the Site that would affect the protectiveness of the remedy. There have been no changes in the Applicable or Relevant and Appropriate Requirements, and there are no new standards which would affect the protectiveness of the remedy.

The exposure assumptions used to estimate the potential cancer risks and noncancer hazards in the risk assessment supporting the RODs and ESD for human health followed the Risk Assessment Guidance for Superfund used by the Agency remain valid. During the Site RI, EPA determined that the contaminated soil under current conditions and industrial zoning posed no unacceptable human health risk from direct soil contact. Under future conditions ingestion of soils from the FCDA by future residents (adult and child) and construction workers exceeded the risk range. The exposure assumptions used in these calculations have not changed from the original risk assessment.

The following chemicals being re-evaluated through the Integrated Risk Information System (IRIS) process include inorganic arsenic, chromium VI, and vanadium pentoxide. The toxicity data and cleanup levels for these chemicals will need to be re-evaluated when the IRIS chemicals are updated. Although the risk numbers may change, the remedial alternatives developed for the Site focus on addressing the risk by capping the area and preventing direct contact with surface soils. The remedy also prevents further groundwater contaminant migration through the Perched Water Management System and groundwater monitoring.

Currently, the residents in the area receive their drinking water from a municipal supply. Well restrictions to prevent the installation of drinking water wells in impacted areas were implemented in 1974 and continue based on Ocean County Board of Health regulations, thereby eliminating the direct exposure pathway. Table 6 provides a comparison of the remediation levels established in the OU1 ROD and updated in Table 2 of the ESD with their respective current residential risk-based concentrations. The current risk-based concentration for total arsenic is below the remediation level of 50 µg/L, from the OU1 ROD and the ESD effluent standard of 8 µg/L. However, due to GERS treatment and slurry walls the plume is contained and the most recent effluent arsenic result reported in the fourth quarter of 2012 was reported as undetected at a detection level of 0.3 µg/L.

Region 2 has evaluated a number of properties with elevated concentrations of groundwater contaminants where potential vapor intrusion may occur. EPA conducted sampling in October of 2007 at properties near the facility. EPA found that contaminant concentrations in the soil gas beneath the structures and in the indoor air at these properties did not require any further investigation or remediation.

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

There is no information that calls into question the protectiveness of the remedy.

Technical Assessment Summary

Based upon the results of this five-year review, it has been determined that the extraction and treatment system is operating to control the plume effectively and contaminant reductions have been observed. The groundwater treatment system has consistently met the treatment standards provided in the 1989 ROD and 1993 ESD. Access to the property and the groundwater is

currently restricted and is preventing any unacceptable exposure until final cleanup standards are achieved. The soil remedy under the OU2 ROD is completed and the direct contact risk has been mitigated.

## VIII. Issues

| Issue | Currently Affects Protectiveness (Y/N) | Affects Future Protectiveness (Y/N) |
|---|---|---|
| Institutional controls not implemented | N | N |

## IX. Recommendations and Follow-Up Actions

| Issue | Recommendations/ Follow-up Actions | Party Responsible | Oversight Agency | Milestone Date | Affects Protectiveness? (Y/N) | |
|---|---|---|---|---|---|---|
| | | | | | Current | Future |
| Institutional controls not implemented | Implement deed restrictions | PRPs | EPA | 2016 | N | N |

## X. Protectiveness Statement

OU1

The OU1 groundwater remedy is protective of human health and the environment.

OU2

The OU2 source control remedy is protective of human health and the environment in the short-term. However, in order for the remedy to be protective in the long term, deed restrictions need to be established.

Site-wide

The remedies are protective of human health and the environment in the short term. However, in order for the remedies to protective in the long term, deed restrictions need to be established.

## XI. Next Review

The next five-year review will be completed before April 2018.

| Table 1: Chronology of Site Events | |
|---|---|
| Event | Date |
| Dye production operations at the Site began | 1952 |
| Site placed on National Priorities List | 1983 |
| OU1, Record of Decision for groundwater | 1989 |
| Dye production operations at the Site ended | 1992 |
| OU1, Explanation of Significant Differences | 1993 |
| EPA entered into a Consent Decree with the Ciba-Geigy Corporation to allow Ciba to design and construct the groundwater remedy | 1993 |
| Administrative Order on Consent between EPA and Ciba to allow Ciba to perform the OU2 Feasibility Study for the Site source areas | 1995 |
| All manufacturing operations at the Site ended | 1996 |
| Groundwater extraction, treatment and recharge systems are fully operational | 1996 |
| EPA approves OU1 Remedial Action Report | 1997 |
| OU2 Feasibility Study for Source Areas | 1999 |
| OU2 Record of Decision for Source Areas | 2000 |
| EPA entered into a Consent Decree with the Ciba Specialty Chemicals Corporation and Novartis Corporation to allow Ciba to design and construct the source area remedy | 2002 |
| Excavation of drums from Stacked Dump Disposal Area completed | 2004 |
| Vapor Intrusion evaluation conducted | 2007 |
| Soil excavation, remediation and backfill of Backfilled Lagoon Area completed | 2007 |
| Soil excavation, remediation and backfill of Building 108/Underground Storage Tank Area completed | 2007 |
| Soil excavation, remediation and backfill of Former South Dye Area completed | 2008 |
| Soil excavation, remediation and backfill of Equalization Basin completed | 2008 |
| In-situ treatment system in Equalization Basin completed | 2008 |
| Soil excavation, remediation and backfill of Drum Disposal Area completed | 2010 |

| Table 1: Chronology of Site Events | |
|---|---|
| Event | Date |
| Soil excavation, remediation and backfill of Filtercake Disposal Area completed | 2010 |
| Decommission of ex-situ on-site treatment building | 2010 |
| Public Meeting for completion of OU2 Source Areas remediation and Optimization of the groundwater remedy | 2010 |
| Preliminary Close-Out Report for the Site | 2012 |
| Bidders meeting and Site walk through for GTS optimization | 2012 |

| Table 2: Documents, Data, Information Reviewed for Five-Year Review | |
|---|---|
| **Document Title and Author** | **Submittal Year** |
| EPA Superfund Record of Decision OU1, EPA | 1989 |
| Sampling, Analysis and Monitoring Plan (SAMP) Investigation reports, Ciba-Geigy | May and June 1992 |
| The Groundwater Extraction System for Ciba-Geigy's Toms River Plant: Locations and Rates for Groundwater Extraction and On-Site Aquifer Recharge, Environ Corporation | November 23, 1992 Revised 6/95 |
| OU1 Explanation of Significant Differences, EPA | 1993 |
| EPA Superfund Record of Decision OU2, EPA | 2000 |
| Long-Term Monitoring Plan, Ciba | 2003 |
| Long-Term Monitoring Report (LTMP)/Site-Wide Monitoring Report (SWMP) for 2005-2006, Ciba Corporation | 2007 |
| Quarterly Compliance Reports | 2005-2012 |
| Annual Report OU-1 Long Term Monitoring Plan (LTMP): Site Wide Monitoring Plan (SWMP), Toms River Monitoring Program (TRMP), Northeast Recharge Area (NERA) Monitoring Process Optimization for 2007/2008, Ciba Corporation | 2009 |
| Annual Report OU-1 Long Term Monitoring Plan (LTMP): Site Wide Monitoring Plan (SWMP), Toms River Monitoring Program (TRMP), Northeast Recharge Area (NERA) Monitoring Process Optimization for 2009, Brown and Caldwell | 2010 |
| 2010 Annual Report OU-1 Long Term Monitoring Report (LTMP), Brown and Caldwell | 2011 |
| Remedial Process Optimization Evaluation Report, Brown and Caldwell | 2011 |
| Basis of Design Report, Upgrade of Groundwater Treatment System, Brown and Caldwell | 2012 |
| Equalization Basins Source Characterization Work Plan, Brown and Caldwell | 2012 |
| 2011 Annual Report for OU-1 Long Term Monitoring Plan (LTMP) and Groundwater Portion of OU-2 LTMP, Brown and Caldwell | 2012 |
| Preliminary Site Close Out Report, EPA | 2012 |

| TABLE 3 – ESD EFFLUENT DISCHARGE LIMIT (µg/L) | | | |
|---|---|---|---|
| **PARAMETER** | **STANDARD** | **PARAMETER** | **STANDARD** |
| | | | |
| **ORGANIC** | | **INORGANIC** | |
| 1,1,1-Trichloroethane | 15 | Total Arsenic | 8 |
| 1,1,2,2-Tetrachloroethane | 2 | Total Cadmium | 3 |
| 1,1,2-Trichloroethane | 2 | Total Chromium | 50 |
| 1,1-Dichloroethylene | 2 | Total Copper | 10 |
| 1,2,3-Trichlorobenzene | 8 | Total Iron | 300 |
| 1,2,3-Trichloropropane | 20 | Total Lead | 10 |
| 1,2,4-Trichlorobenzene | 5 | Total Mercury | 2 |
| 1,2-cis-Dichloroethylene | 5 | Dissolved Nickel | 22 |
| 1,2-Dichlorobenzene | 77 | Total Selenium | 10 |
| 1,2-Dichloroethane | 2 | Total Zinc | 15 |
| 1,2-Dichloropropane | 1 | | |
| 1,2-trans-Dichloroethylene | 10 | **PHYSICAL** | |
| 1,3-Dichlorobenzene | 31 | Chloride | 250 |
| 1,3-trans-Dichloropropylene | Monitor | Nitrogen, nitrate | 10 |
| 1,4-Dichlorobenzene | 10 | Sulfate | 250 |
| 2-Butanone | 150 | Total dissolved solids | 500 |
| 2-Chloroethyl Vinyl Ether | Monitor | Total suspended solids | 40 |
| Acetone | 700 | pH | SU 5-9 |
| Acrylonitrile | 50 | | |
| Benzene | 1 | | |
| Benzidine | 50 | | |
| Bis(2-ethylhexyl)phthalate | 30 | | |
| Carbon tetrachloride | 2 | | |
| Chlorobenzene | 3 | | |
| Chloroform | 3 | | |
| Dibromochloromethane | 5.5 | | |
| Ethylbenzene | 32 | | |
| Methylene chloride | 2 | | |
| Naphthalene | 15 | | |
| Nitrobenzene | 10 | | |
| o-Chlorotoluene | Monitor | | |
| p-Chlorotoluene | Monitor | | |
| PCBs | 0.5 | | |
| Phenol | 10 | | |
| Styrene | 50 | | |
| Tetrachloroethylene | 1 | | |
| Toluene | 26 | | |
| Trichloroethylene | 1 | | |
| Vinyl chloride | 2 | | |
| Xylenes, total | 20 | | |

| Table 4 - Ciba Geigy Corporation Site Five Year Review Inspection Attendees<br>January 23, 2013 | | |
|---|---|---|
| **Name** | **Organization** | **Site Affiliation** |
| Diane Salkie | US EPA Region 2 | Remedial Project Manager |
| Jeff Josephson | US EPA Region 2 | Section Chief |
| Marion Olsen | US EPA Region 2 | Human Health Risk Assessor |
| Ed Modica | US EPA Region 2 | Hydrogeolgist |
| Pat Seppi | US EPA Region 2 | Community Involvement Coordinator |
| Steve Havlik | BASF | Project Manger |
| Fred Goelz | BASF | O&M Manager |
| Tom Legel | Advanced Geoservices | PRP contract support |
| Anne Fung | Brown and Caldwell | O&M contract support |
| Jeff Caputi | Brown and Caldwell | O&M contract support |
| Marek Ostrowski | Brown and Caldwell | O&M contract support |
| Jay Ash | AMO Environmental Decisions | PRP contract support |

| Table 5: O & M Costs Records | |
|---|---|
| **Calendar Year** | **O&M Costs** |
| 2008 | $4,441,000 |
| 2009 | $3,984,000 |
| 2010 | $3,993,000 |
| 2011 | $4,146,000 |
| 2012 | $3,480,000 |

**Table 6: Groundwater Remediation Levels compared with Residential Risk-Based Concentrations**

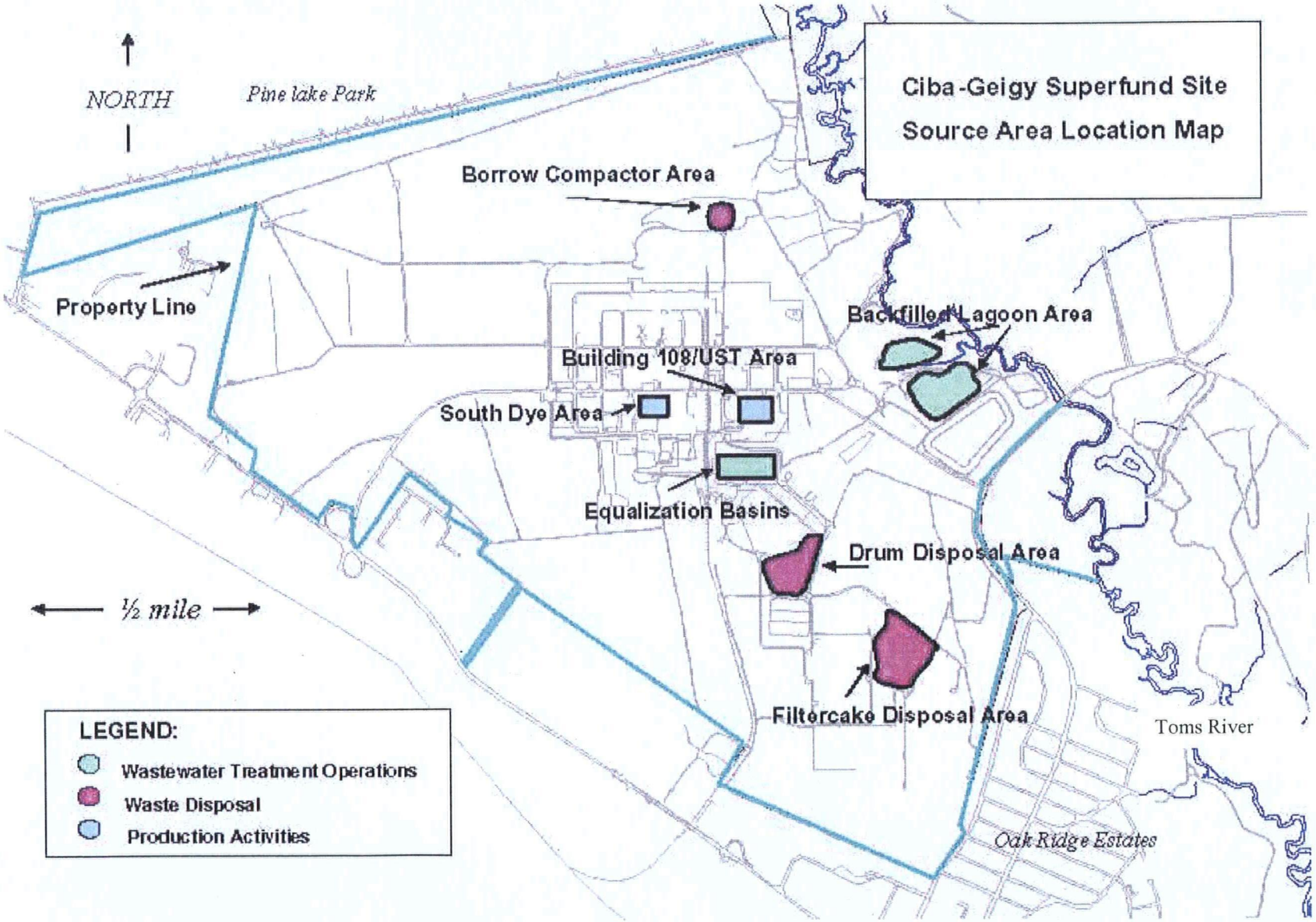
| Chemical | Cleanup Standard (ppb) | Concentration with Risk Level of $10^{-6}$ (ppb) | Concentration with noncancer, HI = 1 (ppb) | Conclusion |
|---|---|---|---|---|
| Arsenic | 50 (new standard is 10 ppb) | 0.045 ppb | 4.7 | MCL is in upper bound of risk range but exceeds an HI = 1 |
| Benzene | 1.0 | 0.39 | 29 | Within risk range and below HI = 1. |
| Cadmium | 5.0 | NC | 6.9 | Below HI = 1. |
| Chlorobenzene | 4.0 | NC | 100 | Below HI = 1 |
| Chloroform | NA | 0.19 | 84 | * |
| 1,2-dichloroethane | 2.0 | 0.15 | 13 | Within risk range and below noncancer HI = 1 |
| Nickel | NA | NC | 300 (based on soluble salts) | * |
| Tetrachloroethylene | 1.0 | 9.7 | 35 | Below risk range and HI = 1. |
| 12,4-trichlorobenzene | NA | 0.99 | 3.9 | * |
| Trichloroethylene | 1.0 | 0.44 | 2.6 | Within risk range and below HI = 1. |

NA – No standard available

NC – This chemical is not carcinogenic through oral exposure

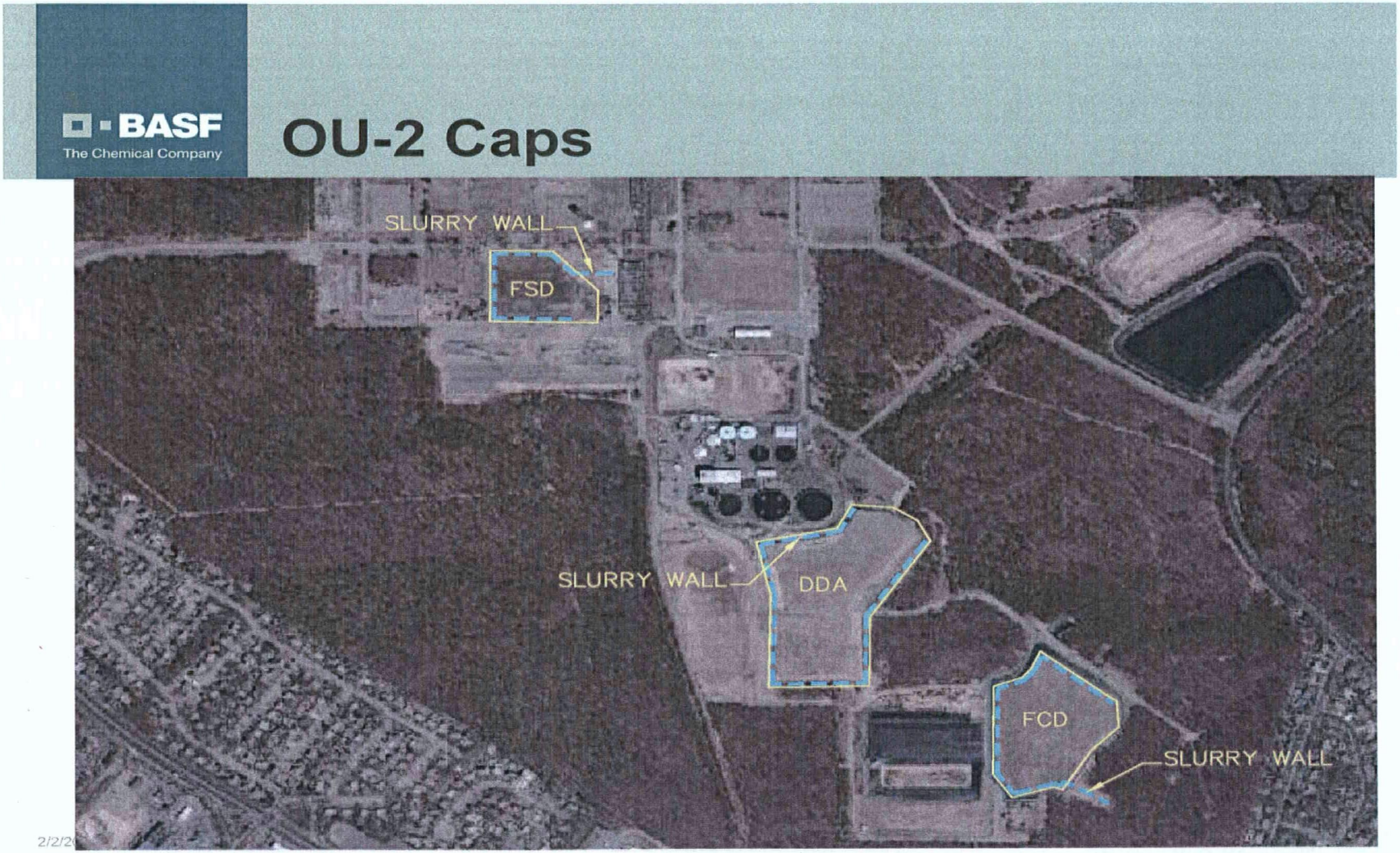
* – No conclusion would be reached since no cleanup standards were available.

Figure 1 – OU-2 Source Areas



Toms River

Figure 2 – OU-2 FSD/DDA/FCD Repository Caps and Slurry walls



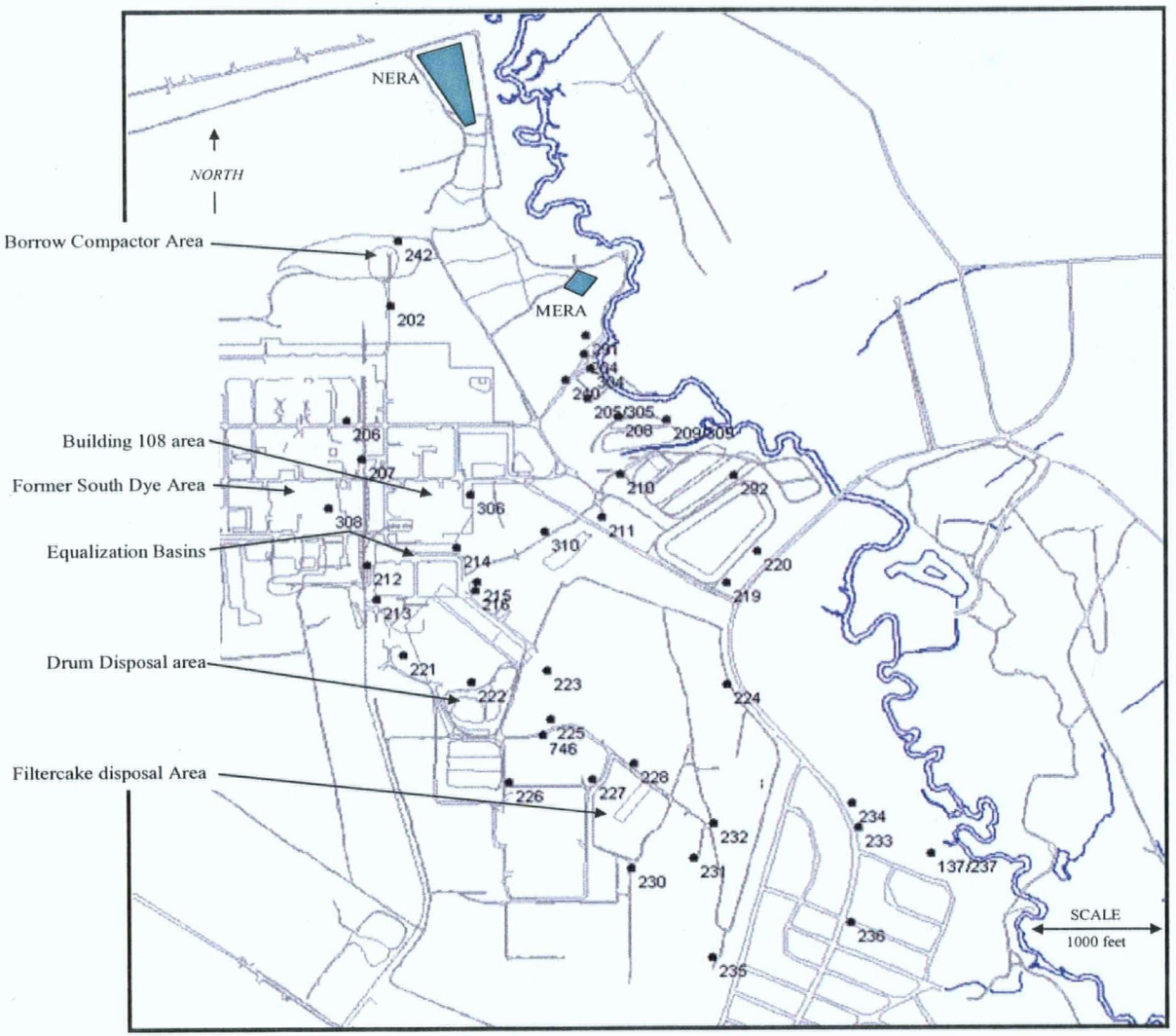



**Figure 3-2 GERS Original Design**

* from the Brown and Caldwell, 2011 Annual Report fo OU-1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU-2 LTMP, Ciba-Geigy Toms River Site, Toms River, New Jersey, August 2012

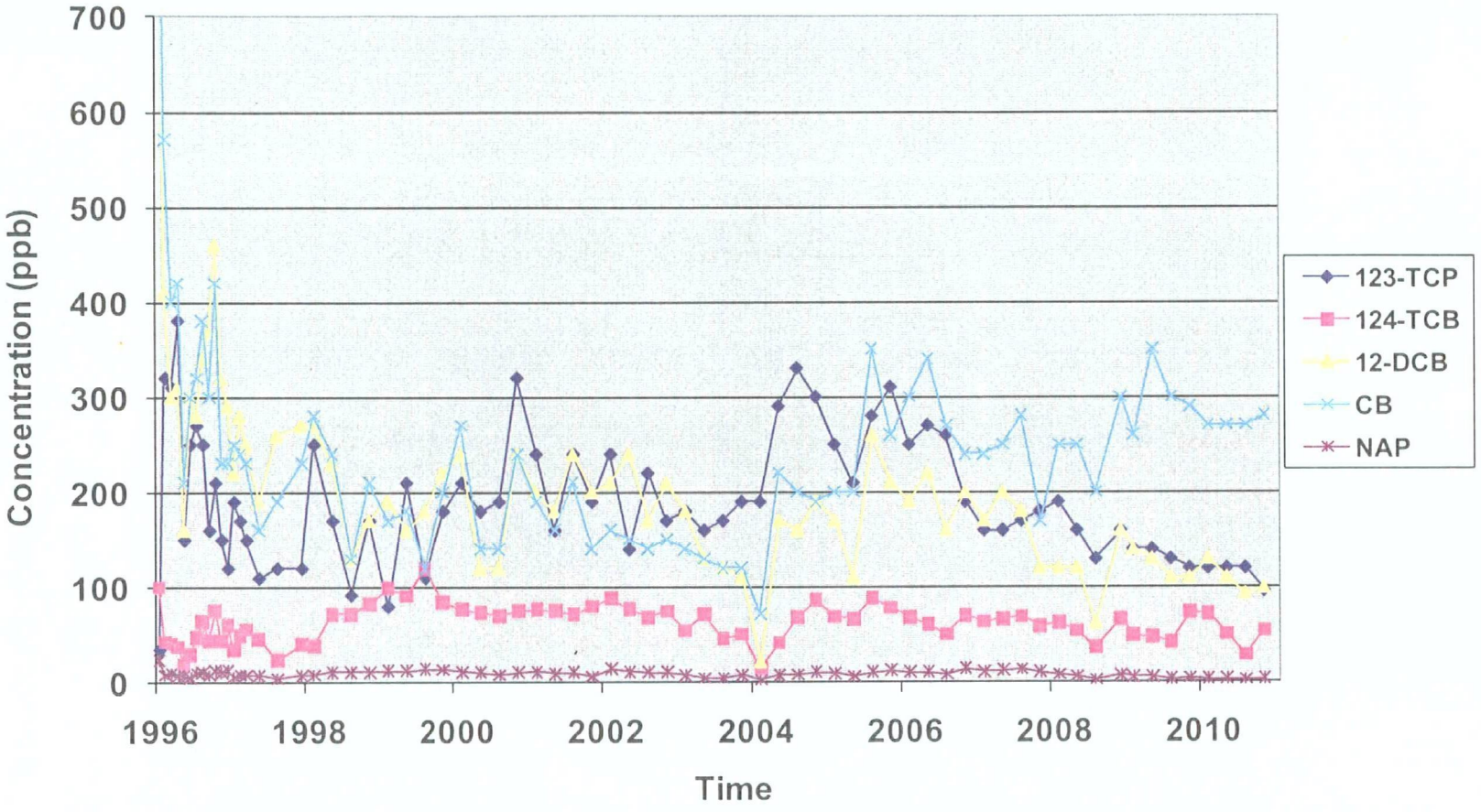



Figure 5-1 GTS Influent Water Quality COC Concentration (at DSNIO3 sample point). 123TCP = 1,2,3-trichloropropane, 124TCB = 1,2,4-trichlorobenzene, 12DCB = 1,2-dichlorobenzene, CB = chlorobenzene, NAP = naphthalene.

* from the Brown and Caldwell, 2011 Annual Report fo OU-1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU-2 LTMP, Ciba-Geigy Toms River Site, Toms River, New Jersey, August 2012

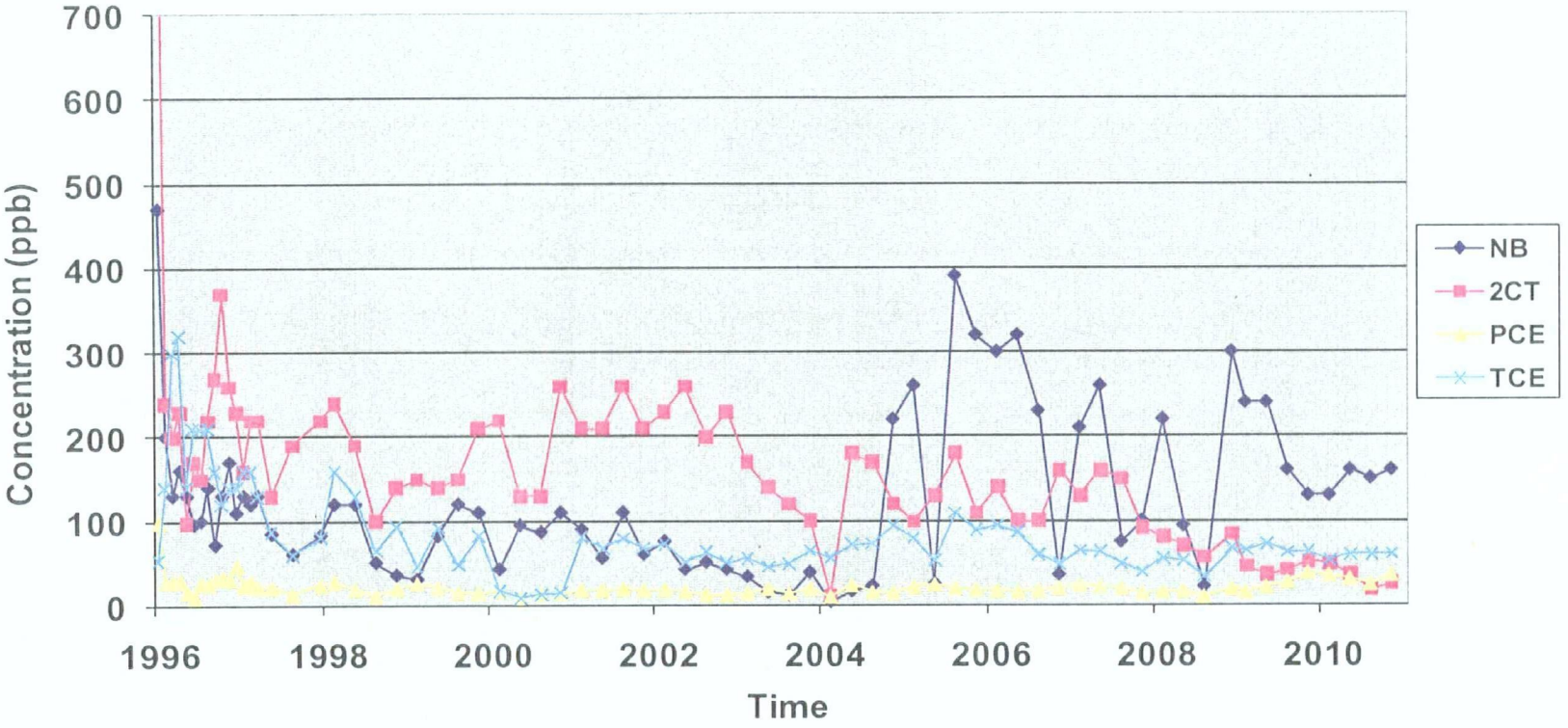



Figure 5-2 GTS Influent Water Quality COC Concentration (at DSNIO3 sample point). NB = nitrobenzene, 2CT = 2-chlorotoluene, PCE = tetrachloroethylene, TCE = trichloroethylene.

* from the Brown and Caldwell, 2011 Annual Report fo OU-1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU-2 LTMP, Ciba-Geigy Toms River Site, Toms River, New Jersey, August 2012

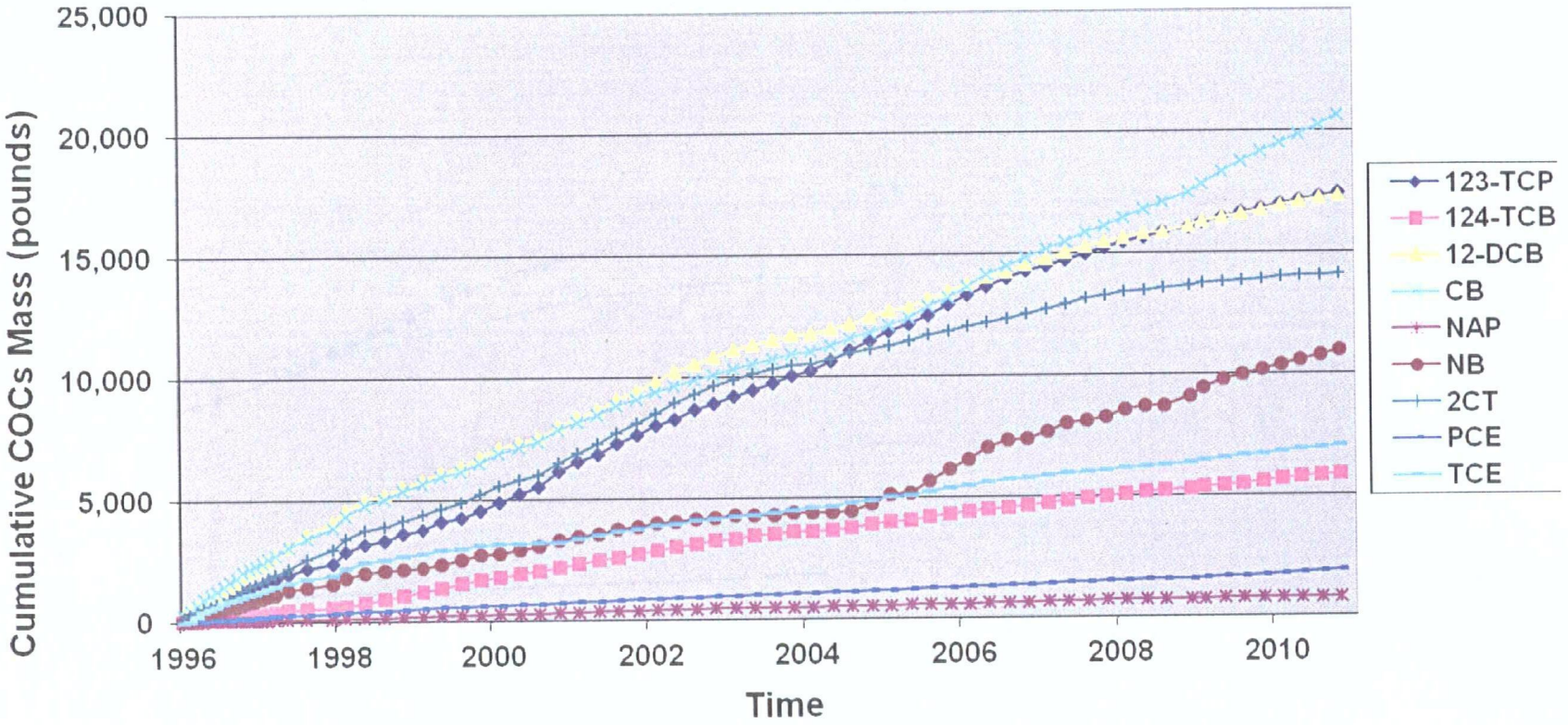
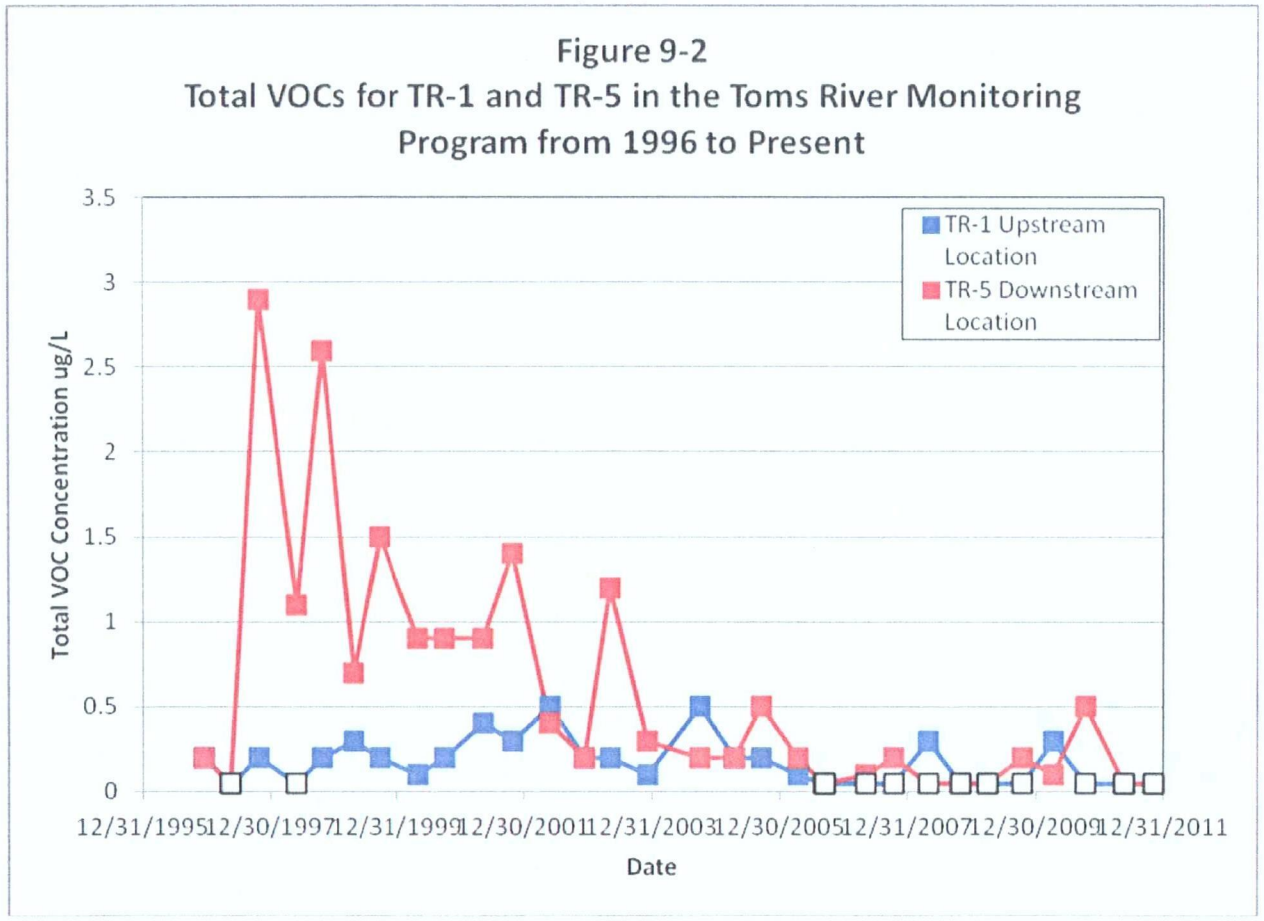



Figure 5-3 Cumulative COC Mass (pounds) that has Entered the GTS Since Startup (at DSNIO3 sample point).
123TCP = 1,2,3-trichloropropane, 124TCB = 1,2,4-trichlorobenzene, 12DCB = 1,2-dichlorobenzene,
CB = chlorobenzene, NAP = naphthalene, NB = nitrobenzene, 2CT = 2-chlorotoluene,
PCE = tetrachloroethylene, TCE = trichloroethylene.

* from the Brown and Caldwell, 2011 Annual Report fo OU-1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU-2 LTMP, Ciba-Geigy Toms River Site, Toms River, New Jersey, August 2012

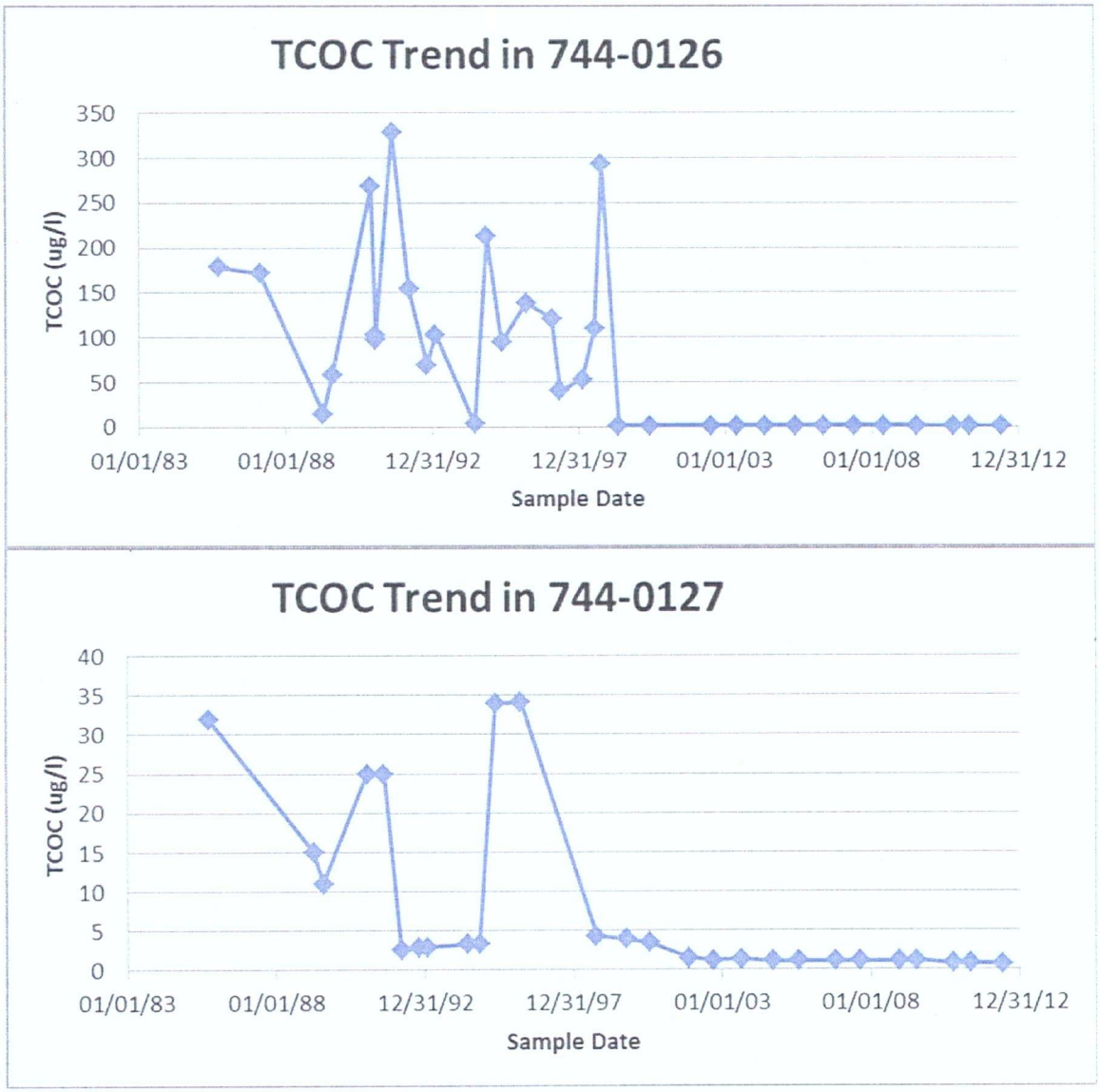
## Figure 9-2
## Total VOCs for TR-1 and TR-5 in the Toms River Monitoring Program from 1996 to Present



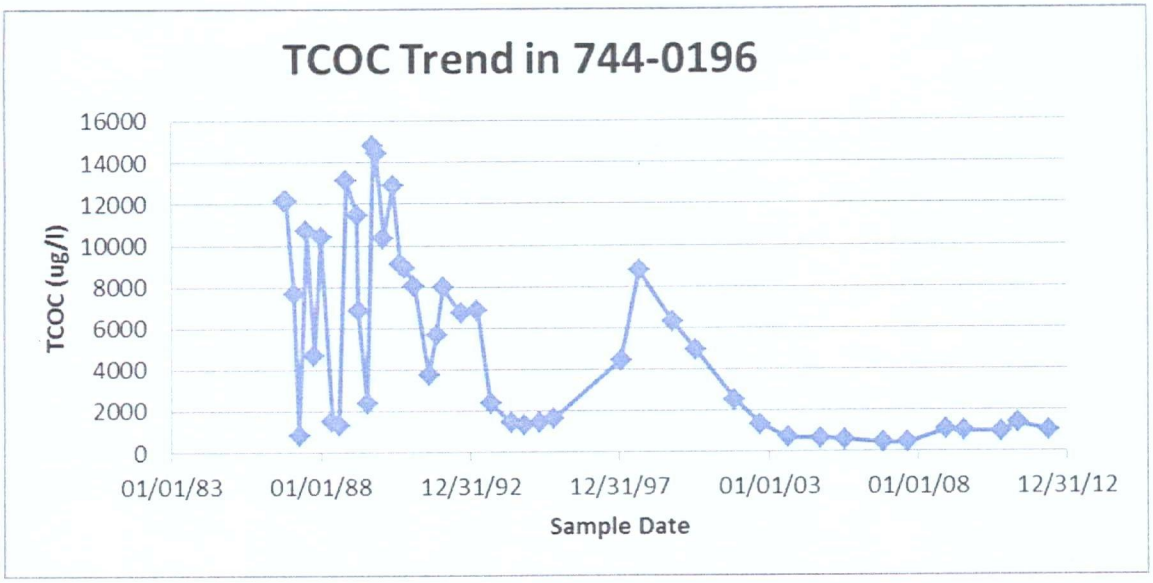

* from the Brown and Caldwell, 2011 Annual Report fo OU-1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU-2 LTMP, Ciba-Geigy Toms River Site, Toms River, New Jersey, August 2012
TR-1 and TR-5 are sample locations in the Toms River

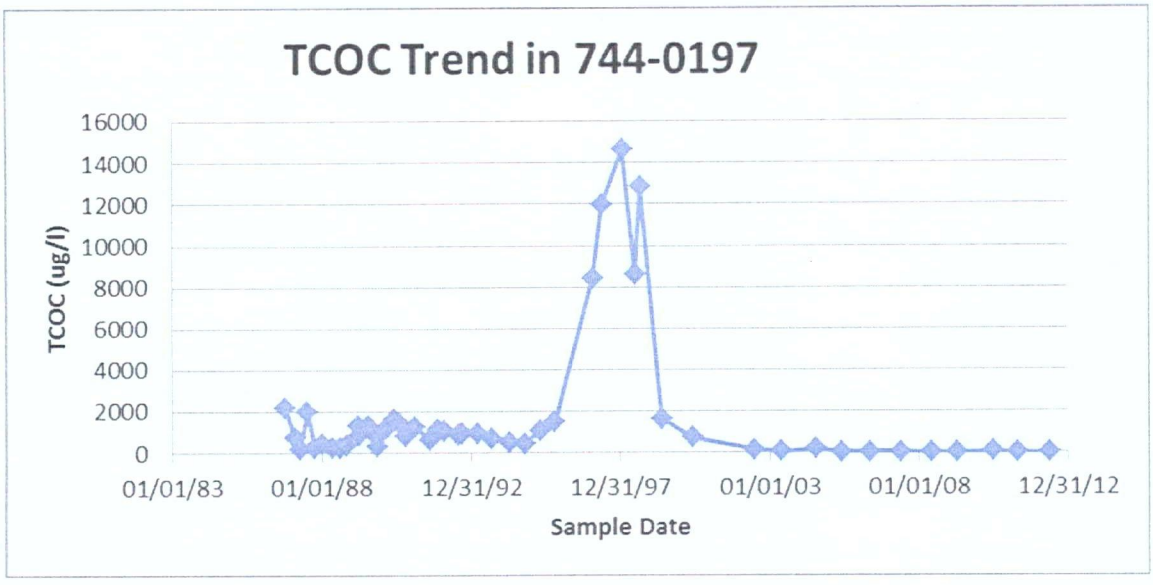
## ATTACHMENT 1

Groundwater Trend Examples

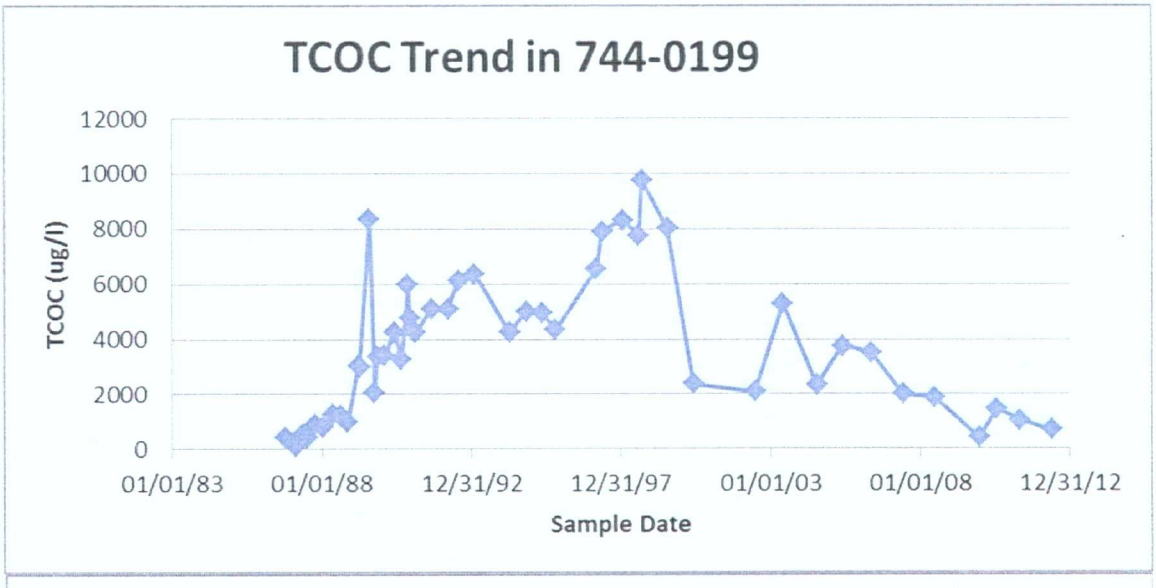


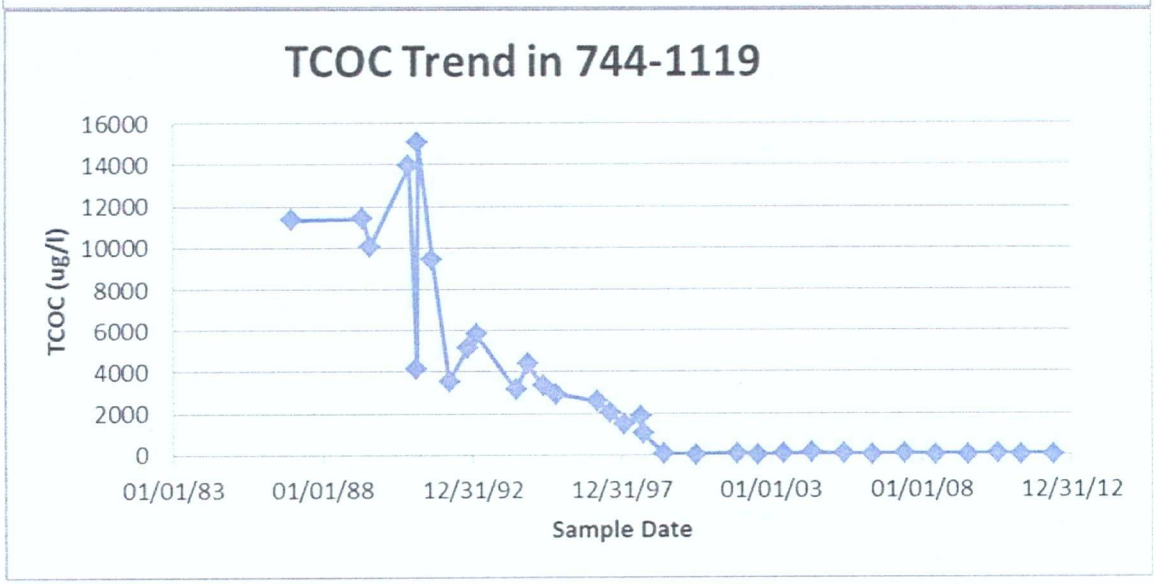

* from the Brown and Caldwell, 2011 Annual Report fo OU-1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU-2 LTMP, Ciba-Geigy Toms River Site, Toms River, New Jersey, August 2012
TCOC – total contaminants of concern




* from the Brown and Caldwell, 2011 Annual Report fo OU-1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU-2 LTMP, Ciba-Geigy Toms River Site, Toms River, New Jersey, August 2012
TCOC – total contaminants of concern

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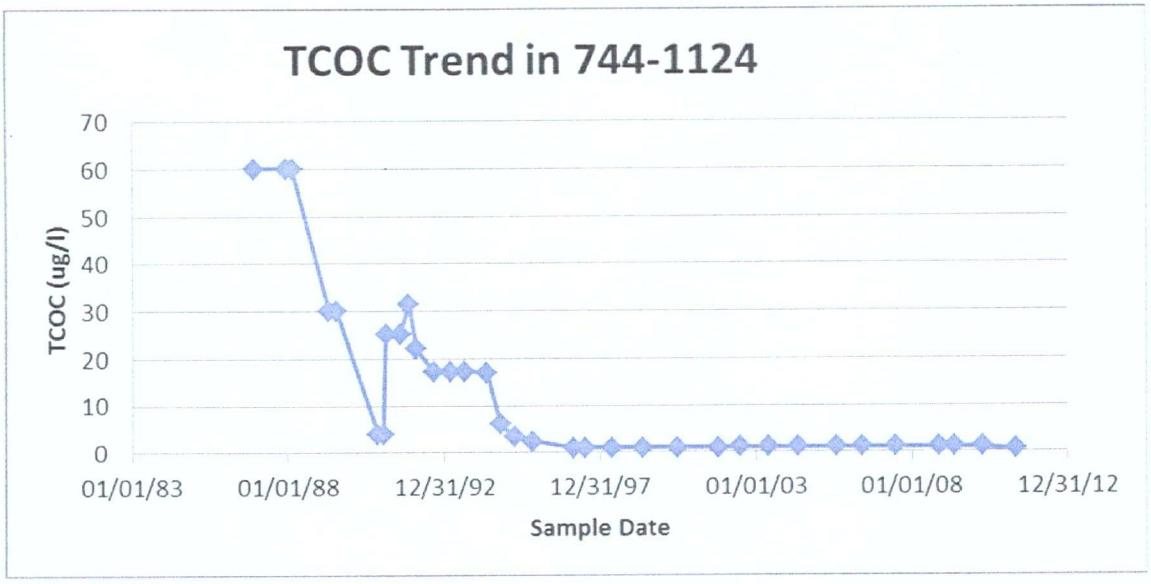


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