Processes	Equation	Description
Hydrodynamic transport	$$\frac{\partial C}{\partial t}+\frac{\partial (uC)}{\partial x}+\frac{\partial (\nu C)}{\partial y}+\frac{\partial (wC)}{\partial z} = \frac{\partial}{\partial x}\left(K_x \frac{\partial C}{\partial x}\right)+\frac{\partial}{\partial y}\left(K_y \frac{\partial C}{\partial y}\right)+\frac{\partial}{\partial z}\left(K_z \frac{\partial C}{\partial z}\right)$$ where C=concentration of a water quality state variable, u, v, w=velocity components in the x, y, and z directions, respectively, Kx, Ky, Kz = turbulent diffusivities in the x, y, and z directions (Park 2005)	For the 3D model, nutrients are advected, dispersed within the water column in x, y and z-direction and transported into the system following the flow. Please note that this equation only applies in the water column with external sources of pollutants.
Biogeochemical processes	$$\frac{\partial C}{\partial t} = k \cdot C + R$$ where k=kinetic rate (1/time) and R= internal/external loadings (Park 1995). Kinetic rate (e.g., algal growth rate) can be illustrated by Michaelis–Menten formulation $$k_c = k_{max}\frac{C}{K_M + C}$$ where kc = reaction rate (1/time), kmax =maximum rate(1/time), C=nutrient concentration (mg/L), and K_M= concentration (mg/L) at half saturation kmax	Biogeochemical reactions transform or remove nutrients by processes such as nitrification and denitrification. Kinetic equations can represent the essence of these processes. Each variable often has each kinetic equation related to its reaction (such as nitrification). The kinetic rate can be phytoplankton growth rate, bacteria, or other reactions (e.g., nitrification, organic carbon degradation).
Sediment-water exchange Adsorption and desorption	Langmuir isotherm model is used to describe substrate P sorption onto sediments, suspended sediments $$\frac{PIP}{SS} = \frac{Pac \times SRP}{SRP + Kps}$$ Where Pac = the maximal sorption capacity of P onto suspended solids (SS), and Kps = the half-saturation constant, PIP = concentration of particulate inorganic phosphorus, SRP = concentration of soluble reactive phosphorus	Some nutrients, such as P, have strong interaction between the particulate and the dissolved nutrients. Their concentrations are thus affected by the suspended sediments and bed sediments.
Water-air exchange	Reaeration is a function of current velocity, wind speed and temperature, which affect saturated DO (Regnier et al., 1997)	The reaeration process can add dissolved oxygen to the waterbody from the atmosphere