Town of Brookhaven

TMDL Development for the Forge River Watershed

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CDM in association with HDR|Hydroqual

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Agenda

- Project Roles & Responsibilities – Introduction to CDM Smith and HDR|HydroQual Project Team
- Project Objective
- Project Overview - Modeling Tools and Approaches
  - Groundwater Model
  - Surface Water Models
  - Sediment Nutrient Flux Model
- Available Data and Data Needs - Hyporheic Zone Evaluation
- Schedule, Communication, Coordination and Reviews
- Questions

Introduction to CDM and HDR|HydroQual Team

Camp Dresser & McKee

- $1 billion global firm, 6,000 professionals in more than 117 offices throughout the world
- Project managed from CDM's Woodbury office
- Suffolk County groundwater models and groundwater-surface water interaction

HDR|HydroQual

- 7,800 professionals in 185 offices
- Over 150 EPA-approved TMDL segments, including Long Island Sound Nitrogen TMDL and NY/NJ Harbor Nutrient TMDL

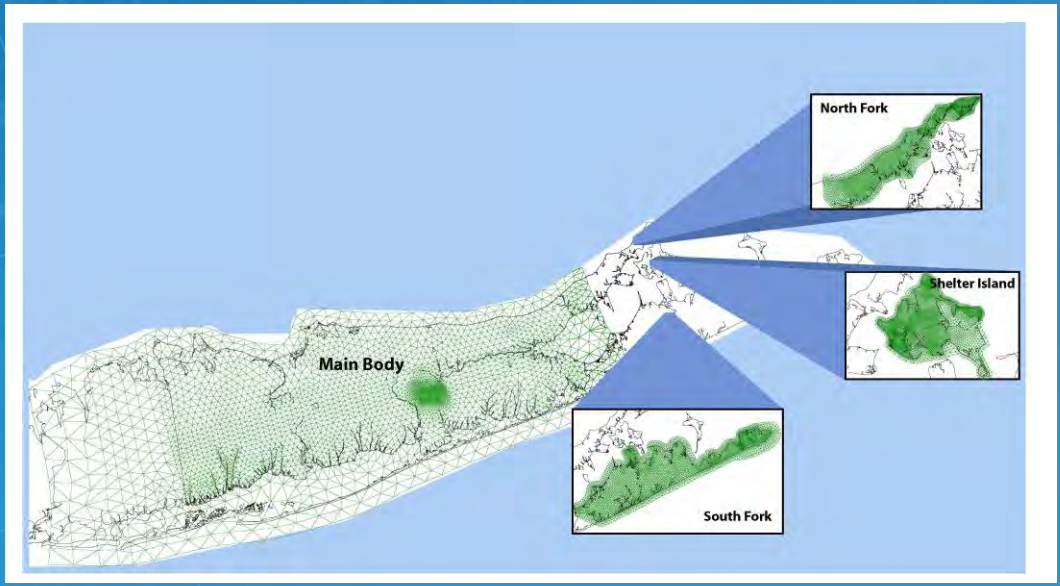
Dr. Larry Swanson and the Stony Brook School of Marine Sciences and Atmospheric Studies

Christopher Smith from Cornell Cooperative Extension

Introduction to CDM and HDR|HydroQual Team

Overview of Approach

- Collaboration and Teamwork
- Reliable, Defensible Modeling Tools to Synthesize Existing Information & New Data Characterizing the Hyporheic Zone



Project Objective:

Establish TMDL for nitrogen, that will enable achievement of the Dissolved Oxygen standard

Project Schedule

		MONTHS																							
Task		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Task 1	Project Scoping Meeting	*																							
Task 2	QAPPs		D		F																				
Task 3	Develop Nitrogen TMDL																								
3a	Establish Endpoint and Targets				TM																				
3b	Source Load Quanitification					TM																			
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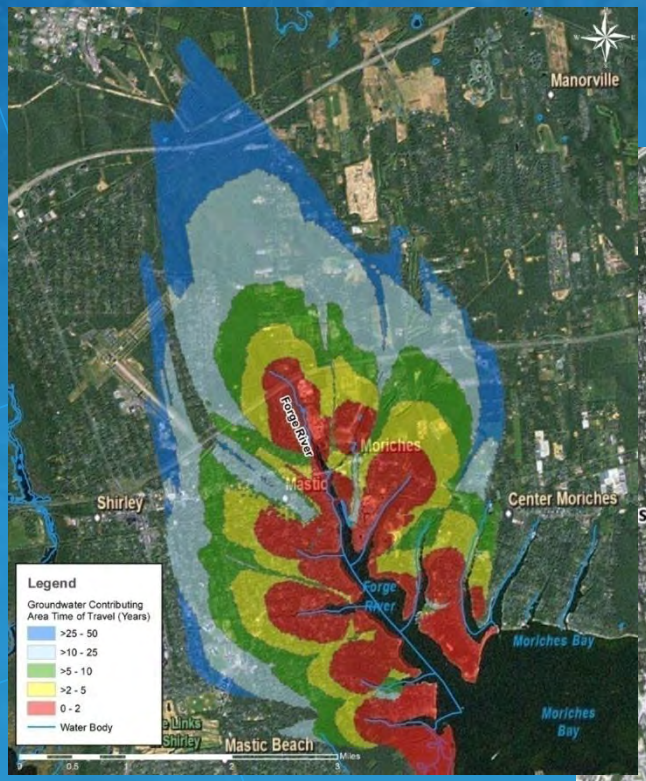
3d	Pollutant Loading Capacity											TM													
3e	Allocation Analysis													TM											
Task 4	Public Outreach												P							P					
Task 5	Monitoring Plan															D		F							
Task 6	Implementation Plan														D		F								
Task 7	TMDL Report																		D		F				
Task 8	Communication/Meetings										*					*					TB				

KEY:

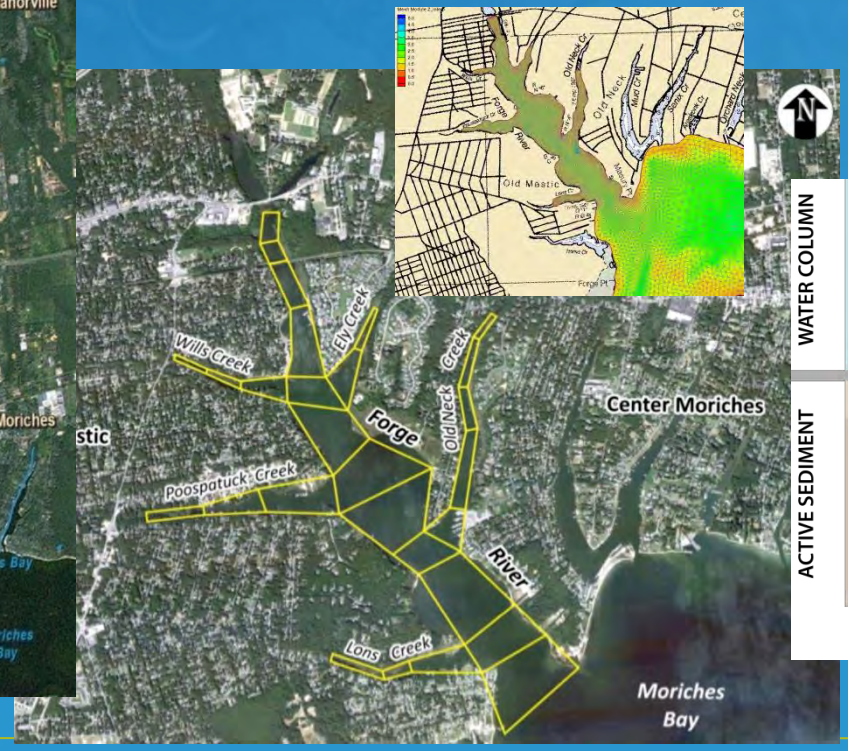
- Town/Stakeholder Review Time
- D Draft Report
- F Final Report
- TM Technical Memorandum
- * Progress Meeting
- P Public Meeting/Presentation
- TB Town Board Meeting

Modeling Tools

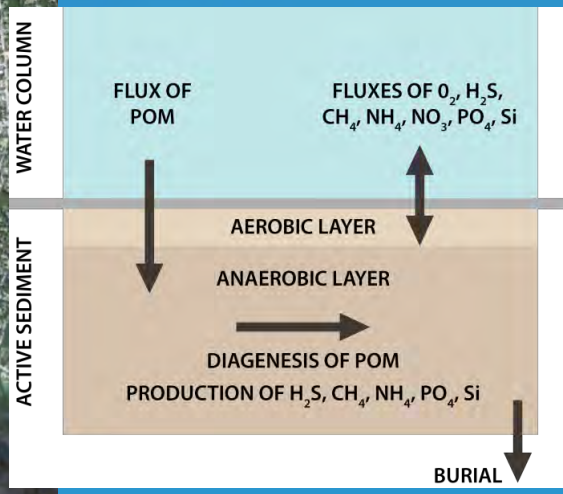
Watershed/ Groundwater



Forge River (Receiving Water)



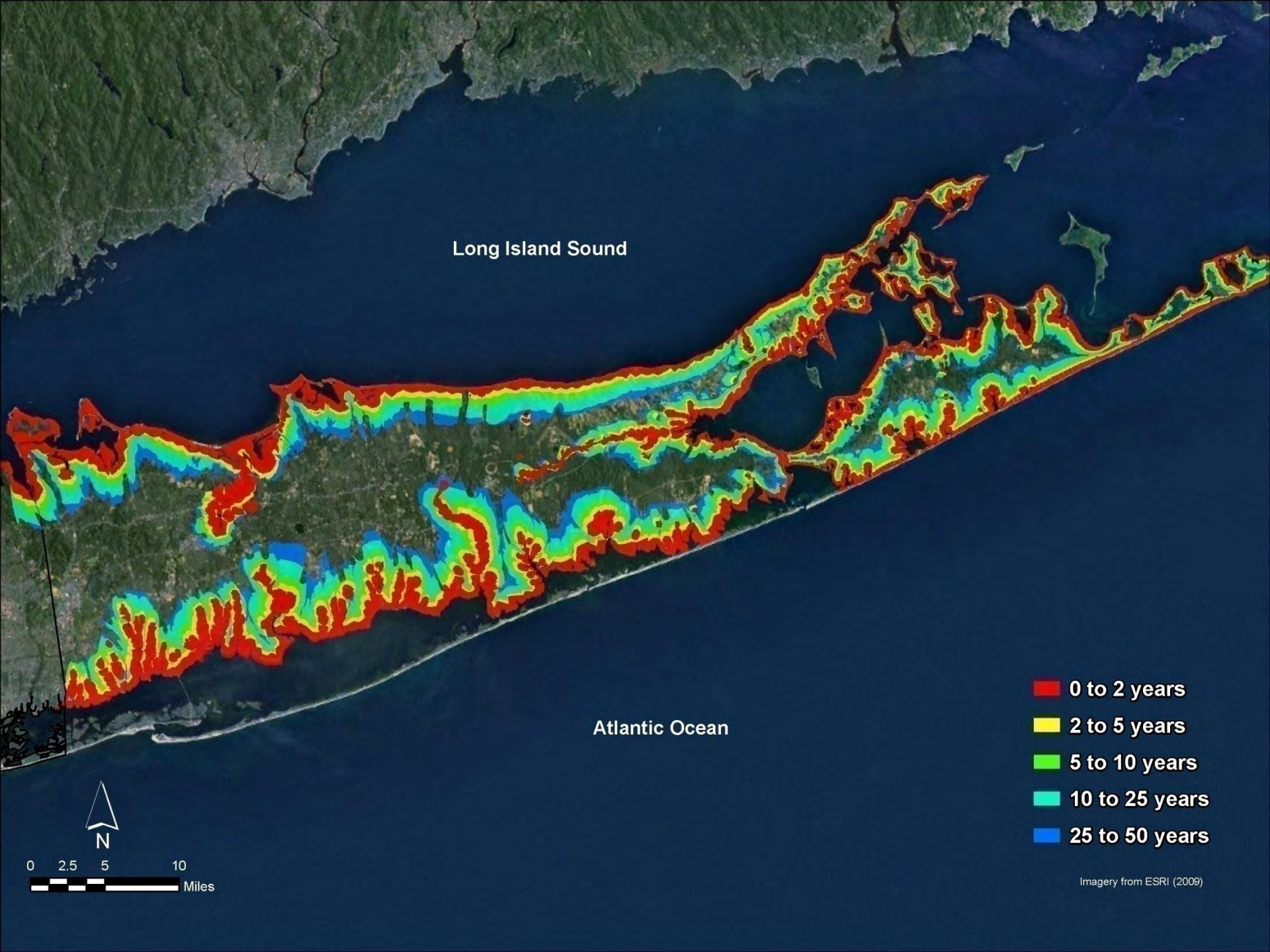
Sediment Flux



Models

- Suffolk County Groundwater Model – DYNSYSTEM code
- ECOM – Estuarine, Coastal & Ocean Model
- RCA – (WASP-based) Eutrophication Module
- Sediment Nutrient Flux Module

Finite Element
Long Island Sound
Peconic Bay
Nassau County
Queens
Atlantic Ocean
N
0 2 4 8
Miles
Imagery from ESRI (2009)


Long Island Sound
Atlantic Ocean
0 to 2 years
2 to 5 years
5 to 10 years
10 to 25 years
25 to 50 years
N
0 2.5 5 10
Miles
Imagery from ESRI (2009)

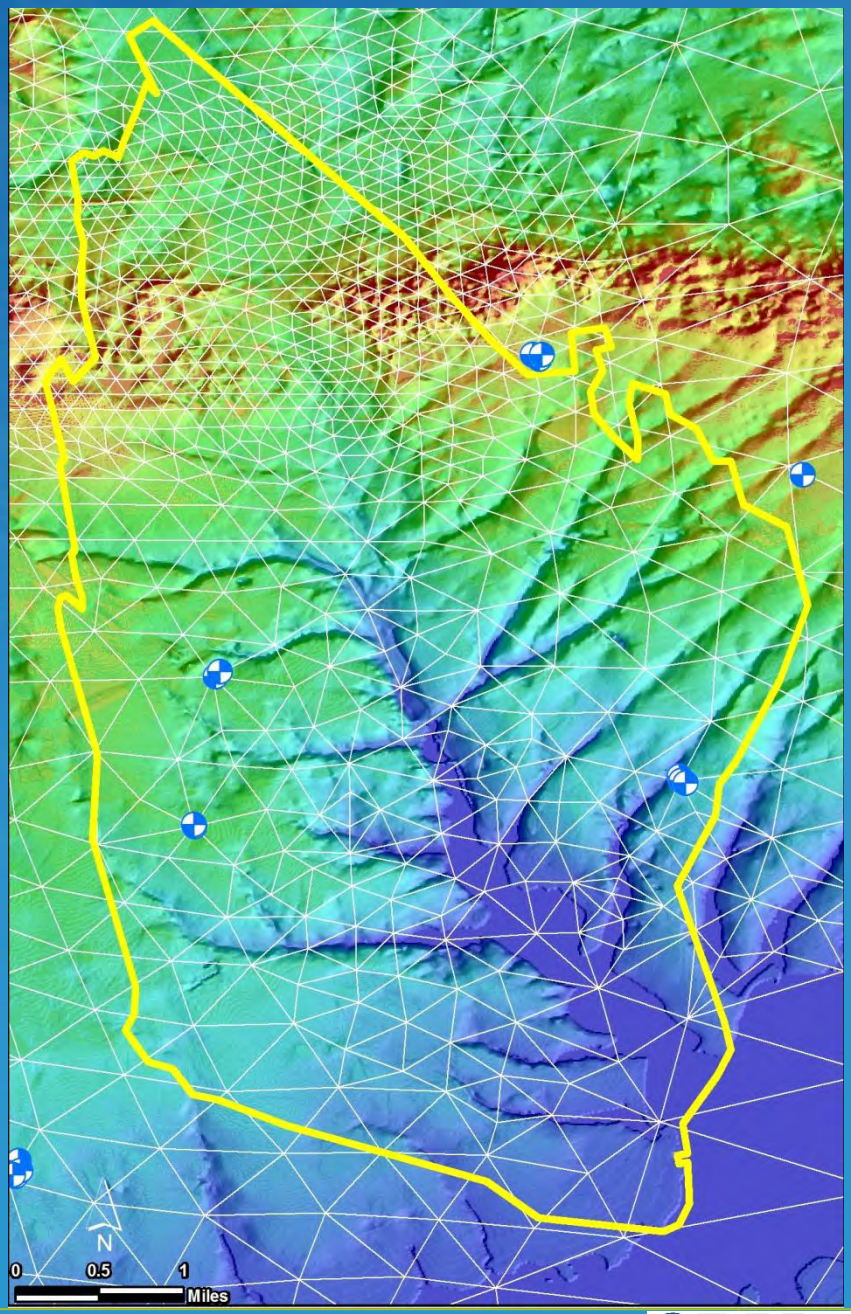
Groundwater Model

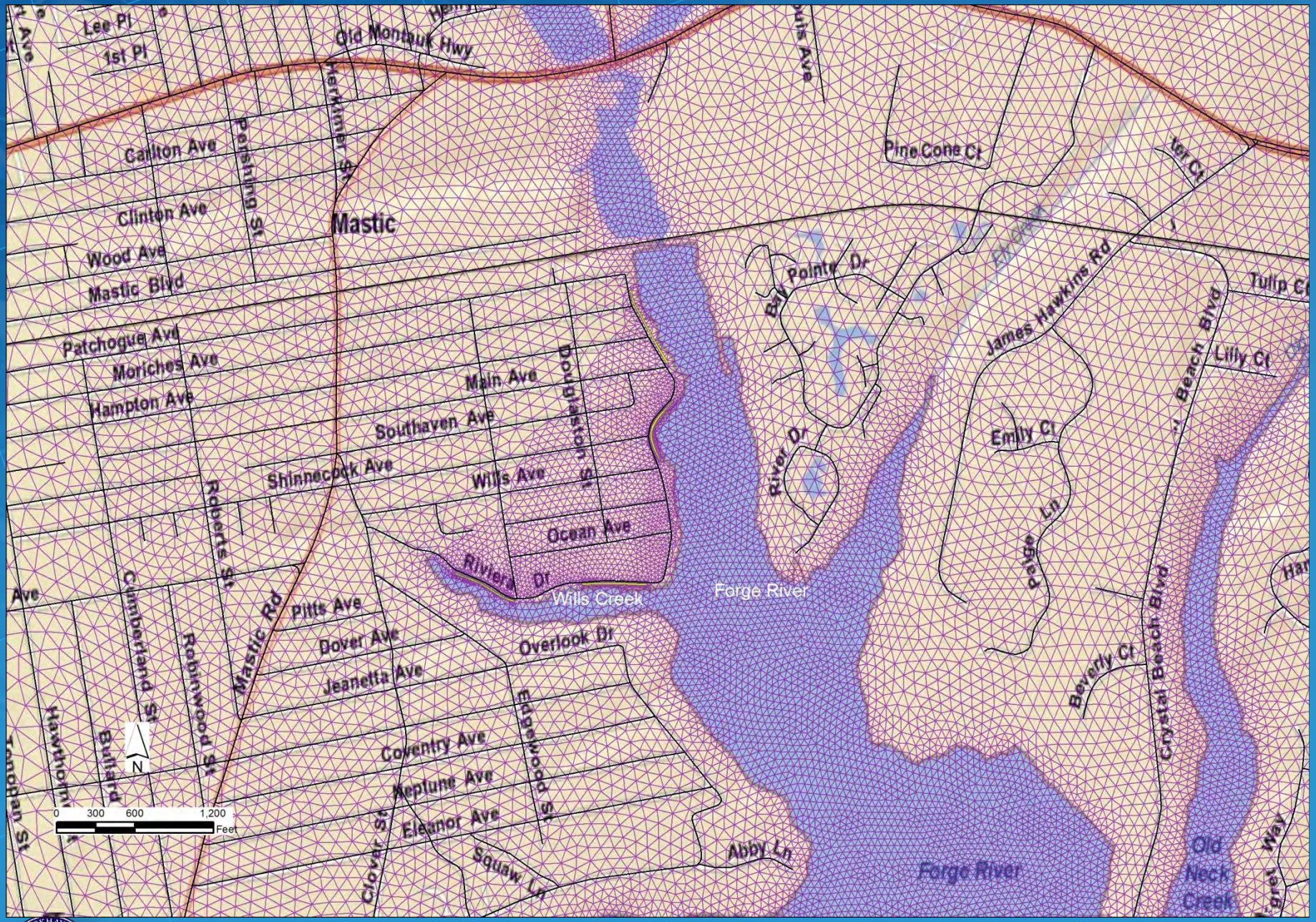
Existing groundwater contributing area to the Forge River is based on a regional assessment

Greater Discretization

Incorporation of LIDAR data

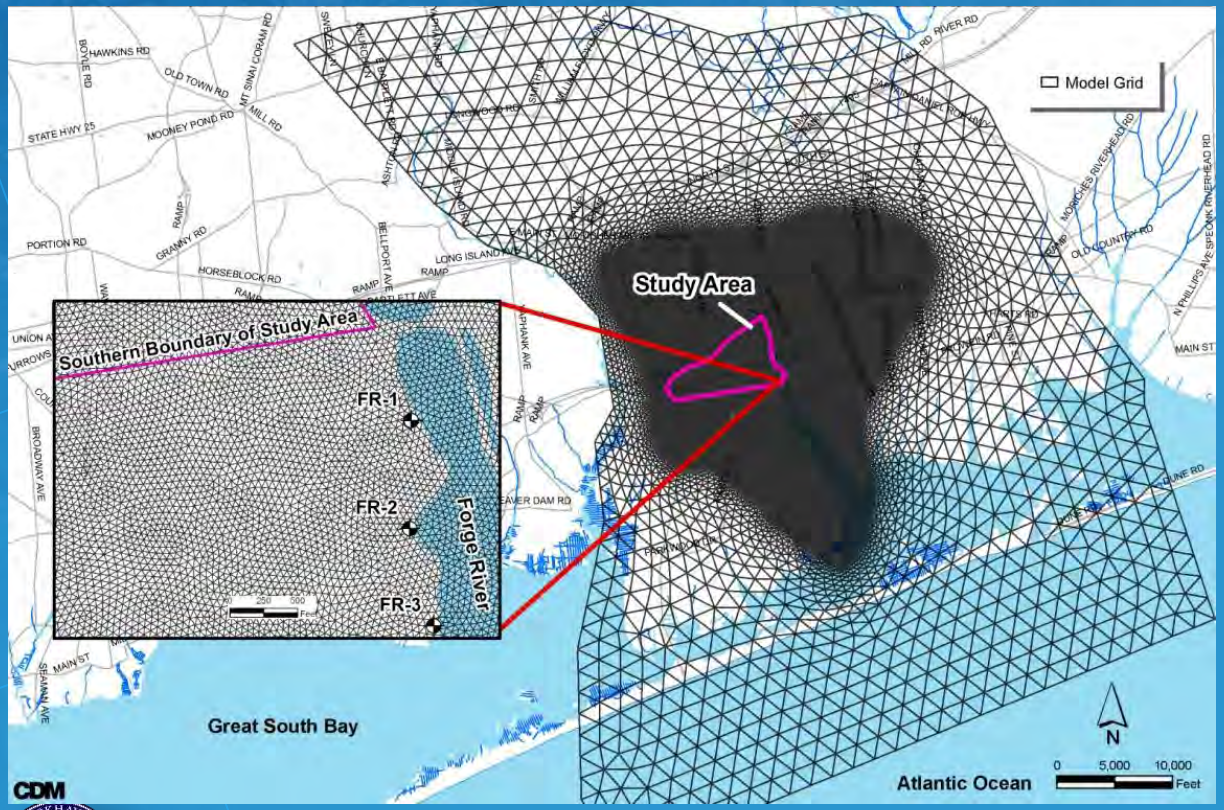
Incorporation of Bathymetry

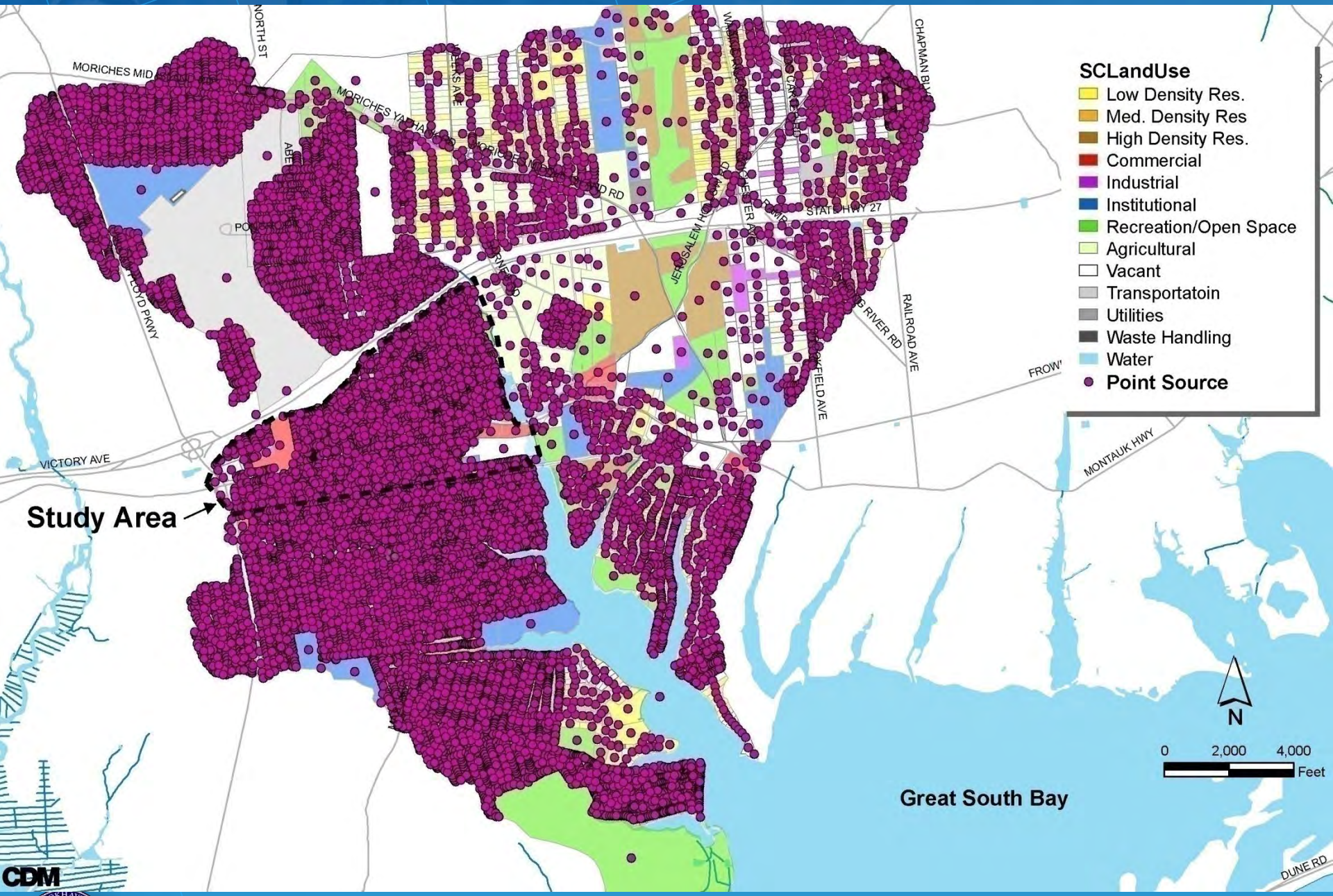



Lee Pl
1st Pl
Old Montauk Hwy
Herkimer St
Carlton Ave
Pershing St
Clinton Ave
Mastic
Wood Ave
Mastic Blvd
Patchogue Ave
Moriches Ave
Hampton Ave
Main Ave
Douglaston St
Southaven Ave
Shinnecock Ave
Wills Ave
Ocean Ave
Riviera Dr
Wills Creek
Forge River
Roberts St
Cumberland St
Robinwood St
Mastic Rd
Pitts Ave
Dover Ave
Jeanetta Ave
Overlook Dr
Edgewood St
Coventry Ave
Neptune Ave
Eleanor Ave
Clover St
Squaw Ln
Abby Ln
Pine Cone Ct
Bay Pointe Dr
River Dr
James Hawkins Rd
Emily Ct
Paige Ln
Beverly Ct
Crystal Beach Blvd
Lilly Ct
Tulip Ct
Old Neck Creek
N
0 300 600 1,200
Feet

Nitrogen Loading Model

- Nitrogen loading model piloted in the Forge River watershed
- Simulates nitrogen loading /movement through the aquifer




SCLandUse
Low Density Res.
Med. Density Res
High Density Res.
Commercial
Industrial
Institutional
Recreation/Open Space
Agricultural
Vacant
Transportatoin
Utilities
Waste Handling
Water
Point Source
Study Area
Great South Bay
MORICHES MID
NORTH ST
MORICHES YAPHANK RD
STATE HWY 27
CHAPMAN BLVD
RAILROAD AVE
FROWN
MONTAUK HWY
VICTORY AVE
FLOYD PKWY
DUNE RD
N
0
2,000
4,000
Feet
CDM

Nitrogen_Loading_Calcs.xls [Compatibility Mode] - Microsoft Excel

D10 | 3.48

Nitrogen Loading - Input Paramteters

Study Area:	Montauk Highway Corridor

Land_Use	Description	Flow_Rate(gpd/sf)	Nitrate Concentration
1	Low-Density Residential	0	0
2	Medium-Density Residential	0	0
3	High-Density Residential	0	0
4	Commercial	0.07	3.48
5	Industrial	0.04	4.25
6	Institutional	0.06	1.02
7	Recreation and Open Space	0.04	1.15
8	Agricultural	0.04	7.83
9	Vacant	0.04	1.15
10	Transportation	0.04	2.39
11	Utilities	0.04	1.02
12	Waste Handling and Manageme	0	5
13	Water	0	0
14	Medium-High Density Residen	0	0
15	Main Street District	0	0
16	Transitional	0	0

Building Footprint - % of Total Parcel	
LU	*Footprint %*
4	20%
5	20%
6	20%
7	100%
8	100%
9	100%
10	100%
11	100%

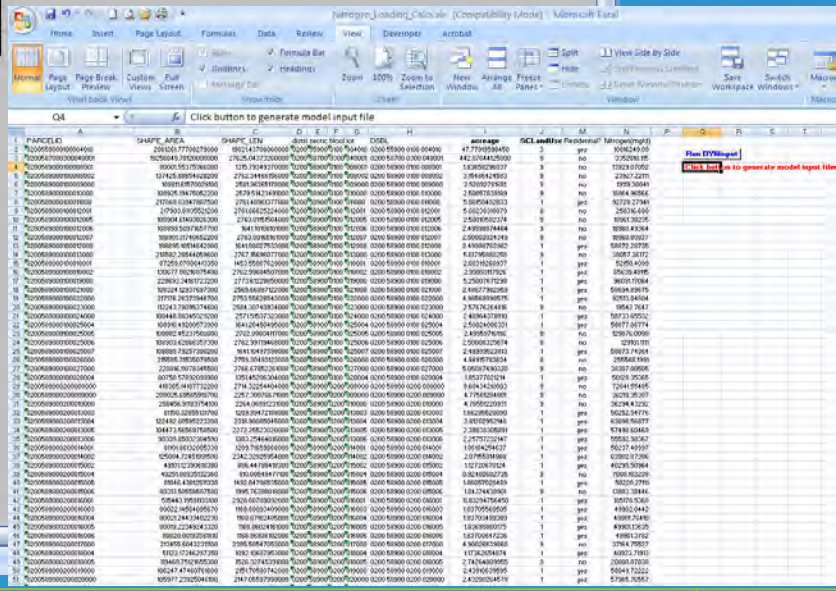
Residential - # Dwelling Units per Acre	
Land_Use	*# housing units per acre*
1	1
2	3
3	8.5
14	5.5
16	1

Residential Mass Rate (lbs-N/person/year)	Removal from Septic Systems (%)	Population Density (people per household)
10	35%	3.1

Fertilizer	
	Application Rate (lbs/1,000sf/year)
	2.5
	Leaching Rate (%)
	20%
% of Residential Parcel Fertilized	
LandUse	*% Fertilized*
1	50%
2	50%
3	50%
14	50%
16	50%

Readme | Parameters | Land_Use | DYNInput

Ready



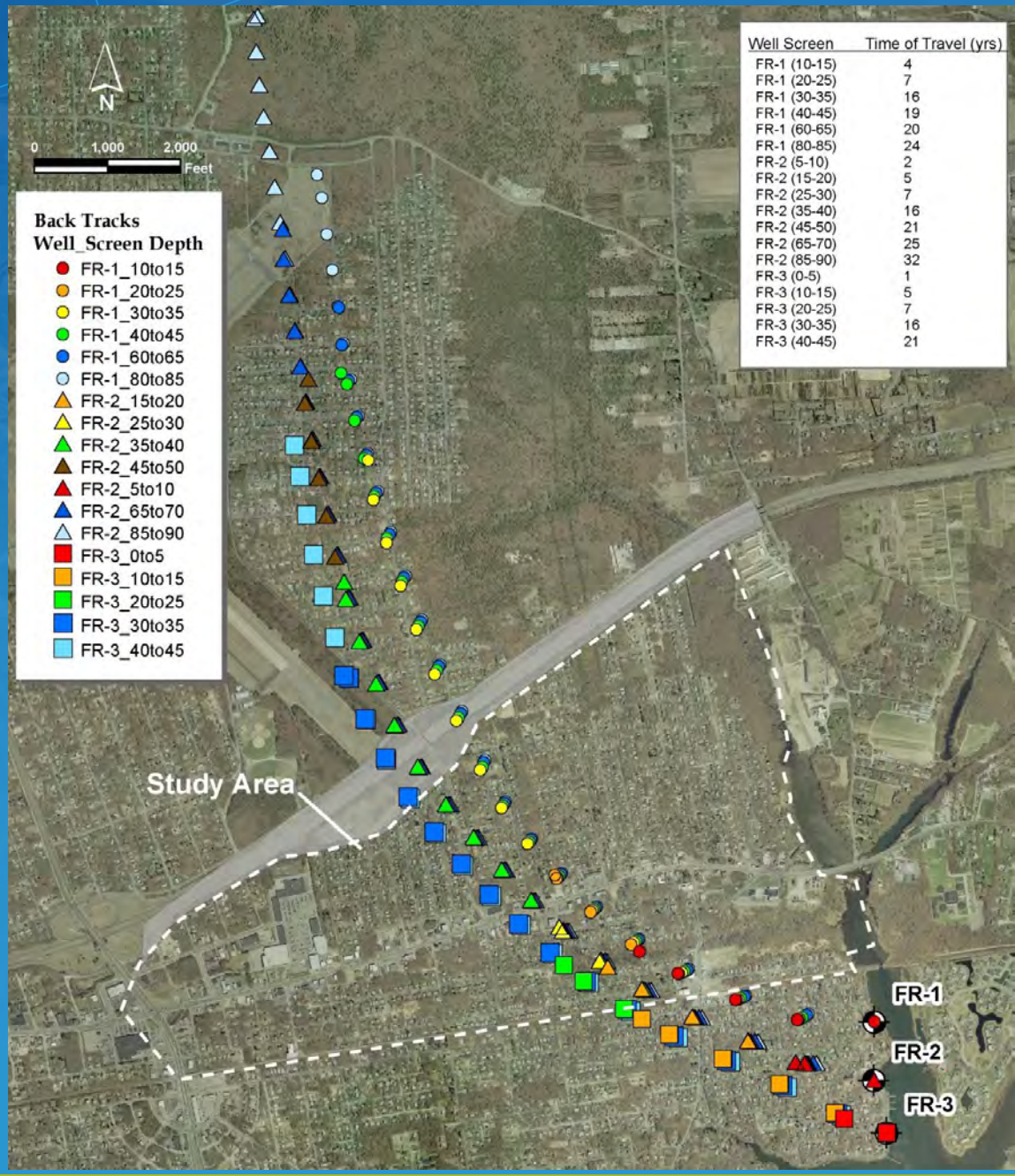
FR-01: 10-15 ft below sfc

20-25 ft below sfc

FR-02: 15-20 ft below sfc

25-30 ft below sfc

FR-03: 20-25 ft below sfc



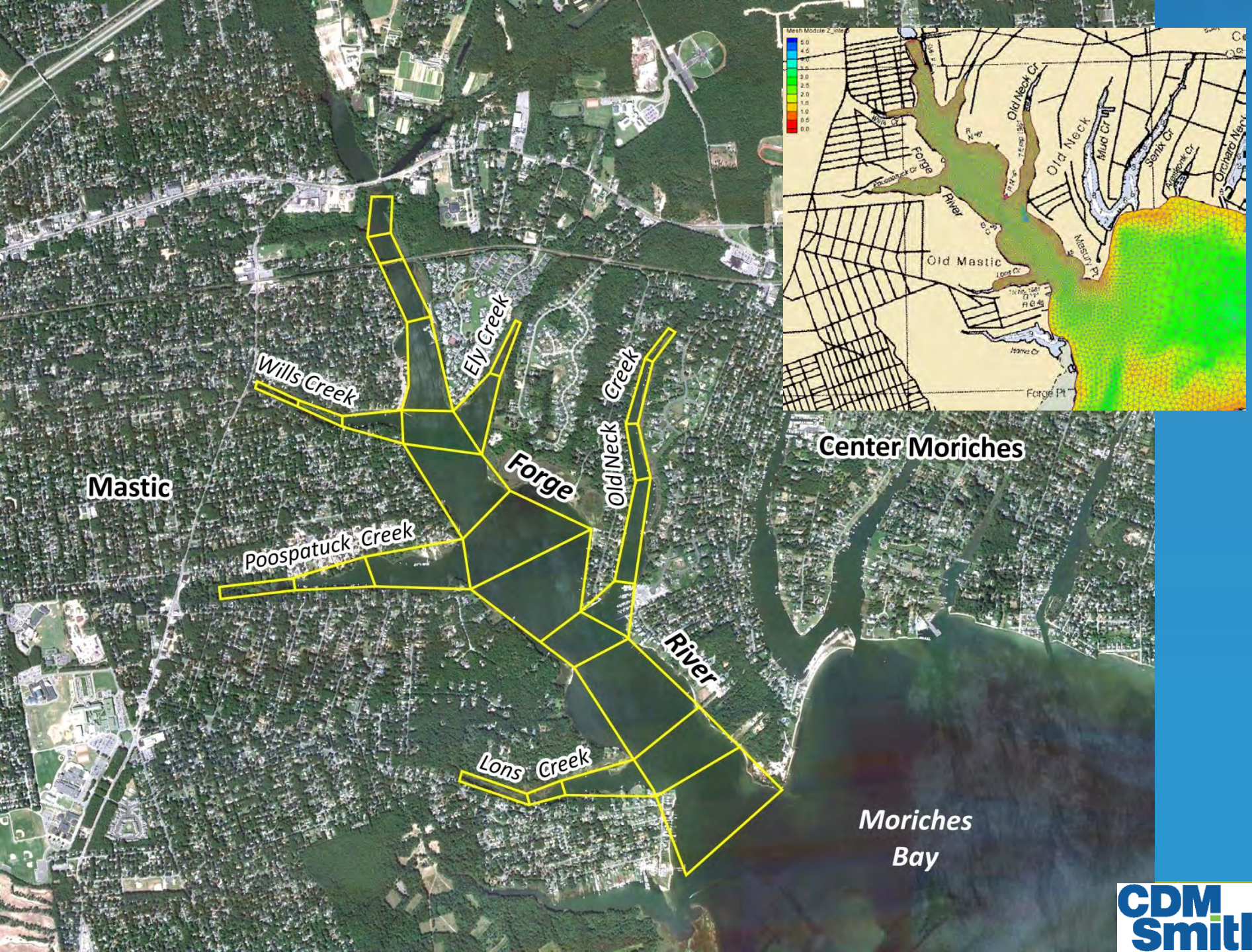
Well Screen	Time of Travel (yrs)
FR-1 (10-15)	4
FR-1 (20-25)	7
FR-1 (30-35)	16
FR-1 (40-45)	19
FR-1 (60-65)	20
FR-1 (80-85)	24
FR-2 (5-10)	2
FR-2 (15-20)	5
FR-2 (25-30)	7
FR-2 (35-40)	16
FR-2 (45-50)	21
FR-2 (65-70)	25
FR-2 (85-90)	32
FR-3 (0-5)	1
FR-3 (10-15)	5
FR-3 (20-25)	7
FR-3 (30-35)	16
FR-3 (40-45)	21

Simulated Nitrogen Concentrations in Good Agreement with Data

Well	Depth (ft below sfc)	Total Nitrogen (mg/L) Observed	Simulated
FR-1	10 to 25	11.03	8.34
	30 to 45	12.29	11.56
	80 to 85	0.30	1.56
FR-2	5 to 20	12.63	12.00
	25 to 40	12.35	11.54
	85 to 90	0.50	2.00
FR-3	0 to 15	9.40	8.49
	20 to 25	7.57	7.54
	40 to 45	3.50	4.51

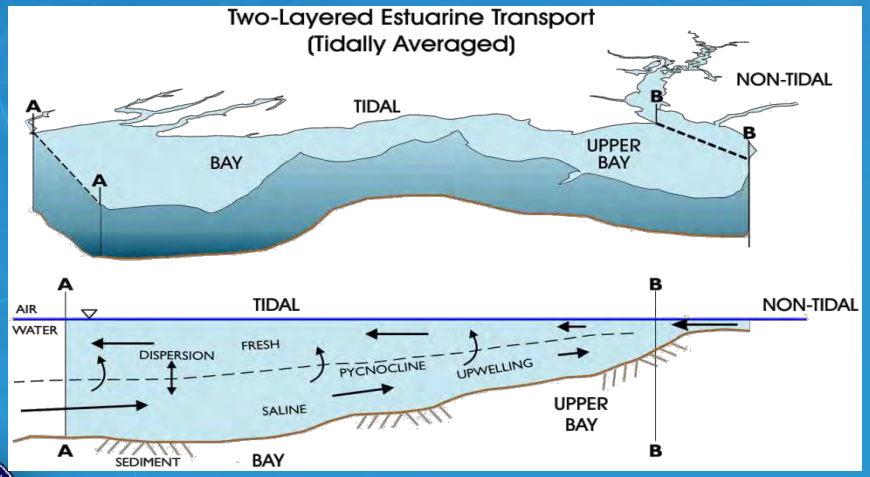
Surface Water Modeling Tools & Prior Application

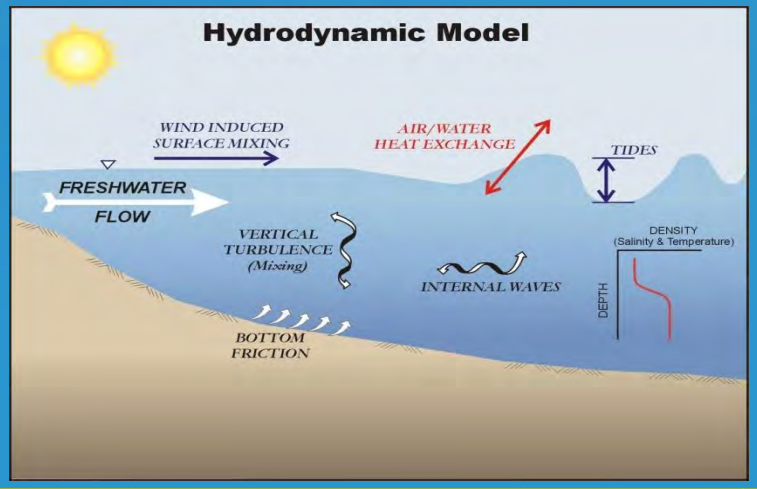
- Hydrodynamic Model
  - ECOMSED or EFDC
- ECOMSED applications
  - Jamaica Bay, NY/NJ Harbor, Hudson River, LIS
  - Delaware Tidal Rivers
  - Many others around US
- EFDC applications
  - Housatonic River (NY/CT)
  - Savannah River/Harbor (SC/GA)
- Eutrophication Model
  - RCA or WASP
- RCA applications
  - Jamaica Bay, NY/NJ Harbor, Hudson River, LIS
  - Delaware Tidal Rivers
  - Many others around US
- WASP applications
  - Perdido Bay (FL)
  - Thames River (CT)
  - Savannah River/Harbor


Mastic
Wills Creek
Ely Creek
Forge
Old Neck Creek
Poospatuck Creek
River
Lons Creek
Center Moriches
Moriches Bay
Old Neck Cr
Old Neck
Mud Cr
Senix Cr
Forge
River
Old Mastic
Forge Pt

Water Circulation (Hydrodynamic Model)

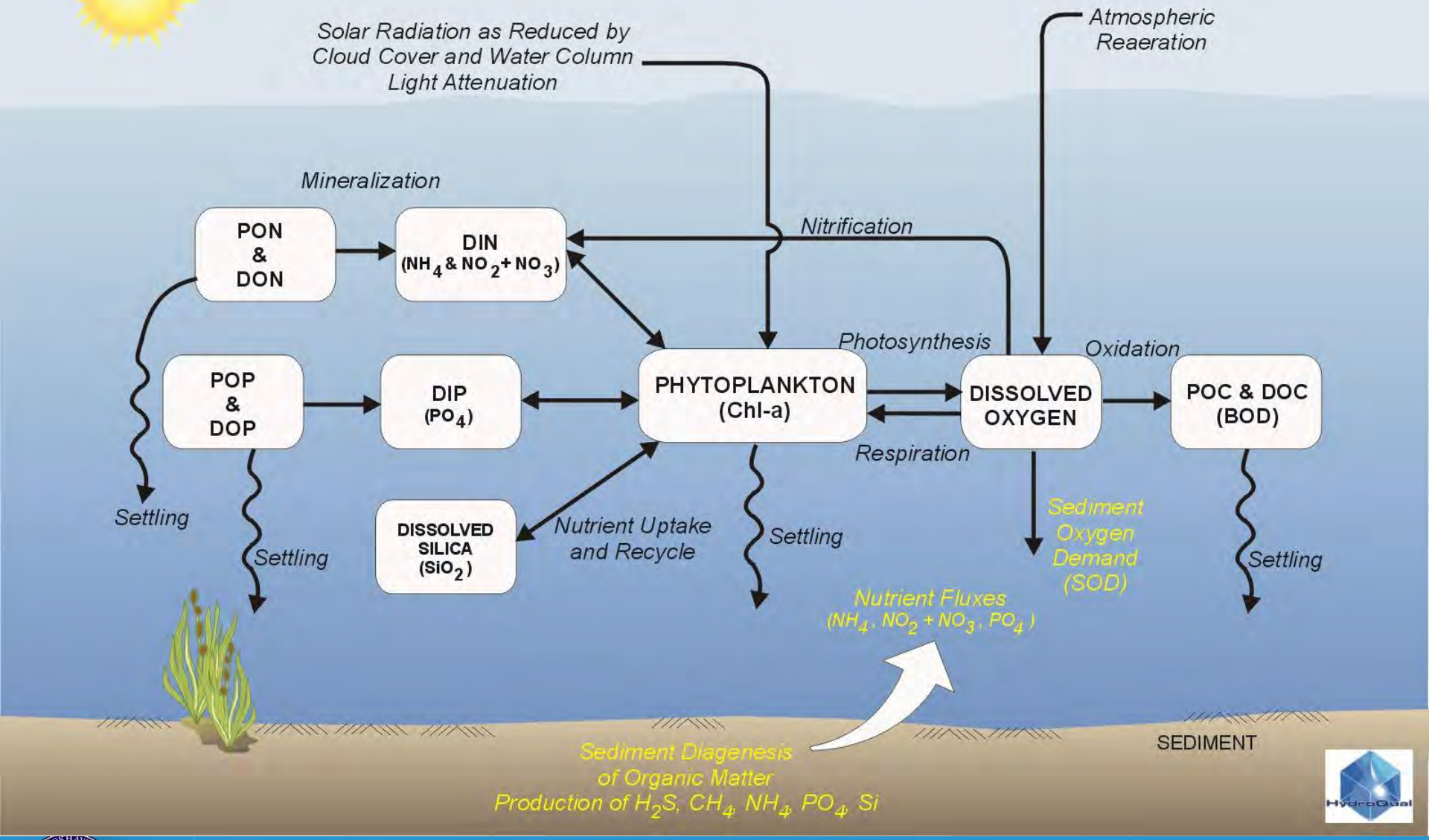
- Original approach: two-layered, tidally averaged (Pritchard)
  - Benefits: quick run time, simple representation of river
  - Drawbacks: cannot assess dredging effects on circulation
- Final approach: time-variable, 3D hydrodynamic model
  - Benefits: better representation of circulation, can assess dredging
  - Drawbacks: longer run times, more complex inputs





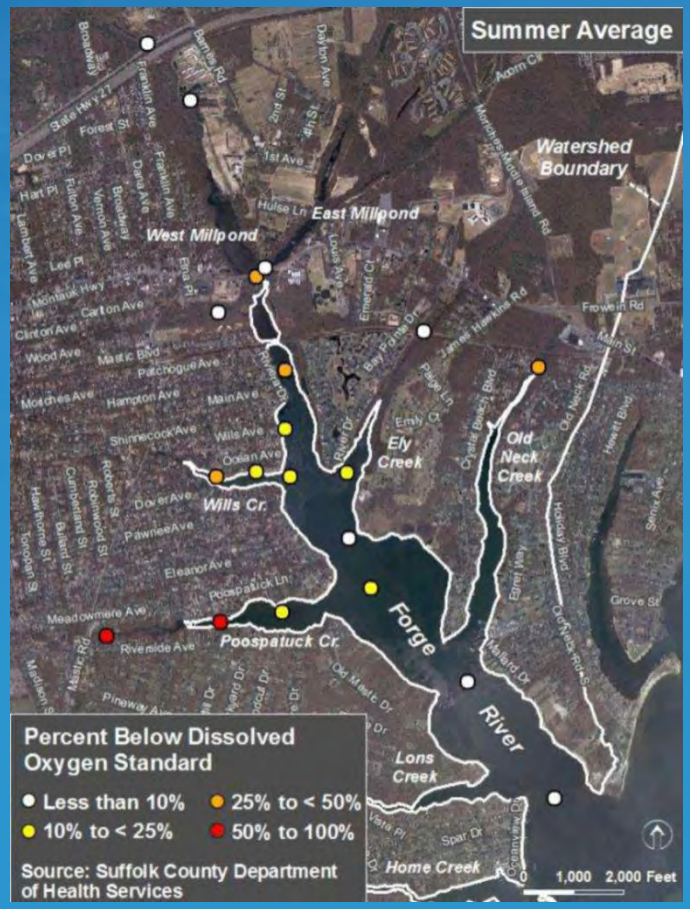
Eutrophication Modeling Framework

(Yellow Text Denotes Sediment Flux Model)



Water Quality Modeling Process

- Define Circulation
  - Currents & Dispersion
- Quantify Loads
  - Groundwater/Watershed Model
- Calibrate Hydrodynamic & Water Quality Models
  - Sediment Nutrient Flux Model
- Sensitivity/Component Analyses
- Determine TMDL & Allocations



Development of Nutrient TMDL Endpoints

- Most critical step in TMDL development !!
- Focus on nutrient effects (endpoints) not concentrations
  - Why we have DO standards (effect) and not BOD standards (cause)
- Also consider:
  - DO, chlorophyll-a, transparency, macro-algae
- Nutrient endpoint target for TMDL is DO

Total Maximum Daily Load (TMDL)

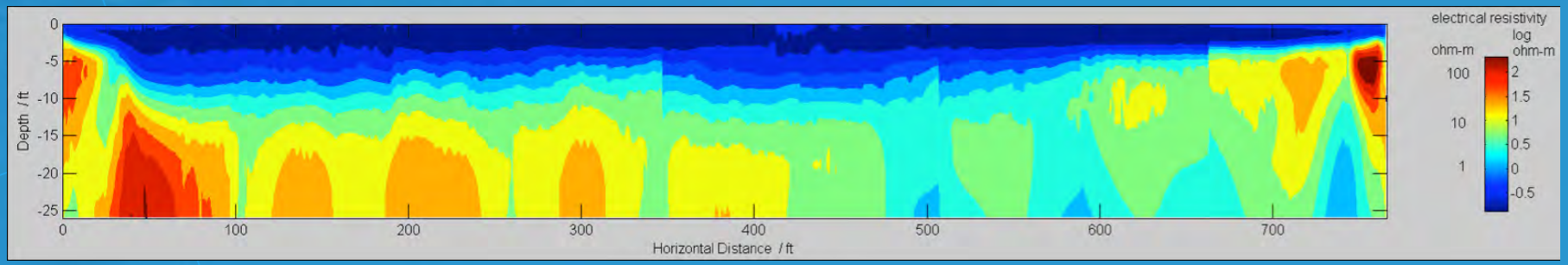
- TMDL = ΣWLA (Wasteload Allocation - Point Sources)

  + ΣLA (Load Allocation - Non Point Sources)

  + MOS (margin of safety)
- May Include Allocation for Reserve Capacity
- Nutrient Endpoint is D.O.
- Equal or Proportional Source Reductions, Account for Prior Reductions, Low Hanging Fruit
- Stakeholder Input & Discussion

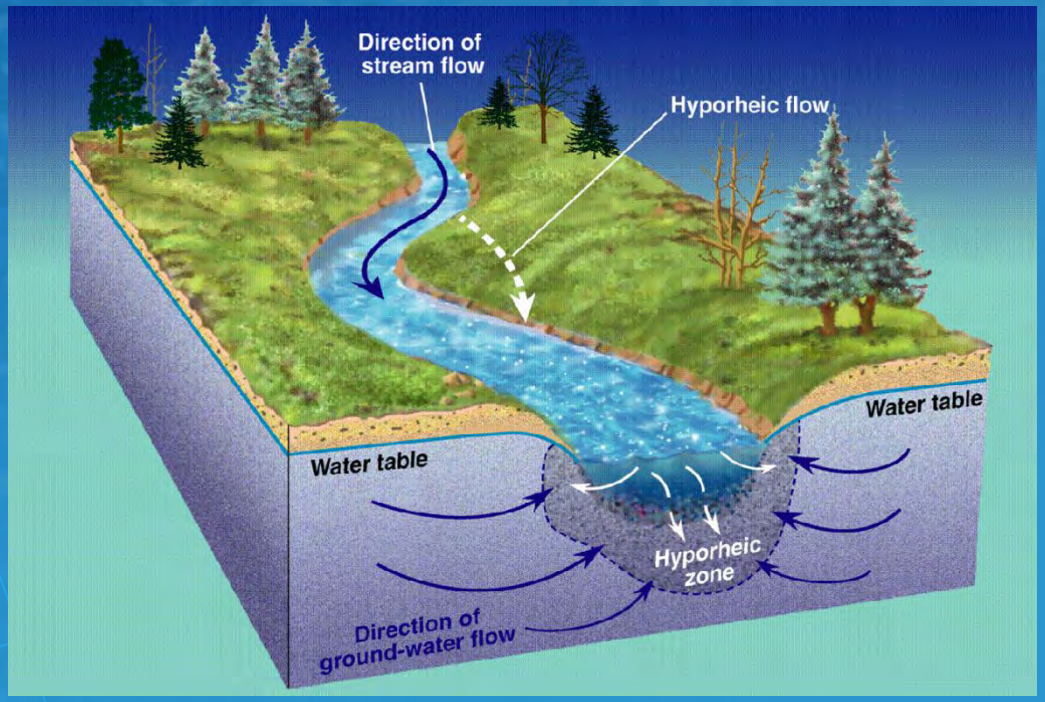
Data Needs

Quantification of Hyporheic Zone Losses

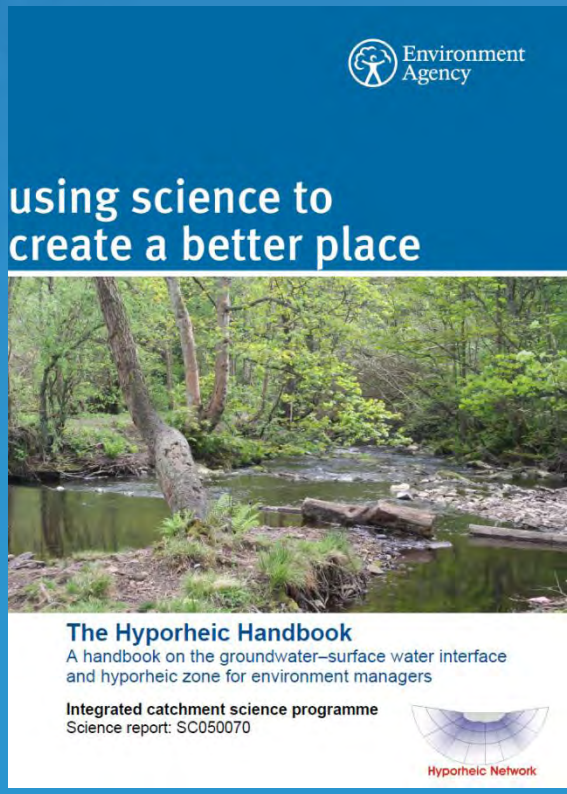


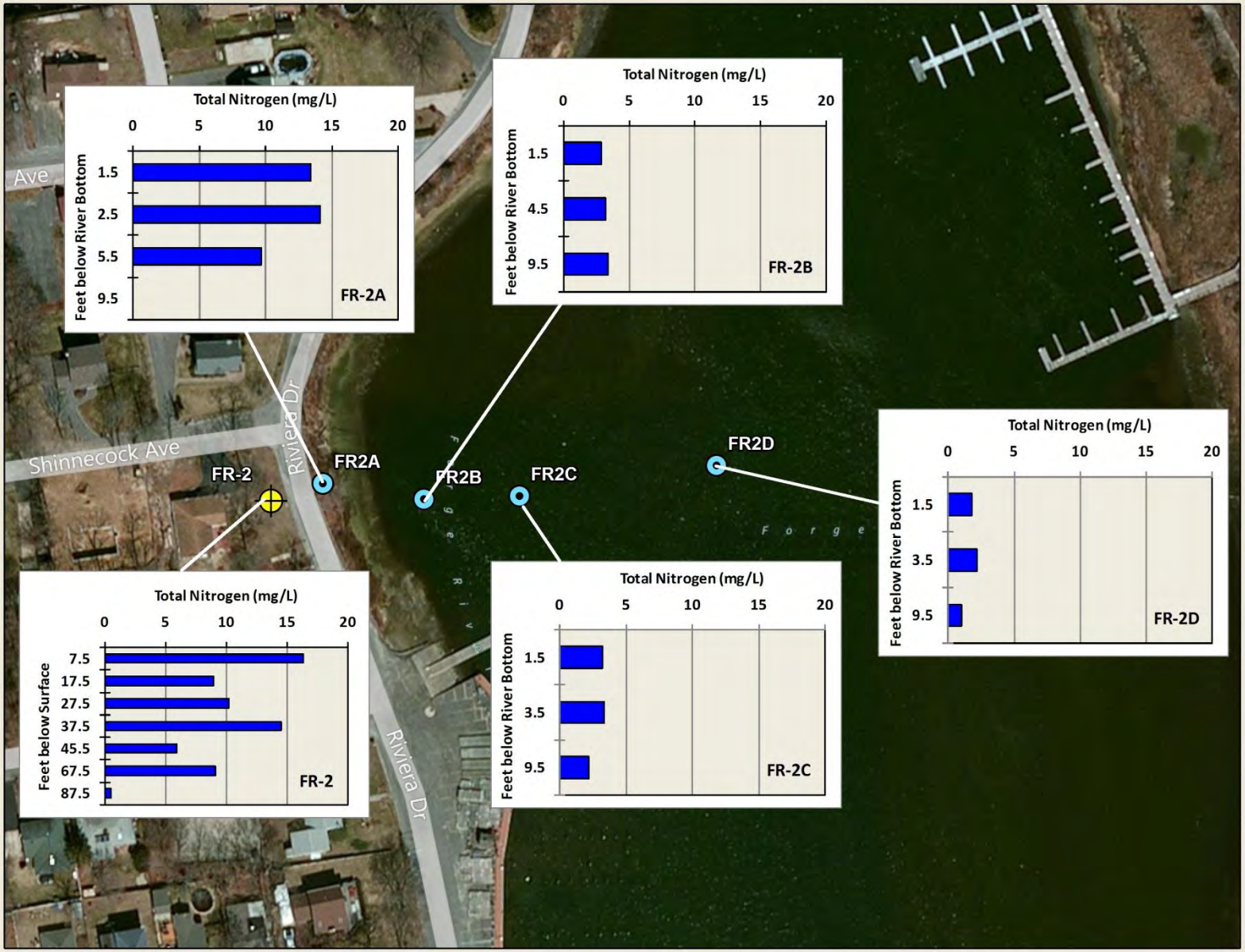
Quantification of Hyporheic Zone Losses

- What is the hyporheic zone and why is it important?



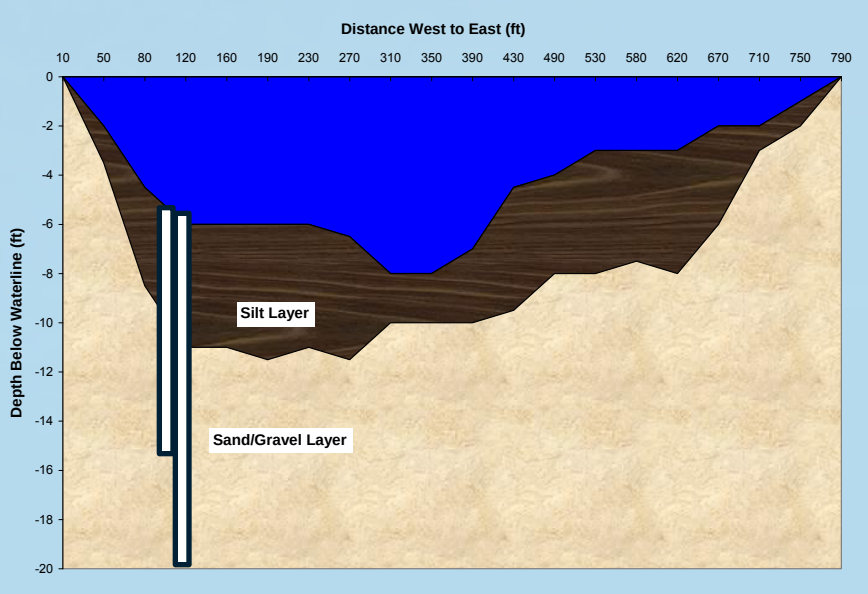
From Environmental Agency, 2009




Total Nitrogen (mg/L)
0 5 10 15 20
Feet below River Bottom
1.5
2.5
5.5
9.5
FR-2A
Total Nitrogen (mg/L)
0 5 10 15 20
Feet below River Bottom
1.5
4.5
9.5
FR-2B
Total Nitrogen (mg/L)
0 5 10 15 20
Feet below Surface
7.5
17.5
27.5
37.5
45.5
67.5
87.5
FR-2
Total Nitrogen (mg/L)
0 5 10 15 20
Feet below River Bottom
1.5
3.5
9.5
FR-2C
Total Nitrogen (mg/L)
0 5 10 15 20
Feet below River Bottom
1.5
3.5
9.5
FR-2D
Ave
Shinnecock Ave
Riviera Dr
Riviera Dr
FR-2
FR2A
FR2B
FR2C
FR2D
Forge River
Forge

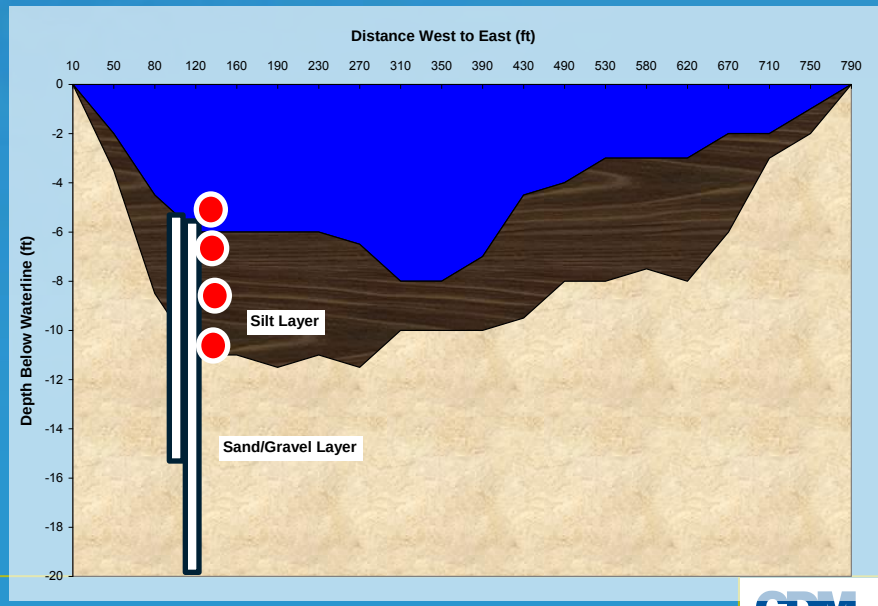
Quantification of Hyporheic Zone Losses

- Expand upon previous investigation by SCDHS/CCE
- Repeat streamline resistivity at high and low tides – set target areas for water quality evaluation
- Install dedicated piezometers along the riverbank and within sand/gravel layer in river



Quantification of Hyporheic Zone Losses

- Collect porewater within silt layer at 3 levels
- Collect porewater from piezometers
- Collect porewater at sediment-water interface
- chloride, conductivity, temperature, pH and nitrate as nitrogen, nitrite, and ammonia



Schedule, Coordination, Communication, Reviews

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Implementation, Monitoring and Coordination

Year:	Implementation Monitoring				
Recommendations	Yes	No	Number	Percentage	Responsibility
Implement alternative on-site treatment					
Remediate/Remove sediment					
Conduct water quality sampling					

Year:	Progress Monitoring				
Targets and Objectives	Criteria	# Samples Collected	# Greater	Percentage	Data Providers
Dissolved oxgyen greater than 3 mg/L	Number of Samples Greater than 3 mg/L				
Dissolved oxgyen greater than 4.8 mg/L	Number of Samples Greater than 4.8 mg/L				

Questions and Discussion