Quality Assurance Project Plan for the Peconic Estuary Climate Ready Assessment

Prepared by:
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Under Contract Agreement to:
Suffolk County Department of Health Services
On behalf of the Peconic Estuary Program
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Prepared for:
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USEPA, Project Officer:	*Sheri Jewhurst*	Date:	
USEPA, QA Officer:	*Esther Nelson*	Date:	
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ABBREVIATIONS

Anchor QEA Team	Anchor QEA Engineering, PLLC, The Nature Conservancy, and Fine Arts and Sciences
CCMP	Comprehensive Conservation and Management Plan
CLPS	Critical Lands Protection Strategy
CNRA	Critical Natural Resource Area
CRA	Climate Ready Assessment
DFIRM	Digital Flood Insurance Rate Maps
LiDAR	Light Detection and Ranging
NEIWPCC	New England Interstate Water Pollution Control Commission
NOAA	National Oceanic and Atmospheric Administration
NYSDEC	New York State Department of Environmental Conservation
NYSERDA	New York State Energy Research and Development Authority
PEP	Peconic Estuary Program
QA	quality assurance
QAPP	*Quality Assurance Project Plan*
QC	quality control
SIN	Shinnecock Indian Nation
SLAMM	Sea Level Affecting Marshes Model
SLOSH	Sea, Lake, and Overland Surges from Hurricanes
TAC	Technical Advisory Committee
TNC	The Nature Conservancy
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WA	Work Assignment

1 Project Management

This *Quality Assurance Project Plan* (QAPP) was prepared in accordance with the U.S. Environmental Protection Agency's (USEPA's) *Requirements for Quality Assurance Project Plans* (USEPA 2001) and USEPA Region 2's *Quality Assurance Project Plan Guidance for Environmental Projects Using Only Existing (Secondary) Data* (USEPA 2014a). The Work Assignment (WA) is to perform Peconic Estuary Climate Ready Assessment Services and involves data gathering, stakeholder meetings, mapping, assessment, and reporting.

1.1 Distribution List

The individuals listed below will receive original copies of the approved QAPP:

- Joyce Novak, PhD, Director, Peconic Estuary Program
- Sheri Jewhurst, Project Officer, USEPA
- Esther Nelson, Quality Assurance (QA) Manager, USEPA
- Shavonne Smith, Shinnecock Indian Nation
- Elizabeth Lamoureux, Consultant, Anchor QEA
- Lena DeSantis, Consultant, Anchor QEA
- Stephen Lloyd, Consultant, The Nature Conservancy

1.2 Project/Task Organization

The purpose of this QAPP is to focus all activities to successfully support overall project objectives and provide data quality objectives, documentation and reporting procedures, and reviews necessary to assure the quality of all work and deliverables.

The primary organizations involved in this project include USEPA, the Peconic Estuary Program (PEP), Shinnecock Indian Nation (SIN), and the "Anchor QEA Team" consultants, which comprises Anchor QEA Engineering, PLLC, The Nature Conservancy (TNC), and Fine Arts and Sciences. These organizations are collaborating to review and assess the Critical Lands Protection Strategy (CLPS) in the Peconic Estuary and the climate change vulnerabilities of the PEP and SIN environmental restoration and protection programs. Additionally, the Anchor QEA Team is coordinating with PEP and SIN to outline a process for developing action plans and identifying areas for appropriate joint action planning, collecting stakeholder input, and assessing the effects of climate impacts on current strategic plans, priorities, and long-term goals.

The project manager and other key roles are described in Section 1.2.1, and the full project team organization is summarized in Figure 1.

1.2.1 Project Managers

Elizabeth Lamoureux of Anchor QEA will serve as the QA/QC Manager and be responsible for maintaining the official, approved QAPP. Ms. Lamoureux will be responsible for QA/quality control (QC) oversight of the project, including data validation.

Lena DeSantis of Anchor QEA will serve as the Project Manager and will plan all internal and external meetings and participate in report generation. She will also facilitate public workshops and generate meeting materials and data outcomes based on risk scenarios. For this task, she will be assisted by Lisa Liquori of Fine Arts and Sciences and members of the TNC team as identified in Figure 1.

John Connolly, PhD, of Anchor QEA will provide overall technical and scientific oversight and specific oversight for evaluating current and future climate change effects on salt marshes and coastal resources, as well as providing screening criteria for risk assessments. For work evaluating climate change effects on salt marshes and coastal resources, Dr. Connolly will be assisted by members of Anchor QEA and TNC as identified on Figure 1.

Stephen Lloyd of TNC will be tasked with developing the project GIS database, including base map data and high tide elevations under current conditions and climate change projections. Mr. Lloyd will be assisted by Karen Leu of TNC. They will analyze the GIS data and generate results in both tabular and mapped forms to support the vulnerability and risk assessment.

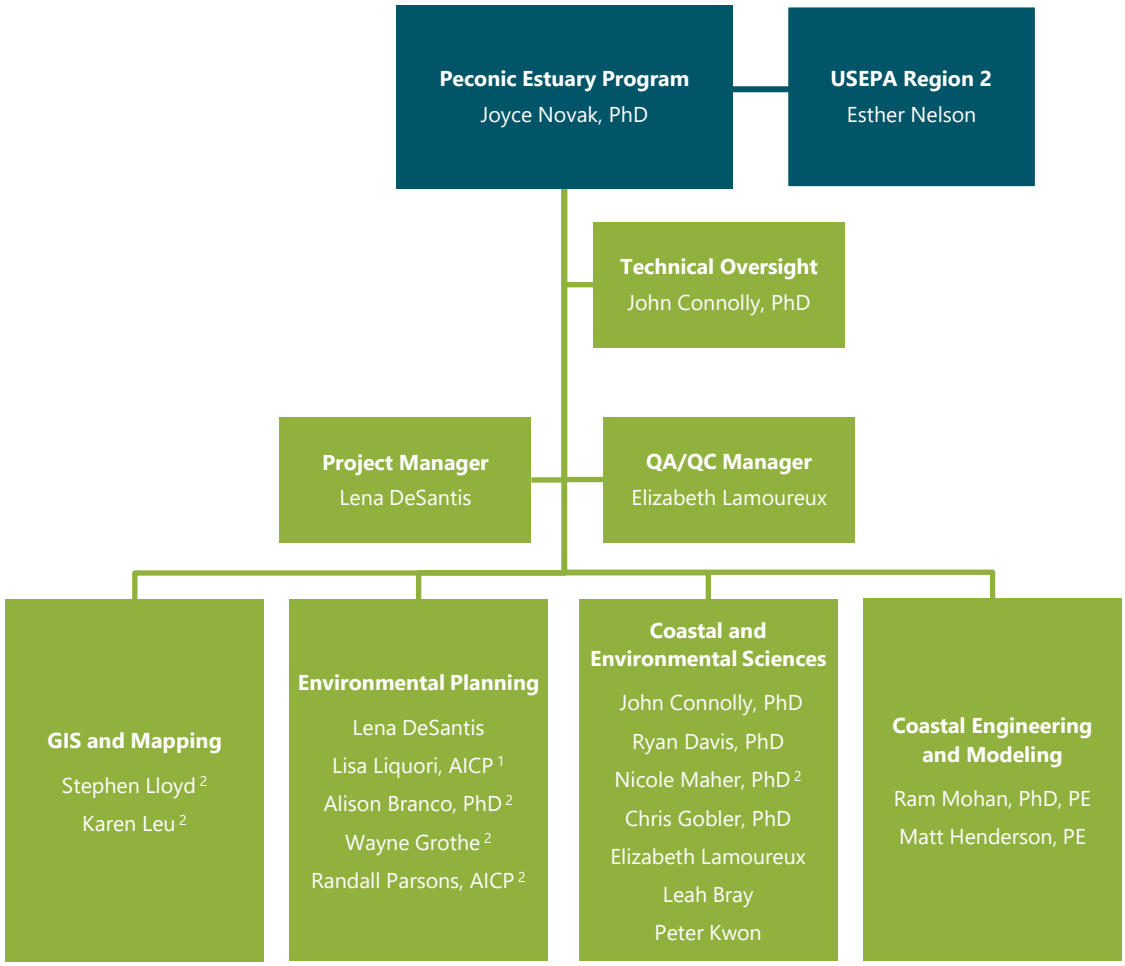
Ram Mohan, PhD, PE, of Anchor QEA will provide engineering support for developing the risk assessment and green coastal solutions. He will be assisted by members of Anchor QEA as identified on Figure 1. Both Anchor QEA and TNC are actively developing soft shoreline protection solutions and will develop a range of possible solutions for consideration.

Joyce Novak, PhD, of PEP will be responsible for technical report review, meeting participation, and workshop development. Dr. Novak will be assisted by Sarah Schafer and Elizabeth Hornstein of PEP. Dr. Novak, Ms. Schaefer, and Ms. Hornstein will also coordinate internal communication and review with Shavonne Smith of SIN.

Sheri Jewhurst, USEPA Project Manager, will participate in technical reviews and internal PEP communication of results.

GIS work will be performed at TNC offices in Cold Spring Harbor and Easthampton, New York. Workshops will occur in various locations on the East End of Long Island. Reports will be generated at Anchor QEA offices in Mattituck, New York, and Woodcliff Lake, New Jersey. All work will be transmitted in digital form via email; a digital copy of results on a CD as well as in printed form will be sent by mail to Dr. Novak of PEP and Ms. Jewhurst of USEPA.

Figure 1
Project Organization Chart



Notes:
1. Fine Arts and Sciences
2. The Nature Conservancy

1.3 Background

The Peconic Estuary is situated between the North and South Forks of eastern Long Island, New York (Figure 2). The Peconic Estuary System includes the Peconic Estuary and those land areas that contribute groundwater and storm water runoff to the Peconic River and the Peconic Bay, including land in six townships and four villages. The Peconic Estuary is one of 28 designated "Estuaries of National Significance" under Section 320 of the Federal Clean Water Act. PEP's *Comprehensive Conservation and Management Plan* (CCMP) (PEP, 2001) was formally approved in 2001 and promotes a holistic approach to improving and maintaining the Peconic Estuary and its watershed. One of the goals of the CCMP is to protect Critical Natural Resource Areas (CNRAs) throughout the

Peconic Estuary. In 2004, PEP developed a Critical Lands Protection Strategy (CLPS) (PEP 2004) that identifies priority parcels based on criteria such as proximity to the shoreline, location within a nitrogen-impaired sub-watershed, location within one of the PEP-designated CNRAs, inclusion of wetlands (as defined by the national wetlands inventory), parcel size, adjacency to other protected lands, and the potential to aggregate multiple preserved parcels adjacent to one another. Climate change-related sea level rise, increased storm intensity and frequency, and changing weather patterns will alter the configuration and characteristics of the shoreline, wetlands, and upland habitat and further contribute to water quality and habitat degradation, habitat loss, and fragmentation. PEP is currently undergoing an update of the CCMP which will incorporate the effects of climate change and the updated CLPS so that planned restoration programs and projects can take potential changes into account.

Figure 2
Peconic Estuary Watershed

Note: Yellow line denotes the boundary of the watershed.

The SIN territory is 800 acres of ancestral land located on the South Fork of Long Island and adjacent to Southampton, New York (Figure 2). SIN has identified climate change as a factor of concern. The Nation is particularly vulnerable to major storms and associated flooding as it resides in a low-lying,

south-facing peninsula on Shinnecock Bay. The SIN developed the *Shinnecock Indian Nation Climate Change Adaptation Plan* (SIN 2013) to begin identifying vulnerabilities and adaptation strategies.

Proposed work under this QAPP will incorporate ClimAID (2014) sea level rise estimates visualized using the Sea Level Affecting Marshes Model (SLAMM; Clough et al. 2014) into the existing PEP CLPS criteria to subsequently re-evaluate the original prioritization strategy, as well as develop a Climate Ready Assessment (CRA) that assesses the risks and vulnerability of the natural resources within the PEP and SIN regions due to climate change.

1.4 Project Description

PEP and the recently federally recognized SIN are seeking to ensure current and future programmatic actions and policies take into account climate risks and vulnerabilities. This project is a combination of two tasks:

1. Climate Change Assessment of PEP Critical Land Protection Strategy Services
2. PEP and SIN Climate Vulnerability Assessment Services

These tasks, described in the following subsections, will rely on existing data gathered from many sources, including climate vulnerability assessments completed for other National Estuaries, and its use will be consistent with USEPA's *QAPP Requirements for Secondary Data Research Projects* (USEPA 1999).

1.4.1 Climate Change Assessment of PEP Critical Lands Protection Strategy Services

The Anchor QEA Team will work with PEP, the PEP Management Conference, and stakeholders under this task. SIN will also be consulted during this task to maximize efficiencies of stakeholder outreach and GIS work and ensure a level of consistency with climate change scenarios among the two tasks. The PEP Management Conference includes representatives of USEPA Region 2, the New York State Department of Environmental Conservation (NYSDEC), Suffolk County, the New England Interstate Water Pollution Control Commission (NEIWPCC), Local Governments, the Technical Advisory Committee and Citizens' Advisory Committee. The PEP stakeholders include elected officials; state, town, and village staff; local non-governmental organizations; industry, including the fishing and real estate sectors; and private citizens.

1.4.1.1 Develop New CLPS Screening Criteria

The first task is to develop new CLPS screening criteria that account for anticipated changing coastal conditions related to climate change, including shoreline advance resulting from sea level rise, increasing precipitation intensity, and storm event frequency. Sea level rise scenarios will also be identified under this task. The sea level rise scenarios and new screening criteria proposed for the

CLPS will be evaluated by working with PEP, the PEP Management Committee, and stakeholders to ensure that climate change will be accounted for in the CLPS process. Environmental criteria of the previous CLPS will also be evaluated through the stakeholder process to ensure they meet PEP habitat and water quality goals and will be and updated if necessary. The new CLPS criteria will be used to reprioritize parcels that are critical to preservation of ecosystem services in the Peconic Estuary.

All criteria will be considered under climate change scenarios, which include short (2020s), medium (2050s) and long term (2080s plus) projections. Considerations include the following:

- Parcels predicted to return to underwater or wetland habitat
- Inland properties that could transition to shoreline positions
- Existing living shoreline and opportunities for new living shorelines
- Parcels that would be at risk for erosion and may require shoreline protection if developed
- Areas appropriate for inland wetland migration in the face of rising sea level
- Proximity to vulnerable sites with environmental risk, if applicable

To support development of these criteria and to facilitate stakeholder input, the Anchor QEA Team will:

- Prepare a list of CLPS climate ready criteria for consideration
- Meet with PEP to discuss and identify draft CLPS climate ready criteria
- Prepare materials and present the draft CLPS climate ready criteria at a stakeholder meeting; receive feedback and comments from stakeholders
- Define a final list of CLPS climate ready criteria

The data and analytical approaches for the GIS Analysis described in Sections 1.4.1.2 and 1.4.1.3 will be determined based on the criteria that are developed.

1.4.1.2 Identify Climate Change Scenarios

Working with PEP and SIN, the Anchor QEA Team will use the Community Risk and Resiliency Act sea level rise projections, referred to as the "2014 ClimAID update," to identify three sea level rise scenarios to evaluate for the CRA. The ClimAID projections will be used because they include regional projections for New York State and have been adopted at the state level (6 NYCRR Part 490, Projected Sea-level Rise). The selection process will be informed by sea level rise projections from other studies including those conducted by the Intergovernmental Panel on Climate Change (IPCC) and the National Aeronautics and Space Administration. The ClimAID projections for the Long Island region are provided in Table 1. Using the appropriate tidal datum for the Peconic Estuary, tide ranges under current conditions and future climate change scenarios will be calculated and compared to identify areas that will become inundated at mean higher high water (MHHW).

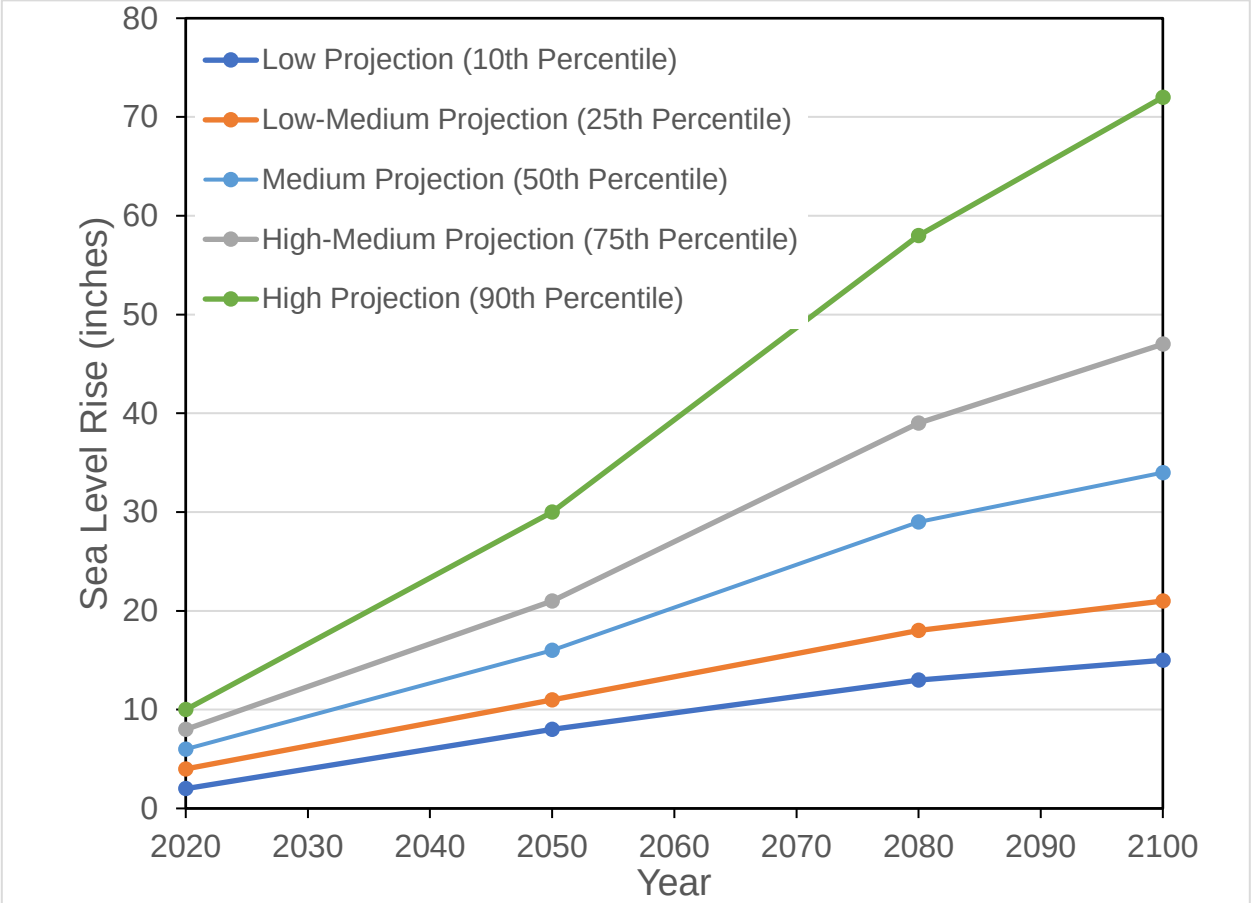
Table 1
Sea Level Rise Projections: Region 4 – Montauk Point

Baseline (2000 to 2004) 0 inches	Low Projection (10th Percentile)	Middle Range (25th to 75th Percentile)	High Projection (90th Percentile)
2020s	2 inches	4 to 8 inches	10 inches
2050s	8 inches	11 to 21 inches	30 inches
2080s	13 inches	18 to 39 inches	58 inches
2100	15 inches	21 to 47 inches	72 inches

Note:
Source: Table 4 from ClimAID, 2011

The 2014 ClimAID sea level rise projections are depicted in Figure 3, along with sea level rise estimates from the earlier version of ClimAID (Rosenzweig et al. 2011). As illustrated by the figure, the range of sea level rise estimates is much smaller in the near-term (2050), than in longer-term projections, such as 2100, which has a much higher level of uncertainty. The Anchor QEA Team will work collaboratively with stakeholders under this task to identify appropriate sea level rise scenarios and the time frame through which they should be evaluated. The uncertainties and limitations associated with climate change projections and effects analyses were incorporated into the SLAMM model projections (Clough et al. 2014); this information as well as the uncertainties and limitations of underlying data will be provided to the PEP, the PEP Management Committee, and stakeholders during workshops and documented in an uncertainty section of the project report.

Figure 3
Comparison of Sea Level Rise Scenarios and New York State CRRA Legislation



The predictive abilities of the CRA for the CCMP/CLPS and the vulnerability and risk assessment rest ultimately on the quality of the underlying data and analysis. This task includes developing the project GIS database, including base map data and high tide elevations under current conditions and climate change projections. Data will be analyzed in GIS, and results will also support the vulnerability and risk assessment in Task 1.5.2.

1.4.1.3 Perform GIS Analysis

Once the new CLPS criteria have been developed and the climate scenarios have been selected, the next step will be to perform the GIS analysis to help create a revised parcel prioritization strategy. The GIS analysis will be led by TNC, who has acquired data relevant to a CRA for the Peconic Estuary and previous applications of the CLPS analytical process. Additionally, TNC developed and maintains an online climate change effects analytical and mapping tool for several geographic areas, including the Peconic Estuary. They have all datasets in-house and are familiar with the technical basis of

climate change analyses, including the sea level rise and SLAMM results that were performed under a grant from the New York State Energy Research and Development Authority (NYSERDA) by the company Warren Pinnacle Consulting using ClimAID sea level rise projections for an area that includes the Peconic Estuary (Clough et al. 2014).

The approach to complete this task involves the following subsections.

1.4.1.3.1 Compile Base Map GIS Data Layers

The initial step in the GIS Analysis will be compilation of all relevant secondary data, including those listed in Table 2. TNC has these data in-house and maintains a license to access up-to-date Suffolk County tax map data.

Table 2
GIS Data Sources

Data Set	Source	Date	File Format	How Will Data Be Used?
Suffolk County Tax Map Data	Suffolk County Real Property Tax Service Agency	2018	geodatabase	Spatial unit of analysis. Will be used to summarize criteria data and prioritize critical lands for habitat protection, water quality, and climate resilience
Sea Level Affecting Marshes Model (SLAMM)	NYSERDA/Warren Pinnacle Consulting, Inc.	2015	tiff	To identify areas within the PEP and SIN that may have marsh migration potential or be inundated under selected sea level rise scenarios, in order to inform parcel prioritization
Sea, Lake, and Overland Surges from Hurricanes (SLOSH) model	National Oceanic and Atmospheric Administration (NOAA) National Hurricane Center	2013	shapefile	To assist as criteria in CLPS parcel prioritization
National Land Cover Database (NLCD)	Multi-Resolution Land Characteristics (MRLC)	2011	img	To assist as criteria in CLPS parcel prioritization
National Wetlands Inventory (NWI)	US Fish & Wildlife Service (USFWS)	2004	geodatabase	To assist as criteria in CLPS parcel prioritization
Tidal Wetlands NYC and Long Island 1974	New York State Department of Conservation (NYSDEC)	2005	shapefile	To assist as criteria in CLPS parcel prioritization
NY High-Resolution Orthoimagery - 4 Band Digital 0.5 ft	New York State Digital Orthoimagery Program (NYSDOP)	2016	web map service	For spatial reference and for mapping prioritization results

Data Set	Source	Date	File Format	How Will Data Be Used?
Coastal New York LiDAR (Light Detection and Ranging)	New York State Department of Conservation (NYSDEC)/ National Oceanic and Atmospheric Administration (NOAA) Coastal Services Center	2016	img	To identify areas within the PEP and SIN that may be inundated under selected sea level rise scenarios, in order to inform parcel prioritization
NOAA Office for Coastal Management Sea Level Rise Data: 1-6 ft Sea Level Rise Inundation Extent	Department of Commerce (DOC), National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), Office for Coastal Management (OCM)	2016	geodatabase	To assist as criteria in CLPS parcel prioritization
Hurricane Sandy Final Surge Extent	Federal Emergency Management Agency (FEMA) Modeling Task Force (MOTF)	2014	shapefile	To assist as criteria in CLPS parcel prioritization
Digital Flood Insurance Rate Map Database, Suffolk County, New York	Federal Emergency Management Agency (FEMA)	2009	geodatabase	To assist as criteria in CLPS parcel prioritization
Critical Natural Resource Areas Within the Peconic Estuary	US Fish & Wildlife Service (USFWS)	1996	shapefile	To assist as criteria in CLPS parcel prioritization

1.4.1.3.2 Map Inundation Under Climate Change Scenarios

The high tide level under current conditions and future climate change scenarios defined in Section 1.4.1.2 will be included in the GIS database. Sea level rise projections will be based on a modified bathtub modeling approach, as detailed by NOAA's Sea Level Rise Viewer mapping tool (NOAA 2017). Mapping of storm inundation will be based on FEMA Digital Flood Insurance Rate Maps (DFIRMs), Saffir/Simpson storm surge classifications (using the SLOSH model), or the level experienced as a result of Superstorm Sandy (Hurricane Sandy Final Surge Extent), as listed above in Table 2.

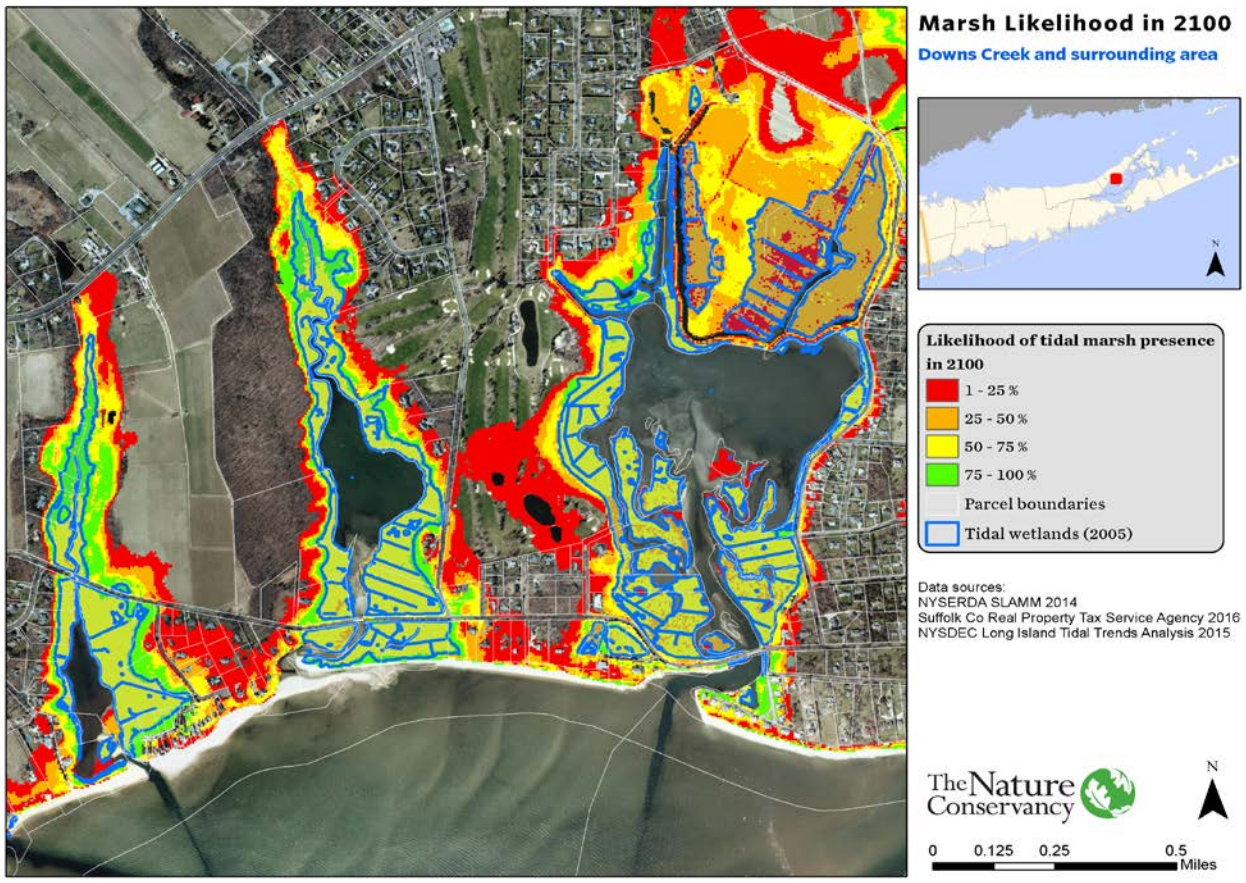
1.4.1.3.3 Evaluate the Effects on Salt Marshes

The effects of sea level rise on coastal marshes will be evaluated using SLAMM results to determine how wetland habitat may change, possibly converting to open water or from high to low marsh habitat. SLAMM will also be used to assess areas of potential inland migration of salt marsh habitat. The SLAMM predictions are based on sea level rise estimates and other area-specific factors, including hydrology and land cover.

Marsh loss and habitat changes due to climate change have been documented (Morris et al. 2002). The analyses under this task will provide critical information as to how climate change may affect

ecosystem services. Stakeholders may prioritize areas that could more easily adjust to sea level rise through habitat adaptation within PEP. Figure 4 is an example of one such area, the Downs Farm Preserve and Downs Creek *Phragmites* habitat restoration area, wherein SLAMM predicts the likelihood of potential marsh migration in 2100. The change from irregularly flooded to regularly flooded area affects current plans to control *Phragmites* and promote re-establishment of native flora and fauna because the vegetation structure within the habitat may change with the rising seas. Current and future restoration opportunities will be discussed with stakeholders and included in project reports.

Figure 4
Marsh Likelihood in 2100



1.4.1.3.4 Apply New Climate Change Criteria to Identify Priority CLPS Parcels

The GIS analysis will involve evaluating data to identify parcels that meet one or more of the climate ready environmental criteria. This will be accomplished by summarizing parcels by the selected climate ready environmental criteria. For example, each parcel may have a summary of its total potential for marsh migration area or proximity to future shoreline. The Anchor QEA Team will

present preliminary results and maps to PEP and begin to fine tune work products. Results of the initial collaboration will be presented during a workshop meeting to serve as the basis for the action plan.

1.4.1.3.5 Prepare Maps and Graphical Representations

The GIS project database will be used to generate summary tables of statistics for each accepted sea level rise scenario based on updated prioritization criteria. The GIS project database will provide a visual for the spatial distribution of the CRA criteria on available lands. Maps containing layers appropriate for each phase of the project will be made available and will include the following:

- A map with the CRA criteria as they relate to each other, overlain on the parcels within the PEP watershed
- A map showing how many of the CRA criteria were met on the parcels, using a color ramp
- A map depicting the parcels according to priority criteria using a color ramp

Any maps using the results of sea level rise and marsh migration scenarios will be created with a text note and/or a chart conveying the range of possible scenarios predicted. Areas of higher or lower mapping confidence can also be visualized using the results from NOAA's Sea Level Rise Viewer. The results of Warren Pinnacle Consulting's marsh migration study using SLAMM also includes an uncertainty analysis (Clough et al. 2014); these data will also be used when possible to show the areas of the landscape that are more or less likely to have tidal marsh in the future based on their simulations across the range of input parameters in the model.

1.4.2 Peconic Estuary Program and Shinnecock Indian Nation Climate Vulnerability Assessment Services

Under this task, the Anchor QEA team will conduct a vulnerability/risk assessment using the analytical results and maps generated by the previous tasks. This task will use USEPA's guidance *Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaptation Plans* (USEPA 2014b). The vulnerability assessment will be largely based on the sea level and storm inundation maps prepared in previous tasks. The risk assessment will identify the specific parcels with the highest probability for sea level rise impacts and storm damage, and the potential impact on the current and future land use.

Anchor QEA will use the vulnerability/risk assessment to develop a draft climate ready action plan. This action plan will identify methods to integrate climate change consideration into all phases of planning, design, and execution of PEP and SIN initiatives and projects. The draft action plan will be presented to PEP and SIN at a workshop. The objectives of the workshop will be to discuss current land use and land cover, the range of effects that could result from climate change, the specific effects of sea level rise, and the missions and short- and long-term plans of PEP and SIN. For the

workshop, the Anchor QEA team will prepare maps and analytical summaries in matrix forms of stakeholder inputs from previous tasks, GIS results, and CLPS criteria to identify and organize vulnerabilities and assess risks. Following the workshop with PEP and SIN, the results of the vulnerability and risk assessment will be presented for input at a stakeholder meeting.

Following the stakeholder meeting, the draft action plan will be revised to incorporate results of stakeholder input and prioritize actions.

1.4.2.1 Reporting

The Anchor QEA team will prepare two separate reports:

- The updated CLPS and recommended modifications to existing priority actions in the CCMP
- Climate ready action plans responding to climate change vulnerability risks for SIN and for all six of the priority management topics in the CCMP

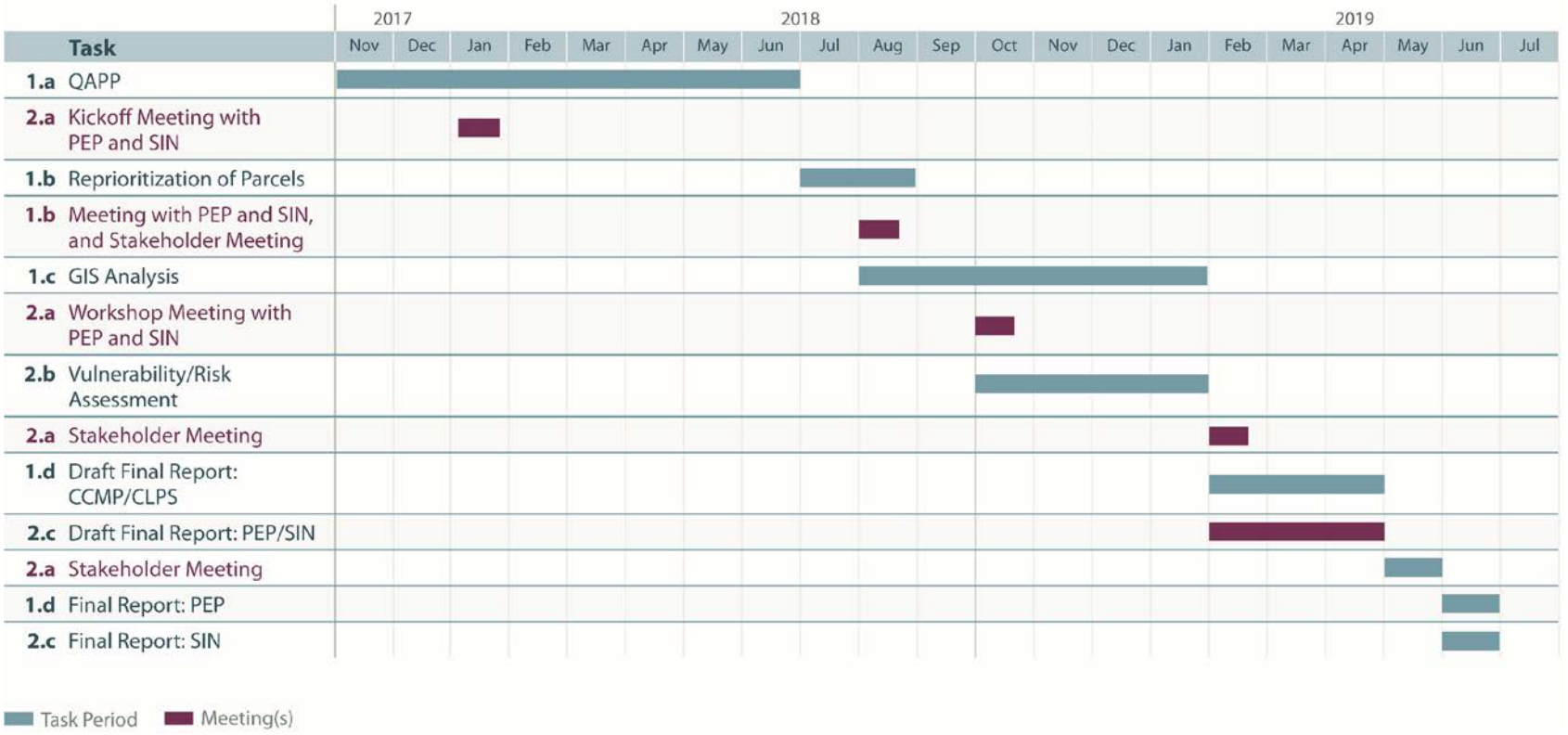
Each of these reports will be prepared in draft form for PEP and SIN to review and for presentation at a stakeholder meeting. Feedback from PEP, SIN, and stakeholders will be integrated into a final report, which the Anchor QEA team will present to the PEP, SIN and the Technical Advisory Committee (TAC).

The final report will present and summarize work completed over the course of previous tasks and will provide a coherent action plan based on analyses and input from PEP, SIN, TAC, and stakeholders.

1.5 Project Schedule

The timeline for completing the project tasks is presented in Figure 5.

Figure 5
Project Schedule



1.6 Quality Objectives and Criteria

The primary objectives of this project are to provide climate ready CLPS criteria and conduct a CRA for PEP and SIN. The secondary data that will be used to achieve these objectives are listed in Section 1.4.1.3.1. The products that will be provided to PEP and SIN include the following:

- Reprioritization criteria tables
- Inundation maps
- CLPS summary tables
- Maps depicting application of CLPS criteria to parcels
- CRA Matrix and/or action plan
- CLPS Report
- CRA Report

These products will meet quality objectives through the use of accurate and precise existing data, ClimAid sea-level rise projections, and SLAMM results. TNC will be conducting the GIS analyses and will ensure the quality of the secondary data through established QA checks throughout the process. These checks have included or will include review of data spreadsheets and shapefiles pre- and post-transfer. Team members will inspect the data and files to ensure all fields and necessary data are present. Metadata and descriptions of QA will be included with the files during the transfer. As datasets are compiled and processed, an independent technical review of each dataset shall be performed to ensure there are no significant errors in the input data. All geospatial input datasets shall be reviewed for completeness, accuracy, precision, representativeness, comparability, and sensitivity. Specifically, geospatial data will be reviewed in accordance with the following QC checklist by an independent member of the project team:

- Metadata availability and completeness
- Unit consistency
- Spatial reference system
- Spatial coverage/extent (i.e., data gaps)
- Grid size and tiling consistency
- NO DATA values in Raster reviewed
- Attribute consistency

The metadata for data to be used in this desktop analysis will be reviewed to ensure they were collected as per the acceptance criteria described in the following subsections.

1.6.1 Secondary Data Acceptance Criteria

Project team members are familiar with and have reviewed the secondary data described in Section 1.4.1.3.1 that will be used in this project. The important datasets (land elevations, wetland

maps, land use, tax parcels, and flood mapping) are of high quality and spatial coverage is complete over the project area. The following criteria have been or will be applied to the secondary data used in this project:

- The accuracy of the source data must be provided for all data.
- Data are at the highest resolution available for the entire study area.
    - The LiDAR (Light Detection and Ranging) elevation data that will be used for the project is the highest resolution available. Additional data sets will not be rejected based on resolution, but limitations and uncertainties will be noted in project reports.
- The source published reliable study methods.
- Metadata is available and complete.
- The dataset is projected accurately and can be converted if necessary.
- Data is in a format supported by appropriate software (e.g., ArcGIS or Excel).
- Data covers the applicable study areas.
- Data contains limited amount of data loss if any conversion is to be done.
- Data contains limited numbers of errors (e.g., very small slivers/features) or duplicates.
- There are no important null features or attributes in the dataset.
- Data limitations and errors encountered will be documented.

1.7 Special Training/Certification

Special training is needed to execute the analysis associated with conducting the climate impact and vulnerability assessment. These include the following:

- Expert proficiency with ArcGIS 10.3 software, the Spatial Analyst extension, and Model Builder
- GIS-specific QA skills

Stephen Lloyd, the GIS and Mapping analyst, is properly trained and has the proper skills to conduct this work. Mr. Lloyd will be supported by GIS Specialist Karen Leu.

1.8 Documentation and Records

To conduct analyses on climate impacts and coastal vulnerability, spatial data is needed. Existing spatial data for this project will be stored as feature classes in an ArcGIS file geodatabase and included in applicable reports and resulting GIS tools. These feature classes include data on the extent of wetland boundaries, wetland elevation, vegetation cover types, projections of sea level rise inundation and resulting habitat changes, development surrounding wetlands, loss of tidal wetlands, and aerial photography. The spatial data also includes all the data generated by the SLAMM developed by Warren Pinnacle Consulting for the Peconic Estuary. These data have important metrics that will be used to analyze salt marsh vulnerability to sea level rise as well as constraints or opportunities for migration and future persistence.

All the spatial data has associated metadata describing the purpose, creation date, credits, generation method of the data, and use limitations has been or will be reviewed. Spatial data must contain associated metadata that is Federal Geographic Data Committee compliant and projections may differ.

Final reports will be prepared for this project in a legible font and font size. The reports will describe methods and results. Electronic formats of data will include excel files, word documents, MS access files, csv files, ArcGIS geodatabase(s) (data limitations permitting), and image files (jpgs).

All data and reports will include information as to the appropriate project name, revision number, date of publication, number of pages, and contact information of the project manager.

The QA manager will be responsible for compiling all assessments. The QA manager will write these reports and provide them to the Project Managers and/or affiliated science staff or partners for review. In any annual progress reports for the various projects that are prepared for USEPA, this compilation will be included.

Records and data will be stored on a file server for a minimum of 3 years following the close of the project. In addition, map product inputs and outputs will be archived in .zip directories following approval of the final model report for a minimum of 7 years.

2 Data Acquisition and Management

2.1 Sampling Process Design

This section is not applicable because this project is only using existing data and no new data will be generated.

2.2 Sampling Methods

This section is not applicable.

2.3 Sample Handling and Custody

This section is not applicable; no hard-copy spatial data is being used.

2.4 Analytical Methods

This section is not applicable; no analysis will be conducted on aerial photographs.

2.5 Quality Control

This section is not applicable.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

This section is not applicable.

2.7 Instrument/Equipment Calibration and Frequency

This section is not applicable.

2.8 Inspection/Acceptance of Supplies and Consumables

This section is not applicable.

2.9 Data Acquisition/Non-Direct Measurements

See Table 2 in Section 1.4.1.3.1.

2.9.1 Intended Use of Existing Data

These data will be used by the Anchor QEA team to complete two tasks. The first task is to conduct and incorporate ClimAid sea-level rise scenarios into the CLPS. The second task is to develop a climate vulnerability assessment using the results of the sea-level rise scenarios from SLAMM.

2.9.2 Hardware/Software for Data Analysis

TNC will utilize ArcGIS 10.3 software for all spatially-explicit data, including the use of ArcCatalog for database management, Spatial Analyst and other toolboxes for analysis, and ModelBuilder for tracking analytical methods. For further description of the spatial hardware/software setup see section 2.10.2.

Tidal marsh complexes will be evaluated in GIS in terms of their resilience to climate change. For each marsh, the amount of potential gain, loss, and persistence of different marsh habitat will be calculated under the selected sea level rise scenario(s) from the results of the SLAMM produced by Warren Pinnacle Consulting (and/or using the outputs from SLAMM uncertainty layers that take into account the suite of scenarios and variation of input parameters). This will be accomplished using raster "combine" to summarize and visualize how different land cover and habitat classifications change over the selected time frame.

With the set of agreed-upon environmental- and climate-specific criteria developed in the stakeholder engagement process, tax map parcels will be prioritized using GIS. Parcels will be scored based on the number of environmental, climate, and other priority criteria that are met. This will be accomplished using ArcGIS geoprocessing tools, such as "spatial join" and "intersect," to overlay vector datasets to determine each parcel's attributes in relation to the proposed criteria. For example, to determine the amount of wetland area on a given parcel of land, the tax map parcels will be intersected with the National Wetlands Inventory to provide an estimate of the acreage of wetlands per parcel. Likewise, "zonal statistics" and "tabulate area" processes will be utilized to summarize parcels by raster extent within them (e.g., outputs from SLAMM). Parcels will be coded by each criterion that is met (1=yes, 0=no) and with an overall sum of the number of achieved criteria. Parcels will be able to be ranked by area as well as the total number of environmental, climate, and other priority criteria met. Parcels will also be classified further in terms of vacant and underdeveloped lands available for development. Maps will be produced using ArcMap to visually show these prioritizations with appropriate color ramps.

2.10 Data Management

2.10.1 Project Management

Existing spatial data will be in the form of a file geodatabase created in ArcCatalog containing point, line, and polygon shapefiles. At least 10% of these data will be checked by an independent observer. The QC checklist described in Section 1.6 will be reviewed to verify data was analyzed for content, and at least 10% of the final data will be checked by the Project Manager, as described in Section 4.1.

2.10.2 Hardware/Software Configuration

All project data will be stored on a TNC New York State GIS server, which is also where data management, analysis, and cartography tasks will be carried out using GIS software. The GIS server is backed up daily, and only those on the project team will have access to the project folder. The GIS server runs Windows Server 2008 (version 6.1, Build 7601, service pack 1) with 128 GB RAM and Intel Xeon 2.60 GHZ x2 processors.

Data will be managed, reviewed, and analyzed using Esri's ArcGIS 10.3 software, including the use of ArcCatalog for database management and metadata creation, and ArcMap for cartography, with Spatial Analyst and other toolboxes utilized for GIS analysis. Spatial data will be stored in a file geodatabase format. Any non-spatial data will be transferred to a geodatabase where needed for the analysis; however, any original files will be maintained in a tabular format (e.g., Excel). Geoprocesses will be documented in ArcGIS ModelBuilder to allow for tracking of methods and to enable easy adjustments to the analysis if necessary.

3 Data Assessment and Oversight

3.1 Assessments and Response Actions

The Project Manager and QA/QC Manager will meet regularly to discuss the project's progress and ensure that all approved assessment procedures are being followed. At these meetings, project staff and project stakeholders will jointly assess and revise the products in an iterative and collaborative manner. If corrective actions need to be made, the Project Manager and QA/QC Manager will work jointly to address any changes deemed necessary.

3.2 Reports to Management

The QA/QC Manager will be responsible for compiling all assessments. The QA/QC Manger will write these reports and provide them to the Project Manager or science staff for review. In progress reports for the project prepared for PEP, this compilation will be included.

4 Data Validation and Usability

4.1 Data Review, Verification, and Validation

Ten percent of the data will be checked for accuracy by the Project Manager. Any data received from subcontractors will be subject to QC by their internal systems as well. A subset of data will then be checked for completeness and accuracy by the QA/QC Manager. The QA/QC Manager will review the data in consideration of how the data are defined and whether use limitations have been identified. The QA/QC Manager shall reference the QC checklist described in Section 1.6. Results of this data verification step will be recorded in a Quality Control Log and stored with the project documents and made available upon request.

The final products of this project must meet the same acceptance criteria previously stated in the "Data Acquisition/Non-Direct Measurements" section of this QAPP (Section 2.9) as well as the following criteria:

- Climate ready assessment and vulnerability analysis were validated.
- Prioritized parcels were validated.
- Ranking and recommendations are within PEP.
- Analysis QA/QC protocol was conducted as planned.
- Any data use limitations will be reported on the Quality Control Log or the analytical report.
- The Project Manager and QA/QC Manager will verify the content.

4.2 Verification and Validation Methods

The Project Manager and QA/QC Manager will review and verify the climate ready criteria and vulnerability assessment. The QA/QC Manager will verify a subset of this data according to the criteria described in Section 4.1. Any problems, incomplete data, or deviations will be flagged by the Project Manager and discussed with the QA/QC Manager and project team. No data will be deleted, but if data are inconsistent or not verifiable, the data will be flagged for future use in the Quality Control Log and any use limitations will be noted in the uncertainty discussion of the final project report. The Project Manager will also be responsible for confirming any calibration data were validated and verified at the source.

4.3 Reconciliation with User Requirements

Data will be subject to QC according to this QAPP. Then a meeting of USEPA, PEP, SIN and the Anchor QEA Team will be called to discuss, reconcile, and refine any analysis results. This group will determine if any parts of the product need to be adjusted or discarded because of documented errors, constraints, or malfunctions. Any such alterations of data products will be fully disclosed to anyone who procures the results.

5 References

Clough, J., M. Propato, and A. Polaczyk, 2014. Application of Sea-Level Affecting Marshes Model (SLAMM) to Long Island, NY, and New York City. Albany: New York State Energy Research and Development Authority.

Morris, J.T., P.V. Sundareshwar, C.T. Nietch, B. Kjerfve, and D.R. Cahoon, 2002. "Responses of Coastal Wetlands to Rising Sea Level." *Ecology* 83(10):2869-2877.

NOAA (National Oceanic and Atmospheric Administration), 2017. Detailed Method for Mapping Sea Level Rise Inundation. January 2017. Available at: https://coast.noaa.gov/data/digitalcoast/pdf/slr-inundation-methods.pdf.

PEP (Peconic Estuary Program), 2004. *Critical Lands Protection Plan*.

Peconic Estuary Program, 2010. Comprehensive Conservation and Management Plan. Available at: https://www.peconicestuary.org/protect-the-peconic/ccmp/.

Rosenzweig, C., W. Solecki, A. DeGaetano, M. O'Grady, S. Hassol, and P. Grabhorn (Eds.), 2011. Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation: Technical Report. NYSERDA Report 11-18. New York State Energy Research and Development Authority.

SIN (Shinnecock Indian Nation), 2013. *Shinnecock Indian Nation Climate Change Adaptation Plan*. October 2013.

USEPA (U.S. Environmental Protection Agency), 1999. *QAPP Requirements for Secondary Data Research Projects*. July 1, 1999. Available at: https://www.epa.gov/sites/production/files/2015-07/documents/found-data-qapp-rqts.pdf.

USEPA, 2001. *EPA Requirements for Quality Assurance Project Plans*. U.S. Environmental Protection Agency, Office of Environmental Information. EPA QA/R-5. March 2001.

USEPA, 2014a. *Quality Assurance Project Plan Guidance for Environmental Projects Using Only Existing (Secondary) Data*. Revision 1.0. March 2014.

USEPA, 2014b. *Being Prepared for Climate Change: A Workbook for Developing Risk-Based Adaption Plans*. U.S. Environmental Protection Agency, Office of Water. August 2014.