RemPlex 2025 Summit - Technical Session - PFAS Progress

"Natural Resource Damages Restoration for Resiliency, Habitat, Replacement Resources and Restoration Project Valuation for a PFAS Air Emissions Impacted Watershed"

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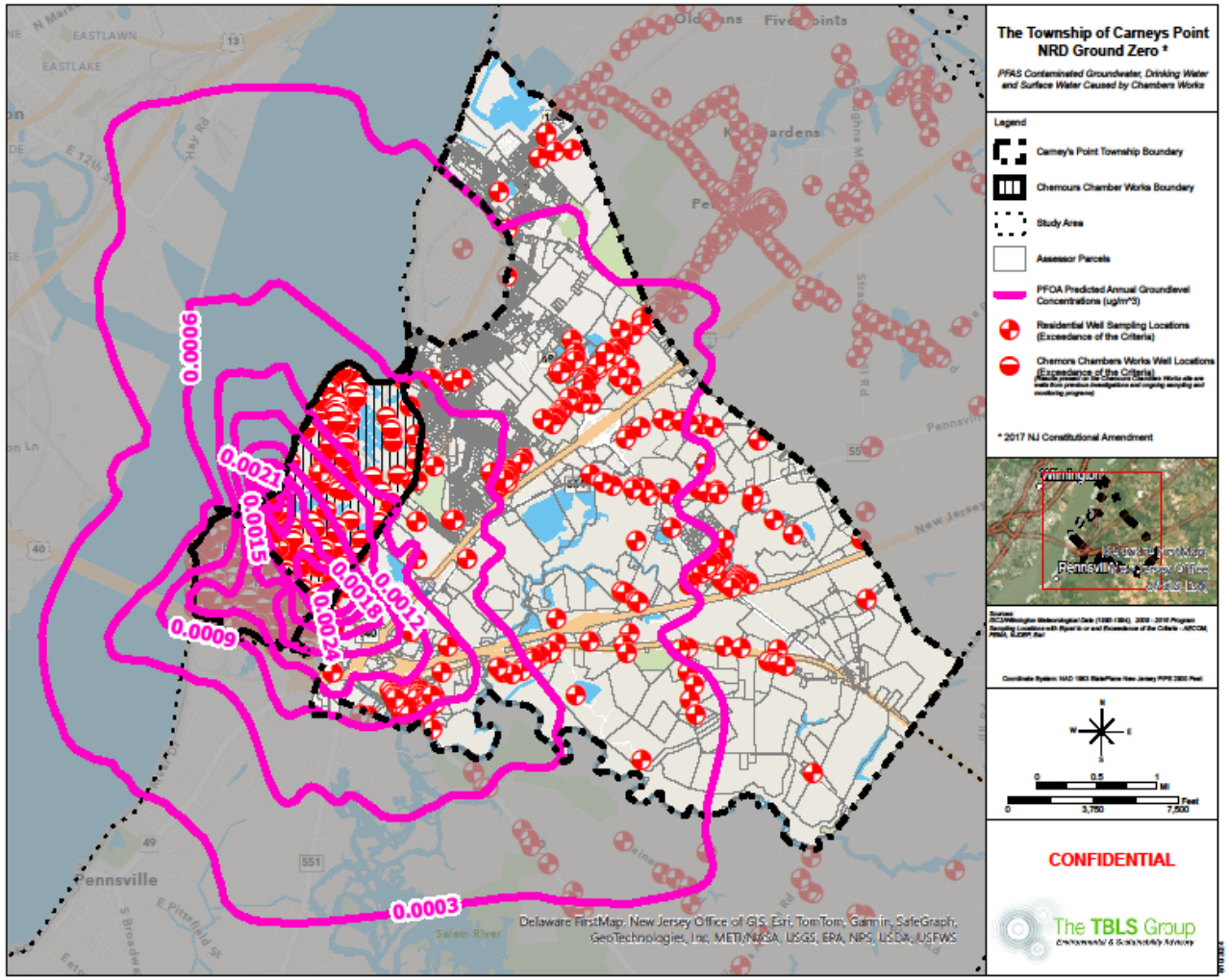
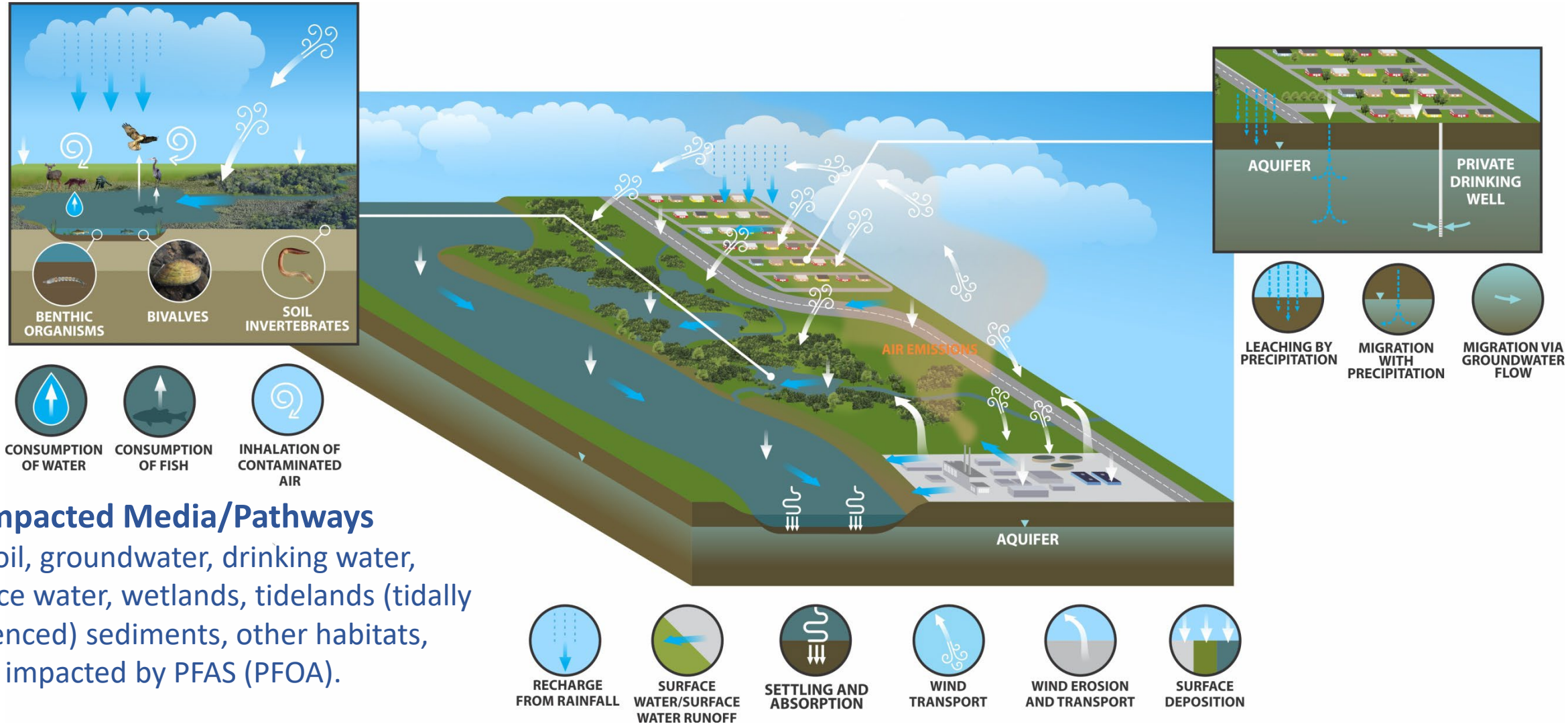
Widespread NRD Impacts to “nexus to injury” Township of Carneys Point

- **State NRD Trustee files in 2019, 2021 NRD (& ISRA/RFS) Lawsuit for PFAS. Carneys Point named nexus to injury community in lawsuits. Carneys Point also a plaintiff (from 2016 to present)**
- Hundreds of wells (red dots) impacted above State/Federal PFAS levels for at least **200 square miles** Area of Concern Study Area (AOC) established by Chemours. Pink contours are from 2009 air emissions dispersion modeling done by NJDEP via stack testing and mimic 2002 done by DuPont. Impacts are agreed to in AECOM CSM for PFAS, 2017.
- EJ Community in State Brownfield Economic Redevelopment Zone
- 11,000 acres in Carneys Point Township injured, >750 residential wells tested, > 250 POET systems deployed since 2015
- All waterbodies and associated fringe wetlands of Delaware River, Salem River, Whooping John Creek, Boutton Creek, ponds, and lakes affected by PFAS.
- At least two National Wildlife and/or State Wildlife protected areas impacted today.
- All infrastructure likely affected (WWTP, Water systems, Sewer, Storm sewer, city parks, roads, by 70 years (1938-2018) of PFOA emissions
- Flooding in Town due to sea/river level rise, and drainage issues at RCRA site and River diversions washes PFAS chemical in surface water back and forth in Carneys Point. All surface water initially drained through Chambers Works. Changes to hydrology at plant progressively has caused flooding in Town over time

**average elevation of Carneys Point = 3 feet, i.e.. flood prone.*



Carneys Point Natural Resource Damages Injury Conceptual Site Model



10 Impacted Media/Pathways

Air, soil, groundwater, drinking water, surface water, wetlands, tidelands (tidally influenced) sediments, other habitats, biota impacted by PFAS (PFOA).

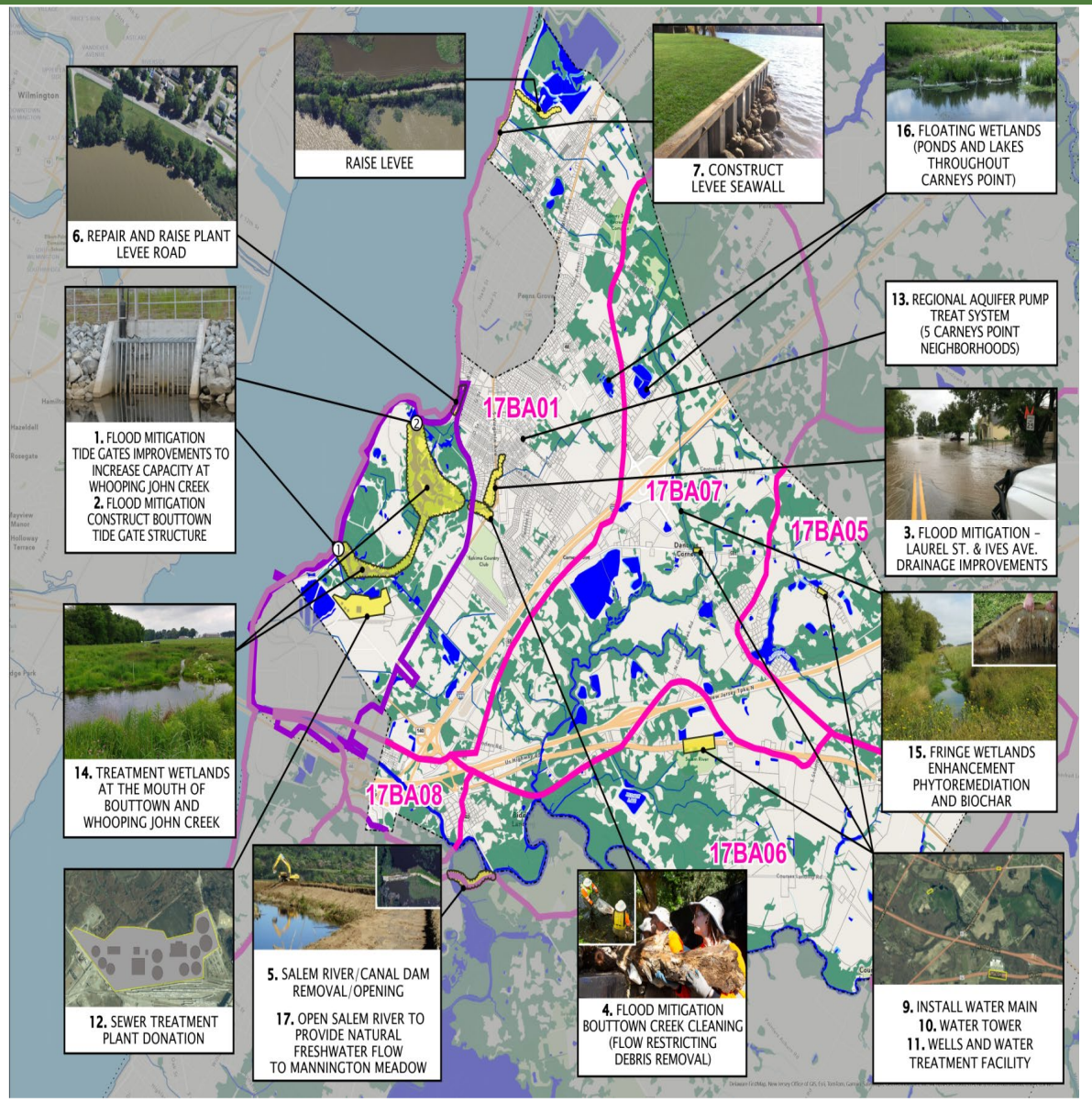
Restoring the Watershed - A Natural Resource Damage Restoration and Ecological Restoration within a NJ Designated Brownfield Economic Enterprise Zone

18 Projects that Integrate with NJ designated Brownfield Enterprise Economic Zone

Addresses Sea Level Rise, Increased Rainfall due to climate change, Flood Control and Critical Infrastructure providing PFAS Sequestration, PFAS Treatment Wetlands Resource Replacement and Return of Base Flow to the River, **without flooding Town/Exposing population to PFAS**

Stops/Treats PFAS mobilization in urban creek/Salem River system

... that enhances economic development needs but does not affect buildable space



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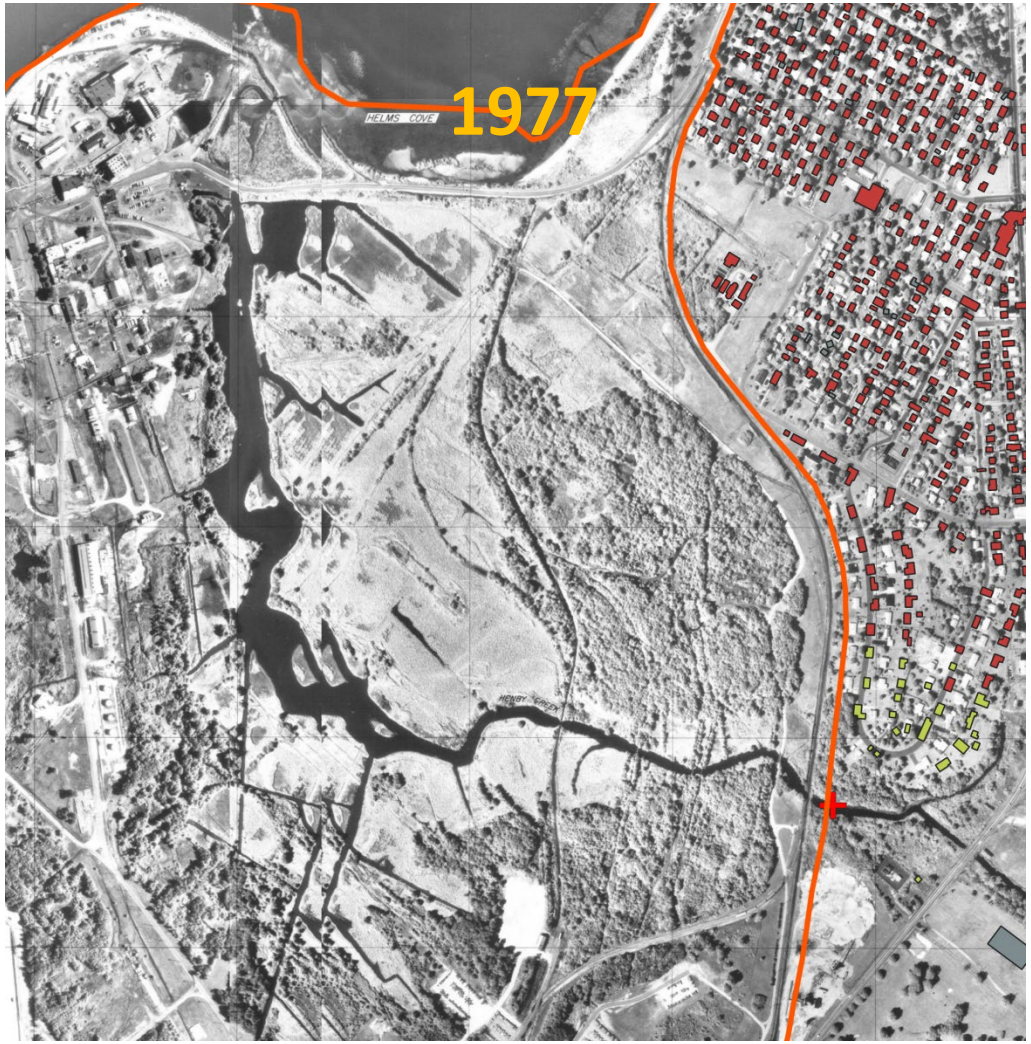
From TBLS Restoration Playbook August 2024

Base Flow and Flood Mitigation from Infrastructure Restoration Projects (Northern Urban Creek System depicted)



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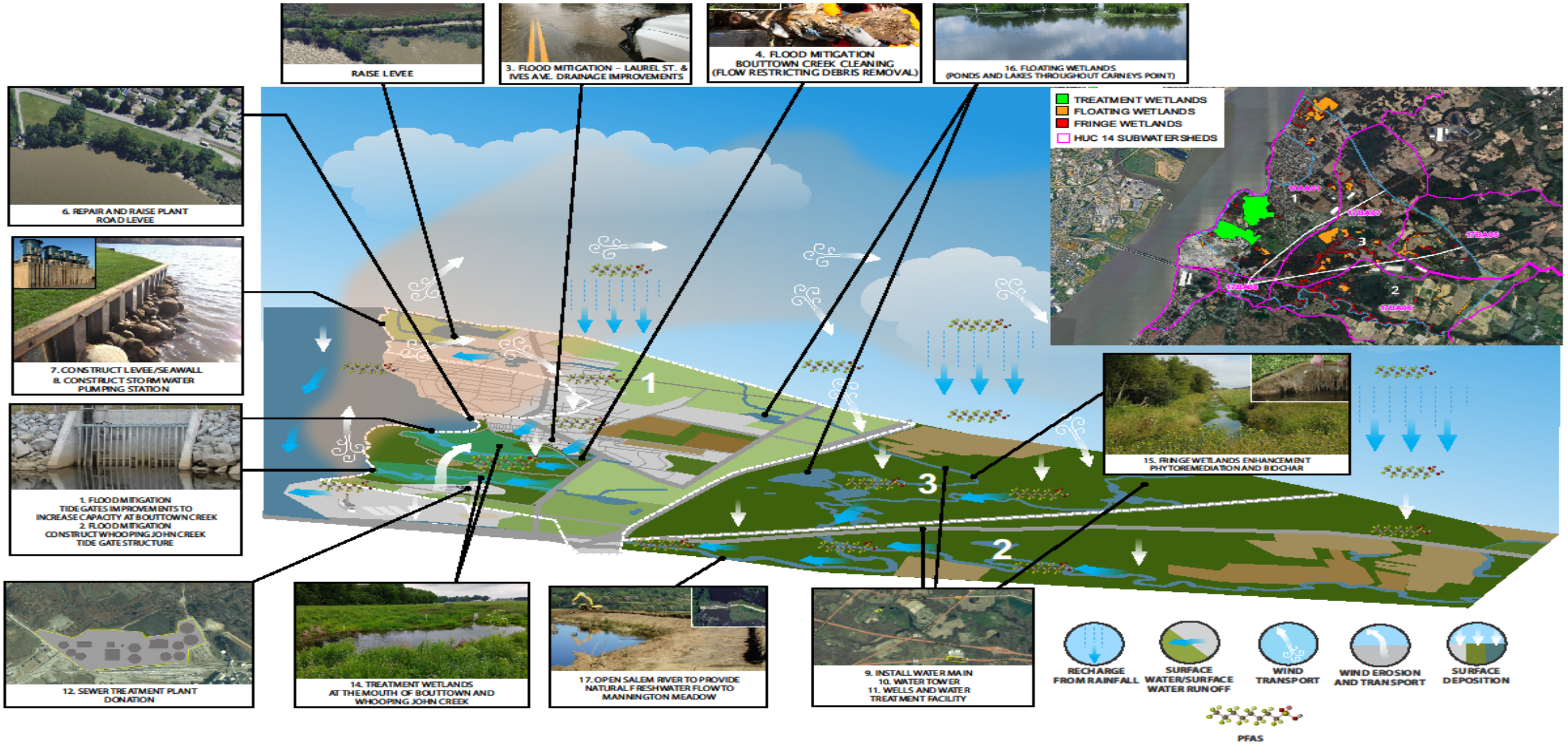
NRD Injury & NRD Restoration Conceptual Site Model



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Analyzing & Fixing Chambers Works Area 1 PFAS Human Health Exposures & Transport in Urban Creek System to Delaware River (Projects #1-8)

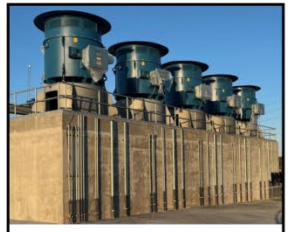
Normal Base Flow

- Both Tidal Gates Are Open
- Treatment Wetlands Are Treating PFAS Prior to Discharge Prior to Delaware River
- Looks 1977
- Fringe Wetlands Sequester PFAS in Watershed of Whooping John and Bouttown Creeks
- PFAS of the Two Creeks is Treated, No Unrelated Discharge to Delaware River

Flood Conditions

- 6 Times a Year Increased Base Flow from Watershed and Mobilization of PFAS
- Tidal Gates Shut to Prevent Sea Level Rise Influx from Delaware River Water
- Storm Water Pump Stations Move Excess Water to Waste Water Treatment Plant for Storage and
- No Lake Formed, No Flooding on Neighborhoods
- Fringe Wetlands on Creeks Decrease Flow
- No Exposure of Town to Mobilized PFAS

1. FLOOD MITIGATION TIDE GATES IMPROVEMENTS TO INCREASE CAPACITY AT WHOOPING JOHN CREEK
2. FLOOD MITIGATION CONSTRUCT BOUTTOWN TIDE GATE STRUCTURE



8. CONSTRUCT STORMWATER PUMPING STATIONS

12. SEWER TREATMENT PLANT DONATION

14. TREATMENT WETLANDS AT THE MOUTH OF BOUTTOWN AND WHOOPING JOHN CREEK

15. FRINGE WETLANDS ENHANCEMENT PHYTOREMEDIATION AND BIOCHAR

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Alternative NRD Drinking Water Resource for Impacted Residential Aquifer by reusing Chambers Works Backup Supply (Project Nos. 9, 10, 11)

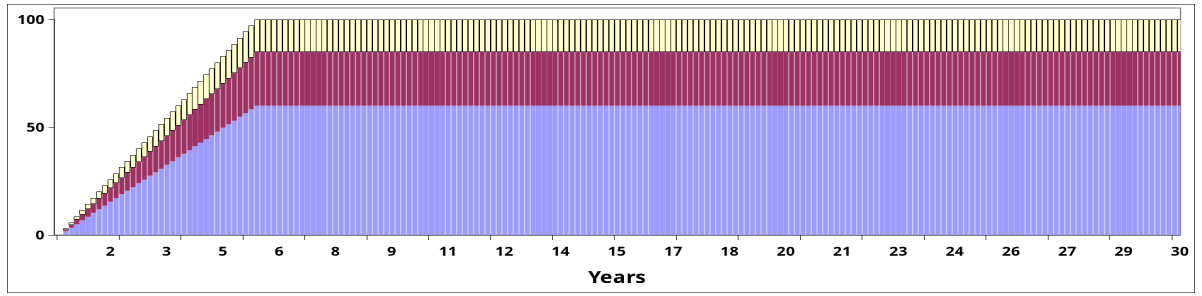
- Town study says need more drinking water supplies for Brownfield Economic Development plans
- Future drinking water resources are limited by treatment costs and water supply by PFAS contamination
- Backup water supply for Chambers Works consists of ***~850 gpm deep well field, which is currently not in use***.
- The residential POET systems were an emergency response to an IEC.
- Because of NRD CSM deeper offsite well field can provide Town with future growth of water supply needed and eliminate current POET systems which are inherently invasive to Town residents and costs same
- Precedent exists for using a ***replacement water source as a Natural Resource Restoration at air emissions sites including at Village of Hoosick Falls NY in 2025***

Industrial Wastewater Treatment Plant Reuse as a NRD Restoration Project (Project #12)

A WWTP As An NRD Restoration has Precedent.

1. **From Gulf Spill Restoration Trustees/Aquifer Quality Improvements for Septic** i.e. The City of Carrabelle's Lighthouse Estates, Florida: Septic Tank Abatement Restoration project pecedent for a WWTP being called NRD restoration.
2. By **Reusing Chambers Works WWTP** (32 MGD permit capacity) to connect upwards of 450 EJ residents and commercial businesses from septic to city sewer as part of Brownfield Economic Development. Uplift for Septic as an aquifer degrader (which can be valued also by a REA in dAFYs). Plus, septic from households are a potential PFAS source to aquifers.
3. Additional service value in that **Chemours WWTP treats PFAS using DuPont SETT Technology**. Replaces 2 other WWTPs that are at operational life and don't treat PFAS. Enhances future Brownfield economic development of the Township
4. WWTP is **Backup relief switch for treatment of PFAS laden surface water in urban creek system to prevent stormwater discharge to Delaware River**

Example of annualized Restoration Value (dAFYs) calculations



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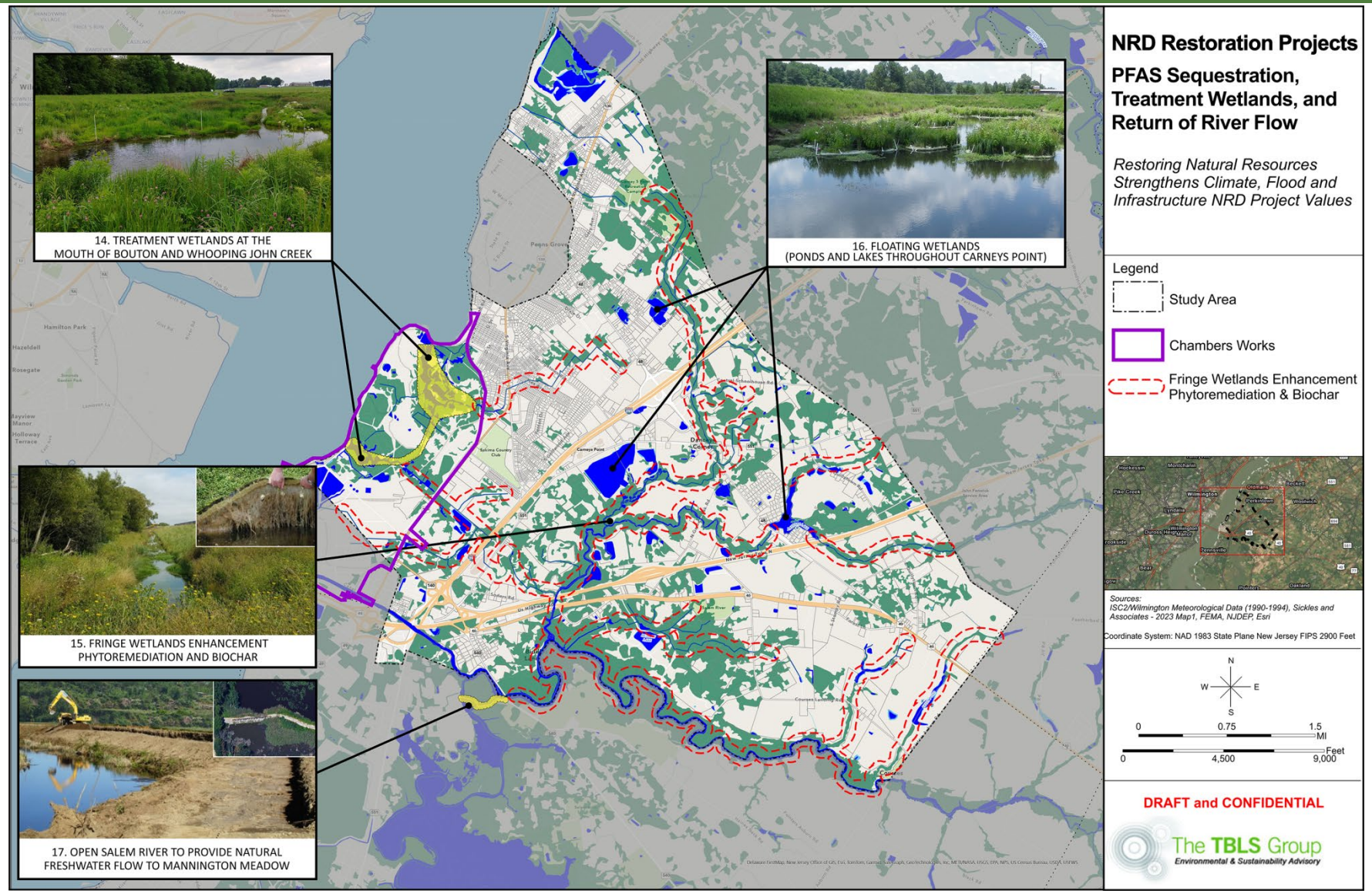
Triple Bottom Line Strategies

Passive PFAS Removal: Sequestration, Treatment Wetlands, Floating Wetlands, Phytoremediation/Harvesting & Dam/Diversion Passage/Removals (Projects 13-17)

Fringe wetlands defined as wetlands within 150-foot buffer around creeks in Carneys Point Township.

Fringe wetlands would be included in every sub-watershed within Carneys Point to provide a comprehensive restoration approach.

Floating wetlands are on any water body greater than 1 acre in size and many technical papers address PFAS removal as an effective removal approach



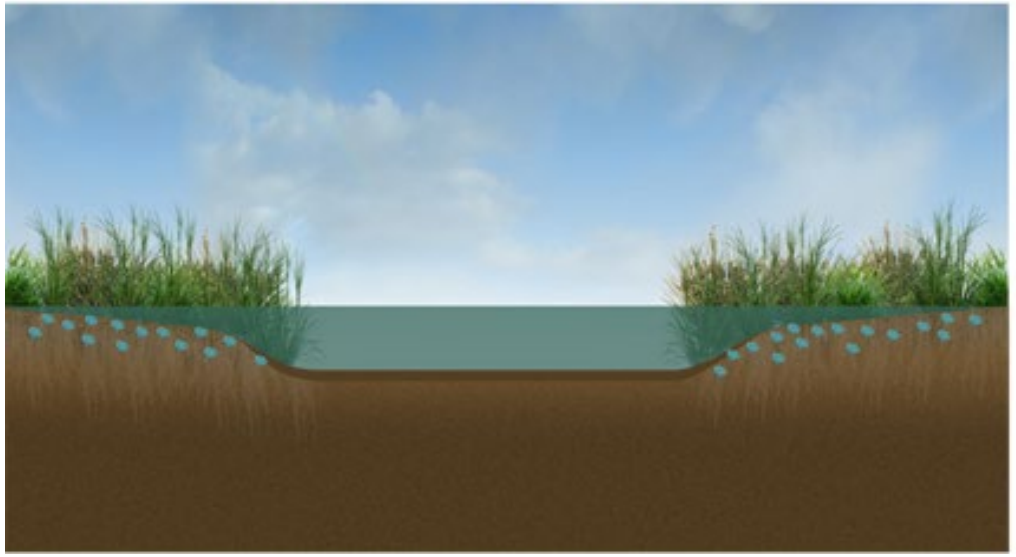
From TBLS Restoration Playbook August 2024

Treatment Wetlands PFAS Process (Project No. 14)

Constructed treatment wetlands system would use cultured bacteria to transform PFAS molecules into less toxic components. Princeton University technology (Dr. Peter Jaffe)

Additional laboratory studies and pilot studies are needed prior to wide-scale field deployment.

One area of focus for these additional studies is the **degree to which artificial root exudates (organic compounds released by plants into soil) may increase microbial metabolism**, thereby increasing the biotransformation capability of the cultured bacteria.



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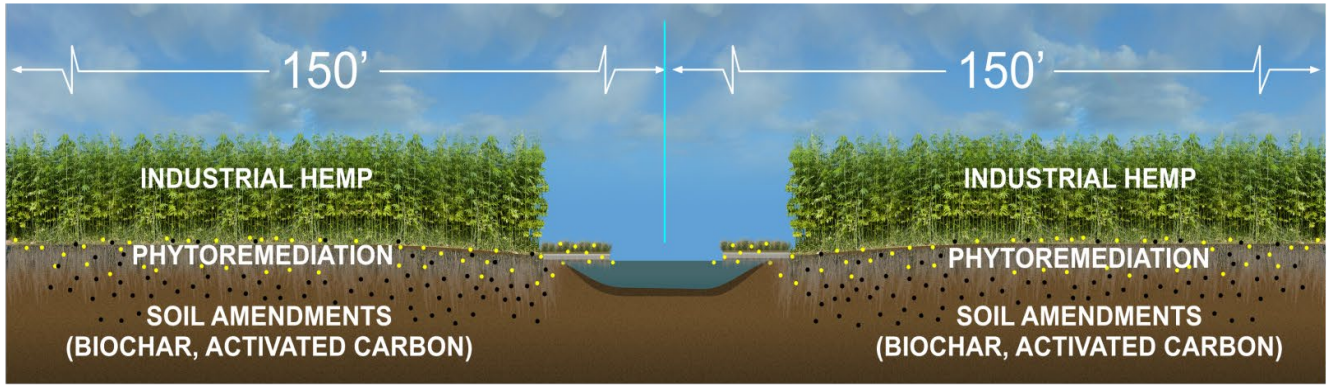
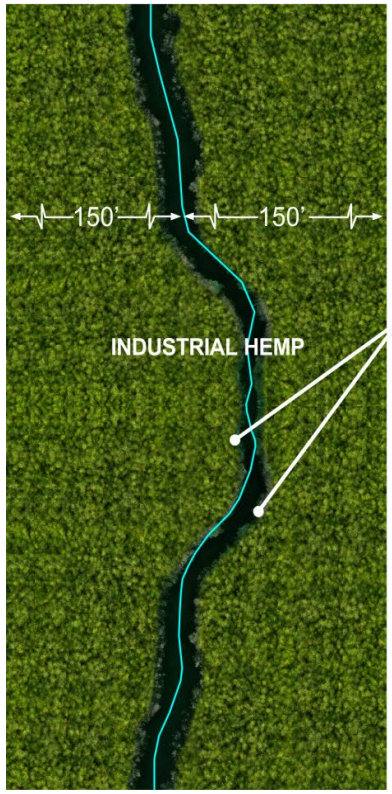
Phytoremediation at Fringe Wetlands (Project No. 15)

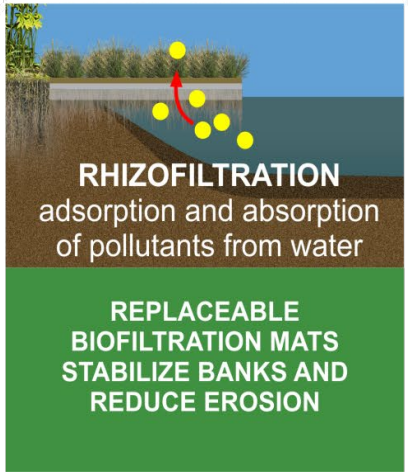
Phytoremediation with a selection of appropriate wetland plant species and soil amendments (e.g. biochar) to passively sequester free PFAS molecules throughout Carneys Point wetlands and waterbodies. (Montclair State & Princeton University)

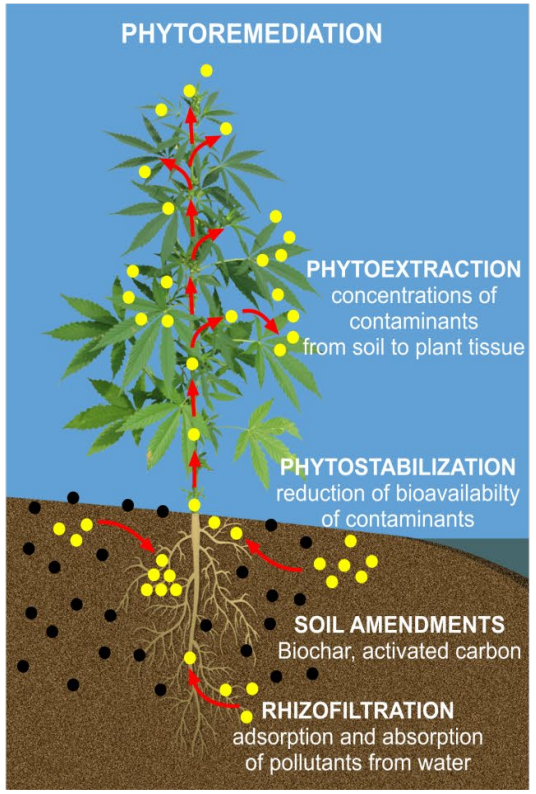
Plants would be periodically harvested to remove PFAS from the watershed. Pilot studies would be conducted to determine optimal locations, plant species, and growing conditions.

Harvested vegetation would be disposed of in Chambers Works Class 3 Hazardous Waste Landfill at transportation cost only. Project Creates hundreds of green jobs in EJ Community & disadvantaged economic enterprise zone









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Salem River Dams Project (Project No. 17)

This project will evaluate alternatives for improving riverine habitat in the Salem River in the vicinity of the Chambers Works site.

Feasibility study will study options for improving the habitat quality of the Salem River. Alternatives to evaluate could include:

- Removing one or both the dams that form the Salem Canal (Munson Dam and Brown Dam)
- Altering the amount and timing of flows that pass through the two dams providing fish passage at one or both the dam

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Innovative HEA and REA Methodologies Developed for NRD Restoration Valuation

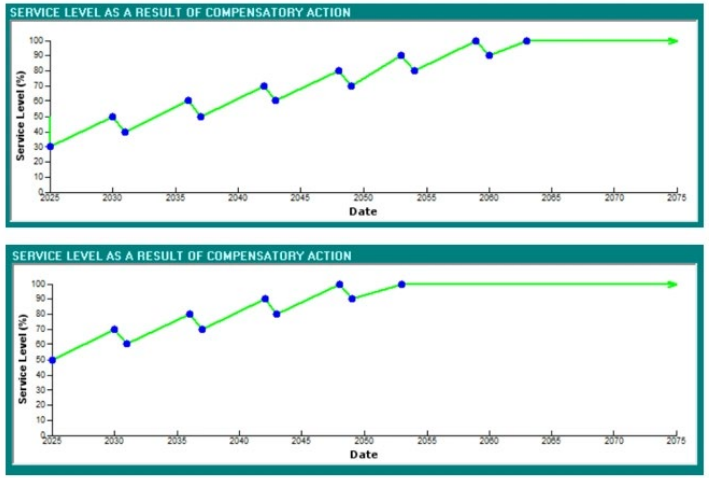
Used innovative Resource Equivalency Analysis (REA) methodology to value infrastructure projects in dAFYs following NJDEP approved precedent to estimate Delaware River sea-level rise levy overtopping and urban creek system storm flood mitigation caused by past Chambers Works hydrological modifications. Also valued WWTP and Replacement Drinking Water projects as NRD using innovative methodologies. **Infrastructure projects ~2500 equivalent green acres recharge value.**

TBLS & WSP used innovative Habitat Equivalency (HEA) methodology using Montclair State University & Princeton University input about project design, baseline service levels, and the trajectories over which these services would be restored. **Over 2500 acres of wetlands for PFAS treatment & Sequestration/harvesting** as part of project i.e. largest restoration project in NJ NRD history and one of the first of its kind in the US

Sample Project: **Floating Wetlands**:

- HEA: ponds & lakes > one acre (501 acres) of surface water PFAS cleansing.
- 30%-50% of 2025 baseline grow/harvest stair-stepping to reach 100% over 50 years

Ponds and lakes greater than 1 acre *within Carneys Point reflecting restoration value in first of its kind* ***stair-stepping HEA methodology***



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Restoration Project Costs Are Reasonable & Necessary

- **Predicted GW NRD injury for 11,000 acres of drinking water aquifer impact only as specified by lawsuit** due to lost atmospheric recharge in air emissions impacted areas as evidenced by residential well and GIS calculations in order to **scale restoration project** size
  - **Term of injury was 160 years of damages (70 years past + 90 years future based on court submitted aquifer modeling from 2020.)**
- **Computed Restoration Value for 50 years of NRD Adaptive Management of the 18 projects** for Resource Equivalency in discounted Acre Feet Years (dAFYs) of Flood/Source PFAS Source Area impact prevention & Township flood prevention value, and Habitat Equivalency for Treatment/Fringe/Floating Wetlands in discounted Service Acre Years (dSAYs) where services were defined as PFAS removal/sequestration that benefits Biota and human health. Eventually services will be fully functioning habitats for support of Biota after 50 years
  - Project valuation in dAFYs and dSAYs = Injury valuation in dAFYs and dSAYs. **Therefore Restoration project is scaled correctly**
- **Typical "Equivalent Green Acres" Cost determined by average Appraised value of acreage in Carneys Point. NRD may be monetized by this method as well of 5,000 acre project = $400,000/acre = $2B**
- **Typical injury Restoration Costs used by NJDEP Trustee = $400,000 / acre**
  - Based on TBLS knowledge of Current NJ cases & SIMAP model used Nationally by NRD Trustees. NRD often monetized by the Cost of the Restoration project that solves/equals NRD injury. **Thus, Trustee value by restoration project cost = $2B.**
- **Carneys Point NRD Restoration for 18 Project cost ~$400 M for 5,000 acres of Restoration that deals with PFAS or $80,000 per acre which is $0.20 on the $1.00 value.**
- **Therefore Carneys Point restoration project playbook is a reasonable alternative by cost and by restoration metrics values.**
- **Current draft settlement of NJDEP v. EI Dupont et. al. announced May 2025 (3M) and August 2025 (DuPont) = $2.5 B.**

PFAS NRD Restoration
Revitalizing The Township of Carneys Point Post Closure of Chemours Chambers Works for Redevelopment

1. **NRD Restoration Project Planning Process – by Public through Municipality funding pre-settlement. Began in 2022**

2. **Restoration Projects Playbook – A Watershed Wide PFAS NRD Restoration Solution (Submitted to Court in August 2024)**
   - **Infrastructure Resiliency** Including Sea-level rise and flood control projects to prevent PFAS source area impacts to Township and Flooding issues that would impact redevelopment due to Sea Level Rise & Increased Rainfall
   - **PFAS Removal** throughout watershed via passive, cost-effective Fringe, Floating and Treatment Wetlands

3. **Building A World Class Team to Implement and Deliver 18 Project NRD and PFAS Watershed Solution**
   - **Princeton University and Montclair State Universities –**bioremediation and phytoremediation technology, research dollar benefit to NJ, as well as "Green Team"(environmental justice, green jobs, training) Economic Analytics
   - **WSP Engineering** –Largest engineering company in world & NJDEP's NRD Restoration Engineer
   - **RES –** Nations Largest Ecological Project Developer
   - **Carneys Point Township & Advisors –** Project Permitting, Brownfield Economic Redevelopment Zone, Access and Infrastructure manager
   - **NJDEP** – Remains in their Trustee oversight role for projects and control of outcome/funding source from litigation
   - **Chemours** – Chambers Works land owner

4. **Inform NJDEP and PRPs of Our Approach, Findings, and Solutions (began in August 2024 as part of NRD court case)**

5. **Public Private Partnership** - Everyone Wins!!!

6. **Integrate with Town's Brownfield Enterprise Redevelopment Zone & Chemours Redevelopment Team**

7. **Create a better World**.