Supplementary File

Figure S1. Hydrograph at site 16 in the Nanfei River in 2015.
SOD flux ($f_0$), is calculated from a linear regression of concentration versus time such that

\[ f_0 = m \frac{V_{OLW}}{A_{cylinder}} = \frac{V_{OLW}}{A_{cylinder}} (O_S - O_W) = h(O_S - O_W) \]  

(S1)

Where $m$ is the slope of the linear regression for change in concentration per unit time, $V_{OLW}$ is the volume of the overlying water enclosed within the cylinder, and $A_{cylinder}$ is the surface area of the sediment enclosed by the cylinder. With the assumption of a smooth surface area, $m$ can be substituted by the differences of the changes in oxygen concentrations in sediment core ($O_S$) and control core ($O_W$) per incubation time (mg L⁻¹ d⁻¹). And $\frac{V_{OLW}}{A_{cylinder}}$ can be substituted by the height of the overlying water (m). Finally for the purpose of the model use, the SOD values were transformed to a standard temperature (20 °C) using the following formula:

\[ SOD_T = SOD_{20} \theta^{T-20} \]  

(S2)

Where, $SOD_{20}$ is the rate value normalized to 20 °C, $SOD_T$ is the rate at incubation temperature, $T$ is the incubation temperature in °C, and $\theta$ is the temperature correction coefficient. The $\theta$ value of 1.045 was taken in accordance with the parameter used in the model.

![Figure S2. Measured SOD flux rates at sites 1, 2, 3, 4, 7, 14, 15 & 16.](image-url)
The CBOD deoxygenation rates and nitrification rates were transformed to a standard temperature (20 °C) using the following formula:

\[ \text{Rate}_{T} = \text{Rate}_{20} \theta^{T-20} \]  

(S3)

Where, \( \text{Rate}_{20} \) is the rate value normalized to 20 °C, \( \text{Rate}_{T} \) is the rate at incubation temperature, \( T \) is the incubation temperature in °C, and \( \theta \) is the temperature correction coefficient. The \( \theta \) value of 1.045 was taken in accordance with the parameter used in the model.

After calculation, the CBOD deoxygenation rates are 0.30 d\(^{-1}\) & 0.09 d\(^{-1}\) at sites 3 and 6 respectively, and the nitrification rates are 0.39 d\(^{-1}\) & 0.16 d\(^{-1}\) at sites 3 and 6 respectively. Considering that the model allows to use different rates for CBOD deoxygenation, the labile CBOD deoxygenation rate from the untreated wastewater was taken as 0.30 d\(^{-1}\), while the refractory CBOD deoxygenation rate from the WWTP1 effluent was taken as 0.16 d\(^{-1}\). However, since the nitrification rate must be consistent for the whole model domain and WWTP1 effluent is more dominant than untreated wastewater for the study reach, 0.16 d\(^{-1}\) was taken for the model calculation.

**Figure S3.** Derivation of CBOD deoxygenation rates and nitrification rates at sites 3 (left) & 6 (right).