UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

SEP 2 0 2016

Mr. Mark Klotz, Director
Division of Water, 4th Floor
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233-3500

Dear Mr. Klotz:

On September 2, 2016, the U.S. Environmental Protection Agency, Region 2, received for review and approval, the New York State Department of Environmental Conservation's document, dated July 2016: "Total Maximum Daily Load (TMDL) for Phosphorus in Lake Carmel, Putnam County, New York."

The EPA approves this TMDL pursuant to Section 303(d)(2) of the Clean Water Act (CWA) and the EPA's implementing regulations at 40 CFR 130.7(d)(2). The rationale for this approval is provided in the enclosure entitled "Review of Total Maximum Daily Load (TMDL) for Total Phosphorus for Lake Carmel, New York."

The TMDL addresses the total phosphorus loading and impairment in this waterbody and is established at a level sufficient to attain the NYSDEC's water quality guidance value for total phosphorus for Lake Carmel.

The EPA expects this approved TMDL will be incorporated in the New York State Water Quality Management Plan.

Sincerely,

Javier Laureano, Director
Clean Water Division

Enclosure

Review of Total Maximum Daily Load (TMDL) for Total Phosphorus for Lake Carmel, New York

This document contains EPA's review of the above-referenced TMDL. This TMDL review document includes TMDL review guidelines that summarize and provide guidance regarding currently effective statutory and regulatory requirements relating to TMDLs. These TMDL review guidelines are not themselves regulations. Any differences between these guidelines and EPA's TMDL regulations should be resolved in favor of the regulations themselves. The italicized sections of this document describe EPA's statutory and regulatory requirements for approvable TMDLs. The sections in regular type reflect EPA's analysis of New York's compliance with these requirements.

Section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R. Part 130 describe the statutory and regulatory requirements for approvable TMDLs. Additional information is generally necessary for EPA to determine if a submitted TMDL fulfills the legal requirements for approval under Section 303(d) and EPA regulations, and should be included in the submittal package. Use of the verb "must" below denotes information that is required to be submitted because it relates to elements of the TMDL required by the CWA and by regulation. Use of the term "should" below denotes information that is generally necessary for EPA to determine if a submitted TMDL is approvable.

1. Identification of Waterbody, Pollutant of Concern, Pollutant Sources, and Priority Ranking

The TMDL submittal should identify the waterbody as it appears on the State's/Tribe's 303(d) list. The waterbody should be identified/georeferenced using the National Hydrography Dataset (NHD), and the TMDL should clearly identify the pollutant for which the TMDL is being established. In addition, the TMDL should identify the priority ranking of the waterbody and specify the link between the pollutant of concern and the water quality standard (see section 2 below).

The TMDL submittal should include an identification of the point and nonpoint sources of the pollutant of concern, including location of the source(s) and the quantity of the loading, e.g., lbs/per day. The TMDL should provide the identification numbers of the NPDES permits within the waterbody. Where it is possible to separate natural background from nonpoint sources, the TMDL should include a description of the natural background. This information is necessary for EPA's review of the load and wasteload allocations, which are required by regulation.

The TMDL submittal should also contain a description of any important assumptions made in developing the TMDL, such as: (1) the spatial extent of the watershed in which the impaired waterbody is located; (2) the assumed distribution of land use in the watershed (e.g., urban, forested, agriculture); (3) population characteristics, wildlife resources, and other relevant information affecting the characterization of the pollutant of concern and its allocation to sources; (4) present and future growth trends, if taken into consideration in preparing the

TMDL (e.g., the TMDL could include the design capacity of a wastewater treatment facility); and (5) an explanation and analytical basis for expressing the TMDL through surrogate measures, if applicable. Surrogate measures are parameters such as percent fines and turbidity for sediment impairments; chlorophyll a and phosphorus loadings for excess algae; length of riparian buffer; or number of acres of best management practices.

A. Identification of Waterbodies and Background Information

EPA received for review and approval the New York State Department of Environmental Conservation (NYSDEC) document: "Total Maximum Daily Load (TMDL) for Phosphorus in Lake Carmel, Putnam County, New York" (TMDL document) on September 2, 2016 (via letter dated August 30, 2016 from Mark Klotz, NYSDEC to Jeff Gratz, EPA).

Along with the TMDL document, a copy of the notice seeking public comment was submitted. A companion document responding to public comments on the Lake Carmel TMDL was also submitted. Collectively, these documents are referred to as "the TMDL submittal."

Lake Carmel (waterbody ID: 1302-0006), located in the town of Kent, Putnam County, is identified on the New York 2014 303(d) list as impaired due to phosphorus. The Lake is a 186 acre waterbody with a direct drainage area of 8,150 acres, excluding its surface area. Table 1 and Figures 3 and 4 of the Lake Carmel TMDL document show the land uses, in both acres and percent, within the lake's drainage basin. The predominant land uses in the Lake Carmel watershed are forest and developed land.

The existing land use and land cover were determined from geographical information system (GIS) datasets and information provided by the public. Digital land use/land cover data were obtained from the most recent 2006 National Land Cover Data Set. The land use and cover map is shown in Figure 4 of the TMDL document.

Lake Carmel is located within the watershed of the NYC East of Hudson Middle Branch drinking water reservoir. A total phosphorus TMDL for the Middle Branch reservoir was approved by EPA in 2000 and identified the Lake Carmel watershed loadings as a major source of total phosphorus to the Middle Branch reservoir.

B. Pollutant of Concern

The pollutant of concern for Lake Carmel is total phosphorus. Data collected through the Citizen Statewide Lake Assessment Program (CSLAP) during the summers of 1986-1990 and by NYSDEC during the summer of 2013 indicate that the epilimnetic total phosphorus concentrations in Lake Carmel exceed the state guidance value of 20 μg/L of total phosphorus (see Figure 6 of TMDL document). Excessive concentrations of total phosphorus increase primary productivity (algal biomass) which leads to eutrophication.

C. Pollutant Sources

The current permitted point sources of total phosphorus to Lake Carmel are the Pelham Nursing and Rehabilitation Wastewater Treatment Facility (WWTF), the Girl Scouts Heart of Hudson WWTF, the Frangel Realty WWTF and the Towns of Kent, Patterson, Pawling, Beekman and East Fishkill Municipal Separate Storm Sewer Systems (MS4). On December, 11, 2014, the Frangel Realty WWTF was diverted to the Kent WWTP which discharges to Palmer Lake.

The nonpoint sources of total phosphorus to Lake Carmel include: streambank erosion; runoff from forest land; septic systems; wetlands; internal loading and groundwater. Stream bank erosion and septic systems are the largest sources of total phosphorus loadings to Lake Carmel.

D. Priority Ranking

Lake Carmel is ranked as low priority for TMDL development on the New York State 2014 Section 303(d) List of Impaired Waters.

EPA finds that the TMDL meets the requirements for describing the waterbody, the pollutant of concern, pollutant sources, and priority ranking.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Target

The TMDL submittal must include a description of the applicable State/Tribal water quality standard, including the designated use(s) of the waterbody, the applicable numeric or narrative water quality criterion, and the antidegradation policy. (40 C.F.R. §130.7(c)(1)). EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation.

The TMDL submittal must identify a numeric water quality target(s) a quantitative value used to measure whether or not the applicable water quality standard is attained. Generally, the pollutant of concern and the numeric water quality target are, respectively, the chemical causing the impairment and the numeric criteria for that chemical (e.g., chromium) contained in the water quality standard. The TMDL expresses the relationship between any necessary reduction of the pollutant of concern and the attainment of the numeric water quality target. Occasionally, the pollutant of concern is different from the pollutant that is the subject of the numeric water quality target (e.g., when the pollutant of concern is phosphorus and the numeric water quality target is expressed as Dissolved Oxygen (DO) criteria). In such cases, the TMDL submittal should explain the linkage between the pollutant of concern and the chosen numeric water quality target.

Lake Carmel is designated by NYSDEC as a "Class B" water. The best usages of Class B waters are: primary and secondary contact recreation and fishing. The lake must also be suitable for fish propagation and survival.

Total phosphorus in waters designated Class A and B waters are addressed under New York's narrative surface water quality standards for nutrients, found at Part 703 of New York State Code, Rules and Regulations (NYSCRR). The narrative criterion for total phosphorus and nitrogen found at Part 703.2 is: "None in amounts that will result in growths of algae, weeds and slimes that will impair the water for their best usages."

As part of its Technical and Operational Guidance Series (TOGS 1.1.1 and accompanying fact sheet, (NYSDEC, 1993)), NYSDEC has suggested that for waters classified as ponded (i.e., reservoirs and ponds, excluding Lake Erie, Ontario and Champlain), the epilimnetic summer mean total phosphorus concentration (from June 1 to September 30) shall not exceed 20 µg/L (or 0.02 mg/L). This guidance value, which is based on aesthetic effects for primary and secondary contact recreation, represents NYSDEC's interpretation of its narrative criterion for total phosphorus found at 6 NYCRR § 703.2. The guidance value of 20 µg/L corresponds to a mesotrophic status. This value represents a transition between a eutrophic to a mesotrophic lake. Achieving the 20 µg/L is expected to reduce in-lake impacts associated with eutrophication.

The TMDL target for Lake Carmel is 20 µg/L total phosphorus.

EPA finds that the TMDL meets the requirements for identifying the applicable water quality standard and numeric water quality target.

3. Loading Capacity – Linking Water Quality and Pollutant Sources

A TMDL must identify the loading capacity of a waterbody for the applicable pollutant. EPA regulations define loading capacity as the greatest amount of a pollutant that a water can receive without violating water quality standards (40 C.F.R. §130.2(f)).

The pollutant loadings may be expressed as either mass-per-time, toxicity or other appropriate measure (40 C.F.R. §130.2(i)). The TMDL submittal should describe the method used to establish the cause-and-effect relationship between the numeric target and the identified pollutant sources. In many instances, this method will be a water quality model.

The TMDL submittal should contain documentation supporting the TMDL analysis, including the basis for any assumptions; a discussion of strengths and weaknesses in the analytical process; and results from any water quality modeling. EPA needs this information to review the loading capacity determination, and load and wasteload allocations, which are required by regulation. TMDLs must take into account critical conditions for stream flow, loading, and water quality parameters as part of the analysis of loading capacity. (40 C.F.R. §130.7(c)(1)). TMDLs should define applicable critical conditions and describe their approach to estimating both point and nonpoint source loadings under such critical conditions. In particular, the TMDL should discuss the approach used to compute and allocate nonpoint source loadings, e.g., meteorological conditions and land use distribution.

A. Loading Capacity

The MAPSHED[1] watershed model was used in conjunction with the BATHUB reservoir response model to develop the TMDL for Lake Carmel. MAPSHED is used to determine the seasonal phosphorus loading to the waterbody, and BATHTUB is used to determine the extent to which the total load must be reduced to meet the water quality target. The total phosphorus loading capacity is calculated by running BATHTUB iteratively, and reducing the concentration of total phosphorus within the drainage basin until the model results demonstrate attainment of the water quality target. The maximum concentration that results in compliance with the TMDL target for total phosphorus is used as the basis for determining the loading capacity. This concentration is then converted into a loading rate for each nonpoint source by using simulated flow from MAPSHED.

The BATHTUB[2] model simulates the fate and transport of nutrients and water quality conditions in response to nutrient loads to a lake or reservoir. BATHTUB performs steady-state water and nutrient balance calculations in a spatially segmented hydraulic network that accounts for advective and diffusive transport and nutrient sedimentation. Eutrophication–related water quality conditions (total phosphorus, total nitrogen, chlorophyll a, transparency, and hypolimnetic oxygen depletion) are predicted by the model using empirical relationships previously developed and tested for reservoir applications. The BATHTUB model has been previously applied to north temperate lakes with characteristics similar to those of Lake Carmel. Appendix B of the TMDL document discusses the setup, calibration, and use of the BATHTUB model.

The MAPSHED model is used to calculate the current nonpoint source loads of total phosphorus to Lake Carmel. Using simulated flow from MAPSHED, the maximum total phosphorus concentrations calculated by BATHTUB for the lake was converted into loading rates. The MAPSHED model was developed under EPA's contract with Cadmus Inc. in response to NY's need for a version of AVGWLF (Arc View Generalized Watershed Loading Function) that would operate in a non-proprietary geographic information system (GIS) package called MapWindow. MAPSHED incorporates an enhanced version of the AVGWLF model developed by Haith and Shoemaker (1987)[3] and the RUNQUAL model developed by Haith (1993)[4]. RUNQUAL was developed to refine the urban runoff component by differentiating among three levels of imperviousness for residential and mixed commercial land uses. The AVGWLF model was initially calibrated and validated for 22 watersheds throughout New York and New England for the period of 1997- 2004. The model was fine-tuned by including additional calibration sites

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1 http://www.MAPSHED.psu.edu/Downloads/RUNQUALManual.pdf

2 Flux, Profile, and BATHTUB: Simplified Procedure for Eutrophication Assessment and Prediction. January 2004. The United States Army Corps of Engineers, Engineer Research and Development Center. http://el.erdc.usace.army.mil/elmodels/emiinfo.html.

3 Haith, D.A. and L.L. Shoemaker, 1987. Generalized Watershed Loading Functions for Stream Flow Nutrients. Water Resources Bulletin, 23(3), pp.471-478.

4 Haith, D.A. 1993. RUNQUAL, Runoff Quality from Development Sites.

in New York to supplement data from the original northeast model calibration and verification sites. Two models were developed based on the Eastern Great Lakes/Hudson Lowlands area and the Northeastern Highlands area and calibrated to better reflect local conditions and ecological and hydrological processes. The model was used to develop TMDLs for a number of lakes in NY.

The MAPSHED model was applied to Lake Carmel to calculate mean seasonal phosphorus loads for the period 1986-2013. Using these loads as inputs to BATHTUB, water quality was modeled in the lake and compared to available data for 1986-1990 and 2013 (refer to Figure 8 of the TMDL document). Modeled values for 1987 and 2013 are significantly higher than the observed values. However, the model's ability to predict lake phosphorus concentrations is acceptable for calculating the TMDL. This conclusion is based on statistical analyses which were conducted to evaluate the water quality model's performance. As described in Appendix B (p. 61) of the TMDL document, error statistics indicate that the simulated vs. observed mean annual phosphorus concentrations vary from "quite good" to "moderately accurate".

The calibrated BATHTUB model was then used to derive the total phosphorus load reduction needed to meet the total phosphorus target of 20 μg/L as a growing season average. Using the modeling framework, the calculated load capacity (TMDL) of total phosphorus for Lake Carmel is 3.370 lbs/day.

The TMDL, waste load allocations (WLA), load allocations (LA) and margin of safety (MOS) for Lake Carmel are identified in Table 1 in Appendix A of this document.

B. Cause-and-Effect Relationship between Numeric Target and Pollutant

In lakes, total phosphorus is typically the limiting nutrient. Excess inputs of total phosphorus result in eutrophication, which is mainly associated with algal blooms and low dissolved oxygen levels in the hypolimnion, along with taste, odor and color problems. By reducing the input of total phosphorus, the impacts associated with eutrophication are reduced. The TMDL target for total phosphorus is applied as an epilimnetic summer mean total phosphorus concentration that will result in water quality standards being met year round throughout the lake. The TMDL target for Lake Carmel is 20 μg/L.

C. Critical Conditions

The critical condition for Lake Carmel is the summer growing season (June 1 through September 30). While AVGWLF takes into account loadings from all periods throughout the year, including spring loads, the BATHTUB model simulations were compared against observed data during the critical growing season. Meeting the TMDL target of 20 μg/L total phosphorus during the critical summer growing period ensures that the standard is achieved throughout the year.

EPA concludes that the loading capacity has been adequately identified and critical conditions have been considered.

4. Load Allocations (LAs)

EPA regulations require that a TMDL include LAs, which identify the portion of the loading capacity attributed to existing and future nonpoint sources and to natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R. §130.2(g)). Where possible, load allocations should be described separately for natural background and nonpoint sources.

The TMDL for Lake Carmel provides LAs for: stream bank erosion; runoff from forested lands; groundwater; septic systems; and internal loading. The TMDL provides for a 100% reduction in septic tank and internal loadings and a 46% reduction in stream bank erosion.

Table 1 in Appendix A of this document lists the current loading for each source, and the load allocations needed to meet the TMDL for Lake Carmel.

EPA concludes that the TMDL has identified load allocations for nonpoint sources of total phosphorus.

5. Wasteload Allocations (WLAs)

EPA regulations require that a TMDL include WLAs, which identify the portion of the loading capacity allocated to individual existing and future point source(s) (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i)). In some cases, WLAs may cover more than one discharger, e.g., if the source is contained within a general permit.

The individual WLAs may take the form of uniform percentage reductions or individual mass based limitations for dischargers where it can be shown that this solution meets WQSs and does not result in localized impairments. These individual WLAs may be adjusted during the NPDES permitting process. If the WLAs are adjusted, the individual effluent limits for each permit issued to a discharger on the impaired water must be consistent with the assumptions and requirements of the adjusted WLAs in the TMDL. If the WLAs are not adjusted, effluent limits contained in the permit must be consistent with the individual WLAs specified in the TMDL. If a draft permit provides for a higher load for a discharger than the corresponding individual WLA in the TMDL, the State/Tribe must demonstrate that the total WLA in the TMDL will be achieved through reductions in the remaining individual WLAs and that localized impairments will not result. All permitees should be notified of any deviations from the initial individual WLAs contained in the TMDL. EPA does not require the establishment of a new TMDL to reflect these revised allocations as long as the total WLA, as expressed in the TMDL, remains the same or decreases, and there is no reallocation between the total WLA and the total LA.

The TMDL includes a total wasteload allocation of 0.286 lbs/d total phosphorus which includes the WLAs for the Towns of Kent, Patterson, Pawling, Beekman and Fishkill MS4s, the Girls Scouts Heart of Hudson Wastewater Treatment Facility (WWTF), the Putnam Nursing and Rehabilitation WWTF and the Frangel Realty WWTF.

The MS4s are assigned a combined WLA of 0.248 lbs/day, a 10 percent reduction from their current load. The Girls Scouts Heart of Hudson WWTF has a WLA of 0.005 lbs/day. The Putnam Nursing and Rehabilitation WWTF has a WLA of 0.033 lbs/day. The discharge from Frangel Realty WWTF has been relocated from Lake Carmel to Palmer Lake and thus has a zero WLA. A WLA for Frangel Realty is provided in the Palmer Lake TMDL which was approved by EPA on July 17, 2015.

Since the Lake Carmel watershed is located within the NYC drinking reservoir watershed, NYC regulations require that the maximum level of total phosphorus for the Girls Scouts Hear of Hudson and the Putnam Nursing and Rehabilitation WWTFs should not exceed 1.0 mg/L. However, to further protect Lake Carmel, NYSDEC determined that a more stringent total phosphorus effluent concentration of 0.2 mg/L should be included in the permit for the Putnam Nursing and Rehabilitation WWTF and a limit of 0.4 mg/L should be included in the permit for the Girl Scouts Heart of Hudson WWTF.

The MS4s located in the Towns Kent, Patterson, East Fishkill, Pawling and Beekman are located in the East of Hudson Watershed Improvement Strategy Area and are therefore subject to "heightened" requirements in NYSDEC's MS4 General Permit for storm water management designed to meet required TMDL reductions, including the WLA of 0.248lbs/day in this TMDL.

Additional information on the WLAs is provided under the Implementation Section below.

6. Margin of Safety (MOS)

The statute and regulations require that a TMDL include a margin of safety (MOS) to account for any lack of knowledge concerning the relationship between load and wasteload allocations and water quality (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)). EPA's 1991 TMDL Guidance explains that the MOS may be implicit, i.e., incorporated into the TMDL through conservative assumptions in the analysis, or explicit, i.e., expressed in the TMDL as loadings set aside for the MOS. If the MOS is implicit, the conservative assumptions in the analysis that account for the MOS must be described. If the MOS is explicit, the loading set aside for the MOS must be identified.

The TMDL for Lake Carmel incorporates an explicit MOS of 10% of the loading capacity.

The 10% MOS applied to the lake is considered appropriate to address the uncertainty in the TMDL. As shown in Figure 8 and supported by statistical analyses (Appendix B) of the Lake Carmel TMDL document, agreement between the observed and modeled data is reasonable.

Although there is a limited data set for the TMDL, previous applications of the model to similar lakes have shown generally good agreement between the loading model (MAPSHED and previous historical TMDLs using the AVGWLF model) and the observed loading and flow data, and good agreement between the BATHTUB water quality model and the observed water quality data for the lakes. As indicated in the TMDL document, the MOS can be reviewed as new data and modeling become available in the future.

EPA concludes that the TMDL incorporates an adequate margin of safety.

7. Seasonal Variation

The statute and regulations require that a TMDL be established with consideration of seasonal variations. The TMDL must describe the method chosen for including seasonal variations. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)).

The BATHTUB model addresses seasonal variation by incorporating total phosphorus as a seasonal average for the summer growing season, when conditions are optimal for the available total phosphorus to produce nuisance algal growth. This is supported in EPA guidance (EPA 440/4-90-006, p. 71, 73), specifically, "Eutrophication models are geared to predicting average water quality conditions over a growing season or year".

Seasonal variation is also represented in this TMDL by taking 28 years of daily precipitation data when calculating runoff through MAPSHED. In addition, the TMDL for Lake Carmel takes into account variations in septic loadings due to seasonal vs. year round residences.

EPA concludes that the TMDL has adequately considered seasonal variation to ensure that the water quality standard is achieved throughout the year.

8. Reasonable Assurances

When a TMDL is developed for waters impaired by point sources only, the issuance of a National Pollutant Discharge Elimination System (NPDES) permit(s) provides the reasonable assurance that the wasteload allocations contained in the TMDL will be achieved. This is because 40 C.F.R. 122.44(d)(1)(vii)(B) requires that effluent limits in permits be consistent with "the assumptions and requirements of any available wasteload allocation" in an approved TMDL.

When a TMDL is developed for waters impaired by both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur, EPA's 1991 TMDL Guidance states that the TMDL should provide reasonable assurances that nonpoint source control measures will achieve expected load reductions in order for the TMDL to be approvable. This information is necessary for EPA to determine that the TMDL, including the load and wasteload allocations, has been established at a level necessary to implement water quality standards.

EPA's August 1997 TMDL Guidance also directs Regions to work with States to achieve TMDL load allocations in waters impaired only by nonpoint sources. However, EPA cannot disapprove a TMDL for nonpoint source-only impaired waters, which do not have a demonstration of reasonable assurance that LAs will be achieved.

Although there are point and nonpoint sources of phosphorus to Lake Carmel, the nonpoint

sources account for 93.5% of the total load. Therefore, nonpoint sources are the overwhelming cause of impairment in Lake Carmel.

The implementation plan for achieving these allocations is described below in Section 10. The largest external sources of total phosphorus to Lake Carmel are from streambank erosion (32.6%) and septic systems (22.6%). Internal loading, a result of nutrient recycling from bottom sediments that have accumulated phosphorus over a long period of time, is also a significant source of phosphorus to the lake (18.8%). As external sources of phosphorus are reduced, it is expected that the impact of internal loading will be attenuated over time.

The TMDL provides a 100% reduction, or zero load allocation, for septic systems which can only be achieved through the connection to a wastewater treatment facility. Some reduction from this source will be achieved through the implementation of the NY's Household Detergent and Nutrient Runoff Law and the implementation of a management system to ensure proper design and operation of septic systems. Additional reductions will be achieved through local laws passed by the towns in the Lake Carmel watershed in conformance with the enhanced MS4 General Permit provisions requiring that all septic systems be inspected and pumped out at least once every 5 years, and where necessary, remediated. NY also requires that the field investigation and inspection include both the septic tank and the disposal field. NY further requires that new homes have septic systems in accordance with NYS's Department of Health regulations (10 NYCRRR Appendix 75-A) or connect to wastewater treatment systems and that homes with a cesspool are upgraded to a septic system conforming to NYS's Department of Health Regulations whenever a bedroom is added to the house. The TMDL provides a process for homeowners to identify whether their cesspool is discharging to the lake or tributary to the lake so they improve treatment.

Streambank erosion, which is estimated to be the largest source of phosphorus to the lake, was assigned a load allocation that amounts to a reduction of 46%. As erosion is related to storm water runoff, any reductions implemented through MS4 permit requirements will also reduce streambank erosion. In addition, other non-regulatory measures have been identified to reduce rates of runoff and reduce erosion. The TMDL document provides the following methods that can be used to stabilize stream channels to prevent erosion: soil bioengineering practices which utilize plants or structures to stabilize reinforce streambanks; native material revetments using such materials as stone and wood to armor streambanks to deflect flow away from the bank; in-stream structures such as rocks and logs to stabilize the streambed and bank; and riparian buffers (vegetated areas along the stream) which prevent sediment, nutrients and other pollutants from reaching the stream.

WWTFs account for less than 3% of the total load to the lake. NYSDEC will modify permits for Girls Scouts Heart of Hudson and Putnam Nursing and Rehabilitation Center WWTFs, both currently discharging at an effluent concentration of 1.0 mg/L, to 0.4mg/L and 0.2 mg/L, respectively. The WLA for Frangel Realty WWTF is zero as the discharge has been relocated to Palmer Lake. Since the WWTFs are located within the NYC drinking water supply system, NYCDEP is required to pay for capital improvements and operation and maintenance in order to meet their revised permit limits.

MS4s account for less than 4% of the total load to the lake. The TMDL provides for a 10% reduction in phosphorus for these sources. This is reasonable given that the watershed is located in the NYC EOH watershed where additional permit requirements including retrofits have been implemented. The MS4 permit requires that MS4s in the NYC EOH watershed develop or modify their storm water management plans to include additional measures to achieve the phosphorus reduction requirements provided in the TMDL.

EPA concludes that the TMDL provides reasonable assurance that the point and nonpoint source load reductions will occur.

9. Monitoring Plan to Track TMDL Effectiveness

EPA's 1991 document, Guidance for Water Quality-Based Decisions: The TMDL Process (EPA 440/4-91-001), recommends a monitoring plan to track the effectiveness of a TMDL, particularly when a TMDL involves both point and nonpoint sources, and the WLA is based on an assumption that nonpoint source load reductions will occur. Such a TMDL should provide assurances that nonpoint source controls will achieve expected load reductions and, such TMDL should include a monitoring plan that describes the additional data to be collected to determine if the load reductions provided for in the TMDL are occurring and leading to attainment of water quality standards.

A monitoring program is included in the Lake Carmel TMDL document (see Section 7.2 of the TMDL document). The purpose of the monitoring program is to track the effectiveness of the implementation plan controls and to develop baseline and trend information for waterbodies. The monitoring sampling plan includes 8 sampling events at the lake's deepest location (approximately 5-6 ft.) during the May-September growing season. The samples will be analyzed for phosphorus (total, soluble reactive, total soluble) and Secchi disk depth. One simple macrophyte survey will be conducted mid-summer. In addition, it would be beneficial to also collect data on: nitrogen (nitrate, ammonia, and total nitrogen); chlorophyll *a*; and dissolved oxygen.

10. Implementation

EPA policy encourages Regions to work in partnership with States/Tribes to achieve nonpoint source load allocations established for 303(d)-listed waters impaired by nonpoint sources. Regions may assist States/Tribes in developing implementation plans that include reasonable assurances that nonpoint source LAs established in TMDLs for waters impaired solely or primarily by nonpoint sources will in fact be achieved. In addition, EPA policy recognizes that other relevant watershed management processes may be used in the TMDL process. EPA is not required to and does not approve TMDL implementation plans.

The TMDL submittal identifies several actions designed to implement the WLAs for point sources (three WWTFs and MS4s) and the LAs for septic systems, internal loading and streambank erosion.

WWTFs

Effluent from the Frangel Realty has been redirected to be treated by Kent Manor WWTF, located in the adjacent Palmer Lake watershed; its WLA is therefore, zero. The WLA for Girl Scouts Heart of Hudson WWT is 0.005 lbs/day; a 60% reduction from the current load. The WLA for the Putnam Nursing and Rehabilitation WWTF is 0.033 lbs/day; an 80% reduction from the current load. NYSDEC will revise the permit limits for the Girl Scouts Heart of Hudson and Putnam Nursing and Rehabilitation WWTPs which are both currently permitted to discharge phosphorus at an effluent concentration of 1.0 mg/l, to a more stringent limit of 0.4 mg/l and 0.2 mg/l, respectively.

MS4s

The Towns of Kent, Patterson, East Fishkill, Pawling and Beekman are regulated MS4s that have developed Storm Water Management Plans (SWMPs) which include Best Management Practices (BMPs) for the required six minimum control measures (refer to Section 7.1.3 of the TMDL document). In addition, because Lake Carmel is located in the NYC East of Hudson drinking reservoir watershed and subject to the Middle Branch Reservoir TMDL, the MS4s are subject to "Heightened Requirements" including additional controls to reduce storm water runoff and phosphorus loadings.

MS4s located in the East of Hudson drinking watershed are required to implement a five-year storm water retrofit program to reduce phosphorus loadings. Retrofit work is ongoing throughout the East of Hudson watershed including several retrofits constructed in the Lake Carmel basin, which are expected to improve Lake Carmel water quality. Retrofits are designed to reduce sedimentation and phosphorus loadings to the lake.

The Town of Kent, where Lake Carmel is located, has installed hydrodynamic separators to filter storm water before it enters the Lake. By filtering runoff, sediments and associated phosphorus loadings do not enter the lake.

Reductions will also be achieved through implementation of New York State's Dishwasher Detergent and Nutrient Runoff Law which limits the use of lawn fertilizer containing phosphorus.

Streambank Erosion

In addition to the MS4 requirements that will improve streambank erosion and reduce inputs of phosphorus to the lake, actions around and along the tributaries to Lake Carmel, which include the Middle Branch Croton River and Stump Pond Stream, will reduce phosphorus inputs to the lake as these tributaries have accumulated excessive amounts of phosphorus laden sediments which can enter the lake and impair water quality. NYSDEC recommends that several actions be taken to reduce phosphorus inputs to the lake from streambank erosion:

- Through the coalition of towns in the East of Hudson Watershed Corporation (EOHWC), actions (e.g., planting native or non-invasive vegetative cover on stream banks, armoring stream banks with materials that combine structure with vegetation).

NYSDEC will provide the EOHWC phosphorus reduction credits toward their MS4 permit requirement if these actions are implemented. This will provide incentives to implement these controls and reduce phosphorus and sediment loadings to Lake Carmel;

- EOHWC should site storm water retrofits that reduce storm water runoff from developed land from adversely affecting the lake, through the construction of infiltration and filtration storm water practices;

- EOHWC should identify large areas of impervious cover which currently discharge directly to waterbodies during runoff events and attempt to install runoff reduction practices to reduce the rate of runoff and therefore reduce in-stream erosion. These practices would also potentially reduce the phosphorous being discharged to the Lake Carmel watershed;

- Establishing protected riparian buffer strips along the stream to filter pollutants and debris in runoff before it enters the stream channel via regulatory land use changes; and

- Maintaining a regular practice of street sweeping to reduce sediment-laden storm water from reaching the streams that feed Lake Carmel.

Additional information on these phosphorus management strategies is included in Section 7.1.4 of the TMDL document.

Septic Systems

The TMDL document recommends that properties with deficient septic systems that are near Lake Carmel connect to a wastewater treatment facility that will operate according to the more stringent phosphorus limits contained in the NYC Watershed Rules and Regulations and the implementation of a management system to assure proper design and operation of any remaining septic systems.

The towns in the Lake Carmel watershed are required to implement a program to inspect and repair onsite wastewater disposal systems at least once every five years.

New York State's Dishwasher Detergent and Nutrient Runoff Law prohibits the sale of newly stocked, phosphorus-containing dishwasher detergents for household and commercial use and therefore will reduce the amount of phosphorus entering septic systems from dishwasher detergent.

While these actions will reduce the loadings from septic systems, the WLA of zero can only be achieved through sewering septic systems from properties located near the lake.

The phosphorus load from Lake Carmel watershed constitutes 52% of the total load to the Middle Branch Reservoir. This reservoir will experience a significant reduction in phosphorus loading and improved water quality when the reductions in phosphorus loadings to Lake Carmel are implemented.

Additional Measures for Reducing Phosphorus Loads
The implementation plan identifies additional measures to reduce nutrient loadings and the impacts related to excessive aquatic plants and algae that interfere with the uses of the lake (refer to pp. 32-40 of the TMDL document).

Further information on implementation can be viewed in Section 7 in the TMDL document.

11. Public Participation

EPA policy is that there should be full and meaningful public participation in the TMDL development process. The TMDL regulations require that each State/Tribe must subject calculations to establish TMDLs to public review consistent with its own continuing planning process (40 C.F.R.§130.7(c)(1)(ii)). In guidance, EPA has explained that final TMDLs submitted to EPA for review and approval should describe the State's/Tribe's public participation process, including a summary of significant comments and the State's/Tribe's responses to those comments. When EPA establishes a TMDL, EPA regulations require EPA to publish a notice seeking public comment (40 C.F.R. §130.7(d)(2)).

Provision of inadequate public participation may be a basis for disapproving a TMDL. If EPA determines that a State/Tribe has not provided adequate public participation, EPA may defer its approval action until adequate public participation has been provided for, either by the State/Tribe or by EPA.

On June 1, 2016, the proposed Lake Carmel TMDL was published in the state's Environmental Notice Bulletin (ENB) and a 30-day public comment period was provided. In addition, the proposed TMDL was made available to local government representatives and interested parties. NYSDEC also made the proposed TMDL document available through the Environmental Bulletin Listserve and the Division of Water "Making Waves" email list.

Prior to developing the TMDL, NYSDEC held an informational meeting on July 29, 2014 in the Town of Kent to discuss the community's water quality goals for the lake and to discuss lake management questions.

Written comments were received from the New York City Department of Environmental Protection and were addressed in NYSDEC's response to comments.

EPA has concluded that the State provided an adequate opportunity for public participation and has responded to comments.

12. Submittal Letter

A submittal letter should be included with the TMDL submittal, and should specify whether the TMDL is being submitted for a technical review or final review and approval. Each final TMDL submitted to EPA should be accompanied by a submittal letter that explicitly states that the submittal is a final TMDL submitted under Section 303(d) of the Clean Water Act for EPA review and approval. This clearly establishes the State's/Tribe's intent to submit, and EPA's duty to review, the TMDL under the statute. The submittal letter, whether for technical review or final review and approval, should contain such identifying information as the name and location of the waterbody, and the pollutant(s) of concern.

The Lake Carmel TMDL was received by EPA Region 2 on September 2, 2016, and was accompanied by a letter dated August 30, 2016, requesting EPA's review and approval of the TMDL.

13. Administrative Record

While not a necessary part of the submittal to EPA, the State/Tribe should also prepare an administrative record containing documents that support the establishment of and calculations/allocations in the TMDL. Components of the record should include all materials relied upon by the State/Tribe to develop and support the calculations/allocations in the TMDL, including any data, analyses, or scientific/technical references that were used, records of correspondence with stakeholders and EPA, responses to public comments, and other supporting materials. This record is needed to facilitate public and/or EPA review of the TMDL.

NYSDEC has prepared an administrative record to support this TMDL; it is available at NYSDEC's offices in Albany, New York.

Table 1. Total Daily Phosphorus Load Allocations for Lake Carmel[1]

Source	Total Phosphorus Load lbs/day		Total Phosphorus Reduction	
	Current	TMDL	lbs/day	%
Load Allocation (LA)				
Stream Bank Erosion	2.428	1.310	1.10	46
Wetland	0.107	0.107	0	0
Forest	0.312	0.312	0	0
Groundwater[2]	1.108	1.108	0	0
Septic Systems	1.682	0	1.682	100
Internal Loading	1,400	0	1.400	100
Subtotal	**6.947**	**2.748**	**4.201**	**40%**
Wasteload Allocation (WLA)				
Girl Scouts Heart of Hudson WWTF (NY0102181)	0.014	0.005	0.009	60
Putnam Nursing and Rehabilitation WWTF (NY 0028924)	0.167	0.033	0.133	80
Frangel Realty WWTF (NY 0143863)	0.025	0	0.025	100
Town of Kent MS4 (NYR20A346) Town of Patterson MS4 (NYR20A140) Town of Pawling MS4 (NYR20A472) Town of Beekman MS4 (NYR29A365) Town of Fishkill MS4 (NYR20A183)	0.276	0.248	0.028	10
Subtotal	**0.481**	**0.286**	**0.195**	**-**
Margin of Safety (MOS)		**0.337**		
TOTAL	**7.428**	**3.370**	**4.396**	**59**

[1]The values reported in Table 1 are the daily integrated values. The annually equivalent values are provided in the TMDL document. In calculating the daily values, numbers were rounded and may not necessarily add up exactly to the sums shown in the table.

[2] Groundwater load is comprised of natural sources and developed land (Refer to Table 5 of TMDL document for individual loads).