Science & Technical Advisory Committee
TEAMS Online Meeting
Feb. 19, 2021 – Meeting Summary

In Attendance:
STAC Members: Jim Ammerman, Chester Arnold, Vincent Breslin, Sylvain De Guise, Kristin DeRosia-Banick, Dianne Greenfield, David Hudson, Beth Lamoureux, David Lipsky, Darcy Lonsdale (New York Co-chair), Kamazima Lwiza, Robin Landeck Miller, John Mullaney, Jim O'Donnell (Connecticut Co-chair), Suzanne Paton, Brad Peterson, Evelyn Powers, Julie Rose, Paul Stacey, Kelly Streich, Mark Tedesco, Johan Varekamp, Penny Vlahos, Nils Volkenborn, Laura Wehrmann, Robert Wilson, Chester Zarnoch
Others: Jeff Barbaro (USGS), Cassie Bauer (New York Stated Department of Environmental Conservation, NYSDEC), Ronald Busciolano (USGS), Chris Conroy (U. New Haven), Mel Cote (EPA), Holly Drinkuth (TNC), Abdulai Fofanah (NYCDEP), Teresa Gagnon (CTDEEP), Michele Golden (NYSDEC), Rick Greene (EPA), Jim Hagy (EPA), Kevin Hanley (NYCDEP), Richard Isleib (HDR), Lizzy Kaplan, Kate Knight (Connecticut Department of Energy and Environmental Protection, CTDEEP), Jim Latimer (EPA), Julia Lewis (Equinor Wind US), Peter Linderoth (Save the Sound, STS), Bill Lucey (STS), Matt Lyman (CTDEEP), John Masterson (USGS), Jon Morrison (USGS), Dacia Mosso (Tetra Tech), Esther Nelson (EPA), Robert Nyman (EPA), Katie O'Brien-Clayton (CTDEEP), Vicky O'Neill (NEIWPCC/NYSDEC, Michael Paul (Tetra Tech), Casey Personius (NYSDEC), Brenda Rashleigh (EPA), Mikayla Reichard (HDR), Victoria Sacks (EPA), Chris Schubert (USGS), Nancy Seligson (Mamaroneck Supervisor, Citizens Advisory Committee New York Co-chair), Lane Smith (NYSG), Cayla Sullivan (EPA Long Island Sound Office, LISO), Andy Thuman (HDR), Don Walter (USGS), Mike Whitney (U. Conn.) Gregory Wilkerson (NYCDEP)

Introductions, Updates; Darcy Lonsdale started the meeting by noting that Jim O'Donnell wants to step down as CT co-chair and that two STAC members from both CT and NY are needed to form a nominating committee to find nominees for the next co-chair.

Beacon Wind, Offshore Wind Energy Project; Julia Lewis, Equinor Wind US
Julia gave a brief introduction of the Beacon Wind project, and offshore wind project about 20 miles south of Nantucket. She is here to provide a brief introduction to the project and to talk about their data needs, a more complete description will be provided at the June meeting. Equinor is a Norwegian energy company increasingly focused on sustainability, they have two leases in the US, Empire Wind in the NY Bight and Beacon Wind south of Nantucket next to other leases. Beacon Wind was selected by New York State in January for a 1,230 MW project called Beacon Wind 1, connecting into Astoria, Queens. They are currently working on permits and environmental assessments to be completed early in 2022, with construction in 2025 and operational in 2028. The export submarine cable would go from the lease area and through LIS to Astoria. They are looking at available data along the cable route and will be conducting additional surveys this spring. They are reaching to any relevant stakeholders with information or comments and more information is at beaconwind.com.

Discussion:

--Jim Ammerman suggested that anyone with relevant information should contact Julia and asked about the Environmental Justice (EJ) implications of connecting to Astoria. She replied that New York has designated Astoria as an EJ community and that the cable would be connecting to existing infrastructure on already disturbed land.

--Sylvain De Guise asked Julia if she was familiar with the Connecticut Blue Plan and associated map viewer, she said she was and was using it.

--Jim Hagy asked if other wind projects used the same cable pathway and Julia said that the 1,200 MW was about the limit for the grid so each project had to find its own connection point but that the second Beacon Wind area should be able to share a major portion of the same cable corridor.

--Dave Lipsky asked about heat generated by the cable and Julia replied that the cable would be buried four to six feed deep and they would do a specific EMF analysis on the cable but she would have to get back to him with heat information.

--Mel Cote mentioned three recent webinar workshops on transmission issues and mentioned the Northeast Ocean Data Portal which Julia said she has used.

LISS FY 2021 Work Plan and Budget Planning; Mark Tedesco

Mark welcomed some EPA colleagues who were attending this morning. Mark noted that Charlie Yarish had resigned from the STAC after over 20 years of service and 10 years as co-chair. Charlie and Larry Swanson were responsible for reforming the STAC in 2002. He wanted to thank Charlie for all his contributions to the program and his connections to many environmental and citizens groups.

Mark said he would provide a brief update. LISS has had a huge growth in funding over the last five years, in FY21 we are funded at $31M, which allows us to invest in new initiatives. A pie chart showed how the funding is distributed, 11% directly to the LISS research grant program administered by NY and CT Sea Grants. Eight new projects with $2.8 M in funding was just announced by this program and the next RFP to be announced in spring 2022 may have more funding. We hope to further strengthen the linkage of research to management.

The LISS has and updated CCMP for 2020-2024 and everything funded must be linked to that. The LISS must always consider the federal match requirement and is currently reviewing 42 enhancement proposals in addition to our continuing programs. This has strained our budgeting process which will probably be revised in the future. Final decisions will be made by April 15. The research portion of the budget is likely to continue to increase in the future. The LISS will also engage the STAC in the development of the topics for the next RFP.

Discussion:

--Paul Stacey commented on how we are getting a lot of money and will be in the spotlight but we are kind of locked in with the Ecosystem Targets and it is hard to pursue new problems. The LISS has done a good job but has settled into addressing just the same issues as before. Jim O'Donnell said that this was a good meeting to attend to address these issues. Mark said that the work groups would be addressing these issues in the future.

Reducing Hypoxia in an Urban Estuary Despite Climate Warming-A New Publication in Environmental Science and Technology; Mike Whitney, U. Conn.

Mike discussed a new paper he and Penny Vlahos recently published in Environmental Science & Technology on research funded by both the LISS and CTSG. It is good news about a decrease in hypoxia due to a reduction in nitrogen loading, but also a cautionary tale that this progress could be undone by global warming. Mike and Penny thought that it was important to get this information in the scientific literature. Their aim was to establish a direct relationship among reduced nitrogen loading, nitrogen concentration, and hypoxic area and volume. They used decades of CTDEEP monitoring data to make this connection. The second goal of the paper was to examine the role of a warming climate, including LIS waters warming faster than elsewhere, and determine the additional nitrogen reduction necessary to combat the negative effects of this warming on LIS dissolved oxygen concentrations. This is a partial success story because management actions have led to reduced nitrogen loading and improved oxygen conditions, which a rare achievement for a large hypoxic system. But global warming has hampered these improvements in oxygen and will continue if unchecked.

Mike compared the hypoxic areas from 1994, 2004, and 2014, as representative of the decrease each decade, though noting that there is also a lot of interannual variability. Much of the rest of the study focused Station A4, Execution Rocks, where hypoxia occurs every year. They look at the August conditions where peak hypoxia is usually reached. While combined loading from CT and NY wastewater treatment plants has decreased since about 1999, the CT loading decreased from the beginning of that period, whereas the New York City treatment plants did not show significant reductions until 2009, leading to a steeper overall decline in the last decade. In the last few years, the 2000 TMDL goal of a 58.5% nitrogen loading reduction has been achieved. Watershed nitrogen loading was much more variable, there was a decline, particularly in the western Sound, but loading in the central and eastern Sound was largely controlled by river discharge which shows large inter-annual variability.

Mike showed a time series of total nitrogen at Station A4 from 1994 to 2018 (March to Augusts averages) which showed a decline in both surface and bottom waters. The linear downward trend in concentrations was significant despite high interannual variability, much of it again due to river discharge. A question remains as to whether this decline will continue or not in future. August dissolved oxygen concentrations at A4 showed a corresponding increase over the same time period, though they would have been 27% higher as shown by the greater decrease in apparent oxygen utilization (AOU), if not for the decreasing oxygen solubility in bottom waters due to the increasing water temperature. August bottom water temperatures, though variable, have increased significantly at Station A4, though surface temperature, salinities, and stratification show no definitive trends. Hypoxia area and volume have also declined, and the recent peak years have not been as high. Spring chlorophyll was also variable, though correlated with hypoxic volume, as also found in a previous study (Lee and Lwiza, 2008). Ecosystem models can hopefully reproduce some of these findings and improve our understanding of mechanisms and responses to management.

Multiple linear regression analysis after Lee and Lwiza, 2008, showed increases in hypoxia area and volume with increased spring chlorophyll (perhaps an early hypoxia warning), and also with higher CT wastewater treatment plant nitrogen loading, as expected. However, there was a puzzling negative correlation with watershed load from eastern and central LIS.

Finally, Mike compared the increase in LIS bottom temperatures already discussed with an ensemble mean of the Community Earth System Model RCP 8.5, the high-emission, "business as usual" scenario, plotted out to 2100. LIS temperatures are increasing faster than this ensemble mean, leading to an oxygen decline in LIS of more than double the 0.05 mg/l per decade of the ensemble mean. Therefore, a continued nitrogen load reduction of 1.2×10^6 kg/year reduction to 2100, just to counter warming. Overall, this a is a wonderful achievement attained over decades, decreasing hypoxia area and volume, a rare success story in such large hypoxic systems. However, further nitrogen load reductions will be required just to maintain the current increase in oxygen, as well as continuing to combat global warming.

Discussion:

--Paul Stacey noted that while we have achieved the nitrogen reduction goal of the TMDL we have not achieved water quality standards which are the main management goal. He suggested that we may be looking at an ecosystem in transition and perhaps should modify our dissolved oxygen targets. Paul asked Mike for comment who said he agreed but that we should also be looking at the bays and harbors as well.

Trends in LIS Hypoxic Area and Volume; Jim O'Donnell, U. Conn.

Jim started by showing a slide of the declining hypoxic area and volume, developed in a recently completed project supported by the LISS. He showed a previous highly-variable hypoxic area graph, from which he had contended that the hypoxic area may not have actually decreased, though his new analysis has now demonstrated to him that it has. He followed this with a list of results from this new project. This includes an ERDDAP-based system with all CTDEEP and most IEC data and an algorithm to calculate hypoxic volume from all the data. There is also an on-line capacity for future cruises and also developed uncertainty estimates with buoy data. This is a more powerful analysis than simple regressions.

In the thirty-year record, nitrogen load plus wind explains all the variability in the hypoxic area in four of five years, but one in five of these years is statistically anomalous and it is unclear why. He concludes that under current load conditions, 80% of the years should show a hypoxic area below 2 mg/l that is not significantly different from zero and a 3 mg/l average area of 180 km^2 +/- 20 km^2. However, in the 20% anomalous years, the 2 mg/l hypoxic area would average 50 km^2 +/- 20 km^2 and the 3 mg/l hypoxic area 500 km^2 +/- 50 km^2. This effort integrated thirty years of ship surveys and twenty years of buoy data and has statistically demonstrated that nutrient management has worked in LIS.

Jim demonstrated his ERDDAP system and MATLAB web apps that calculate hypoxic area and volume for any CTDEEP ship survey. He can also access vertical profiles from CTDEEP or IEC surveys with another app. He has also tested accessing data from EPA's WQX system, though it is slower than ERDDAP. In the past, Jim was critical of regression lines suggesting a decline in hypoxic area because the regression depends on four assumptions that may not be true. These include: 1. an assumption of linearity or other prescribed variation, 2. the estimates all have the same uncertainty, 3. the errors in the estimates are normally distributed, and 4. the estimates are uncorrelated from each other. These assumptions can be tested and most are not true, the trends in loading and hypoxia are not linear, and the estimates are serially correlated and not normally distributed.

Part of this contract was to estimate the uncertainties in the errors to correct the heteroscedasticity problem and make the errors uniform. He can also examine the variation with load, most of this variation is in loads from the East River. Some time ago he realized that the hypoxic areas should be binned in periods of three separate decades to remove the assumption of linearity. The error bars suggested that there was a significant difference between the first and last decades. Estimating errors in the hypoxic area mapping is complicated, in the early years (1987-1991) the maps were generated from only seven or eight stations. Now with many more stations, there is greater granularity. Jim simulated "array bias" by comparing the error from sampling seven stations vs. many stations. It depends on the pattern and with 30 years of data there are lots of ways to estimate the errors which can be a few hundred square kilometers.

A second source of error is due to the hypoxia surveys occur over a couple of days and the hypoxia can vary greatly from day to day as shown by the buoy data, even when the general trend is in one direction. This variation has been shown at the Execution Rocks, Western Sound, and ARTG buoys. The standard deviation in dissolved oxygen is greatest at Execution Rocks, about 0.6 mg/l, while half that (0.3 mg/l) at Western Sound, and only 0.2 mg/l at ATRG, when comparing a point sample to the five-day mean. This shows that previous arguments that the variation in the area of hypoxia were due to wind direction or sampling errors were incorrect. Uncertainty in the hypoxic area is greater when the area is large because the hypoxic contours move to the east where the stations are sparse. Uncertainty was also higher in the early years of the hypoxia survey (1991-1993) when stations were limited.

Using these uncertainty values and Chi-Squared statistics, Jim determined that 80% of the hypoxic area values conform to the nitrogen loading model (the "normal" regime), but 20% (1994, 1997, 2003, 2012, and 2016) do not. This is true for either the 3 mg/l hypoxic contour or the 2 mg/l hypoxic contour, in the latter case the hypoxic area since 2015 is not different from zero. Adding in wind values improves the Chi-Squared statistics but does not explain the anomalous five years, though interestingly the slope of the anomalous years is similar to that of the normal regime. Most of the anomalous years remain to be explained as shown on a brief summary slide.

Discussion:

--Sylvain De Guise asked that since we don't know the cause for the unusual years, do we expect them to occur in equal frequency in the future? Jim said now that we are now are aware of them, we can likely find the causes. Sylvain suggested that a 20% frequency of anomalous years in the future was uncertain. Jim noted that he is using the daily annual average nitrogen discharge, which can vary seasonally and otherwise, and needs to be more closely examined.

LIS Integrated Modeling Effort; Dave Lipsky, NYCDEP; and Andy Thuman, HDR
Dave announced that the Integrated modeling effort has begun and listed the members of the Project Team for DEP (Pinar Balci, himself, and others) and HDR (Robin Miller, Andy Thuman, and others), as well as additional assistance to HDR from CDM for watershed loads and DHI for GUI development. The Model Evaluation Group (MEG) for peer review of the project is led by Andy Stoddard (Dynamic Solutions) and includes Jim O'Donnell (U. Conn.), Carl Cerco (previously with USACE), and John Warner (USGS). The MEG will provide independent review of LIS modeling and project documents and interact directly with DEP and the Modeling Management Advisory Group (MAG). He then listed a number of documents that the MEG would review, including the QAPP and the Model Selection and Setup Report, as well as others.

Andy took over and delved into the model selection and setup and also mentioned the need approval of a QAPP. They are reviewing a series of both hydrodynamic and coupled water quality models using the following criteria: 1. Contains needed processes, 2. Proper spatial scale, 3. Well-tested, 4. Public domain/open source (Particularly Important!), and has 5. Regulatory familiarity. Most of these models have a lot of similarities and specific LIS code refinements will be documented in GitHub as modeling progresses.

Following the above, there will need to be refinements of the old SWEM model grid with smaller segments and including NY and CT embayments. The overall grid will likely extend from Delaware Bay to Nantucket Island and including all the important New York regional area water bodies. There is evidence of an improved resolution of bottom water oxygen over SWEM using a finer model grid previously developed for a larval transport model so they are hopeful that a finer grid will be an important step forward. Andy summarized the water quality kinetics required in the model using a diagram. It included particulate and dissolved organic nitrogen (N), phosphorus (P), and carbon, as well as inorganic N and P. Additional components include silica, multiple algal groups, dissolved oxygen, and a coupled sediment flux modeling which calculates sediment oxygen demand and nutrient fluxes.

Initial model calibration will be to the SWEM 1994-1995 extensive data set and will assess improvements due to model grid revisions, investigate water quality model rate coefficients, and compare to the original SWEM results. Following that will be long-term time series, with model calibration using 2003-2010 data, and model validation with 2011-2018 data. There will also be two stand alone embayment models, one each on Long Island and Connecticut, and testing of the linkages between the embayments and the open Sound model. The time series will include different management scenarios dating back to 1994-1995 and up to 2018 and cover periods both before and after the major reductions in wastewater treatment plant nitrogen loads. A post-audit time period from 2019-2022 will test the mode with an independent data set.

Initial hydrology data analysis shows a wide range in Connecticut River summer flows during both the calibration and validation time periods, with a possible decrease during the latter period. In contrast, temperatures at Station A4 increased between the two periods. The graphical user interface and decision support tool (GUI/DST) to be developed as part of this project will be a cloud-based system made iteratively by GHI. It will provide both model output and data handling and there will be multiple opportunities to provide input on user needs to optimize the user experience. The modeling team will also develop a LIS Wiki SharePoint site for providing and transferring model data and related information. QAPP approval and model selection are the first tasks in the project schedule, hydrodynamic and water quality modeling development will follow, as shown in a timeline. Testing of the 1994-1995 modeling period should happen shortly. There is discussion of trying to accelerate some of the main modeling tasks in the first two years, though the overall project will last five years and the GUI/DST development will continue throughout most of the project due to its iterative nature. At the end of the project there will be a technology transfer component. Andy also showed a list and timeline of panned documents, including those to be reviewed by the MEG. They are currently collecting and compiling needed data and still have some areas where more data is needed, including sediment fluxes, stormwater and combined sewer overflow loads outside New York City, water quality model rates, and offshore water quality among others. Dave Lipsky added that there will be annual workshops to report progress.

Discussion:

--Sylvain De Guise said that the modelers should be aware of recent research investments by the LISS in biogeochemistry both in the water column. Andy said he some information but would further explore the issue.

--Kamazima Lwiza wondered if two phytoplankton groups in the water quality framework was sufficient, particularly in terms of silicate and phosphate utilization. Andy said they were not limited to just two groups, but will consider additional input from data and stakeholders. Kamazima mentioned the following paper as a source of information[1]: Suter, E. A.; Lwiza, K. M. M.; Rose, J. M.; Gobler, C.; Taylor, G. T., Phytoplankton assemblage changes during decadal decreases in nitrogen loadings to the urbanized Long Island Sound estuary, USA. *Mar. Ecol.-Prog. Ser.* **2014,** *497*, 51-67.

<u>Overview of Selected USGS Studies and Data Collection around Long Island Sound, NY and CT;</u>

Jeff Barbaro, Janet Barclay, Ron Busciolano, John Masterson, Jon Morrison, John Mullaney, Chris Schubert, Don Walter, John Warner, and many others, USGS

Jeff Barbaro provided an overview of active and recently completed modeling studies and data collection around LIS which involved a lot of USGS staff. Jeff's outline showed a list of the modeling studies organized by small scale to large scale studies. USGS CT water quality monitoring includes the long-term and surveillance networks as well as project-specific sampling which contributes to modeling by other groups. The outline concluded with information on web and data visualization.

Jeff then summarized the Coastal CT Groundwater Assessment, lead by Janet Barclay, which is completing phase 1 and anticipating a 2021 publication. Phase 2 will focus on groundwater nitrate transport and discharge to the coast and is beginning. Another major study is the sustainability of the LI Aquifer System, led by John Masterson. This is a large and comprehensive study building on many past LI groundwater models, and the model has been developed and calibrated and several reports have been issued. It will ultimately be used for management and addressing climate change. A third project which is completed is the CT Sustainable Yield Estimator, which can estimate daily mean streamflow for ungagged sites in CT from 1960 to 2015. Finally, the last model is the COAWST: Coupled-Ocean-Atmosphere-Wave-Sediment Transport Modeling System which incorporates four open-source models and is mainly used to used to investigate the dynamics of coastal storm impacts and is run in forecast mode.

Water quality projects include the Southern New England Water-Quality Network (Jon Morrison) with 65 discrete sampling sites and 14 continuous sites providing long-term water-quality and loading records useful for hydrologic modeling and going back to the 1960s at some sites. Additional components of the network include the Connecticut River watershed monitoring which now has four stations with continuous nitrate monitors. Also included is a pilot study to sample and fill in gaps in the lower portions of three major tributaries, the Connecticut, Housatonic, and Thames Rivers. USGS is also collecting a calibration data set in support of the CT statewide HSPF model with 24 discrete and 7 continuous sites over three years, a similar project was just completed in the Pawcatuck River Basin. A new project starting this year is the CT priority embayment monitoring in four embayments over three years to provide data for modeling.

Long Island is a groundwater-dominated system in contrast to the CT surface water system, and USGS has a network of 550 monitoring sites on Long Island that are regularly sampled, additional surface water monitoring is also conducted. This information is used for a Depth-to-Groundwater Mapper, a tool to provide this information for any location on Long Island. Finally, Jeff showed a map of the many USGS sites within the LIS watershed with streamflow data from October 2019 to the present. USGS is currently developing a web portal to summarize their studies and make them more accessible, including interactive mapping applications showing nitrogen loads and other parameters.

Use of Numerical Models to Estimate Time-Varying Nitrogen Loads to Coastal Waters, Long Island, NY; Don Walter, USGS

Don introduced his talk by listing the negative impacts of excess nitrogen on water bodies and then mentioned the major sources. He noted that Long Island is at the northern end of the North Atlantic Coastal Plain Aquifer. The only remaining components on Long Island are the Magothy and Lloyd aquifers, which are 60-million-year-old Cretaceous sediments. Overlaying the Magothy is a glacial aquifer and the two are the sole-source aquifers supplying drinking water to the three million people on Long Island. There is a wide range of groundwater ages and travel times in the aquifers and legacy nitrogen sources from past land uses such as agriculture have to be accounted for in models.

In 2016, USGS got involved in the NAQWA Program's North Atlantic Coastal Plain Study. On a regional scale this study evaluated the influence of nitrogen associated with legacy land uses to current nitrogen loading and estimated the current distribution of nitrogen in the Long Island aquifer system. This information could then be leverage to develop detailed inset models for specific watersheds of interest and working with stakeholders to use them to predict management impacts on future nitrogen loads.

The Long Island steady-state regional groundwater flow model (Phase 1) is completed and the information is published, and work is underway on Phase 2 which shows transient conditions, adds solute-transport capabilities, and simulates the freshwater/saltwater interface. Understanding of transient flows, both natural and man-made, is essential to determining nitrogen transport, and Long Island aquifers are dependent on recharge from the variable rainfall. There are also 1600 well pumping 450 million gallons per day on average from the aquifers, and this pumping rate has also varied over time. The model looks at groundwater age, which helps to determine susceptibility to contamination, and also recharge areas with travel times. It displays both pre-development and current conditions, which demonstrates the impacts of pumping.

To simulate nitrogen transport on Long Island, historical sources (wastewater, crop and lawn fertilizer, livestock, and atmospheric) were compiled for the period 1900-2019. Land use and nitrogen sources have changed dramatically over time. These loads were converted to input concentrations based on recharge, attenuation, and other factors. These time-varying nitrogen sources were then incorporated into the transport model to simulate nitrogen transport and estimate the current nitrogen distribution in the aquifer and current and historic loading rates to wells and surface waters. There are three levels of complexity used to simulate nitrogen transport to receptors from the simpler to more complex source aquifers: 1. Watershed and nitrogen-source data layers (GIS-based analysis), 2. Mass-weighted particle tracking (implicitly represent mass), and 3. Solute-transport (explicitly represent mass). Numerous maps of groundwater concentrations were shown, since nitrogen is relatively conservative, there was some correlation with groundwater age, areas of sewers were also evident. When time-vary nitrogen sources and stresses were included, complexity increased, model estimates improved, and future predictions became more realistic. Every estuary has a unique story, nitrogen flushing times for LIS is longer than the South Shore Estuary because there are fewer surface streams and long travel times.

Don finished by using the Peconic Estuary as example of what they can do for LIS. They developed detailed transient solute-transport models of the estuary area and associated watersheds and downscaled aquifer nitrogen concentrations from the regional to the inset model. Working with stakeholders, they can them simulate changes in nitrogen loads in response to management actions by running scenarios and ultimately producing a USGS data release publication. For LIS, about one-third or 470 square miles of Long Island is in the LIS watershed. Seventy percent of groundwater discharge to LIS is directly from the water table, and unusually high percent, freshwater streams and wetlands account for the other 30%. Travel times are long, with mean and median values of 60 and 23 years, respectively. Land use has changed from predominantly agricultural to predominantly residential and this agricultural legacy coupled with the long travel times means nitrogen inputs will continue for a long time. The LIS model includes the Peconic inset model plus two more inset models, LIS East from Peconic headwaters to the Nassau County line, and LIS West which is Nassau County and Brooklyn and Queens. Current goals include model and nitrogen source development in FY21 and scenario development and documentation in FY22. Remaining issues include QAPP preparation, technical coordination, local stakeholder involvement, and scenario development. **It will be particularly important to involve appropriate LIS local and technical stakeholders to provide input.**

Connecticut DEEP: Overview of CT's Modeling Efforts; Kelly Streich, CTDEEP
Kelly provided an update on Connecticut's modeling efforts, including planning activities and expectations going forward, they are still in early phases so don't currently have many results. She will review the history of the nitrogen TMDL for LIS, Connecticut's 2nd generation nitrogen strategy, priority embayments, embayment demonstration projects, and large-scale efforts including the statewide HSPF model and embayment specific models.

Kelly reviewed the LIS nitrogen TMDL adopted in 2000 which called for a 58.5% reduction in total nitrogen loading which included reductions from wastewater treatment plants (WWTPs) in NY and CT, WWTPs in upstream states, non-point source reductions (NPS), and atmospheric reductions. CT's WWTPs reductions were 63.5%. CT achieved its WWTP target in 2014 and 65 to 72.5% reductions in 2015 to 2019. Additional NPS effort have included watershed-based planning and BMP implementation, agricultural nutrient management plans, and stormwater permits including nitrogen controls and monitoring.

She then showed a graph of the decline of CT WWTPs nitrogen loading from 2002 to present, with its annual variation due climate conditions, and briefly reviewed the reduction in hypoxic area discussed by Mike Whitney earlier of about 0.5 mg/l per decade. She also mentioned the Mullaney 2015 report showing decreasing total nitrogen fluxes in some CT rivers but not others. The 2nd general nitrogen strategy is a response to remaining nitrogen loading problems including: 1. Continued focus on WWTPs, including planned upgrades and the nitrogen trading program, 2. Enhanced stormwater management including regulatory measures, 3. Continue NPS stormwater management, and 4. Focus on embayments including outreach and education, choose priority embayments for evaluation and TMDLs, and assess septic nitrogen loading in coastal watersheds. Modeling efforts focus on the last three, stormwater, NPS, and embayments.

Priority embayments were chosen based on ecological stressors and social factors from existing data and/or knowledge of active organizations. Other factors including high nitrogen estimated loading and inorganic nitrogen concentrations determined by Vaudrey et al. in 2016. These embayments were shown on a map and several include additional areas adjacent to those listed. Certain waters and watersheds are also on the priority list for further studies.

A demonstration project in the Niantic River Estuary is a cooperative effort with the Nitrogen Work Group, federal and state partners, NGOs, and other interested stakeholders. There is a long history of information and data collection from this area, so it was largely a synthesis of impacts on eelgrass and hypoxia from stressor like river flow and nutrients. It includes development of an estuarine model with watershed loading input, and additionally development of nitrogen loading targets protective of eelgrass. Evaluation of mitigation strategies and assessing the transferability of this approach to other CT embayments are additional tasks. Data synthesis for the Niantic project is complete and 89% of the variability in eelgrass health is explained by five factors, primarily average summer air temperature and average annual water temperature. The hydrodynamic modeling is complete and the biogeochemical modeling is being finalized. The modeling is conducted by U. Conn and reviewed by EPA ORD. A second project is the Pawcatuck River project which involves Rhode Island DEM and includes sampling by USGS, EPA, and others. There is also HSPF watershed and WASP modeling.

The larger scale statewide HSPF model will include watersheds at a minimum of HUC 12 scale. It should also predict nitrogen, phosphorus, suspended solids, dissolved oxygen, chlorophyll *a*, and water clarity. It should also nest with the new LIS integrative model or provide input to it, as well simulate actual and predicted conditions and management scenarios. The software must also be support, accessible, and with a proven record of use. The modeling process started in 2020 and the QAPP and model simulation plan are in preparation. The original HSPF model was calibrated in 2001, the new model will benefit from enhanced monitoring by USGS. The HSPF model will include a scenario analysis manager for management purposes. Statewide embayment modeling is also in progress and should accurately represent variations in embayment water quality. Several different embayments including Norwalk Harbor and Mystic River are targets and are the focus of increased monitoring. Challenges include climate change simulation to 2050 factoring in both sea level rise and water temperature increases. Land use/land cover in 2050 is another important factor, as is correlating modeling targets with water quality standards.

Discussion:

--Dave Lipsky suggested that Westchester County was not mentioned and should be included in the future.

--Mark Tedesco said some of the USGS CT work extends into Westchester and that the information is available.

--Jim O'Donnell noted that Charlie Yarish is is retiring from the STAC and also Joop Varekamp and Ellen Thomas (both at Wesleyan) are retiring and he wanted to acknowledge their contributions the STAC and LIS.

--Dave Lipsky asked Don Walter about his source for the NYC atmospheric load. Don said his source was Jack Monti (jmonti@usgs.gov) at USGS. He has a complete report coming out soon.

--Paul Stacey said that it was an excellent meeting, and noted especially Jeff and Don's modeling work, but said nitrogen attenuation was a crucial parameter that was not well understood.

--Mark Tedesco commented that we began the meeting with the major nitrogen reductions from WWTPs, which was the low-hanging fruit from a management perspective, even if it took 20 years. The rest of the meeting was about nitrogen reductions we still need to make that are likely to be more challenging.

--Paul Stacey said that we still need to establish nitrogen loading and concentration criteria and the criteria are likely to be very different for eelgrass than hypoxia which has been the focus so far.

<u>NYSDEC Modeling Overview;</u> Michele Golden, NYSDEC (Postponed to June Meeting)