



# Developing a Terrestrial and Management Model

---



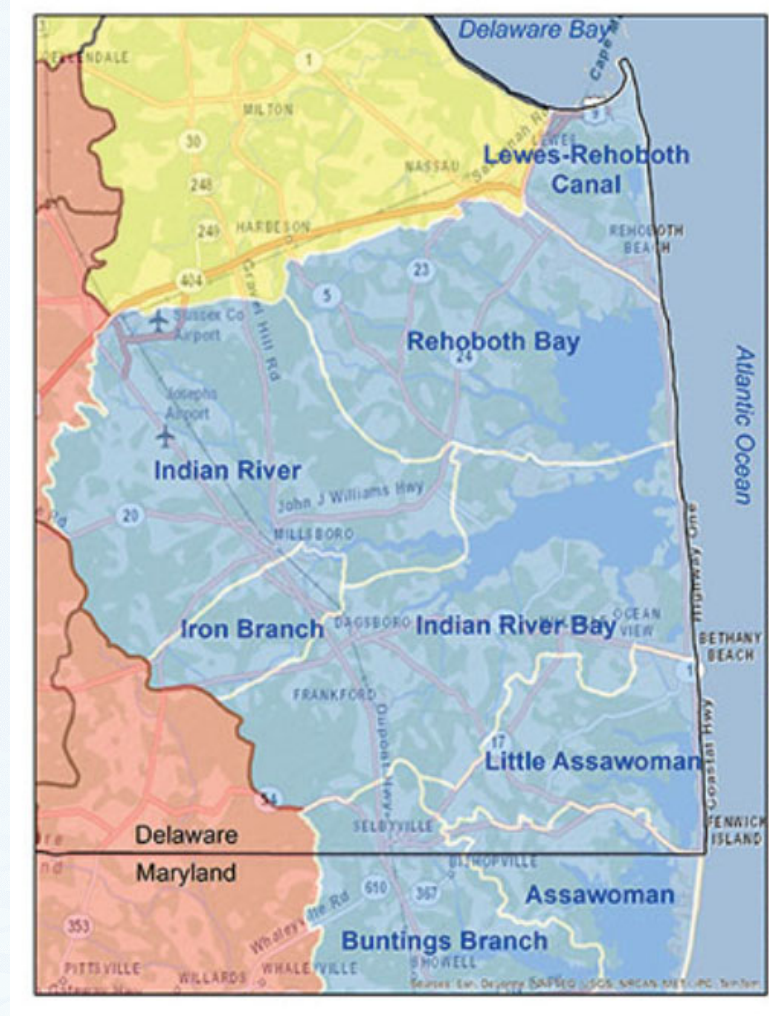
THE MOST INCREDIBLE THING  
WE'VE ENGINEERED IS **OUR TEAM**

*ISO 9001:2015 Certified | Employee-owned Since 1988*

# Model purpose

## *Improve the Inland Bays*

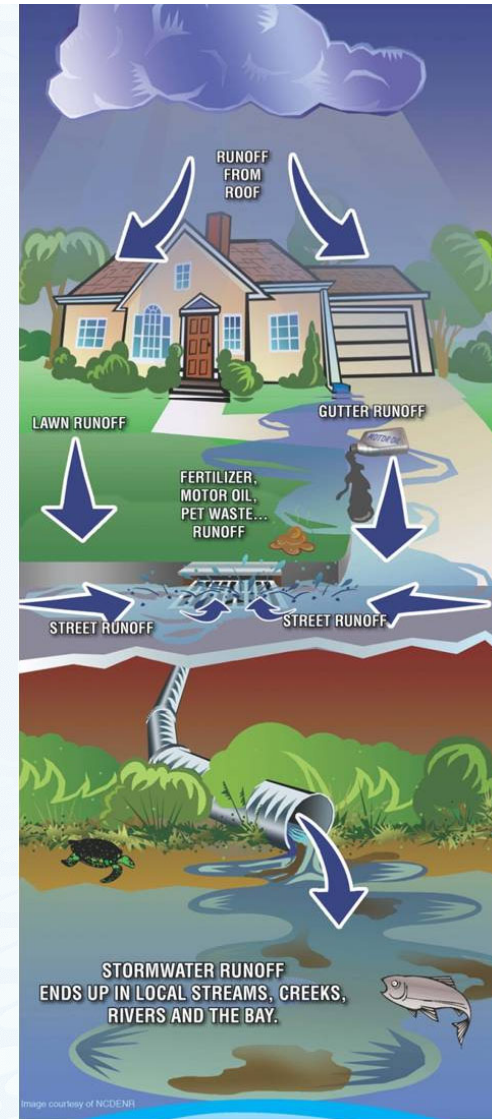
- Identify sources of contaminants
- Determine which management actions can be targeted to control the pollutants
- Assess the effect of management actions on water quality delivered to the Inland Bays
  - Change in land use
  - BMPs
  - Cropping practices
  - More
- Assess the impact of climate change on pollutant loads delivered to the Bays



## Questions a terrestrial/management model answers

Determine the effect of management actions on nutrient and sediment delivery

- Stormwater requirements for inches treated
  - ❖ Runoff reduction
  - ❖ Stormwater treatment
- New development/land use changes
- Agricultural tillage management
- Wastewater spray irrigation impact
- Climate change impacts
- Combinations of BMPs on limiting nutrient applications and runoff



# Model Development

---

- There are two existing models that include information that can be used to evaluate the effects of management actions and climate change
  - USGS's Sparrow model
  - Chesapeake Bay Program's CAST, or Watershed Model
- Both include information that can be used to inform a model that determines the nitrogen, phosphorus and sediment loads delivered to the edge of small streams and to the Inland Bays.
- The CIB Terrestrial and Management Model would simply use data from Sparrow and CAST, not work like or be add-ons to those existing models.

# Data from Chesapeake Bay Program

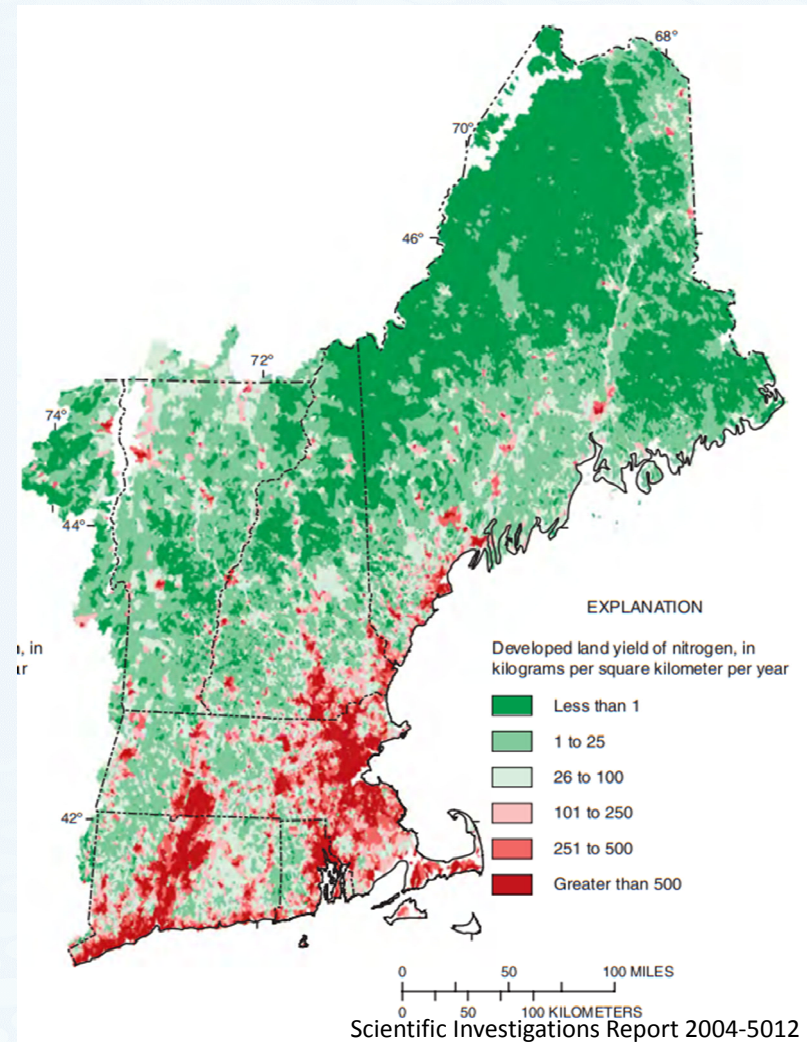
---



- BMP efficiencies
- Land use/land cover
- Loading rates

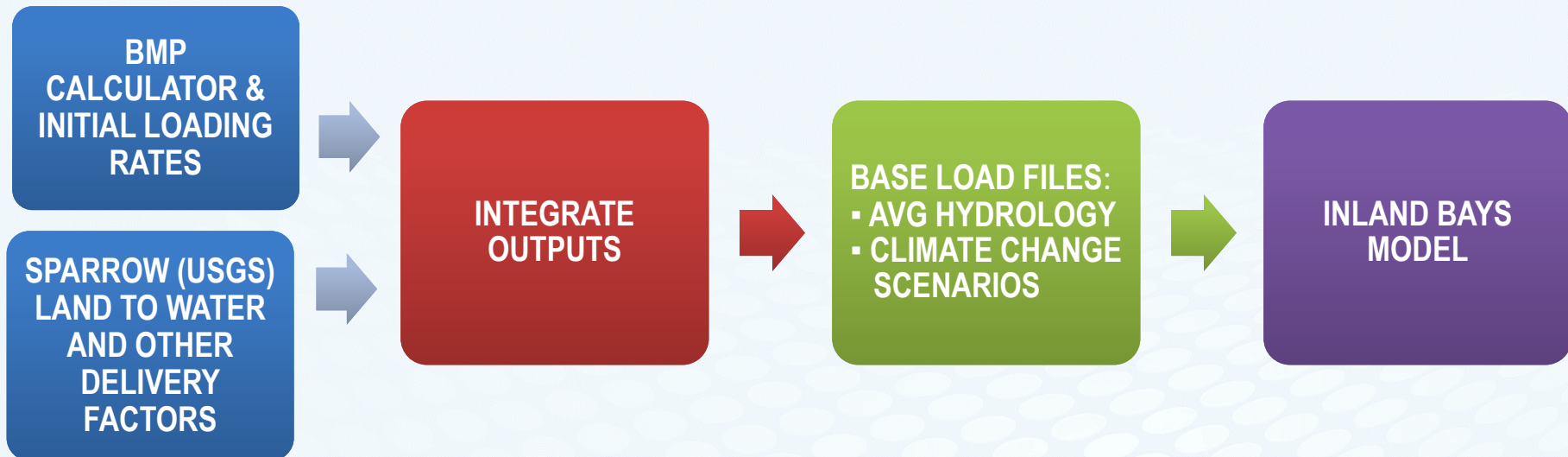
# Sparrow

- Characterizes nutrient loads in rivers based on a regression equation
- Includes nutrient sources, land to water delivery of nutrients, and riverine transport and loss
- Relies on geographic information to link river segments and contributing drainage areas



# Process for Model Development

- Develop a management action calculator that reduces loads depending on the BMPs in a scenario.
- Sparrow provides the loading rate under various hydrologic conditions for various land uses



# Addressing Climate Change

---



- To address climate change, a number of additional hydrologic simulations can be created and used as alternative base conditions from the average hydrology.
- Users of the proposed Inland Bays model will be able to select various management practices and one of several hydrologic conditions to determine the impact on nitrogen, phosphorus and sediment at a stream or to the Inland Bays.
- The effect of BMPs and land use changes can be assessed with the various climate change conditions.



# Model Components



- Manure and fertilizer inputs (from 2018 publication)
- Spray irrigation and rapid infiltration basins
- Point sources
- Management practice data currently in place (DE already has these data from the stormwater database and NRCS)
- Varying hydrological inputs for modeling climate change scenarios
- Appropriate time-scale for inputs to the Estuarine Model
- Available monitoring data



# BMPs

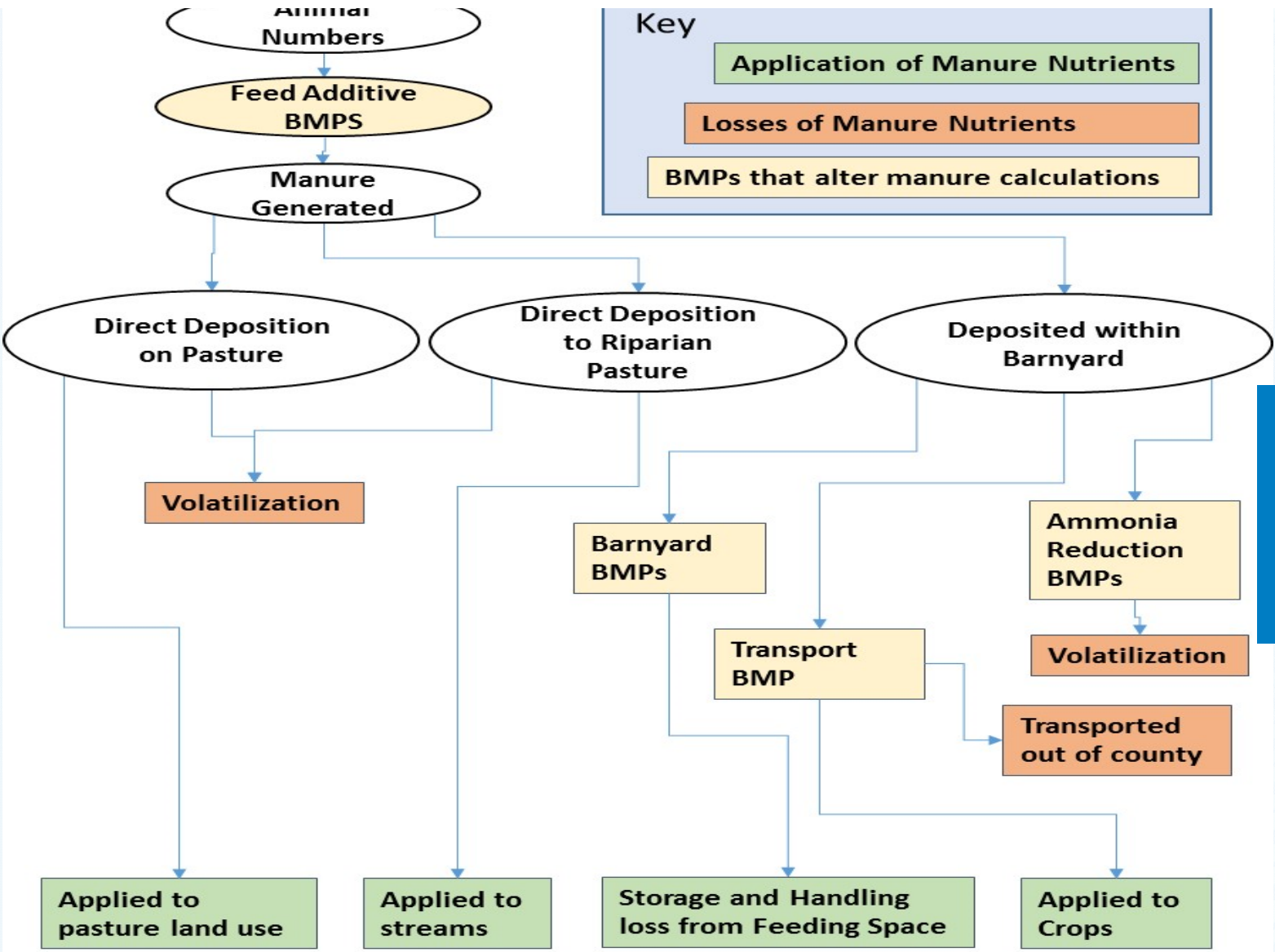
---



- Land use change
  - Captures effects of new developments and infill
  - Forest preservation and new tree planting
  - Agricultural land retirement to open spaces
- Urban sector
  - Green stormwater like infiltration and detention
  - Performance standards like treating first inch of rainfall
  - Stream restoration
  - Septic system upgrades

# Agricultural BMPs

- ❖ Location
- ❖ Sources

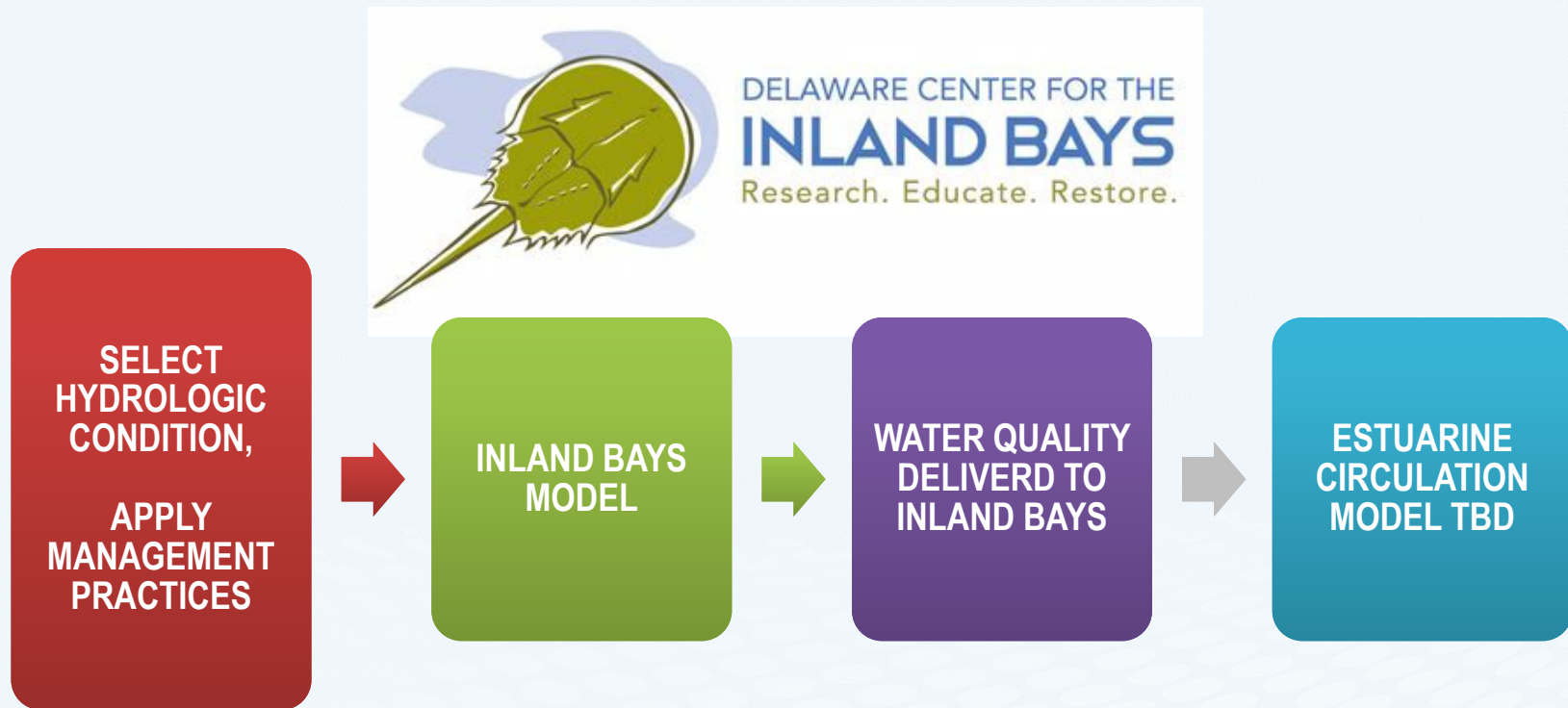


## Using the model

---

- Scale: available at small spatial scales, such as the National Hydrography Dataset Plus (NHD+).
- Source Assessment: model output would include allocation to various land uses to facilitate environmental planning and management.
- Data output
  - the management practice and implementation levels selected by the user
  - the hydrologic simulation selected by the user
  - the amount of reduction in nitrogen, phosphorus and sediment at the edge of a stream or delivered to the Inland Bays.
- Designed to be friendly to those without a modeling background. The requirement for users would be a knowledge of the various management actions, which they can select from a list.

# Model in Application



# Estuarine Circulation Model

---

- The output of the proposed Inland Bays model can be used as inputs for an estuarine circulation model.
- To predict water quality a hydrodynamic model needs nutrient and sediment input terms from non-tidal areas
- Terrestrial model can build on Sparrow but can be enhanced by more and continuous monitoring
- Continuous monitoring is also needed to develop a well-defined hydrodynamic model
- Developing the terrestrial/management model first while collecting monitoring data will facilitate development of the hydrodynamic model.
- Ultimately, terrestrial and estuarine models are both needed.

# Partners

---



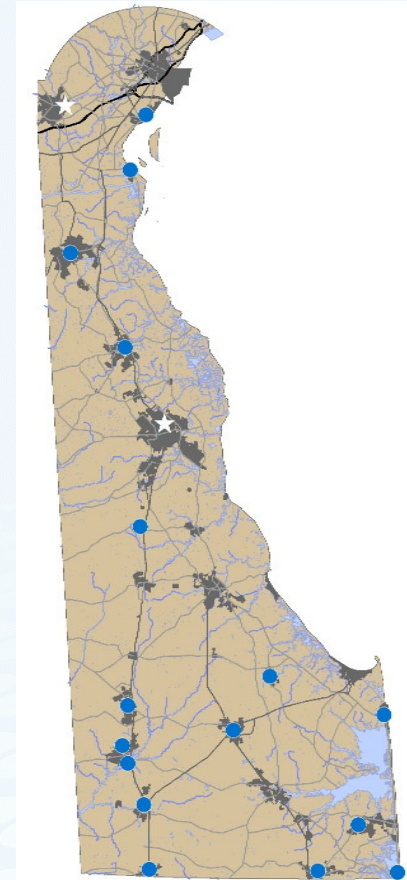
- USGS MD-DE-DC Water Science Center
  - Mark Nardi
  - Scott Ator
  
- KCI Technologies
  - Olivia Devereux

# KCI's Delaware Government Client Portfolio



## Sussex County Delaware

- Serving 12 out of 24 Municipalities
  - 6 Comprehensive Plans
  - 1 Sustainable Community Plan
- Sussex County Engineering
- Multiple Project Partner Relationships







# Questions?

OLIVIA DEVEREUX

KCI TECHNOLOGIES

[OLIVIA.DEVEREUX@KCI.COM](mailto:OLIVIA.DEVEREUX@KCI.COM)