# Quantitative Bounding Evaluation of the Importance of Shoreline Seeps in a Complex Urban Superfund Site

Sediment Management Work Group

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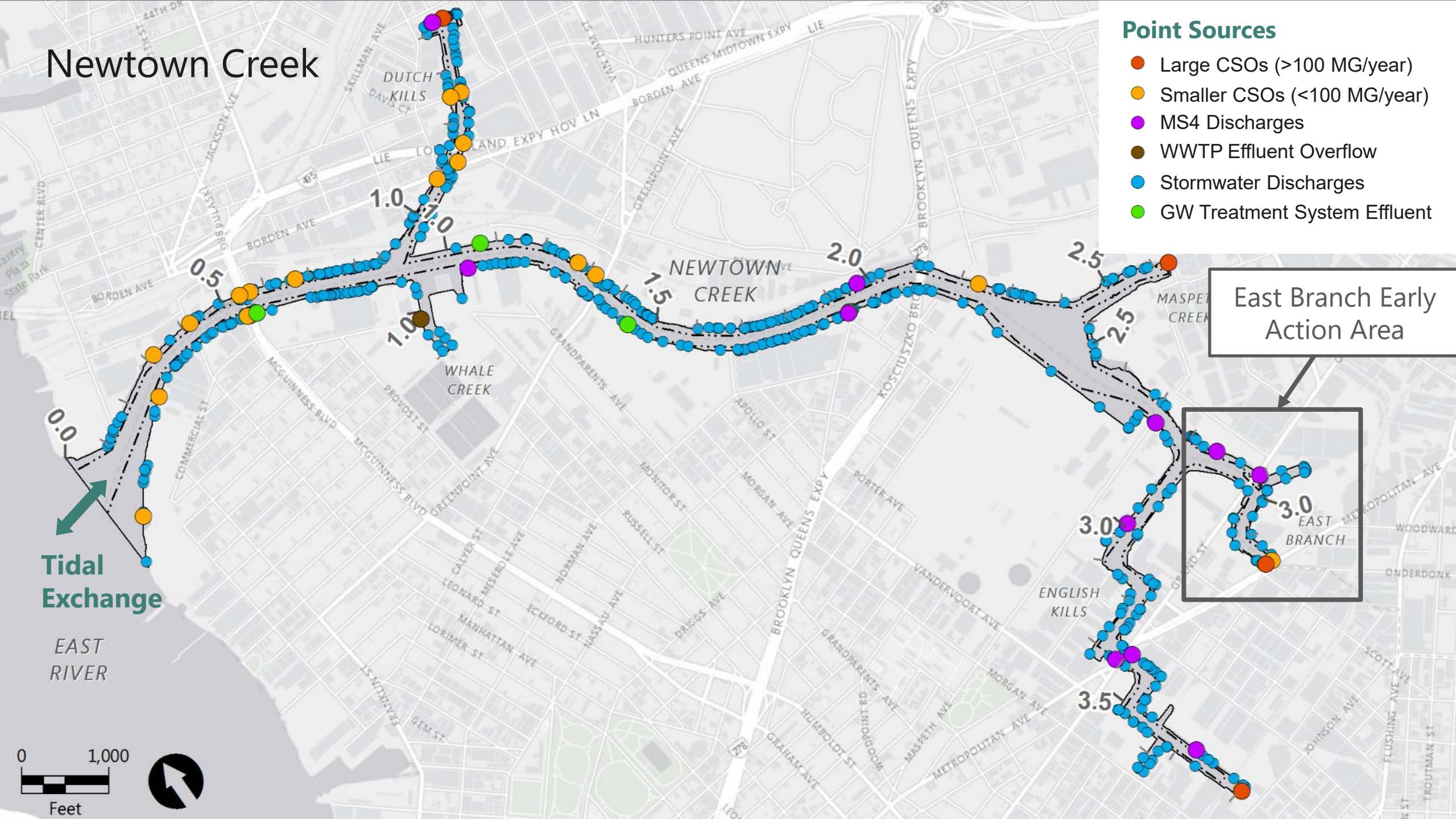
Photo by Bill Rhodes


Queens
Manhattan
Hudson River
East River
Newtown Creek
Study Area
Brooklyn


Newtown Creek
Point Sources
Large CSOs (>100 MG/year)
Smaller CSOs (<100 MG/year)
MS4 Discharges
WWTP Effluent Overflow
Stormwater Discharges
GW Treatment System Effluent
East Branch Early Action Area
Tidal Exchange
EAST RIVER
NEWTOWN CREEK
DUTCH KILLS
WHALE CREEK
EAST BRANCH
ENGLISH KILLS
0.0
0.5
1.0
1.0
1.0
1.5
2.0
2.5
2.5
3.0
3.0
3.5
0
1,000
Feet

# Introduction and Overview

- Understanding the significance of ongoing external sources of contamination is important to inform remedial decision-making and to provide a perspective on expectations during post-remedy long-term monitoring
- There are multiple ongoing external sources of contamination to Newtown Creek that are expected to continue after remedy implementation
  - East River
  - Point source discharges (e.g., combined sewer overflows, stormwater, direct drainage)
  - Treated groundwater effluent
  - Atmospheric deposition
  - Lateral groundwater
  - Bank erosion
  - Shoreline seeps

# Background Information on Shoreline Seeps

- Shoreline seeps may be discharge of shallow groundwater, bank storage, nonaqueous phase liquid (NAPL), or a combination of these
- Shoreline seep samples were collected during the RI field work where a shoreline seep was observed in Newtown Creek, and the RI Report concluded that seeps do not appear to represent a significant source of contaminants of concern (COCs)
- Other stakeholders (NYCDEP and NYSDEC) have repeatedly raised concerns about seeps representing a significant uncharacterized source (based largely on isolated observations of NAPL seeps)
  - Performed separate field surveys on shoreline seeps outside of the RI/FS process

# Evaluation of Shoreline Seeps

- Although several field surveys on shoreline seeps have been performed, the information collected has been insufficient to calculate mass loadings of contaminants due to the lack of volumetric flow rate measurements
  - Measuring flow rates would have been challenging, but not impossible
- A multiple-lines-of-evidence approach was developed for the East Branch Early Action area to evaluate whether these seeps could negatively impact sediment-based remedies

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# Multiple-lines-of-evidence Approach to Evaluate Shoreline Seeps

# Seep Chloride and Conductivity Data

- Elevated chloride and conductivity are indicative of bank storage of brackish or saline surface water draining out of shoreline areas at low tide, whereas freshwater seeps are indicative of fresh groundwater seeping into the creek
- Half of the seep samples had chloride and conductivity concentrations within the range of the dry weather surface water measurements, likely reflecting bank storage
- The other half of the seep samples had lower chloride and conductivity concentrations, likely reflecting a mixture of fresh groundwater and bank storage

# Seep and Surface Water Contaminant Concentration Data

- Total polycyclic aromatic hydrocarbon (34) (TPAH [34]) was evaluated
  - TPAH (34) was studied during the RI/FS
  - TPAH (34) has a preliminary remediation goal
  - PAHs make up a fraction of the hydrocarbons that compose NAPL at the site
- Approximately two-thirds of the seep samples collected have a TPAH (34) concentration within the range of dry weather surface water TPAH (34) concentrations (0.1 to 3 µg/L), indicating that potential seep loadings of PAHs are likely not significant



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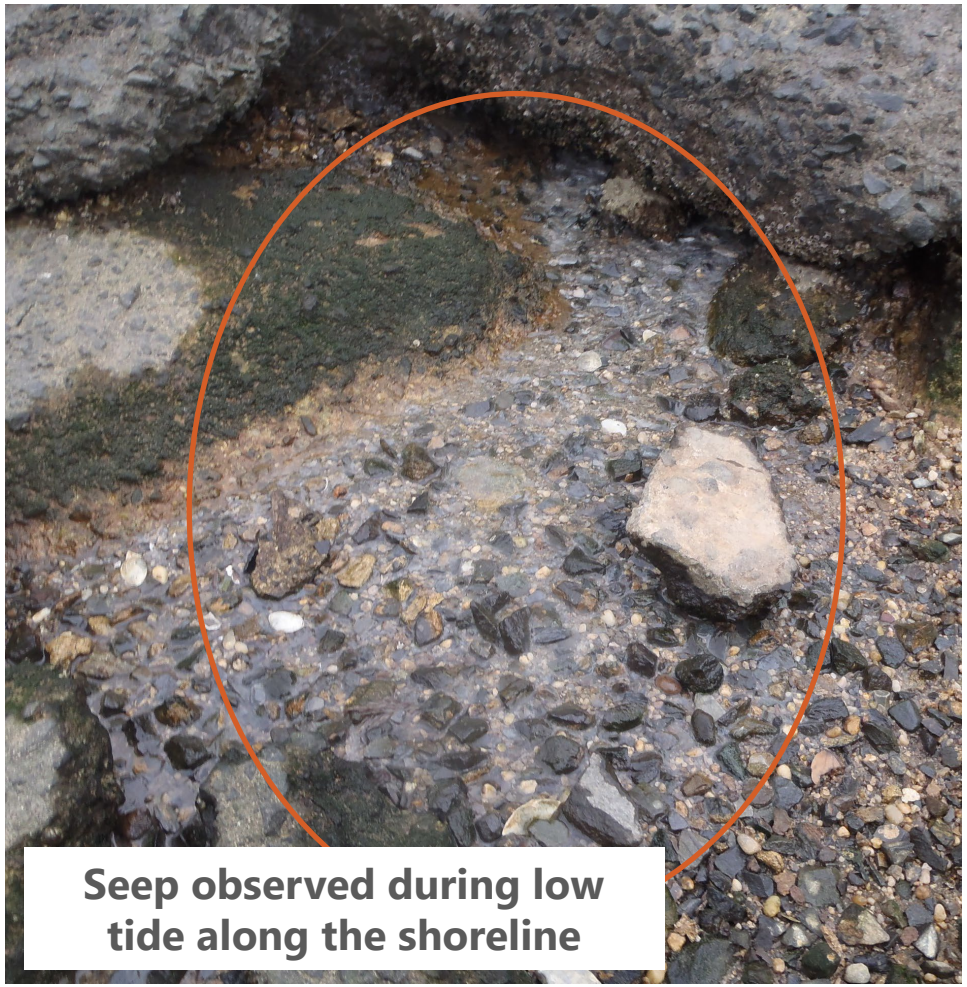
# Quantitative Bounding Evaluation

- None of the seep surveys performed to date have included measurement of seep volumetric discharge rates; therefore, the NAPL and contaminant mass loads entering the Study Area from seeps cannot be quantified
- Quantitative bounding evaluation was performed using existing data and a long-term equilibrium (LTE) modeling evaluation to estimate the hypothetical loads of TPAH (34) and NAPL associated with seeps that would be necessary to negatively impact the sediment-based remedy
- This hypothetical additional NAPL seep load was compared to existing data to contextualize the load relative to other TPAH (34) or NAPL sources to East Branch



**Seep observed during low tide along the shoreline**



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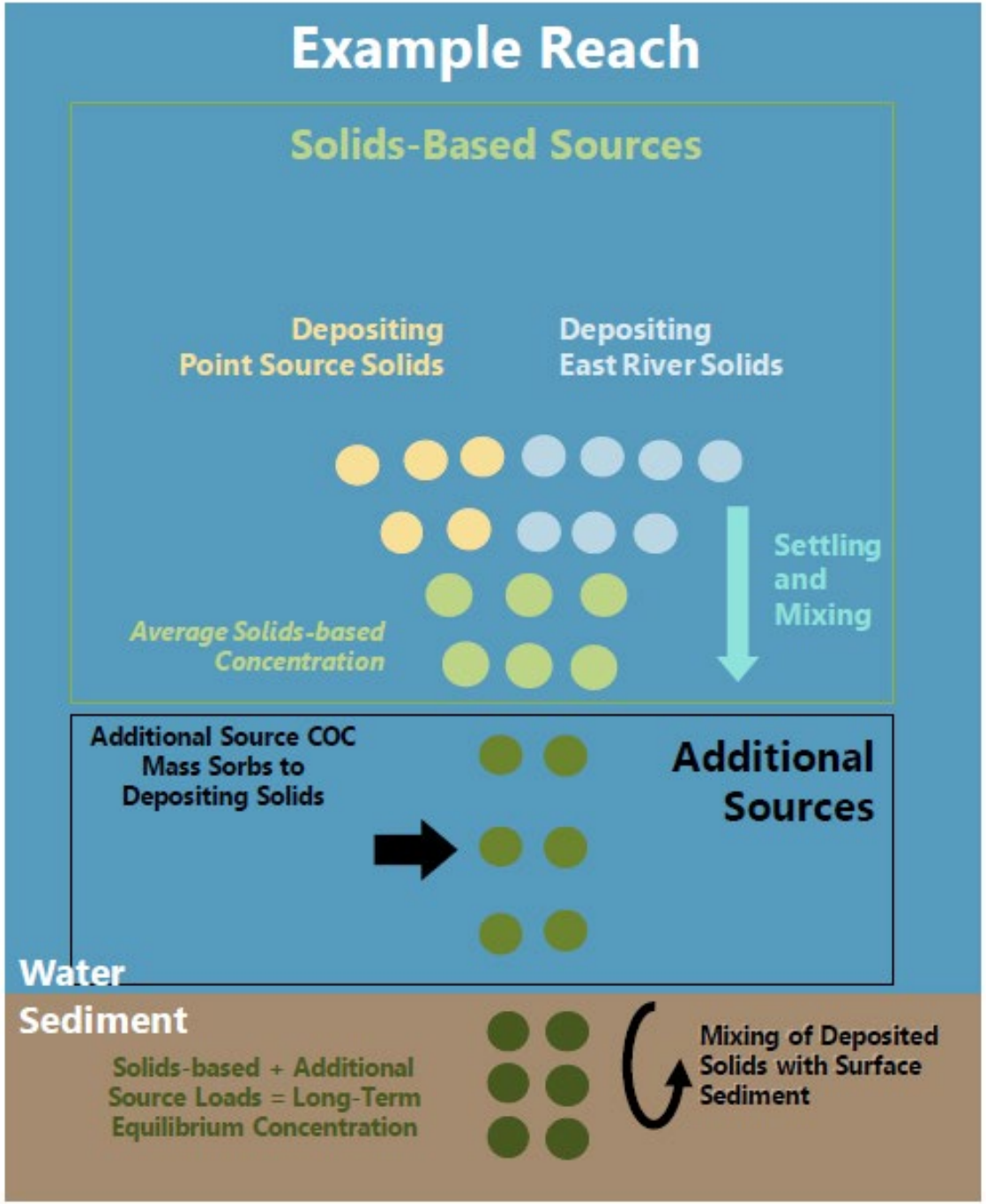
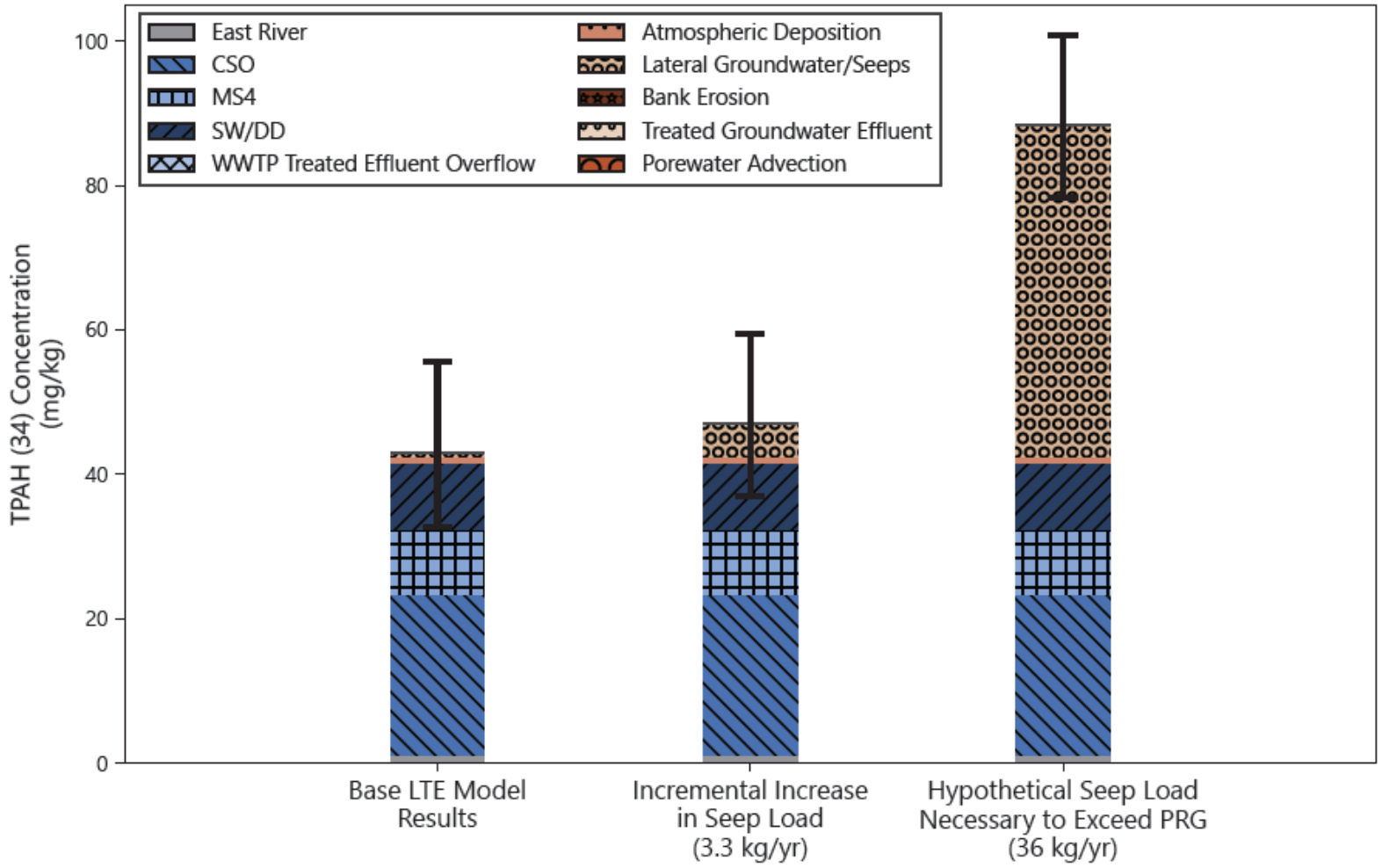
# Overview of the LTE Model

- A spreadsheet-based model was developed to assess the relative contribution of external ongoing sources to post-remedy LTE surface sediment concentrations
- The calculation is based on a mass accounting approach that includes net sedimentation rates and quantifies the primary contaminant inputs



# LTE Model Quantitative Bounding Evaluation

- The hypothetical seep TPAH (34) load to East Branch was incrementally increased until the upper-bound LTE concentration predicted in East Branch exceeded the preliminary remediation goal of 100 mg/kg
- The resulting hypothetical additional TPAH (34) load in East Branch is 36 kg/yr



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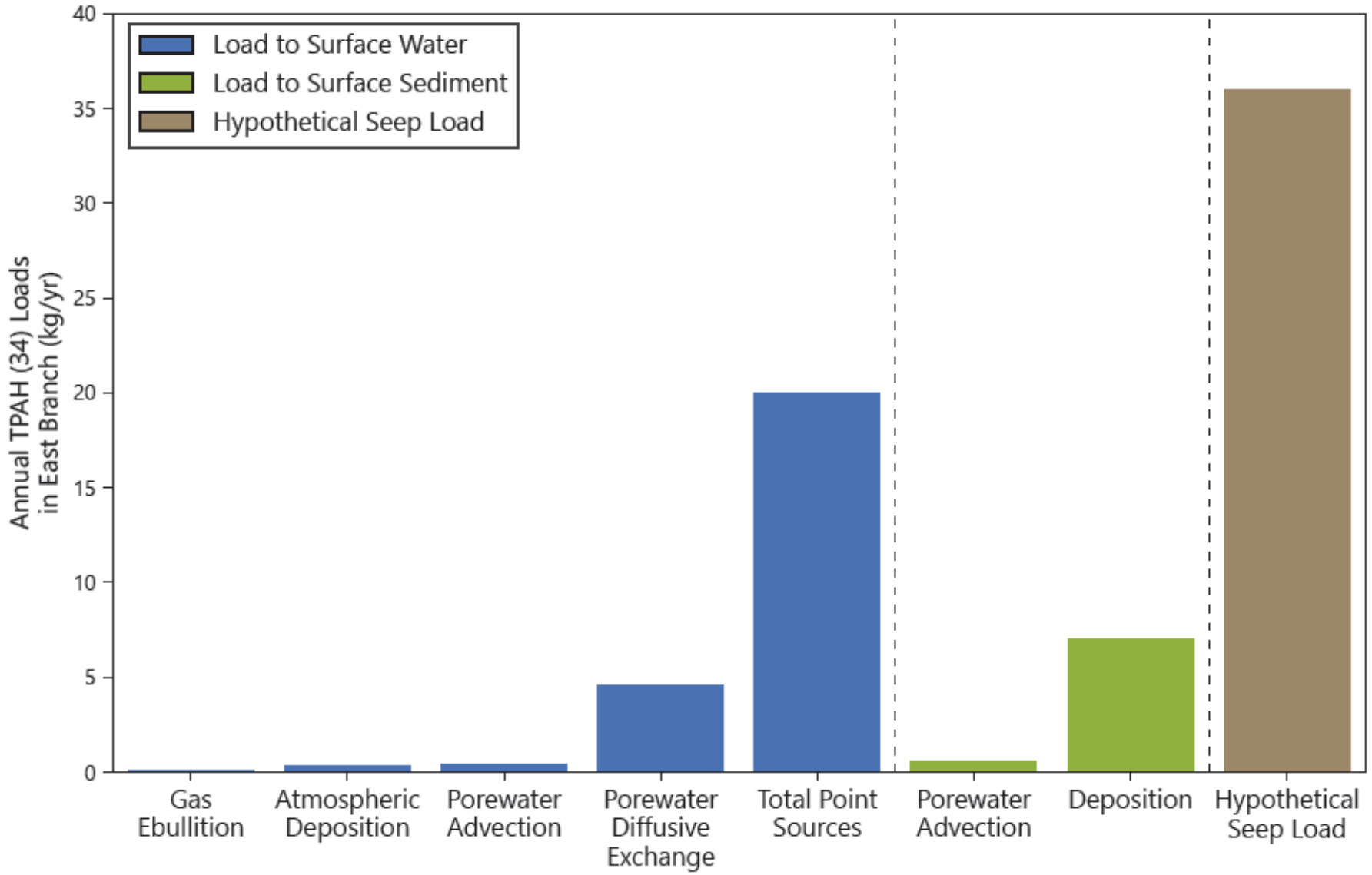
# Contextualized Hypothetical Seep Load



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# Contextualized Hypothetical Seep Load (cont.)

- The contextualized hypothetical seep load shows the implausibility of such a large seep load to East Branch
  - Would need to be larger than all other TPAH (34) loads to East Branch surface water combined
  - Would create approximately 1.1 to 6.8 acres of sheen in East Branch (~10% to 60% of total surface area) during every low tide cycle—such an extensive and frequent sheen has never been observed in East Branch
  - Continuous seep flow rate would need to be approximately 23 gallons per minute (of water containing dissolved phase contaminants) for each of the 10 observed seeps in East Branch; none of the field observations indicate seep discharge rates even close to this magnitude

# Key Takeaways

- Even though mass loadings of contaminants from seeps could not be quantified due to the lack of volumetric flow rate measurements, qualitative and quantitative evaluations were able to be performed using available data
- These evaluations indicate that many of the sampled seeps likely reflect bank storage and that aqueous and NAPL seeps represent a comparatively minor source of COCs and NAPL to East Branch
- This evaluation was focused on the East Branch area of Newtown Creek, and the methods could be adapted to provide similar insights on the relative importance of seeps in other areas of Newtown Creek
  - A similar multiple-lines-of-evidence approach could be adopted for other sites with similar data limitations (i.e., the inability to quantify a contaminant mass load)

# Questions?