Total Maximum Daily Load for Nitrogen in the Peconic Estuary Program Study Area, Including Waterbodies Currently Impaired Due to Low Dissolved Oxygen: the Lower Peconic River and Tidal Tributaries; Western Flanders Bay and Lower Sawmill Creek; and Meetinghouse Creek, Terrys Creek and Tributaries

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The Peconic Estuary Program (PEP) is a partnership of governments, environmental groups, businesses, industries, academic institutions, and citizens. The PEP’s mission is to protect and restore the Peconic Estuary system. Learn more at www.peconicestuary.org.

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Total Maximum Daily Load for Nitrogen in the Peconic Estuary Program Study Area, Including Waterbodies Currently Impaired Due to Low Dissolved Oxygen: the Lower Peconic River and Tidal Tributaries; Western Flanders Bay and Lower Sawmill Creek; and Meetinghouse Creek, Terrys Creek and Tributaries

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Executive Summary

Pursuant to Section 303(d) of the Federal Clean Water Act (CWA), this document contains nitrogen discharge loads for three sewage treatment plants (STPs), one other wastewater treatment plant, and for municipal stormwater facilities in the Peconic Estuary System. These loads will form the basis for regulatory permit requirements. It also contains target loads for other sources of nitrogen to the Estuary, including atmospheric deposition, groundwater, and tributaries.

The CWA creates a process where States establish meaningful uses and appropriate standards for waterbodies. States must also periodically assess waters to see if these standards and uses are being attained. If standards are not being met, States must determine what must be done to achieve standards. This includes considering pollution from point sources discharges (such as outfall pipes) and pollution sources that are diffuse (termed “nonpoint sources”). The combined pollutant load from both the point and nonpoint sources cannot exceed that amount required to achieve or maintain water quality standards. This combined pollutant load (called a Total Maximum Daily Load or TMDL) needs to also include a margin of safety to account for uncertainties, and consider seasonal variation, future development and growth.

Estuaries are areas where fresh water from the land and salt water from the oceans mix. They are among the most important ecosystems on the earth, serving as important nursery and spawning areas for finfish and shellfish. These coastal areas are also highly valued by humans. The Peconic Estuary System of eastern Suffolk County, NY has been designated an “Estuary of National Significance” under the Clean Water Act. In order to address both problems and threats facing the Peconic Estuary and its watershed, a Comprehensive Conservation and Management Plan has been prepared.

Like many other estuaries, nutrient over-enrichment (in the form of excess nitrogen loadings) is a priority management topic for the Peconic Estuary. Nitrogen comes from many sources, both natural and as a result of human activities. Sources include wet and dry atmospheric deposition, sewage treatment plants, stormwater runoff, and groundwater that becomes enriched as a result of excess fertilizer being applied to lawns, landscaping, and agricultural crops, as well from on-site waste water disposal systems (“septic systems”).

While nitrogen is an important nutrient for a healthy ecosystem, excess nitrogen can lead to problems. Too much nitrogen can cause too much algae to grow. When algae blooms and then dies, the decomposition process consumes oxygen. Aquatic plants, including algae, also use oxygen at night through respiration. The combined effect of plant decomposition and respiration can cause dissolved oxygen to drop to low levels, especially in the early morning hours and during the warm weather months. Aquatic animals need dissolved oxygen to live. When conditions become stressful due to low dissolved oxygen levels, some organisms may suffocate and die, while others may flee the area.

Based upon data that has been submitted by the Suffolk County Department of Health Services (SCDHS), the New York State Department of Environmental Conservation has determined that three waterbodies of the Peconic Estuary System are not meeting dissolved oxygen standards. They are: the Lower Peconic River and Tidal Tributaries; Western Flanders Bay and Lower Sawmill Creek; and Meetinghouse Creek, Terrys Creek and Tributaries. It is important to note that in order to achieve dissolved oxygen standards in these waters both now and in the future, it is necessary to look at the nitrogen contributions
from not only their contributing watersheds, but nitrogen loads from the entire Peconic Estuary Watershed.

A sophisticated water quality model has been developed through the efforts of the Peconic Estuary Program which can accurately predict water quality conditions based on current conditions and nitrogen loadings as well as changes that can be expected as nitrogen loadings change in the future. An important consideration was the nonpoint source load from various land uses. Loads from any individual land parcel can be estimated to increase, decrease or stay the same, depending on land preservation efforts or residential or commercial development, as well as the effectiveness of implementing applicable management practices such as at agricultural operations, existing development, and new development. Factored into this analysis is the nationwide and local implementation of controls under Clean Air Act laws, which are projected to have an important positive impact on water quality. Limitations on point source discharges (including sewage treatment plants and regulated stormwater areas) are important locally in improving water quality.

This TMDL effort has resulted in the identification of a “practical load reduction scenario” which includes a reasonable cumulative full build-out scenario for the watershed, addressing farmland preservation, preservation of open space and developed but further subdividable land parcels, and future residential and commercial development both inside and outside of sewer districts. It also establishes achievable nitrogen loading rates groundwater from agricultural operations, golf courses, and existing and new development, including the need for greater management in watersheds of currently impaired waterbodies. Reductions in the nitrogen loading from atmospheric deposition are also taken into account. Finally, this TMDL establishes nitrogen wasteload allocations for point sources discharges from the Riverhead, Sag Harbor and Shelter Island Heights STPs, and Atlantis Marine World. Discharges from STPs at Brookhaven National Laboratory, the Naval Weapon Industrial Reserve Plant and Plum Island are also discussed. Wasteload Allocations for stormwater loads are included, which will affect entities subject to the Phase II Stormwater Permits (including Suffolk County, the Town of Brookhaven, Riverhead and Southampton, and the Villages of Sag Harbor and North Haven). Other areas may become subject to municipal stormwater permits in the future.

Even the aggressive wasteload allocations for point sources and management goals in the form of load allocations for nonpoint sources will not be enough to meet existing or proposed water quality standard for dissolved oxygen. Mechanical aeration has been added to the scenario to specific locations to bring the dissolved oxygen levels into compliance with the both existing and proposed New York water quality standards.

The Peconic Estuary Program seeks to have this TMDL fully implemented within 15 years from approval, based upon current expectations for full build-out and land acquisition programs, development and implementation of education and outreach programs, full participation in the agricultural stewardship and environmental management program, and other necessary efforts. The SCDHS also will continue its monitoring efforts in the Peconic Estuary to further document water quality conditions and trends. The Peconic Estuary Program plans to track and report on progress in implementing and achieving this TMDL at five-year intervals. Full implementation of this TMDL is expected to result in water quality standards for dissolved oxygen being met where they are not currently attained and ensure continued compliance where these standards are presently achieved.
I. Introduction
This section provides an overall introduction, including an overview of the Peconic Estuary and the Peconic Estuary Program, the problems associated with low dissolved oxygen and how and why it occurs and the impact it has on aquatic life, and a regulatory process (“303(d)”) for identifying problems and developing plans to restore impaired waters.

A. The Peconic Estuary and the Peconic Estuary Program
The Peconic Estuary is one of 28 estuaries in the country designated by U.S. Environmental Protection Agency (EPA) as an “estuary of national significance” under Section 320 of the Federal Clean Water Act (CWA). The National Estuary Program (NEP) was established to protect and restore nationally significant estuaries threatened or impaired by pollution, development, and overuse. The Peconic Estuary was formally accepted as part of the NEP in 1992. Officially commenced in 1993, the Peconic Estuary Program (PEP) includes numerous stakeholders, representing citizen and environmental groups, businesses and industries, academic institutions, and local, county, state, and federal governments. The EPA, New York State Department of Environmental Conservation (DEC) and the Suffolk County Department of Health Services (SCDHS) are the sponsoring government agencies for the program.

The PEP Comprehensive Conservation and Management Plan (CCMP) was approved by the EPA Administrator on November 15, 2001, with the concurrence of the New York State Governor. The CCMP promotes a holistic approach to protecting, enhancing and restoring the Estuary and its watershed. Priority management topics for the Peconic Estuary are Brown Tide (a type of harmful algal bloom), nutrients, habitat and living resources, pathogens, toxic pollutants, and critical lands protection. These six priority topics, together with public education and outreach, financing, and post-CCMP management, form the basis for the CCMP action plans.

The PEP Management Conference has identified nutrient over enrichment and the resultant low dissolved oxygen levels in the Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill Creek, and Meetinghouse Creek, Terrys Creek and Tributaries as a priority problem needing attention. The PEP is fortunate to have an extensive water quality monitoring database, a three-dimensional water quality model with a predictive sediment submodel, as well as many related studies available on land use, zoning, groundwater quality and other topics in order to understand the mechanistic nature/behavior of the Peconic Estuary system.
B. Low Dissolved Oxygen Levels (Hypoxia)
The data collected by the PEP reveal periods of low dissolved oxygen (DO) levels during
the warm weather months (generally May through September). Figure I.1 depicts the
Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill
Creek, and Meetinghouse Creek, Terrys Creek and Tributaries, where low DO levels
have been and continue to be observed. These low levels of dissolved oxygen are linked
to areas of limited flushing and high nutrient loadings.

Figure I.1: Peconic Estuary waterbodies impaired due low dissolved oxygen
The chief regulators of DO concentrations in the Estuary are related to biological activity. While nitrogen is essential to a productive ecosystem, too much nitrogen fuels the excessive growth of aquatic plants, including phytoplankton and macroalgae that may, through night-time respiration, result in low dissolved oxygen levels in the water column. Night-time respiration of plants results in DO demand and can cause short-term DO depressions in the early morning hours; this is known as “diurnal” dissolved oxygen variation.

Bacterial decomposition of organic matter, including dead and dying vegetation, also results in dissolved oxygen being consumed. Most decomposition occurs in the sediments; this process is termed “sediment oxygen demand”. Sedimentary decomposition also results in the recycling of nutrients, including nitrogen, back into the water column (“sediment nutrient flux”), which can further exacerbate water quality problems. Excessive oxygen demand results in dissolved oxygen concentrations being reduced to levels that are deleterious to aquatic organisms over relatively short periods of time.

The overproduction of algal biomass (and nighttime respiration), along with sediment oxygen demand, and sediment nutrient flux, accompanied by poor flushing, limited

Image I.1: Measuring low levels of dissolved oxygen on a warm summer morning is not unusual in the western Peconic Estuary (Image Credit: Rick Balla, EPA, September 2005)
atmospheric exchange, and possibly naturally occurring density stratification of the water column in deeper areas, have caused DO concentrations to dip to hypoxic (DO less than 3.0 mg/L) and anoxic (that is, no dissolved oxygen) conditions in the Lower Peconic River and Meetinghouse Creek. Water temperature also contributes to the likelihood of stressful water quality conditions, as warmer water holds less dissolved oxygen. While strong winds can act to infuse and mix atmospheric oxygen into surface waters, periods of relative calmness can exacerbate low dissolved oxygen conditions. When conditions become stressful due to low DO levels, some organisms may suffocate and die, while others may flee the area.

Excessive microscopic algal growth can also discolor the water, and decrease water clarity and sunlight penetration. Reduced sunlight penetration can negatively impact submerged aquatic vegetation (SAV), especially eelgrass. Because SAV beds are important spawning and nursery habitat and serve as a refuge from predators for finfish and shellfish, factors that degrade them can have repercussions throughout the aquatic ecosystem and on commercial and recreational fisheries which humans highly value.

Excessive nitrogen inputs have impaired the function and health of the Lower Peconic River, Meetinghouse Creek/Terrys Creek and to some degree western Flanders Bay (Lower Sawmill Creek). The PEP has estimated that the load of nitrogen delivered to Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill Creek, and Meetinghouse Creek, Terrys Creek and Tributaries has increased 200% since the 1950s due to increasing residential populations served by on-site disposal systems (septic systems) and a more pervasive use of highly soluble fertilizers in agricultural operations and on turf (lawns and golf courses). Point source discharges to the Estuary include sewage treatment plants (STPs) in Riverhead, Sag Harbor and Shelter Island Heights, Atlantis Marine World (the Riverhead Aquarium) and stormwater runoff covered by Municipal Separate Storm Sewer Systems (MS4) Phase II Stormwater Permits. Nonpoint sources of nitrogen to the Estuary include groundwater influx, atmospheric deposition, and stormwater runoff not covered by a permit.

In spite of the generally good water quality of the Peconic Estuary overall, eelgrass and scallop populations in particular are present at a small percentage of their former abundance. Since nitrogen loads will be managed in the process of working towards achieving DO objectives, it should also have the benefit of improving water quality conditions necessary to support other ecological objectives, such as restoring eelgrass, scallops, and hard clams. Achieving desirable and balanced loadings and ambient waterbody concentrations of nitrogen is only one aspect of what is necessary to restore these three species and others. For example, a slime mold present since the 1930s likely played a role in the decline of eelgrass, while the persistent brown tide (*Aureococcus anophagefferens*) blooms of the 1980s further contributed to losses. Eelgrass beds are also known or suspected of being adversely impacted by competition from invasive plants present in the system, predation from crustaceans and wildlife, and disturbances from boating, dredging and shellfish harvesting. Loss of genetic diversity and pesticides are also suspected of playing a role in eelgrass declines. Similar discussions can be provided for scallops and hard clams. In summary, nitrogen management is one of many
objectives that needs to be pursued in order to improve the quality of estuaries, habitats, and living resources.

C. Requirements of Section 303(d)
Section 303(d)(1)(C) of the CWA and the EPA implementing regulations (40 CFR Part 130) require states to identify those waterbodies that do not meet water quality standards after application of the technology-based effluent limitations required by the CWA and to establish total maximum daily loads (TMDLs) for such waters for the pollutant of concern. The TMDL establishes the allowable pollutant loading from all contributing sources at a level necessary to achieve the applicable water quality standards. TMDLs must account for seasonal variability and include a margin of safety that accounts for uncertainty of how pollutant loadings may impact the receiving water. Once the public has had an opportunity to review and comment on the TMDL and any necessary revisions are made, it is submitted to the EPA by the state for review and approval. Upon approval, the TMDL is incorporated into the state water quality management plan and it becomes a basis for water quality permit decisionmaking and watershed management.

D. Fulfillment of Section 303(d)
To address the recognized low dissolved oxygen (hypoxia) problem, the PEP proceeded with a phased approach to nitrogen reduction and management, allowing the program to move forward in stages as more information is obtained to support more aggressive steps.

The first formal action to address hypoxia took place in 1994 with the release of the PEP Action Plan. The report announced that the nitrogen load from the Riverhead STP would not be allowed to increase beyond the amount being discharged at that time. Subsequently, DEC issued a State Pollutant Discharge Elimination System (SPDES) permit in 1996 establishing a nitrogen discharge loading limit from the Riverhead STP. The Town of Riverhead agreed to upgrade the plant to ensure continued compliance with the nitrogen limit should the plant reach its design flow/capacity. The treatment upgrade, which cost $8.1 million and included the construction of sequencing batch reactors, took place from August 1999 to May 2001. The Riverhead STP began full denitrification treatment in May 2001. This constitutes what is known as Phase I of the hypoxia management program. Descriptions of other ongoing and potential actions and programs the PEP has identified to reduce and better manage nitrogen are discussed under Implementation in this report.

The Peconic Estuary Program’s CCMP contains 85 actions which are further broken down into steps; Actions N-1, N-3, N-4, and N-5 in the Nutrients Chapter directly relate to the development of a TMDL for western portions of the estuary. The CCMP recommends that a TMDL analysis be conducted based upon the listing of impaired waters on the 303(d) list (Action N-3). Accordingly, DEC evaluated these waters from a water quality point of view, and placed these waters on the 2002 303(d) list, as candidates for developing TMDLs.

This TMDL is being prepared to fulfill the recommendations of the CCMP and the requirements of Section 303(d).
II. Waterbody Name, Location and Description
This section provides waterbody and pollutant descriptions, including the Peconic Estuary and three waterbody segments that are impaired based on not attaining state dissolved oxygen standards, and the pollutant loadings affecting the impaired waterbodies.

A. The Peconic Estuary
The Peconic Estuary is situated between the north and south forks of eastern Long Island, New York, and consists of more than 100 distinct bays, harbors, and tributaries. The Peconic watershed includes those areas that contribute groundwater, surface water, and stormwater runoff to the river and estuary. The watershed has an area of 196 square miles. The Peconic Estuary Program study area includes 246 square miles of estuarine surface waters. The watershed is nearly 100 miles long from west to east and 20 miles from north to south at its widest point. The western boundary of the study area is at the headwaters of the Peconic River, just west of the William Floyd Parkway. The eastern end is an imaginary line through Block Island Sound between Plum Island and Montauk Point, beyond which lies the open sea (Figures II.1 and II.2).

![Figure II.1: Long Island and the Peconic Estuary Program Study Area (boundary outlined)](image)

The study area includes the following municipalities: all of the Town of Shelter Island; significant portions of the Towns of Riverhead, Southold, East Hampton, and Southampton; a small portion of the Town of Brookhaven; a significant portion of the Village of Greenport, and all of the Villages of Dering Harbor, Sag Harbor, and North Haven. The entire Peconic watershed is located within Suffolk County.
Of eastern Long Island’s mean annual precipitation, 50% is recharged to groundwater while 1-2% results in stormwater runoff. The remainder is taken up by plants and evapotranspires. The Peconic River, the major river discharging freshwater to the Estuary, is groundwater fed and contributes approximately 13% of the freshwater to the Peconic Estuary. The largest source of freshwater input to the estuary (aside from direct precipitation on the Estuary surface) is from groundwater seepage (or underflow) directly into the Estuary. Stormwater runoff accounts for less than 4% of the total freshwater budget entering the Estuary.

The Peconic Estuary is a relatively shallow, well-mixed waterbody. The deepest areas of the Estuary are at the “races” (the relatively narrow straits that run between the north and south forks of the mainland and Shelter Island), ranging from approximately 5.5 m to 29 m [18 to 95 ft]. Flanders Bay is the most shallow of the bays in the Estuary, having a maximum depth of about 4.3 m (14 ft). The other bays that make up the Peconic Estuary range between 6 and 12 m (20 to 40 ft) deep at their centers with deeper pockets located east of Robins Island in Little Peconic Bay and southeast of Cedar Point Beach in Gardiners Bay. Water depths increase to greater than 28 m (91 ft) east of Gardiners Island.

The Estuary is not well flushed as evidenced by the salinity gradient along the main stem of the estuary. Average salinity increases rapidly from less than 24 practical salinity units (psu) at the Peconic River to approximately 27 psu in Flanders Bay, and then increases more gradually toward the east to approximately 29 psu.

**B. Impaired Waterbodies on the 303(d) List**

In order to fulfill certain requirements of the Federal Clean Water Act, the DEC must
provide regular, periodic assessments of the quality of the water resources of the state. These assessments reflect monitoring and water quality information drawn from a number of programs and sources, both within and outside the DEC. This information has been compiled by the DEC into an inventory database of all waterbodies in the state used to record current water quality information, characterize all known and/or suspected water quality problems and issues, and track progress toward their resolution. This inventory of water quality information is the Waterbody Inventory/Priority Waterbodies List.

This nitrogen TMDL addresses the Peconic Estuary and its impaired waters (due to low dissolved oxygen): Lower Peconic River and Tidal Tributaries; Western Flanders Bay and Lower Sawmill Creek; and Meetinghouse Creek, Terrys Creek and Tributaries of the Peconic Estuary (Figure 1-1). Previously, in 2006, the State prepared and EPA approved 20 TMDLs for 25 Peconic Estuary waterbodies impaired due to pathogen contamination and impacts to shellfishing waters. Descriptions of the three DO impaired waterbodies from the New York State Priority Waterbodies List follow.

1. **Lower Peconic River and Tidal Tributaries (NYS Priority Waterbodies List Segment #1701-0259)**

   According to the New York State Priority Waterbodies List, this segment includes the tidal portion of the Peconic River and its tributaries, spanning from the dam near Peconic Avenue to a line due south of the mouth of Sawmill Creek (see Figure I-1 and Image II.1). The entire waterbody segment spans approximately 200 acres. The boundaries of the Lower Peconic River and its tidal tributaries are shared between the Hamlet of Riverside in the Town of Southampton and the Hamlet of Riverhead in the Town of Riverhead.

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**Image II.1:** The Tidal Peconic River, looking west. The County Route 105 bridge is in the foreground. (Image credit: Rick Balla, EPA, August 29, 2006)
2. Western Flanders Bay and Lower Sawmill Creek (NYS Priority Waterbodies List Segment #1701-0254)
According to the New York State Priority Waterbodies List, this segment includes the estuarine waters between a line due south of the mouth of Sawmill Creek and a line from Indian Island to the northwest boundary of Reeves Bay (Iron Point), including the tidal portion of Sawmill Creek (see Figure I-1 and Images II.2A and II.2.B). The entire waterbody segment spans approximately 100 acres. The boundary of Western Flanders Bay is shared by the Hamlet of Riverside in the Town of Southampton and the Hamlet of Riverhead in the Town of Riverhead. Sawmill Creek is situated in the Hamlet of Riverhead in the Town of Riverhead.

![Image II.2A and II.2B: Sawmill Creek. Top image II.2A – Sawmill Creek looking south. Indian Island County Park is in the foreground. Sawmill Creek separates the Park from the Indian Island Golf Course. County Route 105 appears on the right. (image credit: Helen Grebe, EPA, August 29, 2006). Bottom image II.2B – Sawmill Creek (on the right) and western Flanders Bay (in the foreground and to the left) looking east. (Image credit: Rick Balla, EPA, August 26, 2004)](image)

3. Meetinghouse Creek, Terrys Creek and Tributaries (NYS Priority Waterbodies List Segment #1701-0256)
According to the New York State Priority Waterbodies List, this segment includes the tidal portions of Meetinghouse Creek and Terrys Creek as well as their tributaries (see Figure I-1 and Image II.3). The entire waterbody segment spans approximately 200 acres. Meetinghouse Creek is situated entirely within the Hamlet of Aquebogue in the
Town of Riverhead while the boundaries of Terrys Creek are shared by the Hamlets of Aquebogue and Riverhead in the Town of Riverhead.

Image II.3: Meetinghouse Creek (on the right) and Terrys Creek (on the left).
(Image credit: Helen Grebe, EPA, August 29, 2006)

C. Pollutant Loads Affecting Impaired Waterbodies
Because the Peconic Estuary is a tidal system, the quality of water outside of the impaired waters can both positively and negatively affect the quality of impaired waters. For this reason, this TMDL addresses loads from waters and watersheds outside the impaired waterbodies. Addressing waters and loads outside of the impaired waters is necessary to ensure that water quality standards are met throughout the Peconic Estuary System.

Sources of pollution resulting in impairments due to nitrogen enrichment include atmospheric deposition, on-site wastewater disposal systems, agricultural operations, turf and landscape maintenance, point sources including sewage treatment plants, and stormwater. These sources are discussed further detail in sections IV.C (Pollution Sources to Impaired Waters) and V.B (Nutrient Loading Data).

III. Applicable Water Quality Standards
This section provides an overview of nutrient issues and related standards and criteria, including a description of nutrient enrichment and its impacts, and New York State water quality standards and criteria for dissolved oxygen levels to support aquatic life uses.
A. Nutrient Enrichment and Impacts on Dissolved Oxygen
In the Peconic Estuary, nitrogen is the primary limiting nutrient for algal growth that leads to low DO levels and the subsequent non-attainment of designated uses. Nitrogen's relationship to impaired designated uses is indirect and complex, with intermediate steps of algal blooms and decomposition, low DO, poor water clarity, inhibited SAV (primarily eelgrass) growth, and stress on marine fauna. The relationship between nitrogen loading, ambient nitrogen concentration, and DO conditions is complex, often nonlinear, and typically requires calibrated and verified mathematical models to account for the controlling hydrologic, physical, chemical, and biological interactions. The PEP, based on water quality data and model runs, derived a maximum allowable water column nitrogen concentration from the relationship between nitrogen values, algal biomass, and dissolved oxygen.

Based on monitoring and modeling, the PEP has determined that reducing nitrogen loads necessary to achieve the water quality standards for DO will protect and maintain designated uses in the Peconic Estuary, especially for the 303(d) listed waterbodies. While the TMDL for nitrogen is translated from DO standards, other eutrophication-related impairments resulting from the intermediate steps of algal blooms and decomposition, poor water clarity, inhibited submerged aquatic plant growth, and stress to marine organisms have been considered, and would benefit from nitrogen load reduction.

B. New York State Water Quality Standards for Class SC waters
New York State’s marine and fresh water classifications, designated best uses, and floating substances standards are contained in NYCRR, Title 6, Chapter X, Parts 701 and 703. Below are the pertinent applicable water classifications, designated best uses, and dissolved oxygen standard for the Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill Creek, and Meetinghouse Creek, Terrys Creek and Tributaries and other marine waters of the Peconic Estuary system.

**Designated Best Usage**

**Class SC**
The best use of Class SC waters is fishing. These waters shall be suitable for fish propagation and survival. The water quality shall be suitable for primary and secondary contact recreation, although other factors may limit the use for these purposes.

**Dissolved Oxygen Standard**

**Class SC**
Dissolved oxygen shall not be less than 5.0 mg/L at any time.

C. Proposed Revisions to New York’s State’s DO Standard for Class SC Waters
On December 13, 2006 a public hearing was announced in the New York State Environmental Notice Bulletin, in order to give the public an opportunity to provide oral or written comment on the Department’s proposal to amend portions of Parts 700 - 704 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR). The proposed revisions are necessary to amend water quality standards based upon the most current scientific information. The marine dissolved
oxygen standard was among the items proposed for revision. As of the date of this TMDL, the proposed revisions have not yet been adopted. The proposed standard follows:

**Acute:** Shall not be less than 3.0 mg/L at any time.

**Chronic:** Shall not be less than a daily average of 4.8 mg/L at any time, except that the daily average dissolved oxygen concentration may fall below 4.8 mg/L for a limited number of days, as defined by the formula:

\[ DO_i = \frac{13.0}{2.80 + 1.84e^{-0.1t_i}} \]

where \( DO_i \) = DO concentration in mg/L between 3.0 - 4.8 mg/L and \( t_i \) = time in days.

This equation is applied by dividing the DO range of 3.0 - 4.8 mg/L into a number of equal intervals. \( DO_i \) is the lower bound of each interval (i) and \( t_i \) is the allowable number of days that the DO concentration can be within that interval. The actual number of days that the measured DO concentration falls within each interval (i) is divided by the allowable number of days that the DO can fall within interval (\( t_i \)). The sum of the quotients of all intervals (i=1...n) cannot exceed 1.0; i.e.,

\[ \sum_{i=1}^{n} \frac{t_i \text{(actual)}}{t_i \text{(allowed)}} < 1.0 \]

The DO shall not fall below the acute standard of 3.0 mg/L at any time.

In preparing this TMDL, we have considered, calculated and modeled the loads necessary to achieve both the existing and proposed water quality standards for dissolved oxygen. The analyses, loads, and load reductions necessary to achieve both the existing and proposed water quality standards are presented in this document.

IV. CWA 303(d) Listing
This section describes the impaired waters and pollutants, including the monitoring data documenting low dissolved oxygen levels in three waterbody segments, the pollutants of concern, and a brief overview of the pollution sources to the impaired waters. There are other impaired waterbodies in the Peconic Estuary System, identified for reasons other than low dissolved oxygen and excess nitrogen. Twenty five waterbodies have been identified as impaired due to pathogen contamination. In September 2006, TMDLs were adopted and approved for twenty of these waterbody segments.

A. Use Impairments
1. Lower Peconic River and Tidal Tributaries
Monitoring data collected from 1995 to 2000 show that the water quality standard of 5 mg/L was not attained during the summer months (June 1st – September 30th) in the
Lower Peconic River (see Figure IV.1 for monitoring station locations). The low dissolved oxygen levels are in the range of 2.0 - 4.9 mg/L. Three percent of the dissolved oxygen values are below 3.0 mg/L and twenty five percent of the dissolved oxygen levels are below 5.0 mg/L. In summary, state water quality standards for dissolved oxygen are frequently not attained in the Lower Peconic River.

Figure IV.1: Peconic Estuary Program Routine Marine Monitoring Stations

2. Western Flanders Bay and Lower Sawmill Creek
Monitoring data collected from 1990 to 2000 show that the water quality standard of 5 mg/L was not attained during summer months in the Western Flanders Bay area (see Figure IV.1 for monitoring station locations). The low dissolved oxygen levels are in the range of 4.2 - 4.9 mg/L. The ambient data show that four percent of the DO values are below 5.0 mg/L. In summary, state water quality standards for dissolved oxygen are infrequently not attained in the Western Flanders Bay and Lower Sawmill Creek segment.

3. Meetinghouse Creek, Terrys Creek and Tributaries
Monitoring data collected from 1995 to 2000 show that the water quality standard of 5 mg/L was not attained to a greater degree than the waterbodies named above during summer months in Meetinghouse Creek (see Figure IV.1 for monitoring station locations). The low dissolved oxygen levels are in the range of 0.2 - 4.9 mg/L. The ambient data show that twenty four percent of the dissolved oxygen values are below 3.0 mg/L.
mg/L and fifty three percent of the DO values are below 5.0 mg/L. In summary, the lack of attainment of state water quality standards for dissolved oxygen in Meetinghouse Creek is frequent and severe.

4. Commonalities among the Impaired Waterbodies
The low dissolved oxygen levels in these three waterbody segments are attributed to the excess loadings of the nutrient nitrogen in these waterbodies in combination with other factors. The high levels of nitrogen loadings lead to the proliferation of uncontrolled algae growth resulting in the abundance of readily oxidizable organic matter during algae senescence and death, and accumulation in sediments. The organic matter then oxidizes to carbon and consumes available dissolved oxygen in the water column causing violations of the dissolved oxygen standard. Night-time respiration of aquatic plants also results in DO demand and can cause short-term DO depressions in the early morning hours (“diurnal” dissolved oxygen variation).

Based on the documented and recurring violations of the applicable dissolved oxygen standard, best usages of these waterbodies are not being attained and these waters described above are impaired. Impacts and uses that are impacted include but are not be limited to: decreased fish propagation, increased mortality of sensitive organisms, poor water clarity, reduction in commercial and sport fisheries values, reduction in wildlife habitat value, degradation of seagrass beds, impact on tourism and real estate values, and poorer aesthetics. All these uses would benefit from improved water quality resulting from nitrogen load reductions.

Based upon the impaired conditions of the Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill Creek, and Meetinghouse Creek, Terrys Creek and Tributaries, DEC has included these waterbodies on the 2002 Clean Water Act Section 303(d) list. These waterbodies have been listed as impaired on the State’s Priority Waterbodies List (PWL) and have been identified as not meeting the dissolved oxygen quality standard at all times and as priorities for TMDL development.

B. Pollutants of Concern
The primary pollutant contributing to low dissolved oxygen levels in the Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill Creek, and Meetinghouse Creek, Terrys Creek and Tributaries is nitrogen. Excess nitrogen promotes the uncontrolled growth of algae leading to the production of organic biomass. The decay of this organic matter and its accumulation in bottom sediments exerts a demand for dissolved oxygen in the water column and along with night time algal respiration results in the lowering of the DO levels and violations of the applicable water quality standard. This process is the dominant mechanism for causing low oxygen levels in Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill Creek, and Meetinghouse Creek, Terrys Creek and Tributaries. The principal pollutant for these TMDL analyses, therefore, is nitrogen.

Organic carbon is also a key element in the process leading to low dissolved oxygen levels but is not a pollutant targeted for reduction in this analysis as reduction of organic
carbon loadings has very little beneficial effect in improving DO levels when compared with the reduction of nitrogen.

C. Pollutant Sources to Impaired Waters
There are a number of significant sources of nitrogen that contribute to low DO in the Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill Creek, and Meetinghouse Creek, Terrys Creek and Tributaries. Other point sources are described later in this document:

1. One municipal wastewater treatment facility (the Riverhead STP) currently discharging less than one million gallons of treated effluent per day to the surface waters of the tidal Peconic River just west of the County Route 105 Bridge. Atlantis Marine World (the Riverhead Aquarium) also discharges a small flow and contributes a nutrient load to the tidal Peconic River.

2. Stormwater from the Towns of Riverhead and Southampton is regulated under the EPA’s Phase II Stormwater Program, as are the New York State Department of Transportation and Suffolk County stormwater facilities within these towns. As of March 2003, the municipal separate storm sewer systems (MS4s) that serve these two towns were required to have a NPDES permit and a management plan that prevents polluted stormwater from being discharged into nearby water bodies and impacting water quality. The outfalls from these MS4s are considered point sources to the Peconic Estuary. The Town of Brookhaven is also regulated under the Phase II Stormwater Program, though stormwater from the Town of Brookhaven enters and contributes only to the non-tidal Peconic River upstream of the impaired segments and is included in tributary loads.

3. Nonpoint sources contribute to groundwater loads that eventually recharge surface waters, including: fertilizer losses from agricultural operations and turf grass maintenance (at residences and other developed properties, and golf courses); and onsite wastewater disposal systems from properties not connected to sewage treatment plants. Other unregulated stormwater sources also contribute to the nonpoint nutrient load.

4. Sediment nutrient flux attributed to highly organic substrates found in the Lower Peconic River and Tidal Tributaries, Western Flanders Bay and Lower Sawmill Creek, and Meetinghouse Creek, Terrys Creek and Tributaries.

5. Wet and dry atmospheric deposition directly to water surfaces and to the landscape.

6. Boundary conditions, that is, the quality of the water flushing from other waters, will influence the quality and response of impaired waterbodies.
D. Other Point Sources Outside of Impaired Waters
In addition to sources described in the above section, there are additional sewage treatment plants in the Peconic Study Area that discharge to estuarine waters outside of the impaired waters: the Sag Harbor Sewage Treatment Plant and the Shelter Island Heights Sewage Treatment Plant. As noted previously, the Villages of Sag Harbor and North Haven, the Towns of Brookhaven, Riverhead, and Southampton, the New York State Department of Transportation, and Suffolk County stormwater facilities are currently regulated under the EPA’s Phase II Stormwater Program. While other municipalities within the Peconic study area (the Towns of Shelter Island, Southold, and East Hampton) are not currently covered by the Phase II regulations, they may be designated by the New York State Department of Environmental Conservation for such coverage during the second Phase II permit cycle (2008-2013). In addition, the Brookhaven National Laboratory STP, which discharges to the freshwater Peconic River is addressed as a boundary/tributary load, as is the Plum Island STP which discharges to Gardiners Bay. While the former Naval Weapon Industrial Reserve Plant (previously operated by the Grumman Corporation) in Calverton, NY also has an STP that discharges to a branch of the freshwater Peconic River, the operators have submitted engineering reports to upgrade and build a new facility discharging to groundwater outside of the Peconic Estuary study area.

V. TMDL Development
This section provides a description of the data inputs to the modeling process and ultimately the TMDL, including ambient data, nutrient loading data, and uncertainties associated with current and projected future nutrient loads.

A. Available Ambient Data
Data from the SCDHS’s water quality monitoring efforts as well as data from PEP funded studies and reports were used to calibrate and validate the Peconic Estuary EFDC (Environmental Fluid Dynamics Code) three-dimensional hydrodynamic and water quality model by Tetra-Tech, Inc. The SCDHS, in part through the Peconic Estuary Program, conducts an extensive water quality sampling program in the Peconic Estuary and its watershed.

1. Routine Water Quality Monitoring Program
While the SCDHS began limited surface water quality sampling in 1976, the number of stations and samples taken in the Peconics increased through the years. Currently, monitoring is conducted every other week at 32 stations throughout the year; two surface water quality monitoring stations are located in the waters for which the nitrogen this TMDL is being developed. Water samples are tested for a suite of nitrogen components (NH3, NO2+NO3, Urea, TN, TDN), phosphorus components (TP, TDP, orthophosphate), carbon components (TOC, DOC), silicate (SiO3), total suspended solids (TSS), chlorophyll-a (Total and < 10 μm), coliform bacteria (Total and Fecal), and Brown Tide (Aureococcus). At each station, secchi depth, temperature, dissolved oxygen, salinity, and the extinction of photosynthetically active radiation at incremental