FIFTH FIVE-YEAR REVIEW REPORT FOR CIBA-GEIGY CHEMICAL CORPORATION SUPERFUND SITE OCEAN COUNTY, NEW JERSEY

Prepared by

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Date

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LIST OF ABBREVIATIONS & ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
BLA	Backfilled Lagoon Area
CD	Consent Decree
CEA	Classification Exception Area
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CIC	Community Involvement Coordinator
COCs	Chemicals of Concern
DDA	Drum Disposal Area
EPA	United States Environmental Protection Agency
EQ Basins	East and West Equalization Basins
ESD	Explanation of Significant Differences
FCD	Filtercake Disposal Area
FSD	Former South Dye Area
FYR	Five-Year Review
GERS	Groundwater extraction and recharge system
GTS	groundwater treatment system
ICs	Institutional Controls
LGAC	Liquid granular activated carbon
LCOH	Lower Cohansey
LTMP	Long term management plan
MCL	Maximum contaminant level
MWDC	Megawatt direct current
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NERA	Northeast Recharge Area
NJDEP	New Jersey Department of Environmental Protection
NPL	National Priorities List
O&M	Operation and Maintenance
OU	Operable Unit
PAC	Powdered Activated Carbon
PCOH	Primary Cohansey
PHE	Public Health Evaluation
PRP	Potentially Responsible Party
RAO	Remedial Action Objectives
RI	Remedial Investigation
RPO	Remedial Process Optimization
ROD	Record of Decision
RPM	Remedial Project Manager
SWMP	Site-wide management plan
TBC	To be considered
TCOC	Total contaminants of concern
UU/UE	Unlimited Use and Unrestricted Exposure
VOC	Volatile Organic Compound
yds^3	cubic yards

I. INTRODUCTION

The purpose of a five-year review (FYR) is to evaluate the implementation and performance of a remedy in order to determine if the remedy is and will continue to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports such as this one. In addition, FYR reports identify issues found during the review, if any, and document recommendations to address them.

The U.S. Environmental Protection Agency (EPA) is preparing this FYR review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121, consistent with the National Contingency Plan (NCP) (40 CFR Section 300.430(f)(4)(ii)) and considering EPA policy.

This is the fifth FYR for the Ciba-Geigy Chemical Corporation Superfund Site. The triggering action for this statutory review is the date of the last FYR, May 7, 2018. The FYR has been prepared due to the fact that hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure (UU/UE).

The Site consists of two operable units (OUs), both OUs will be addressed in this FYR. OU1, which involves the extraction, treatment and on-site recharge of contaminated groundwater, is operational. OU2, which addresses contaminated material and buried drums in source areas on the Site, is complete.

The Ciba-Geigy Chemical Corporation Superfund Site FYR was led by Diane Salkie, EPA remedial project manager (RPM). Other EPA participants included Marian Olsen (human health risk assessor), Michael Clemetson (ecological risk assessor), David Edgerton (hydrogeologist), and Patricia Seppi (Community Involvement Coordinator, or CIC). The current potentially responsible party (PRP), BASF, was notified of the initiation of the FYR. The review began on 6/1/2022.

Site Background

The Site is located in Toms River Township, (formerly known as Dover Township), Ocean County, New Jersey. On-site structures include piping associated with the groundwater collection system, the groundwater treatment plant, remediation facilities and recently added solar power arrays. Of the original 1,320 acre Site, approximately 1000 acres were never developed and remain in a natural state. Approximately 320 acres were developed and used for manufacturing operations, waste treatment, disposal activities, and administrative and laboratory facilities. An undeveloped portion of the Site that is in Manchester Township, comprising approximately 70 acres, was transferred to Manchester Township as conservation land around 2003. The 1,250 acres of the Site remaining today is all in Toms River Township and consists of approximately 1,210 acres of industrially zoned land on the west side of Oak Ridge Parkway and approximately 40 acres of conservation-residential zoned land on the east side of Oak Ridge Parkway. Based on soil sampling, approximately 750 acres are outside the area requiring remediation and no restriction on their future use is necessary. Approximately 410 acres are within, or close to the remediation zone and are not appropriate for residential use and are therefore restricted to Commercial/Industrial/Recreational use. Finally, the waste management zone comprises 90 acres, the use of which is restricted to waste management activities. The entire Site is fenced with restricted access.

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.

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 contaminated groundwater plume. Surface waters from the Toms River are not used as potable water.

The seven uppermost geologic members underlying the Site in descending order are: the Upper Cohansey Member, Cohansey Yellow Clay, Primary Cohansey Member (PCOH), Cohansey/Kirkwood Transitional Member, the Lower Cohansey Member (LCOH), 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 three major Site activities were production-related activities, wastewater treatment operations and solid waste disposal. The two source areas associated with production are the Former South Dye Area (FSD) and the Building 108/Underground Storage Tank Area. During 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).

Several solid waste disposal areas are known to have operated at different times during operations at the Site which include the Filtercake Disposal Area (FCD), Lime Sludge Disposal Area, Drum Disposal Area (DDA), Standpipe Burner Area and the Borrow/Compactor Area, (see Figure 1).

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? Yes	**Has the site achieved construction completion?** Yes	

REVIEW STATUS
Lead agency: EPA ***[If "Other Federal Agency", enter Agency name]*:**
Author name (Federal or State Project Manager): Diane Salkie
Author affiliation: EPA Region 2
Review period: 6/1/2022 - 12/31/2022
Date of site inspection: 10/20/2022
Type of review: Statutory
Review number: 5
Triggering action date: 5/7/2018
Due date *(five years after triggering action date)*: 5/7/2023

II. RESPONSE ACTION SUMMARY

Basis for Taking Action

In 1984, EPA began a remedial investigation (RI) of the Site. The RI 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 to quickly address potential public health concerns by preventing further off-site migration of groundwater contaminants. The OU2 RI 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 cancer risks to future residents consuming groundwater from the site were 1×10^{-2} (one in 100) exceeding the NCP risk range of 1×10^{-6} to 1×10^{-4} (i.e., one in a million to one in ten thousand) 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 1×10^{-4} (cancer risk of 1 in 10,000) to 1×10^{-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 extended 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 COCs are reported as total contaminants of concern (TCOC) in groundwater reports.

The OU2 ROD evaluated potential risks from exposure to the FCD. The risks 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 1.1×10^{-4} (cancer risk of 1.1 in 10,000) from inhalation. The risks for the residential adults from ingestion of groundwater were 3×10^{-4} (cancer risks of 3 in 10,000) and the noncancer HI = 11. The future risks to the child were 2.9×10^{-4} (cancer risks of 2.9 in 10,000) and the noncancer HI = 92. The OU2 ROD also evaluated potential risks to construction workers from exposure to the FCD. The noncancer hazard to the future construction workers was a HI = 9.2. 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 there were no adverse impacts to terrestrial and aquatic biota in these areas.

Response Actions

Initial Response

During the late 1970s and early 1980s, 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 Site under the Potential Hazardous Waste Site Program. The Site was placed on the Superfund National Priorities List (NPL) in 1983.

OU1

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 plant;
- extraction of contaminated groundwater until federal and state cleanup standards are met to the extent that is technically practicable;
- modify the wastewater treatment plant to treat contaminated groundwater to meet NJDEP discharge levels;
- conduct a pilot study to confirm the practicability of achieving discharge levels; 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 Explanation of Significant Differences (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 4). The primary remedial action objective (RAO) of the OU1 ROD and ESD is aquifer restoration.

OU2

On September 29, 2000, EPA issued a ROD for OU2 describing the selected remedy for the on-site source areas. The RAOs 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 (yds^3) of contaminated material from the source areas;
- excavation and off-site disposal of approximately 35,000 drums from the DDA and 5,000 yds^3 of soils not suitable 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 filtercake disposal area 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 Equalization 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 (GERS) implemented as part of OU1; and
- appropriate environmental monitoring to ensure the effectiveness of the selected remedy.

Status of 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 groundwater treatment system (GTS) component for the GERS was constructed from the original wastewater treatment plant (existing from site operations) and consisted of aerators and powdered activated carbon (PAC), followed by polishing in granular activated carbon (GAC). The resulting GERS originally included 43 pumping wells designed to extract a maximum of four million gallons per day (MGD) of contaminated groundwater (see Figure 2). The systems became fully operational in March 1996.

Three recharge areas were created: the Northeast Recharge Area (NERA), Mideast Recharge Area (MERA) and the Southeast Recharge Area (SERA). Before recharge began, all recharge water went to the NERA to eliminate potential for treated water to enter a public water supply well located across the Toms River. Groundwater electrical conductance is monitored at wells in the NERA to track groundwater recharge movement and ensure that it does not move to the Pine Lake Park community located northwest of NERA.

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 a pre-engineered building 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.

The OU2 ROD identified a number of discrete, pre-determined volumes at each of the source areas, called source blocks, which were calculated using fate and transport and groundwater flow models. The source blocks determined the amount of soil to be removed and treated in the ex-situ treatment system. 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. 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.

In 2003, 47,055 drums were removed from DDA source area and sent off-site for disposal. Soil was excavated from the DDA as well as the FCD, 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. 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 was pumped

from the extraction wells, oxygenated and then re-injected to stimulate aerobic, biological treatment of contamination in the saturated zone. Throughout its operation, the system required extensive maintenance related to the plugging and corresponding decreases in capacity of the extraction and injection wells.

Soil was excavated, treated on-site and placed in the DDA/FCD/FSD depository from the remaining sources: the BLA, the FSD and the borrow compactor area (BCA). 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 of 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 Preliminary Close-Out Report was signed in September 2012, documenting that all on-site construction was completed.

One component of the OU2 remedy is optimization of the GERS implemented as part of OU1. The GERS optimization was initiated in 2000. In 2003-2004, based on groundwater quality, operation and maintenance data, and flow modeling analysis, nine of the original extraction wells were idled and three new wells were installed. In August 2010, BASF conducted a Remedial Process Optimization (RPO) project to evaluate further optimization of the GERS. One of the recommendations of the RPO was optimization of the EQ Basins. With EPA's concurrence, the operation of aerobic treatment was discontinued in August 2011 in preparation for the characterization activities. BASF performed further investigations and characterizations of the EQ Basins to initiate the optimization process. These investigations confirmed high concentrations, as well as non-aqueous phase liquid (NAPL), in the groundwater within the Basins. A second optimization idled ten extraction wells located in the PCOPH based on their locations on the periphery of the plume or very low COC mass recovery rates. The modifications proposed in the report were approved by EPA. Ten extraction wells screened in the PCOH were idled. Seven wells were idled in 2016 and three wells were idled in March 2017.

In May 2022, as a next step in the OU2 remedy optimization, BASF submitted an Optimization Report for GERS including the EQ Basins. This plan calls for additional extraction wells to be installed in the southern end of the plume where increased concentrations of groundwater contamination have been found. Additional extraction wells and NAPL recovery wells are planned for installation in the EQ Basins. EPA commented on the report and approved the revised version in October 2022.

In addition, in 2014, BASF upgraded the GTS system from the former wastewater treatment plant to new, self-contained air stripping and liquid granular activated carbon (LGAC) adsorption system. Due to the high levels of iron in the aquifer, BASF added an iron removal system consisting of a sludge thickening unit and geotube. The non-hazardous sludge cake is removed and disposed of at an approved landfill. The update resulted in a more efficient water treatment system with the same end result of meeting discharge permit requirements. A final remedial action completion report, which included optimization of the GTS and GERS was completed by BASF and approved by EPA in 2015.

IC Summary Table

Table 1: Summary of Planned and/or Implemented Institutional Controls (ICs)

Media, engineered controls, and areas that do not support UU/UE based on current conditions	ICs Needed	ICs Called for in the Decision Documents	Impacted Parcel(s)	IC Objective	Title of IC Instrument Implemented and Date (or planned)
Groundwater	Yes	No	Contaminated Groundwater	Restrict the use of groundwater	Classification Exception Area 2001
Soil	Yes	Yes	Block 411, Lots 6.02 and 6.03	Restrict land use	Deed restrictions Planned date 2023

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 classification exception area (CEA) restricting the installation of new wells into the Cohansey and Kirkwood aquifers in the vicinity of the Site.

The OU2 ROD requires deed restrictions on the property 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 restrictions for the property to ensure future land use, consistent with the OU2 ROD, are expected to be implemented in the future. In preparation of the deed restrictions, in 2013, the Township subdivided the property into three lots with Block 411, lot 6.01, 6.02 and 6.03.

Systems Operations/Operation & Maintenance

The 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 annual 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 (SWMP) to monitor groundwater and the GERS; the Toms River Monitoring Program for monitoring surface water of the Toms River; and the NERA monitoring. LTMP annual reports have been submitted from 2005 through 2022. A Wetlands

Monitoring Program was in place from development in 1994 until 2002, when EPA eliminated the requirement because no changes were recorded.

The SWMP is a groundwater data collection program that monitors water quality and elevation and provides information used to evaluate the GERS. The groundwater elevation measurements are taken from 328 wells and one round of water quality data is collected annually from monitoring wells. For the operation year 2021, water samples were collected in 92 monitoring wells. The groundwater quality samples are analyzed for all of the 90 parameters listed in Table 6 on odd numbered years (2019, 2021, etc.). During even numbered years (2018, 2020, etc.) the metals analysis is limited to GERS wells only, see Table 6. To monitor the performance of the OU2 remedial action perched water management system of slurry walls and caps, an OU2 LTMP was developed. The groundwater monitoring portion of the OU2 LTMP was developed as part of the 2009 OU1 LTMP and includes eight extraction wells and 13 monitoring wells located downgradient of the source areas.

The OU2 groundwater LTMP includes two semi-annual rounds of groundwater quality sampling and analysis from selected monitoring wells and extraction wells located near the OU2 source areas. Of the seven on-site source areas, based on the 2021 LTMP results, the BCA and Building 108 are not likely to be a source of groundwater impacts. Based on elevated groundwater concentrations in a downgradient well, impacts to groundwater from the FSD source may still be ongoing. As part of the optimization, BASF has agreed to further investigate this area. TCOC concentrations near the BLA and FDA have declined since the OU2 remedy, however, residual contamination appears to continue to be impacting groundwater quality at lower concentrations than prior to the OU2 remedy. BLA contamination is contained within the capture zone. The DDA showed a temporary increase in TCOC concentrations in nearby wells, which has been attributed to the passing of a slug of contaminants that was liberated during the implementation of the OU2 remedy in the 2000s. EPA commented on a concern with increasing TCOC concentrations in monitoring well RI-04D, located at southern end of the plume, close to the Toms River that may be attributable to the slug of contaminants from the OU2 remedy implementation. BASF submitted a Southern Plume Investigation Workplan to address EPA's concerns with increasing TCOC concentrations in monitoring well RI-04D, located at southern end of the plume, near the boundary of the plume, close to the Toms River. As part of the optimization plan, BASF submitted a revised workplan in February 2023 which is currently under EPA review. The contamination found near the DDA and FDA will be addressed with the southern plume optimization. Finally, the EQ Basins will be addressed by the optimization plan. See Figure 1.

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 4 in this document).

The final part of the SWMP, the Toms River Monitoring Program, is in place to evaluate whether the GERS is effective at containing 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 of the NERA monitoring program is to prevent recharge water from entering the residential community of Pine Lake Park.

As part of the routine maintenance activities, pipe insulation is repaired as needed, and piping is cleaned due to the metal oxide deposits when the excessive level deposit is observed. At times, these deposits have been found to significantly reduce the flow area of the piping. In the past, BASF addressed the problem of metal oxide deposition by using the deposit control agent FeREMEDE®. The use of FeREMEDE® was gradually phased out between 2011 and 2012, when it was replaced with other deposit control agents such as bleach and citric acid to address metal oxide fouling.

It should be noted that the Ciba Geigy Site has been affected by power outages during intense storms that tend to have a greater effect on the coastal areas of New Jersey. During Superstorm Sandy, the site was out of power for a week and therefore the PRP was not able to maintain the GERS system during that time. In 2019, as part of a 35-megawatt direct current (MW DC) grid-tied solar array system, a smaller 2-MW DC net-metered solar array was installed. This smaller system provides nearly 100% of the electricity required to power the GERS system. This would protect the system from shutdowns during large, intense storms. In addition, based on a review of the screening tools identified in Appendix D, potential site impacts from future impacts associated with climate change have been assessed, and the performance of the remedy is currently not at risk.

III. PROGRESS SINCE THE LAST REVIEW

This section includes the protectiveness determinations and statements from the fourth FYR as well as the recommendations from the fourth FYR and the current status of those recommendations.

Table 2: Protectiveness Determinations/Statements from the 2018 FYR

OU #	Protectiveness Determination	Protectiveness Statement
1	Protective	The OU1 groundwater remedy is protective of human health and the environment.
2	Short-term Protective	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.
Sitewide	Short-term Protective	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.

Table 3: Status of Recommendations from the 2023 FYR

OU #	Issue	Recommendations	Current Status	Current Implementation Status Description*	Completion Date (if applicable)
2	Deed restrictions have not been completed	BASF, NJDEP and the Township of Toms River need to complete the deed restrictions.	Ongoing	The previous FYR included an anticipated date of completion in 2023. To facilitate the implementation of ICs over the past five years, the property was subdivided by the	Planned 2023

				township. Although deed restrictions have not yet been implemented, progress continues.	

In 2019, BASF leased 166 acres of the site for a 35-megawatt direct current (MW DC) grid-tied solar array system. The project is almost entirely within the footprint of the site's former manufacturing area and connects to an on-site substation. A smaller 2-MW DC net-metered solar array provides nearly 100% of the electricity required to power the groundwater extraction and treatment system. EPA worked with BASF to make sure all solar arrays on site are ground mounted and do not penetrate the caps. The design ensures that reuse is compatible with the remedy and the remedy remains protective of human health and the environment.

IV. FIVE-YEAR REVIEW PROCESS

Community Notification, Involvement & Site Interviews

On August 15th, 2022, EPA Region 2 posted a notice on its website indicating that it would be reviewing site cleanups and remedies at Superfund sites in New York, New Jersey, and Puerto Rico, including the Ciba Geigy site. The announcement can be found at the following web address: https://www.epa.gov/superfund/R2-fiveyearreviews.

In addition to this notification, the CIC for the site, Patricia Seppi, posted a public notice on the EPA site webpage https://www.epa.gov/superfund/ciba-geigy and provided the notice to the Borough of Toms River by email on January 31, 2023, with a request that the notice be posted in municipal offices and on the village/town webpages. This notice indicated that a Five-Year Review (FYR) would be conducted at the Ciba Geigy site to ensure that the cleanup at the site continues to be protective of human health and the environment. Once the FYR is completed, the results will be made available at the following repository/ies: Ocean County Public Library, 101 Washington Street, Toms River, NJ and the EPA Region 2, Superfund Records Center at 290 Broadway, 18th Floor, New York, New York 10007. In addition, the final report will be posted on the following website: https://www.epa.gov/superfund/ciba-geigy. Efforts will be made to reach out to local public officials to inform them of the results.

Data Review

Since the last FYR in 2018, five rounds of annual monitoring well sampling have been conducted in the spring of 2018 through the spring of 2022 (data from 2022 has not been reported at this time). During the years 2018-2021, 27 wells comprised the GERS and the overall extraction rate was equal to 46 to 54 percent of the current design rate, both the extraction rates and design rates are expressed as the average annual values. In addition, 54 pumps were replaced, and 8 wells were redeveloped due to iron fouling; in 2021, 33 pumps were replaced and no wells were developed. 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 monitoring of the groundwater and Toms River. In addition, an upgrade of the GTS system from PAC to an air stripper in 2014 continues to meet surface water discharge requirements. The effluent continues to meet standard requirements specified in the ESD (see Table 4).

The LTMP incorporates the following monitoring programs: the SWMP 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 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 the system has been effective in preventing the migration of the plume. Figures 7-1, 7-2 and 7-3 located in Appendix C, are figures from the 2021 LTMP showing the plume concentrations of total contaminants of concern (TCOC) in the Primary Cohansey, Lower Cohansey and Kirkwood Sands aquifers, respectively. A comparison of the 2021 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 the groundwater remedy is functioning as designed in order to attain the more stringent of the federal and/or state Maximum Contaminant Levels (MCLs) established in the 1993 ESD. The overall reduction in plume size is approximately 50 percent of the pre-GERS extent.

BASF submitted a Southern Plume Investigation Workplan to address EPA's concerns with increasing TCOC concentrations in monitoring well RI-04D, located at southern end of the plume, near the boundary of the plume, close to the Toms River. As part of the optimization plan, BASF submitted a revised workplan in February 2023 which is currently under EPA review.

The 2021 LTMP report concludes the treatment system consistently meets performance criteria. Results in wells downgradient of the EQ Basins, FSDA, DDA and the FDA still show elevated results and as stated earlier, additional extraction wells are planned for installation as part of the OU2 remedy optimization plan. Data will continue to be collected from the downgradient wells, to ensure the OU2 remedy is functioning as designed.

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. In 2020, two site contaminants were found in the Toms River, 1,2,4-trichlorobenzene and chlorobenzene, at levels below the New Jersey Surface Water Quality Criteria. In 2021, BASF added additional surface water sampling locations in the Toms River. However, the 1,2,4-trichlorobenzene and chlorobenzene found in the 2020 samples were not detected. In fact, there were no VOC detections in 2021. 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 New Jersey's surface water and drinking water standards. Throughout the years, aluminum has been found at similar levels upstream and downstream and acetone, a common laboratory and field contaminant and not a site COC, has been detected in the samples.

The 2021 groundwater monitoring results from along the Site's northern border supports the conclusion that no treated water from the recharge areas has migrated under the Pine Lake Park residential area.

In summary, the 2021 LTMP indicates that:

- While the capture area is reduced (due to prior optimization efforts and iron fouling), TCOC concentrations at monitoring and pumping wells near the river continue to trend downward, thereby indicating that the reduced area of capture is not adversely impacting the remedy.
- In addition, sampling in Toms River continues to show the river to be free of significant site-related contamination. There were no detections in 2021.

- The VOC plume has been reduced in size (magnitude and dimension) over time. The area covered by the plume core, as defined by the extent of the 1,000-ppb isoconcentration line, has decreased by approximately 70 percent and 30 percent in PCOH and LCOH, respectively, as compared to the original size in the pre-GERS period (between mid-1990s and the 2021 monitoring year). The overall plume size (the 10-ppb area) has also decreased. Throughout the plume, both near the sources and especially away from the sources, the predominant concentration trends in the monitoring wells are either decreasing or are stable at levels lower than in the pre-GERS period.
- In the southern plume, a likely migration of a slug of high concentration groundwater is superimposed on that pattern. This is attributed to the release of mass during the excavation that occurred in the early 2000s as part of the OU2 source remediation.

In December 2021, BASF submitted an Optimization Report for the GERS that includes installation of new GERS wells in the key areas of the plume to increase TCOC mass recovery and accelerate aquifer restoration. The plan includes increased groundwater extraction in the EQ Basins via the installation of four additional PCOH extraction wells with two located in each of the two EQ Basins. In addition, one LCOH extraction well will be installed downgradient of the EQ Basins. The optimization plan also includes increased groundwater extraction in the southern plume area. Three extraction wells would be installed along the southern property boundary due to elevations in well RI-04D which is located near the plume boundary. As part of the OU2 optimization of the GERS, a work plan to investigate the EQ Basins and southern plume via membrane interface probe/ hydraulic profiling tool (MIP/HPT) technologies to conduct high-resolution delineation of soil and groundwater VOC impacts and characterize aquifer properties was submitted in November 2022. Based on these results, it is expected that five monitoring wells will be installed in the EQ Basins and four in the southern plume. The work plan is under EPA review.

Located on the Ciba Geigy Site, but not a part of the Superfund site, are 3 NJDEP-regulated industrial waste landfills, known as Cells 1, 2 and 3, where the groundwater and leachate are monitored semi-annually. In December 2020, NJDEP issued a Major Modification to the permit for monitoring NJDEP's on-site regulated landfills that added a perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid and perfluorononanoic acid requirement. One well, located to the south of Cell 1 had PFOA detected above NDEP's Groundwater Quality Criteria of 14 ng/L three different times at 18, 20 and 23 ng/L. BASF is conducting a remedial investigation, with NJDEP oversight, to determine the horizontal and vertical extent of the PFOA impacts in groundwater.

Based on these results, EPA requested BASF initiate a PFOA investigation at the entire site, beginning with influent to the GTS.

Site Inspection

The inspection of the Site was conducted on 10/20/2022. In attendance in person from EPA were Diane Salkie, RPM, David Edgerton, hydrogeologist. In attendance virtually from EPA were Jeff Josephson, acting Branch Chief, Frances Zizila, attorney, Marian Olsen, human health risk assessor and Michael Clemetson, ecological risk assessor. Representing BASF were Steve Havlik and Laura McMahon in person and Karyllan Mack and Doug Reid-Green virtually. Jeff Caputi, Scott Nelson and Peter Randazzo of Brown and Caldwell attended in person as well. The purpose of the inspection was to assess the protectiveness of the remedy.

BASF and Brown and Caldwell provided a presentation consisting of background information as well as progress and changes made since the last FYR. This included GERS and optimization updates, including topics concerning the EQ Basins, southern plume and FSD elevated groundwater levels. Deed notice status was also discussed. Following the presentation, some members accompanied the EPA personnel on a site tour, visiting the GTS, capped areas, recharge basins, solar fields and groundwater wells. There were no issues found during the inspections.

V. TECHNICAL ASSESSMENT

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

Analysis of data over the past five years indicates 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. Fencing around the Site and the continuous security activities that are in place interrupt exposures to potential trespassers. The effectiveness of the extraction, treatment and recharge system is continually monitored through groundwater, river and effluent sampling. Optimization of the GTS occurred in 2014 and continues to meet discharge requirements. An additional optimization to the number of GERS wells was initiated in 2016 resulting in discontinuation of unnecessary extraction wells. Future monitoring will assess the effect of this action on the plume. NJDEP approved a CEA restricting the installation of new drinking water wells into the Cohansey and Kirkwood aquifers in the vicinity of the Site.

Remedial Action Performance

According to the 2021 LTMP report, the VOC plume has been reduced in size over time, especially in those areas farther away from the source areas. Based on model output, the performance of the GERS over the 2021 operational year has led to a capture envelope that has reduced in size relative to the design or target envelope. However, throughout the plume, both near the sources and especially away from the sources, the predominant concentration trends in the monitoring wells are either decreasing or are stable at levels lower than prior to the GERS. Therefore, the site is making progress toward meeting the objectives of mitigation of the effects of groundwater contamination on public health and the environment and restoration of the upper sand aquifer to drinking water standards through optimizing the groundwater extraction from the remaining source areas.

The OU2 source area remedy was completed in 2010 for all sources except the saturated zone at the EQ Basins. The EQ Basins were further delineated to define the nature and extent of contamination, define groundwater flow behavior and update the conceptual site model. The sampling delineated sources in the groundwater and BASF is currently assessing options for optimization of the remedy, as included in the OU2 ROD.

Changes in distribution and magnitude of the dissolved-phase impacts are expected to occur as a result of OU2 implementation and are currently being further investigated.

System Operations/O&M

Analysis of groundwater system monitoring data indicates the groundwater remedy is functioning as designed in order to treat extracted water to the more stringent of the federal and/or state MCLs as specified in the 1993 ESD.

In 2014, BASF upgraded the GTS system from the former wastewater treatment plant to a new, self-contained air stripping and LGAC adsorption system. The update resulted in a more efficient water treatment system with the same end result of meeting discharge permit requirements.

The OU2 remedy addressing soil contamination was completed in 2012. This remedy addressed exposure to soils through caps to prevent direct contact exposure and prevent contamination 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.

Implementation of Institutional Controls and Other Measures

A CEA has been established to prevent direct exposure through the use of groundwater as a drinking water source. Consistent with the OU2 ROD, appropriate deed restrictions and ICs will be put in place and maintained to protect human health from direct exposure to soils based on potential future 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 (ARARs), and there are no new standards which would affect the protectiveness of the remedy.

Changes in Standards and TBCs

Table 5 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 micrograms per liter (µg/L). The MCL of 50 µg/L was subsequently updated in 2001 to 10 µg/l. Additionally, the ESD revised the effluent standard to 8 µg/L. However, due to the GERS treatment and slurry walls, the plume is contained, and the most recent effluent arsenic result reported in the fourth quarter of 2022 was undetected at a detection level of 2.0 µg/L.

Changes in Toxicity and Other Contaminant Characteristics

The following chemicals continue to be re-evaluated through the Integrated Risk Information System (IRIS): inorganic arsenic, chromium VI, and vanadium and compounds. The toxicity data and cleanup levels for these chemicals will need to be re-evaluated when the IRIS chemicals are updated and finalized. Although the risk values 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.

Changes in Exposure Pathways

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 and associated guidance used by the Agency remain valid. During the Site RI, EPA

determined that 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. In 2014, EPA's Superfund program updated exposure assumptions (OSWER directive 9285.6-03). These updates do not change the conclusions of the risk assessment or the cleanup goals.

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 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.

Although the ecological risk assessment screening values used to support the OU1 and OU2 RODs may not necessarily reflect the current methodology, the remedy remains protective of ecological receptors as the contaminated soil has been addressed by the remedy. Additionally, based on the monitoring the Toms River does not appear to be adversely impacted by the Site.

The RAOs for the site remain valid.

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.

VI. ISSUES/RECOMMENDATIONS

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): OU2	**Issue Category:** Institutional Controls			
	Issue: Deed restrictions have not been completed			
	Recommendation: BASF, NJDEP and the Township of Toms River need to complete the deed restrictions			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Party Responsible**	**Oversight Party**	**Milestone Date**
No	Yes	PRP	EPA	2023

Other Findings:

As part of the OU2 ROD, optimization of the OU1 remedy is continuing. This consists of optimization of the GERS which includes investigating the EQ Basins and the southern groundwater plume and

installation of additional recovery wells and EQ Basins NAPL recovery wells. EPA will continue to track the progress of these investigations and oversee installation of the optimization recovery wells over the next five years.

VII. PROTECTIVENESS STATEMENT

Protectiveness Statement(s)	
Operable Unit: 01	*Protectiveness Determination:* Protective
Protectiveness Statement: The OU1 groundwater remedy is protective of human health and the environment.	
Operable Unit: 02	*Protectiveness Determination:* Short-term Protective
Protectiveness Statement: 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.	

Sitewide Protectiveness Statement
Protectiveness Determination: Short-term Protective
Protectiveness Statement: The remedies for the Ciba-Geigy Chemical Corporation Superfund Site are protective of human health and the environment in the short-term. In order for the remedies to be protective in the long term, deed restrictions need to be established.

VIII. NEXT REVIEW

The next FYR report for the Ciba-Geigy Chemical Corporation Superfund Site is required five years from the completion date of this review.

APPENDIX A – REFERENCE LIST

- Brown and Caldwell. May 2019. *2018 Annual Report for OU1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU2 LTMP Ciba-Geigy Toms River Site Toms River, New Jersey.*
- Brown and Caldwell. July 2020. *2019 Annual Report for OU1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU2 LTMP Ciba-Geigy Toms River Site Toms River, New Jersey.*
- Brown and Caldwell. July 2021. *2020 Annual Report for OU1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU2 LTMP Ciba-Geigy Toms River Site Toms River, New Jersey.*
- Brown and Caldwell. August 2022. *2021 Annual Report for OU1 Long-Term Monitoring Plan (LTMP) and Groundwater Portion of OU2 LTMP Ciba-Geigy Toms River Site Toms River, New Jersey.*
- Brown and Caldwell. December 2021. *Draft Southern Plume Investigation Workplan Ciba-Geigy Toms River Site Toms River, New Jersey.*
- Brown and Caldwell. May 2022. *Optimization Report for the Groundwater Extraction and Recharge System Ciba-Geigy Toms River Site Toms River, New Jersey.*
- BASF. June 2018 – June 2022. *Operable Unit 1 Operations, Maintenance and Monitoring and Remedial Process Optimization Progress Report*

APPENDIX B – ADDITIONAL TABLES

TABLE 4 – 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 5 Groundwater Remediation Levels Compared with Residential Risk-Based Concentrations				
Chemical	Cleanup standard (ppb)	Concentration with Risk Level of 10-6 (ppb)	Concentration with noncancer Hazard Quotient (HQ) = 1 (ppb)	Conclusion
Arsenic	50 (new standard is 10 ppb as of 2001)	0.052	6	MCL (50 ppb) is in upper bound or risk range but exceeds an HI = 1. MCL (10 ppb) is within the risk range but exceeds the non-cancer HQ = 1.
Benzene	1	0.46	33	MCL within the risk range and non-cancer HQ = 1.
Cadmium	5.0	None	9.2	Below HQ = 1.
Chlorobenzene	4.0	None	78	Below HQ = 1.
Chloroform	NA	0.22	97	No cleanup level in ROD for comparison.
1,2-dichloroethane	2.0	0.17	13	Level within the risk range and below HQ = 1.
Nickel	NA	None	390 (based on soluble salts)	No cleanup level in ROD for comparison.
Tetrachloroethylene	1.0	11	41	Below risk range and HQ = 1
1,2,4-trichlorobenzene	NA	1.2	4.1	No cleanup level in ROD for comparison.
Trichloroethylene	1.0	0.49	2.8	Within risk range and below HQ = 1.

TABLE 6 - SITE-WIDE MONITORING PROGRAM - ANALYTICAL PARAMETERS

Organics (µg/L)	MDL	Organics (µg/L)	MDL	Organics (µg/L)	MDL	Organics (µg/L)	MDL
1,1,1,2-Tetrachloroethane	0.3	1,3-Dichlorobenzene	0.3	Dichlorobromomethane	0.2	N-Propylbenzene	0.3
1,1,1-Trichloroethane	0.3	1,3-Dichloropropane	0.3	Dichlorodifluoromethane	0.2	O-Xylene	0.4
1,1,2,2-Tetrachloroethane	0.3	1,3-Trans-Dichloropropylene	0.2	Diethyl Ether	0.2	P-Chlorotoluene	0.3
1,1,2-Trichloroethane	0.3	1,4-Dichlorobenzene	0.3	Ethyl Methacrylate	0.3	Pentachloroethane	0.2
1,1-Dichloroethane	0.3	2,2-Dichloropropane	0.3	Ethylbenzene	0.4	P-Isopropyltoluene	0.3
1,1-Dichloroethylene	0.3	2-Chlorotoluene	0.3	Hexachlorobutadiene	2	Sec-Butylbenzene	0.3
1,1-Dichloropropylene	0.3	2-Hexanone	0.4	Isopropylbenzene	0.2	Styrene	0.3
1,2,3-Trichlorobenzene	0.4	3-Chloropropene	0.3	M+P-Xylene	2	Tert-Butylbenzene	0.3
1,2,3-Trichloropropane	0.3	Acetone	0.7	Methacrylonitrile	6	Tetrachloroethylene	0.3
1,2,4-Trichlorobenzene	0.3	Acrylonitrile	0.3	Methyl Bromide	0.3	Tetrahydrofuran	0.7
1,2,4-Trimethylbenzene	1	Benzene	0.3	Methyl Chloride	0.2	Toluene	0.2
1,2-Cis-Dichloroethylene	0.3	Bromobenzene	0.3	Methyl Ethyl Ketone	0.5	Trans-1,4-Dichloro-2-Butene	6
1,2-Dibromo-3-Chloropropane	0.3	Bromochloromethane	0.2	Methyl Iodide	0.3	Trichloroethylene	0.3
1,2-Dibromoethane	0.2	Bromoform	1	Methyl Isobutyl Ketone	0.5	Trichlorofluoromethane	0.2
1,2-Dichlorobenzene	0.2	Carbon Disulfide	0.3	Methyl Methacrylate	0.3	Vinyl Chloride	0.2
1,2-Dichloroethane	0.3	Carbon Tetrachloride	0.3	Methylene Bromide	0.3		
1,2-Dichloropropane	0.3	Chlorobenzene	0.3	Methylene Chloride	0.3		
1,2-Trans-Dichloroethylene	0.3	Chlorodibromomethane	0.2	Methyl-T-Butyl Ether	0.2		
1,3,5-Trimethylbenzene	0.3	Chloroethane	0.2	Naphthalene	1		
1,3-Cis-Dichloropropylene	0.2	Chloroform	0.3	N-Butylbenzene	0.3		
Inorganics (mg./L)	MDL			Other Parameters			
Arsenic	0.016			TSS (mg/L)	1		
Cadmium	0.001			TDS (mg/L)	12		
Chromium	0.0016			Nitrite (mg/L)	0.04		
Copper	0.012			Sulfate (mg/L	1.5		
Iron	0.04			Chloride (mg/L)	1		
Lead	0.0071						
Mercury	0.079						
Nickel	0.0021						
Selenium	0.016						
Zinc	0.0037						

MDL – Method Detection Limit

APPENDIX C – SITE FIGURES

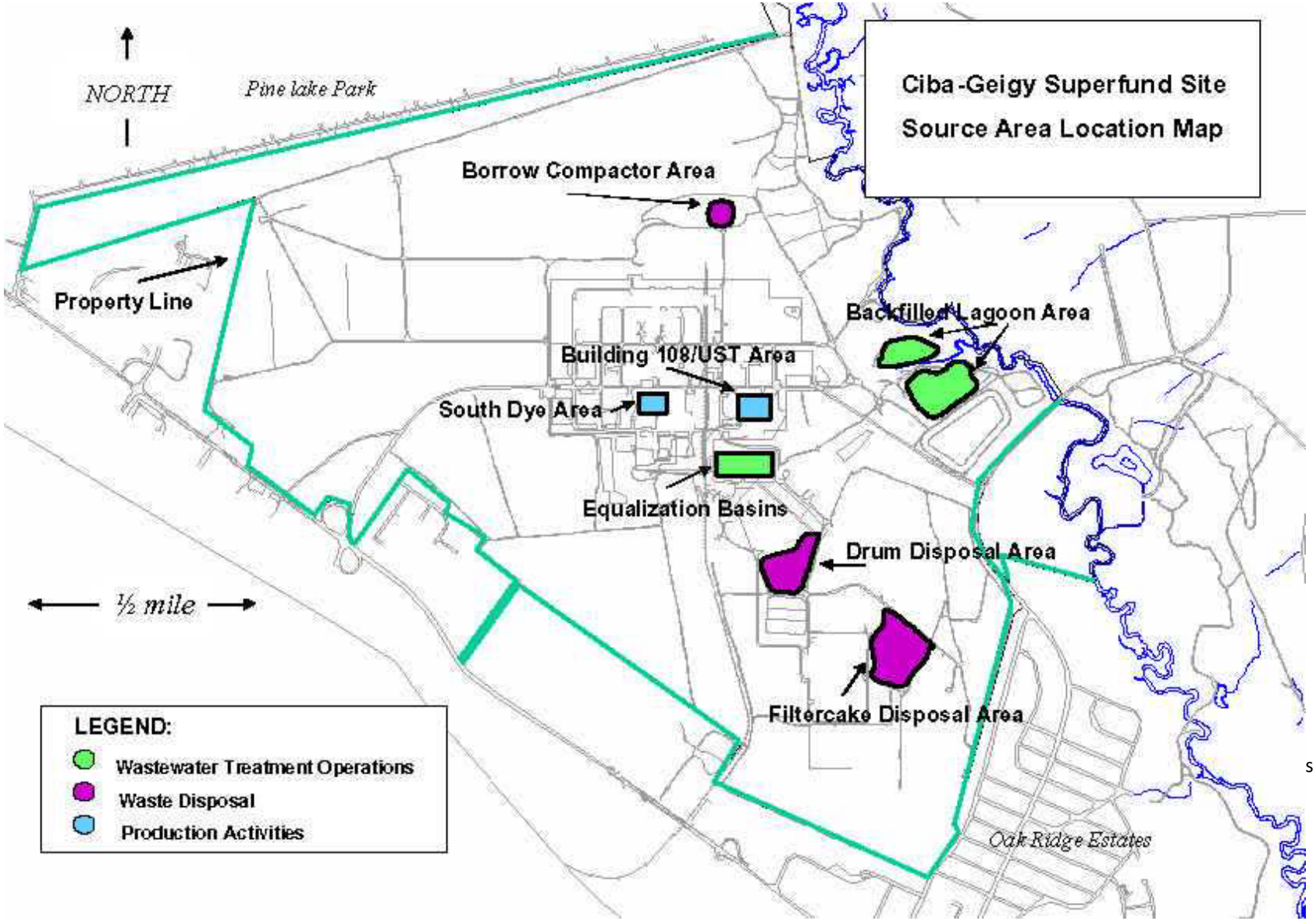


Figure 1 – OU2 Source Areas

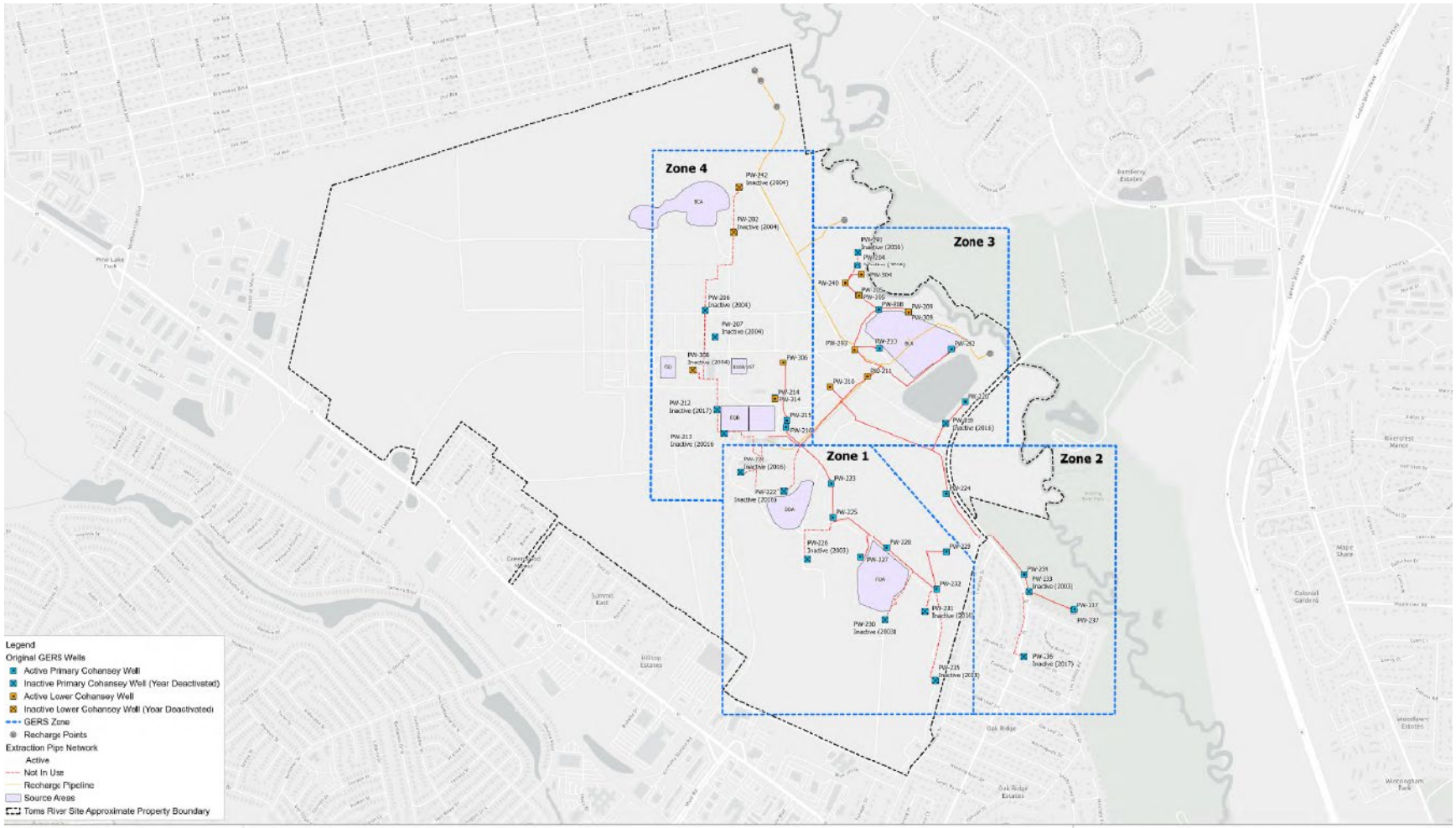


Figure 2 GERS Original Design

* from the Brown and Caldwell, 2021 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 2022

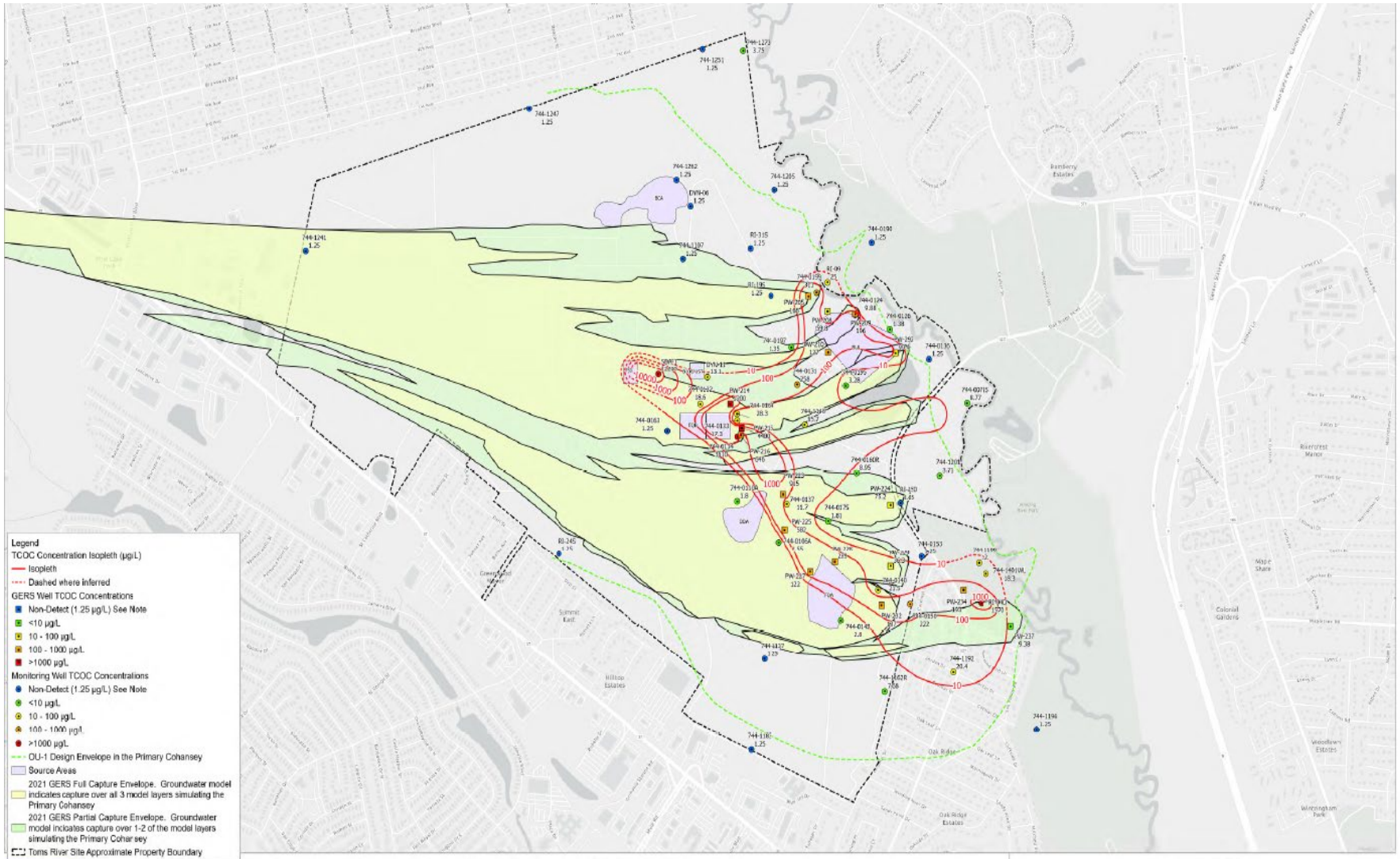
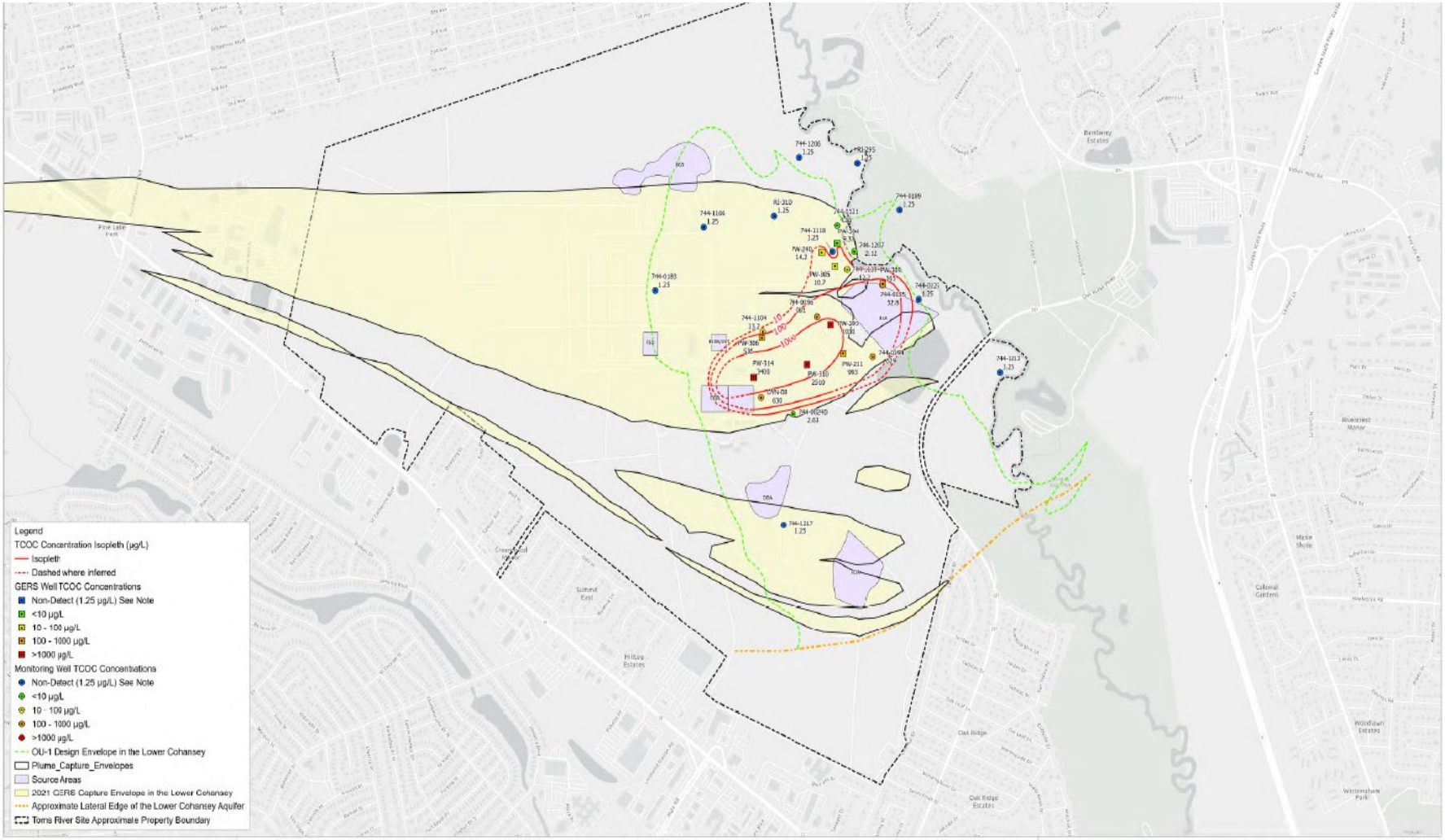


FIGURE 7-1
2021 TCOC CONCENTRATIONS AND MODELED CAPTURE IN THE PRIMARY COHANSEY MODEL LAYERS 1, 2, 3



Brown AND Caldwell

BASF - 156468

CIBA-GEIGY TOMS RIVER SITE, TOMS RIVER, NJ
2021 LTMP REPORT

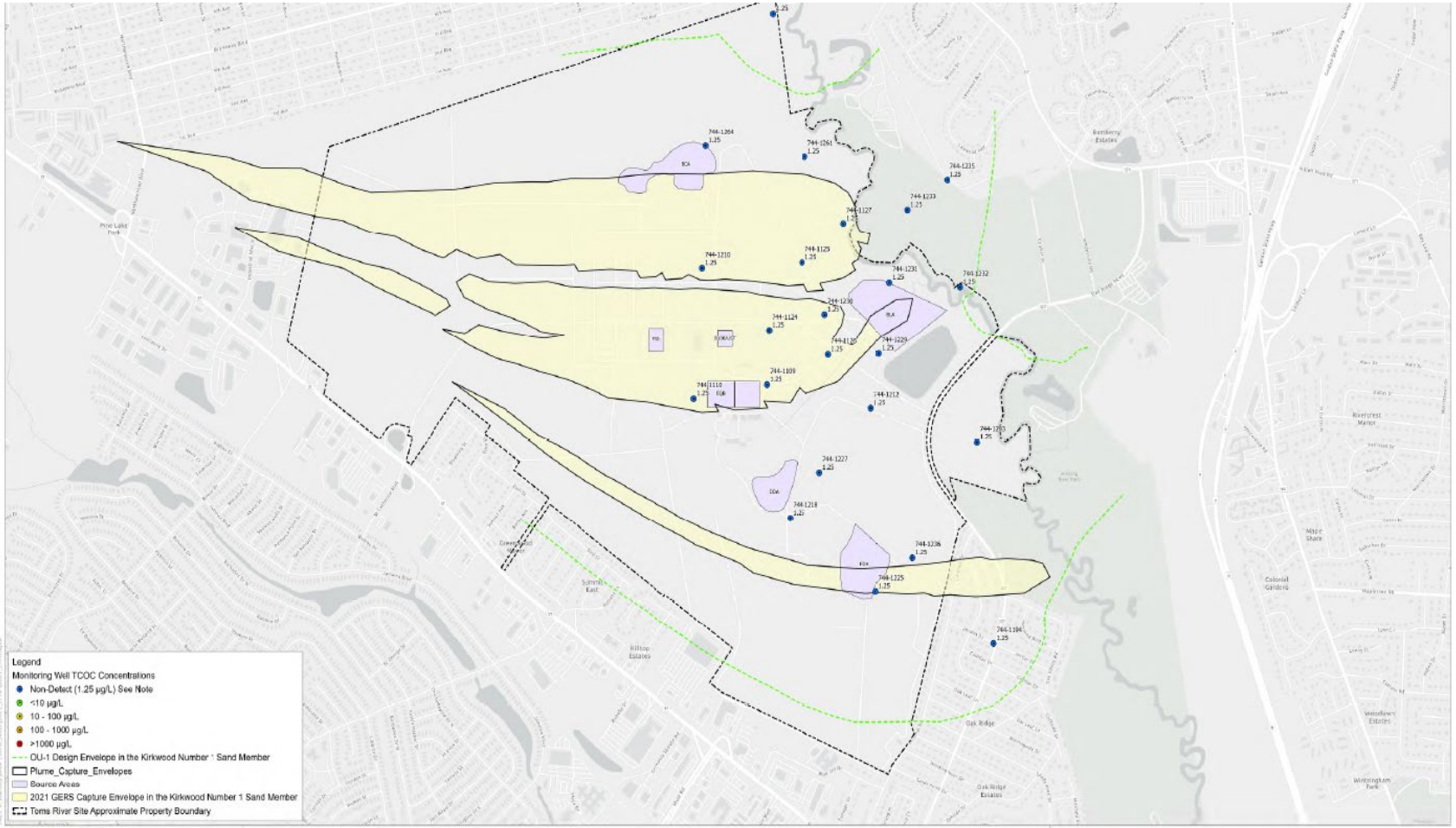
Notes: µg/L - micrograms per liter. TCOC is calculated by summing the concentration of the eight COCs. Non-detections are included at half the detection limit. A value of 1.25 is the sum of half the detection limits. This value indicates that no COCs were detected above typical detection limits.

Spatial Reference:
Name: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Drawn By: Chelsie Veal
Checked By:

Esri Community Maps Contributors, New Jersey Office of GIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA

FIGURE 7-2
2021 TCOC CONCENTRATIONS AND MODELED CAPTURE IN THE LOWER COHANSEY MODEL LAYER 5



Brown AND Caldwell

BASF 154458

CIBA-GEIGY TOMS RIVER SITE, TOMS RIVER, NJ
2021 LTMP REPORT

Notes: µg/L - micrograms per liter. TCOC is calculated by summing the concentration of the eight COCs. Non-detections are included at half the detection limit. A value of 1.25 is the sum of half the detection limits. This value indicates that no COCs were detected above typical detection limits.

Spatial Reference:
Name: NAD 1983 StatePlane New Jersey FIPS 2900 Feet

0 300 600 1,200 Feet

Esri Community Maps Contributors, New Jersey Office of GIS, © OpenStreetMap, Microsoft, Esri, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA

FIGURE 7-3
2021 TCOC CONCENTRATIONS AND MODELED CAPTURE IN THE KIRKWOOD NUMBER 1 SAND MEMBER MODEL LAYER 7

APPENDIX D- CLIMATE CHANGE TOOLS

According to the *Region 2 Guidance for Incorporating Climate Change Considerations in Five Year Reviews*, three climate change tools were utilized to assess the Ciba Geigy Superfund Site. Screenshots from each of the tools assessed are included below, a red star on the figure depicts the site.

The first tool used to assess Toms River Township was *The Climate Explorer*. According to this tool, coastal flooding may increase as global sea level rises 0.5-2 feet. Intense rainstorms in the area are projected to have a 1% decrease and a 4% increase. As can be seen from Figure D1, there is a projected increase of days per year with maximum temperatures > 100 °F. As can be seen on Figure D2 there is a slight increase in potential drought conditions. A summary of the Top Climate Concerns from the tool can be seen as Figure D3.

The second tool utilized is called the *Risk Factor*. According to the flood factor portion of the assessment tool, there are nearly 12,000 properties in Toms River that have greater than a 26% chance of being severely affected by flooding over the next 30 years which gives the Township a rating of Major. However, as can be seen from Figure D4, the Ciba Geigy Site is outside of that major flood risk area. *Risk Factor* also assesses risk from fire and shows that Toms River has a moderate fire risk over the next 30 years. 99% of all properties in Toms River have some risk of being affected by wildfire. See Figure D5. Finally, *Risk Factor* also assesses heat factor. Toms River is at severe risk from heat, see Figure D6

The final tool utilized is called *Sea Level Rise*. Once again, Toms River Township is vulnerable to sea level rise, however, the Ciba Geigy site is located farther from the Atlantic Ocean compared to other parts of the Township. Figure D7 shows the site, notated as “Toms River Cincinnati Chemical Corp”, at current conditions. For comparison, Figure D8 shows the area with a 10-foot sea level rise which shows the Township affected by the rise, however, the Site itself is unaffected. This can also be seen from Figure D9 showing flooding frequency.

Based on a review of the screening tools identified above, potential site impacts from climate change have been assessed, and the performance of the remedy is currently not at risk due to the expected effects of climate change in the region and near the site.

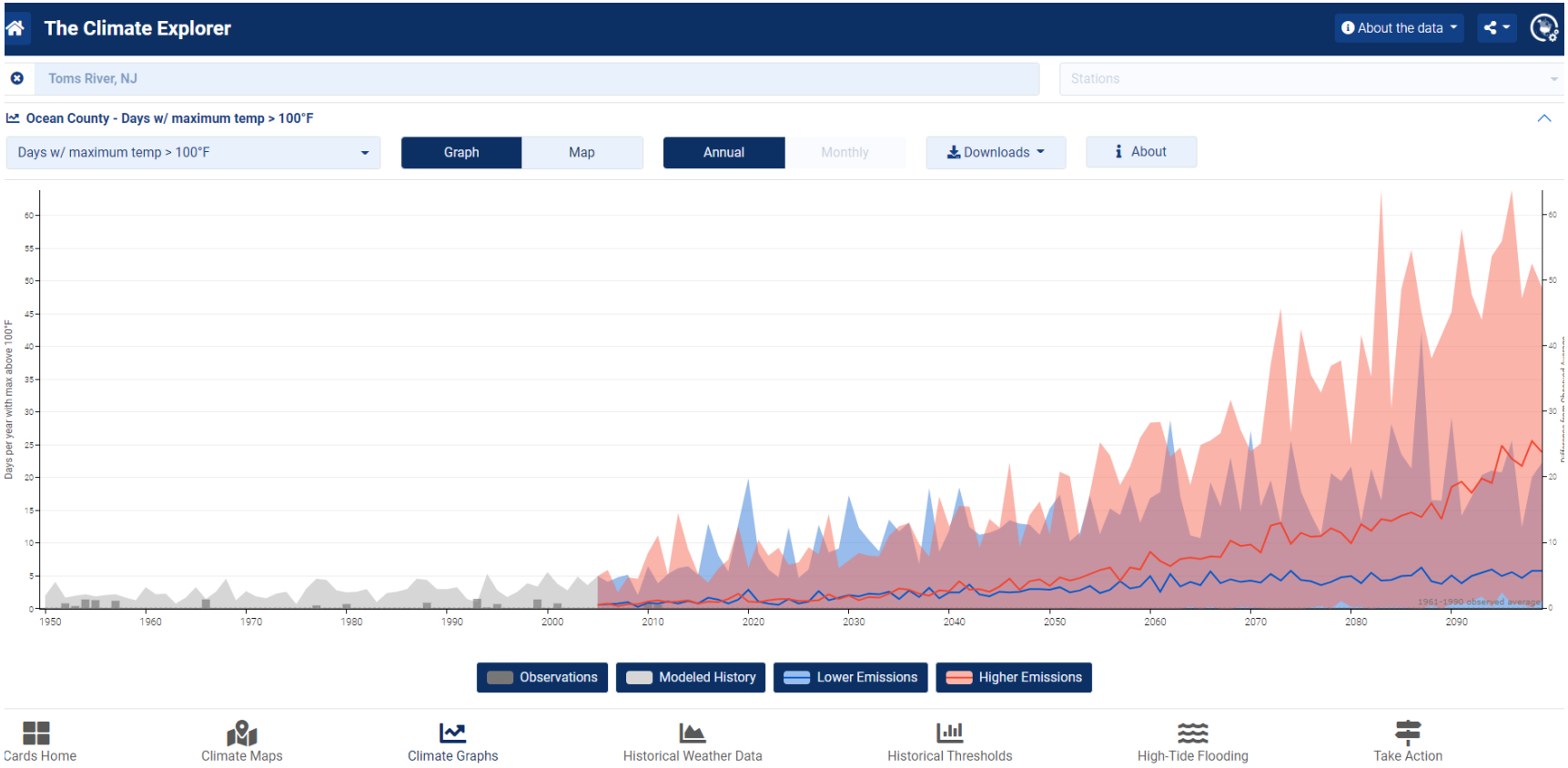

The Climate Explorer
About the data
Toms River, NJ
Stations
Ocean County - Days w/ maximum temp > 100°F
Days w/ maximum temp > 100°F
Graph
Map
Annual
Monthly
Downloads
About
Days per year with max above 100°F
1961-1990 observed average
Observations
Modeled History
Lower Emissions
Higher Emissions
Cards Home
Climate Maps
Climate Graphs
Historical Weather Data
Historical Thresholds
High-Tide Flooding
Take Action

Figure D1


The Climate Explorer
About the data
Toms River, NJ
Stations
Ocean County - Dry Days
Dry Days
Graph
Map
Annual
Monthly
Downloads
About
Dry Days (days/period)
Difference from Observed Average
1961-1990 observed average
Observations
Modeled History
Lower Emissions
Higher Emissions
Cards Home
Climate Maps
Climate Graphs
Historical Weather Data
Historical Thresholds
High-Tide Flooding
Take Action

Figure D2

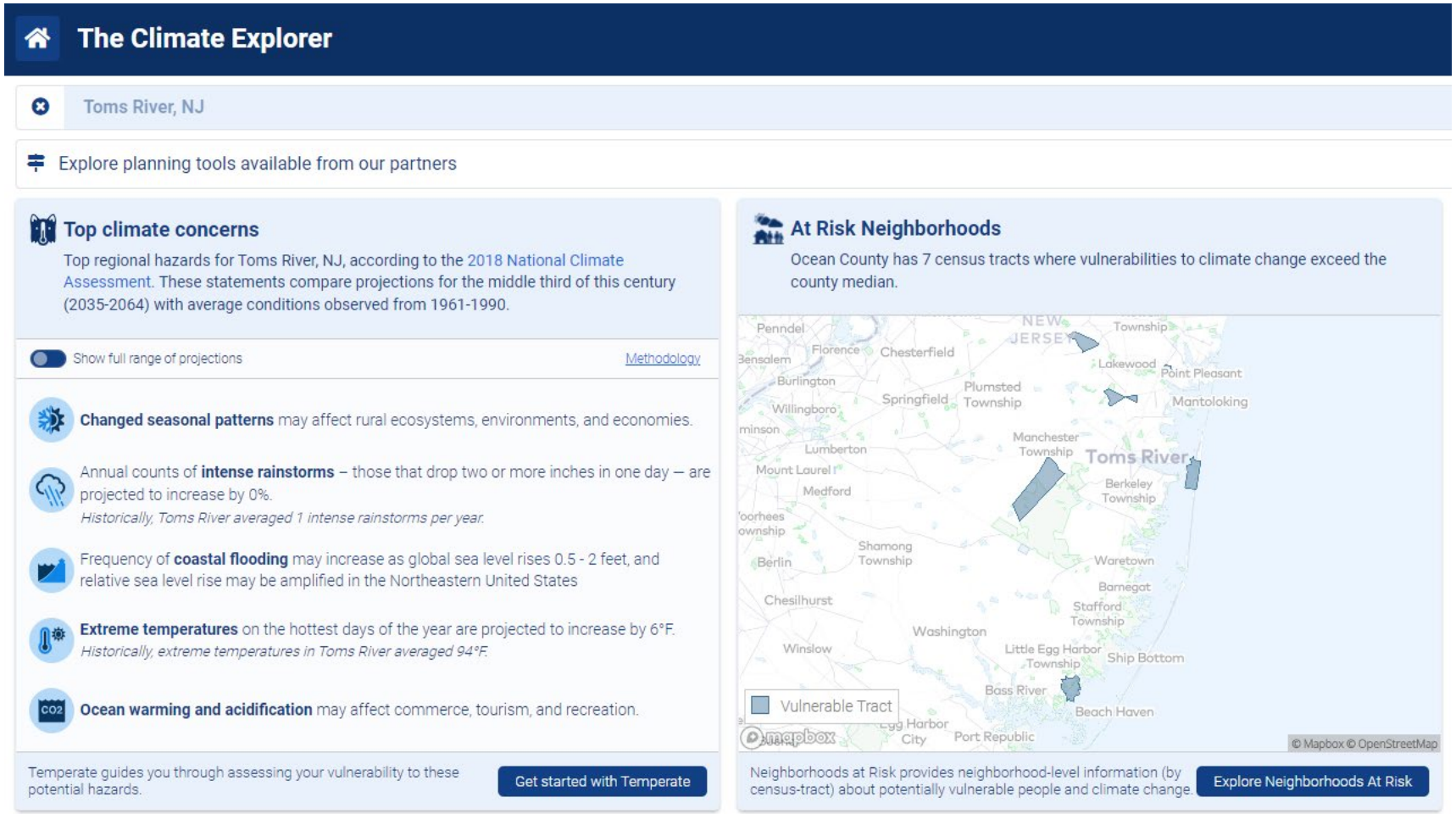

The Climate Explorer
Toms River, NJ
Explore planning tools available from our partners
Top climate concerns
Top regional hazards for Toms River, NJ, according to the 2018 National Climate Assessment. These statements compare projections for the middle third of this century (2035-2064) with average conditions observed from 1961-1990.
Show full range of projections
Methodology
Changed seasonal patterns may affect rural ecosystems, environments, and economies.
Annual counts of intense rainstorms – those that drop two or more inches in one day — are projected to increase by 0%.
Historically, Toms River averaged 1 intense rainstorms per year.
Frequency of coastal flooding may increase as global sea level rises 0.5 - 2 feet, and relative sea level rise may be amplified in the Northeastern United States
Extreme temperatures on the hottest days of the year are projected to increase by 6°F.
Historically, extreme temperatures in Toms River averaged 94°F.
Ocean warming and acidification may affect commerce, tourism, and recreation.
Temperate guides you through assessing your vulnerability to these potential hazards.
Get started with Temperate
At Risk Neighborhoods
Ocean County has 7 census tracts where vulnerabilities to climate change exceed the county median.
Penndel
Florence
Chesterfield
Burlington
Willingboro
Springfield
Plumsted Township
Lakewood
Point Pleasant
Mantoloking
Lumberton
Mount Laurel
Medford
Manchester Township
Toms River
Berkeley Township
Shamong Township
Berlin
Waretown
Barnegat
Chesilhurst
Stafford Township
Washington
Winslow
Little Egg Harbor Township
Ship Bottom
Bass River
Beach Haven
Egg Harbor City
Port Republic
Vulnerable Tract
© Mapbox © OpenStreetMap
Neighborhoods at Risk provides neighborhood-level information (by census-tract) about potentially vulnerable people and climate change.
Explore Neighborhoods At Risk

Figure D3

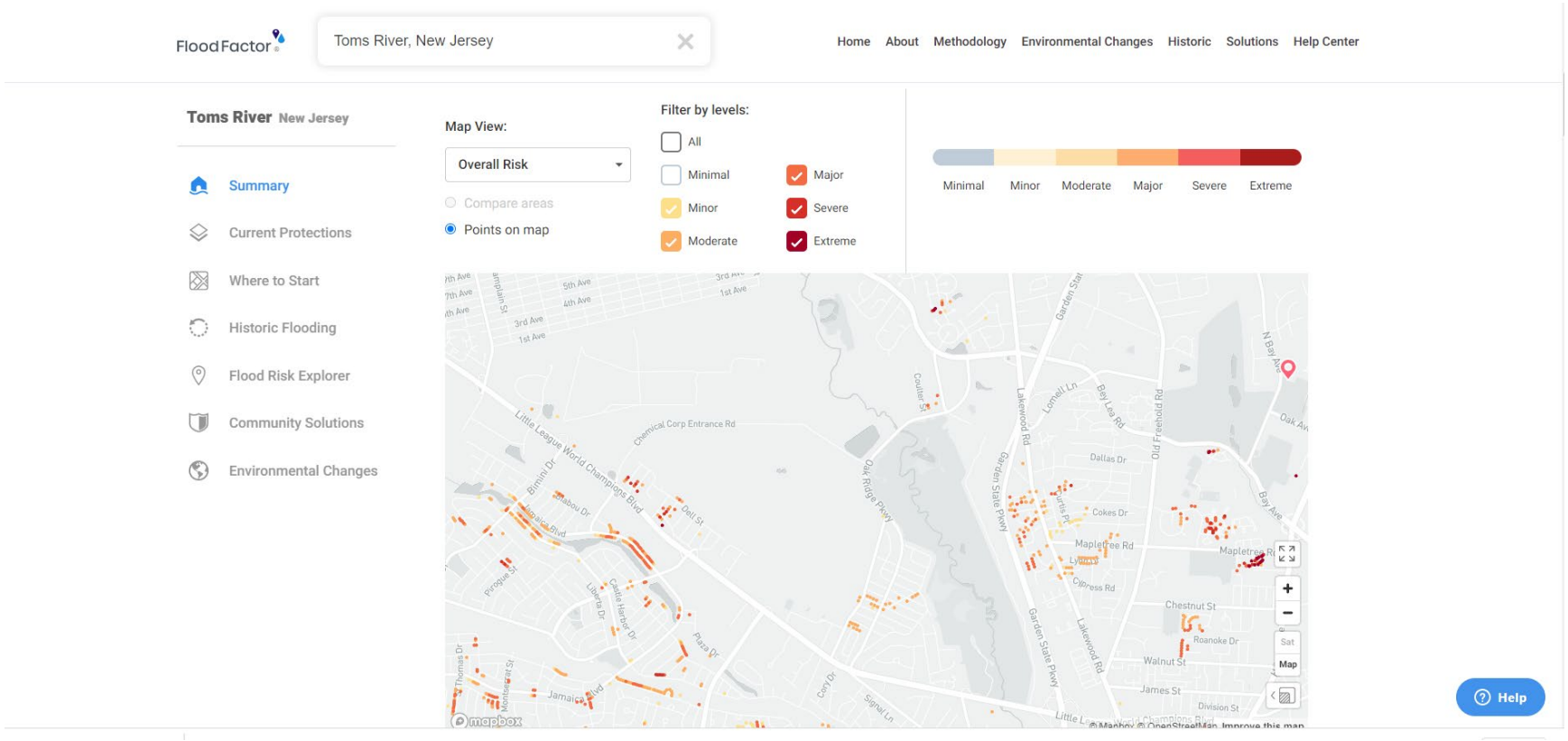

FloodFactor
Toms River, New Jersey
Home
About
Methodology
Environmental Changes
Historic
Solutions
Help Center
Toms River New Jersey
Summary
Current Protections
Where to Start
Historic Flooding
Flood Risk Explorer
Community Solutions
Environmental Changes
Map View:
Overall Risk
Compare areas
Points on map
Filter by levels:
All
Minimal
Minor
Moderate
Major
Severe
Extreme
Minimal
Minor
Moderate
Major
Severe
Extreme
Help

Figure D4

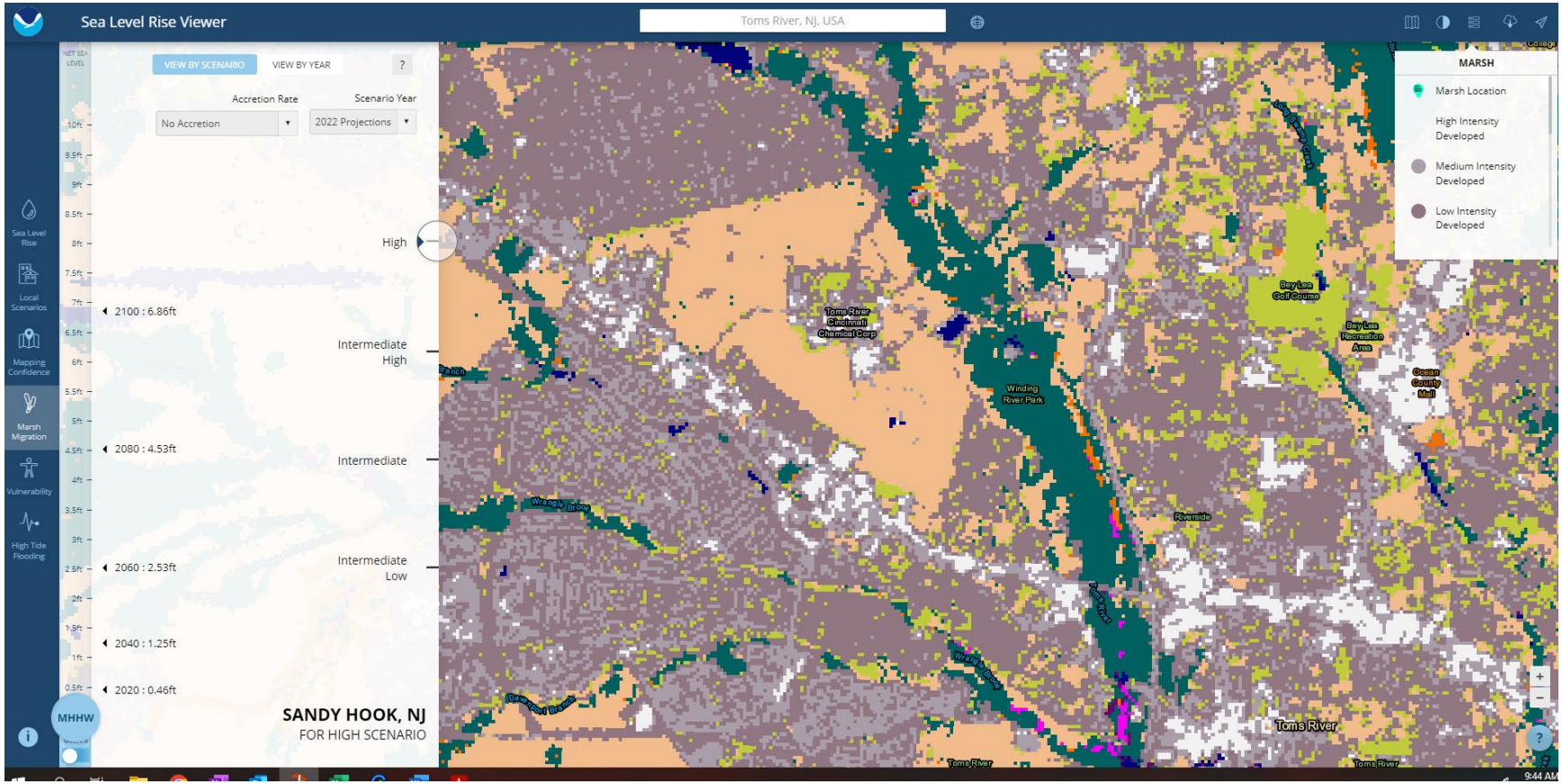

Sea Level Rise Viewer
Toms River, NJ, USA
VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
No Accretion
Scenario Year
2022 Projections
High
2100 : 6.86ft
Intermediate High
2080 : 4.53ft
Intermediate
2060 : 2.53ft
Intermediate Low
2040 : 1.25ft
2020 : 0.46ft
MHHW
SANDY HOOK, NJ
FOR HIGH SCENARIO
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
MARSH
Marsh Location
High Intensity Developed
Medium Intensity Developed
Low Intensity Developed
Toms River Chemical Corp
Bay Lea Golf Course
Bay Lea Recreation Area
Winding River Park
Riverside
Toms River
9:44 AM

Figure D5

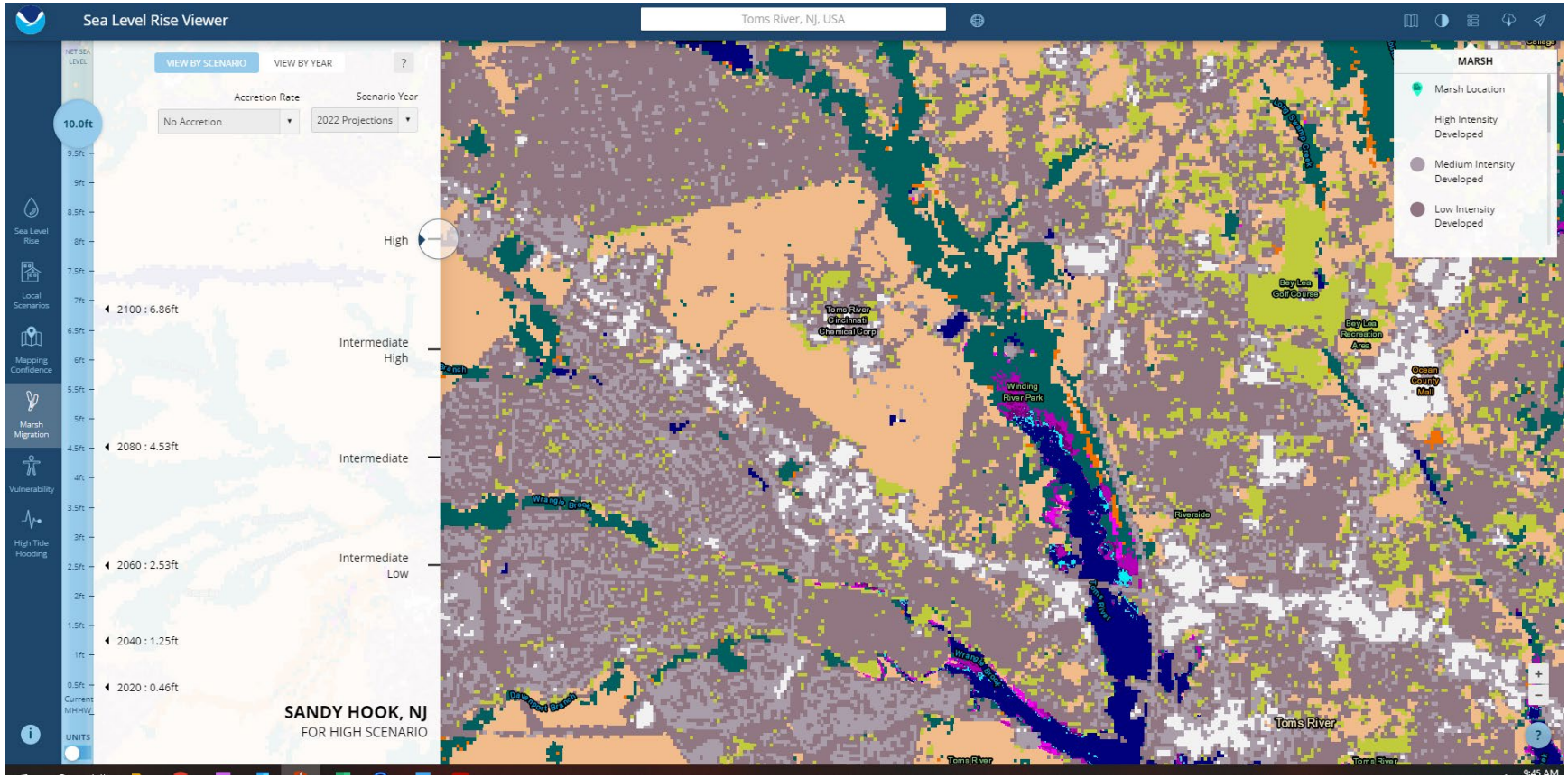

Sea Level Rise Viewer
Toms River, NJ, USA
VIEW BY SCENARIO
VIEW BY YEAR
Accretion Rate
No Accretion
Scenario Year
2022 Projections
10.0ft
High
2100 : 6.86ft
Intermediate High
2080 : 4.53ft
Intermediate
2060 : 2.53ft
Intermediate Low
2040 : 1.25ft
2020 : 0.46ft
SANDY HOOK, NJ
FOR HIGH SCENARIO
MARSH
Marsh Location
High Intensity Developed
Medium Intensity Developed
Low Intensity Developed
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
Toms River Chemical Corp
Bay Leo Golf Course
Bay Leo Recreation Area
Ocean County Mall
Winding River Park
Riverside
Toms River

Figure D6

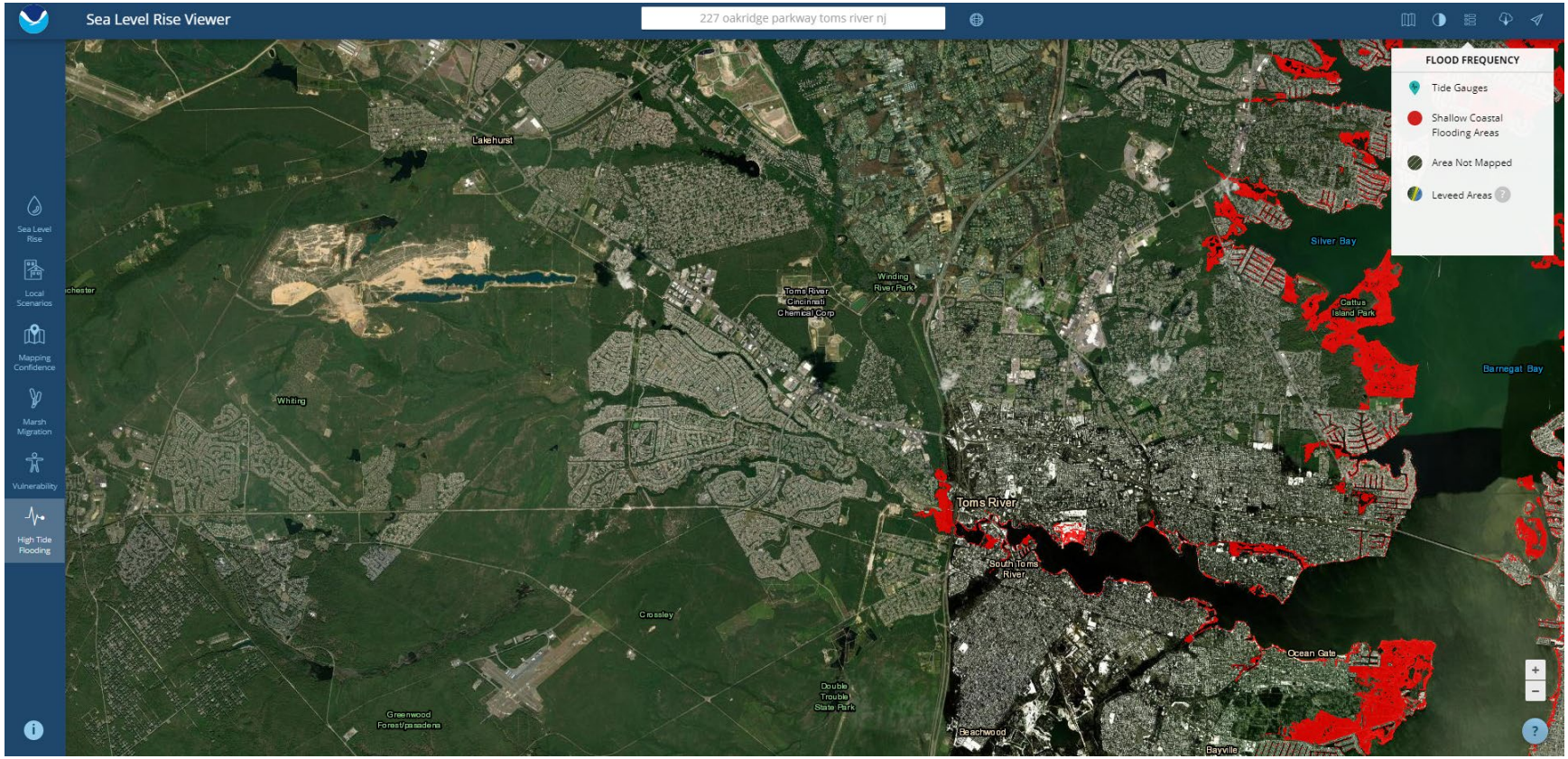

Sea Level Rise Viewer
227 oakridge parkway toms river nj
FLOOD FREQUENCY
Tide Gauges
Shallow Coastal Flooding Areas
Area Not Mapped
Leveed Areas
Sea Level Rise
Local Scenarios
Mapping Confidence
Marsh Migration
Vulnerability
High Tide Flooding
Lakehurst
Whiting
Crossley
Greenwood Forest/pasadena
Toms River Cincinnati Chemical Corp
Winding River Park
Silver Bay
Cattus Island Park
Barnegat Bay
Toms River
South Toms River
Ocean Gate
Double Trouble State Park
Beachwood
Bayville

Figure D7