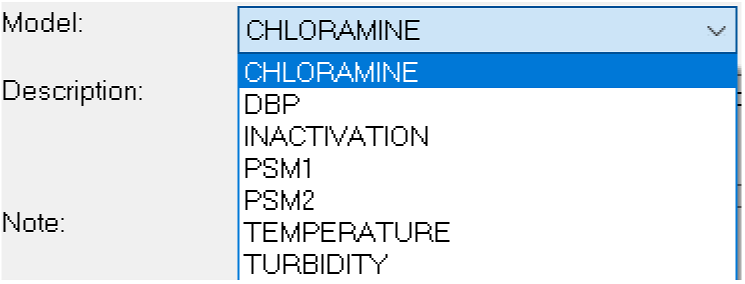
Base Model

There are seven system example models with InfoWater Pro MSX.

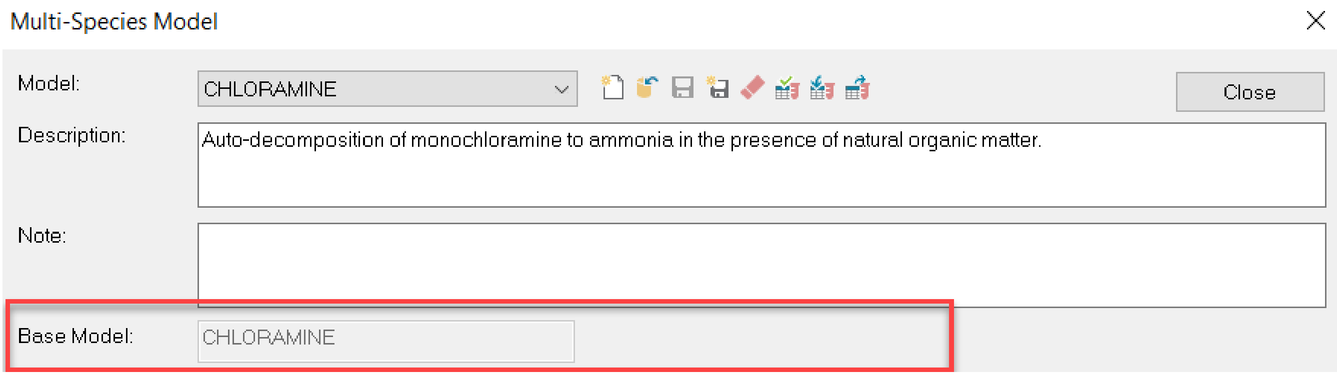


Model	Description
Chloramine	The system being studied is the auto-decomposition of monochloramine to ammonia in the presence of natural organic matter (NOM). When chloramines are used as a secondary disinfectant care must be taken to avoid producing excessive amounts of free ammonia that can contribute to biological nitrification episodes within the distribution system. The reaction model used for this system was developed by Valentine and co-workers (Jefvert and Valentine, 1992; Duirk et al., 2005). The principal species are hypochlorous acid (HOCl), hypochlorite ion (OCL-), ammonia (NH3), ammonium ion (NH4+), monochloramine (NH2Cl), dichloramine (NHCl2), an unidentified intermediate compound (I), and total organic carbon (TOC). Because the reactions involve acid-base dissociations and the rate coefficient of the disproportionation of NH2Cl is a function of both pH and carbonate species, the pH-carbonate equilibrium system is also included.
DBP	Disinfection Byproducts Model. We assume the linear relationship between the disinfection byproducts (DBPs) generated and disinfectant consumed in bulk water (Clark, R. M., 1998). Such a relationship can be modeled as: $$\frac{dC_a}{dt} = k_b C_a$$ $$\frac{dC_b}{dt} = -a k_b C_a$$ Where C_a = disinfectant concentration; C_b =DBPs concentration; k_b = disinfectant bulk decay coefficient; and a = ration between disinfectant consumed and DBP generated. Your inputs are the decay coefficents and DBPs production ration *r* which can be determined in the labs like bulk decay coefficients.
Inactivation	Regulatory agencies and water utilities have long been concerned about accidental intrusions of pathogens into distribution system pipelines and are increasingly concerned about deliberate pathogen contamination. Vulnerability of water distribution to microbiological contamination is of great interest to the water industry. The rate of inactivation of microorganisms can be expressed as a pseudo first order law (Uber, J. G. and Propato, M., 2004): $$\frac{dP}{dt} = k_p P C^n$$ $$\frac{dC}{dt} = kC$$ where d*P*/d*t* is the rate of inactivation, *P* is the concentration of viable pathogens, *C* is the concentration of disinfectant, *n* is the reaction order with respect to disinfectant, *k* is the disinfection bulk decay coefficient, and k_p is the pathogen kinetic decay rate constant. Here we can derive pathogen decay rate constant k_p based on *CT* values (with *C* as the effluent disinfectant concentration from the contact basin and *T* as the characteristic contact time) for specific pathogen and disinfectant in the Surface Water Treatment Rule guidance manual. You need to select the pathogen of interest and disinfectant they use and, of course, the location and strength of the pathogen sources in order to do analysis.

PSM1	The concentration (mg/L) change rate of particles in the bulk water of pipes is modeled as: $\frac{dC}{dt} = -T_a(C - C_s)$. Where *C* = particle concentration in bulk water; C_s = steady state concentration of *C*; and T_a = particle settlement/suspension rate coefficient which can be a constant or a curve function of the pipe flow velocity or shear velocity. The particle concentration at pipe surface (mg per surface area unit) is assumed to be in steady state: Where C_w = particle concentration at pipe wall; A_v = pipe surface area per unit volume and T_b is a unit less coefficient.
PSM2	The settlement/suspension rates of the particle with the pipes are defined as: $\frac{dC}{dt} = -T_aC + T_b * C_w * Av$ $\frac{dC_w}{dt} = T_a * C / Av - T_bC_w$. Where T_a is the settlement rate coefficient and T_b is the suspension rate coefficient. Both values can be defined as functions of pipe flow velocity. This can be achieved through Curve function. User needs to define two curves: PSM_CURVETA and PSM_CURVETB with *x* value being flow velocity and *y* value being *TA* or *TB* value. The *TA* and *TB* are defined as "Terms" TA = CURVE(PSM_CURVETA, U, LINEAR) TB = CURVE(PSM_CURVETB, U, LINEAR) Where *U* is a keyword that represents pipe flow velocity and LINEAR is curve interpolation method which can also be STEPWISE.
Temperature	The heat exchange between the water in a pipe and the ambient environment can be expressed as: $\Delta Q = hA(Ta - Tw)\Delta t$. Where, ΔQ = Net heat loss from the pipe water to ambient environment (BTU for English unit and J for SI unit); A = Heat transfer surface area, which is πDL for a pipe with diameter D and length L; h = Overall heat transfer coefficient (BTU/s.ft^2.^{0}F for English unit and W/(m^2.K) for SI unit); Δt = Time interval; Tw = Water temperature in the pipe segment; Ta = Ambient temperature which can be soil temperature or air temperature. The corresponding change rate of water temperature is: $\frac{dT_w}{dt} = hA(Ta - Tw)/(\rho Vc) = 4h(Ta - Tw)/(D\rho c)$ Where ρ = Water density; C = Specific heat of water; The heat transfer coefficient between the bulk of the fluid and the pipe surface can be expressed as:

	$h_1 = \frac{kw}{D} Nu$ Where kw = Thermal conductivity of the water (BTU/s.ft.^{0}F for English unit and W/(m.K) for SI unit); Nu = Nusselt number which is a function of Reynolds number Re and Prandtl number Pr. If Re > 2300 (turbulent flow), $Nu = 0.0149 \, Re^{0.88} \, Pr^{0.3333}$ Else $Nu = 3.66 + \frac{0.0668 * \frac{D}{L} * Re * Pr}{1 + 0.04 * (\frac{D}{L} * Re * Pr)^{0.667}}$ The heat transfer coefficient through pipe wall can be described as: $h_2 = \frac{kp}{0.5 * D * \log(\frac{D_o}{D})}$ Where kp = Thermal conductivity of the pipe wall (BTU/s.ft.^{0}F for English unit and W/(m.K) for SI unit); D_o = Outer pipe diameter. For buried pipe lines, the heat transfer from the pipe to the soil, here called h_3, can be calculated as follows (Davenport, T.C. and Conti, V.J, 1971): $h_3 = \frac{ks}{0.5 * D_o * \cosh^{-1}(\frac{H}{0.5 * D_o})}$ Where ks = Thermal conductivity of the soil (BTU/s.ft.^{0}F for English unit and W/(m.K) for SI unit); H = Buried depth to center of pipe. The overall heat transfer coefficient of these three heat transfer processes in series is simply described as: $\frac{1}{h} = \frac{1}{h_1} + \frac{1}{h_2} + \frac{1}{h_3}$ This model is quite general and can model the temperature change of pipe water under the influence of ambient temperature, wall material, flow condition, buried depth, etc. Complete mixing is still assumed as in other water quality models. Ambient temperatures can be described a s either a time pattern or ambient temperature. You need to provide base ambient temperature *Ta* and a time pattern PATTERN_AMBTEMP.
Turbidity	The Turbidity model is used to determine water loss due to the presence of particulates in water. The more suspended solids in the water, the darker it seems and the higher the turbidity. It is used as a way to measure the quality of water.

You can derive a model from one of these base models by clicking on **Save As**. Base Model shows whether the model is a new model or is derived from one of the seven system example models. If it is derived from a system example model, the species number, names and type, reaction equations, number and names of parameters and constants, and some model options, such as unit and integration method, cannot be changed. You can change the values of parameters, constants and global initial qualities, and certain options such as water quality time step and global tolerance values. For example, if you want to use the CHLORAMINE model, you need to modify the model parameters of the model; you can save it as a different model.


Multi-Species Model
Model:
CHLORAMINE
Close
Description:
Auto-decomposition of monochloramine to ammonia in the presence of natural organic matter.
Note:
Base Model:
CHLORAMINE