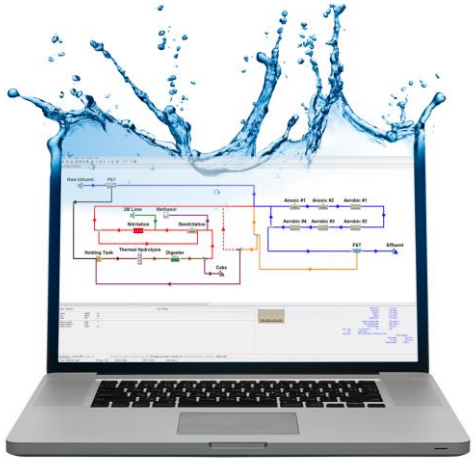
What's New in BioWin 6.0



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Introduction

- **This document provides a quick overview of new features in BioWin 6.0**
- **Two main areas:**
  1. Model Additions
  2. Usability Upgrades

Model Additions

- Chemical Phosphorus Removal
- Sulfur (Biological, RedOx, *etc.*)
- Industrial Organics
- CEPT
- Iron RedOx
- P Recovery (Brushite, Vivianite)
- Cellulose
- Source Separated Organics

Usability Upgrades

- Drawing Tools / Undo
- Excel Reporting
- Variable Naming / Sorting
- Element Tags
- Table Transposition
- Optional Alarms
- More Example Flowsheet Templates
- Set All Parameters Default
- Metal Salt Sol'n Densities
- m^3/hr Flow Units Option
- Wet Tonne Sludge Cost Option

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Introduction

- **For more details on topics, references to relevant sections of the BioWin Help Manual are provided**
- **The BioWin Manual is provided in two forms:**
  1. As a PDF (default install location is C:\Program Files(x86)\EnviroSim\BioWin 6.0\Manuals)
  2. In "Windows Help" format from within BioWin

- **To Use PDF**
  - Open it from directory above
  - Or copy it to any other location of your choice (*e.g.* Desktop, My Documents)

- **To Use Windows Help**
  - Select Help > Contents & Index
  - Click Help button 
  - Press F1 key on your keyboard (context-sensitive method; will open a relevant topic in the manual)

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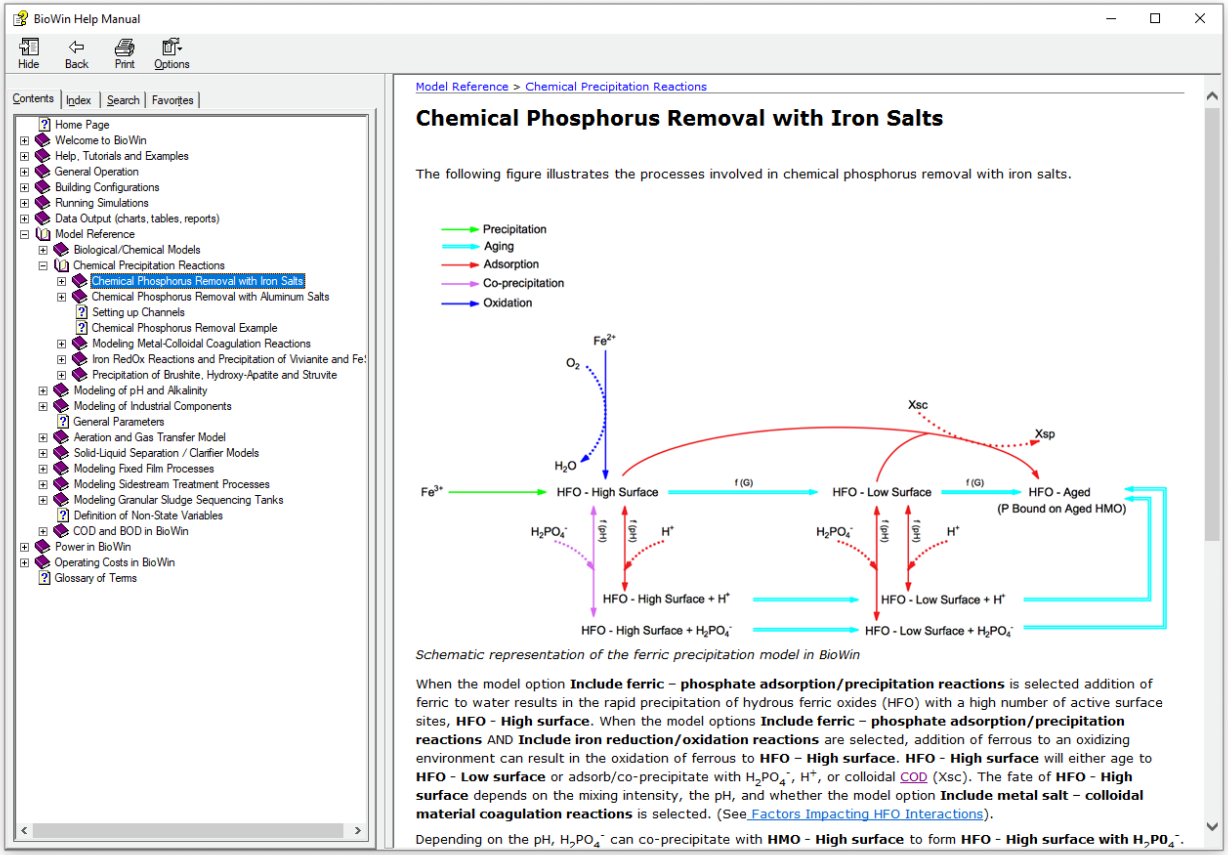
Introduction

- **Example Manual reference:**

  Model Reference > Chemical Precipitation Reactions > Chemical Phosphorus Removal with Iron Salts



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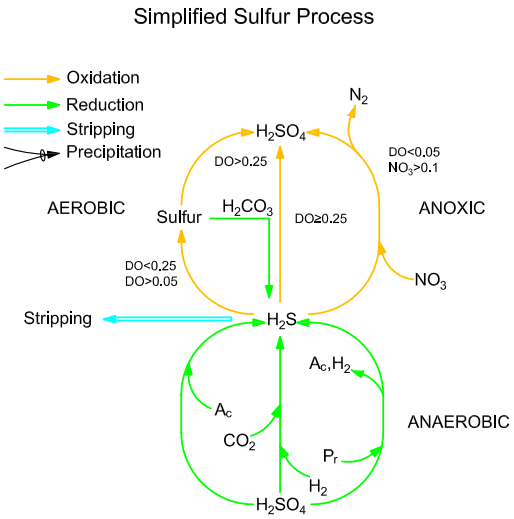
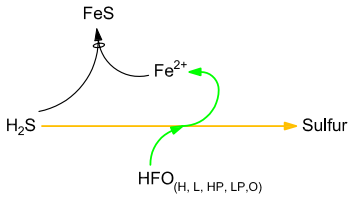
Model Addition - Sulfur

- **Extension of what has been in PetWin for several years**
  - Sulfide-oxidizing bacteria
  - Sulfate-reducing bacteria (multiple types)
  - Potential hydrogen sulfide stripping
  - Iron-sulfide (FeS) precipitation
  - Model iron addition for H_2S control





Manual reference:

Model Reference > Biological/Chemical Models > Sulfur Modeling

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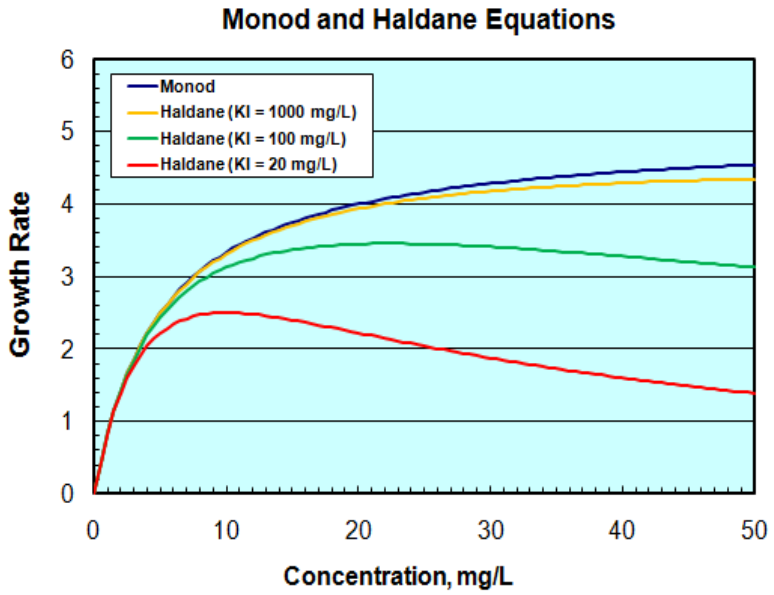
Model Addition – Industrial Organics

- **Based on original Alison Baker PhD (~1994, McMaster)**
  - Four new state variables for industrial components
  - Mixed removal pathways – **stripping** and/or **biodegradation**
  - Default settings for industrial components mimic xylene, phenol, benzene, and toluene
  - Biodegradation according to inhibitory Haldane kinetics



$$\mu = \mu_{max} \cdot \left[\frac{S}{K_S + S + \frac{S^2}{K_I}} \right]$$

Manual reference:

Model Reference > Modeling of Industrial Components

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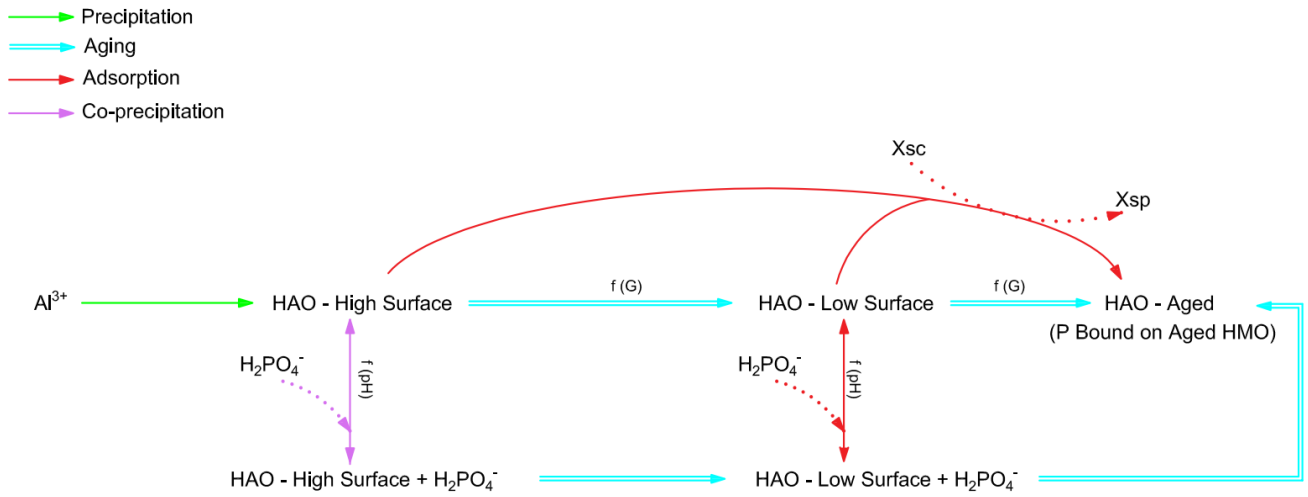
Model Addition – Chemical Phosphorus

- **New P removal mechanisms (hydrated metal oxides)**
  - Based on EnviroSim-sponsored research
  - Extensive calibration for wastewater systems
  - Overcomes weaknesses of old "WEF model" (*e.g.* fixed Me:P stoichiometry)
  - Can have simultaneous ferric / ferrous / alum inputs



Manual reference:

Model Reference > Chemical Precipitation Reactions > Chemical Phosphorus Removal with Aluminum Salts

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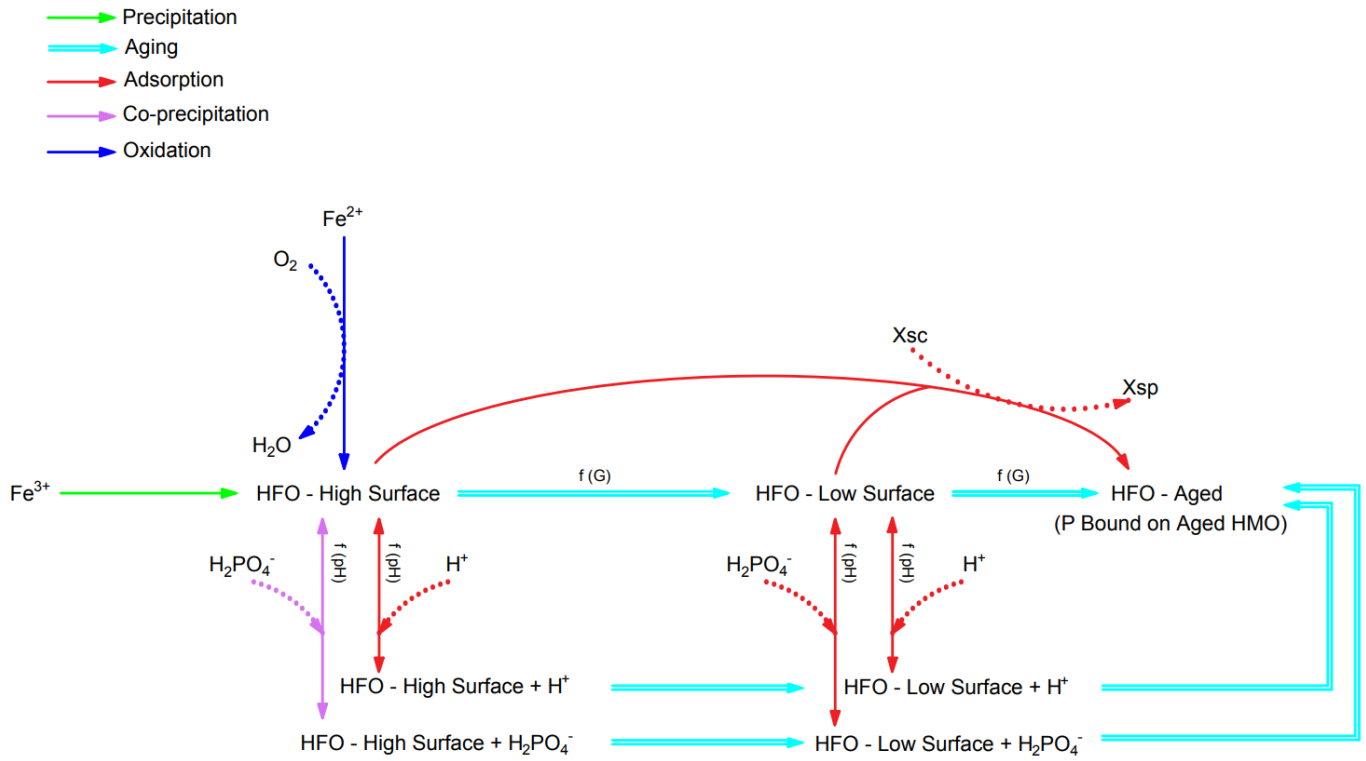
Model Addition – Chemical Phosphorus

- **Updated P removal mechanisms (hydrated metal oxides)**



Manual reference:

Model Reference > Chemical Precipitation Reactions > Chemical Phosphorus Removal with Iron Salts

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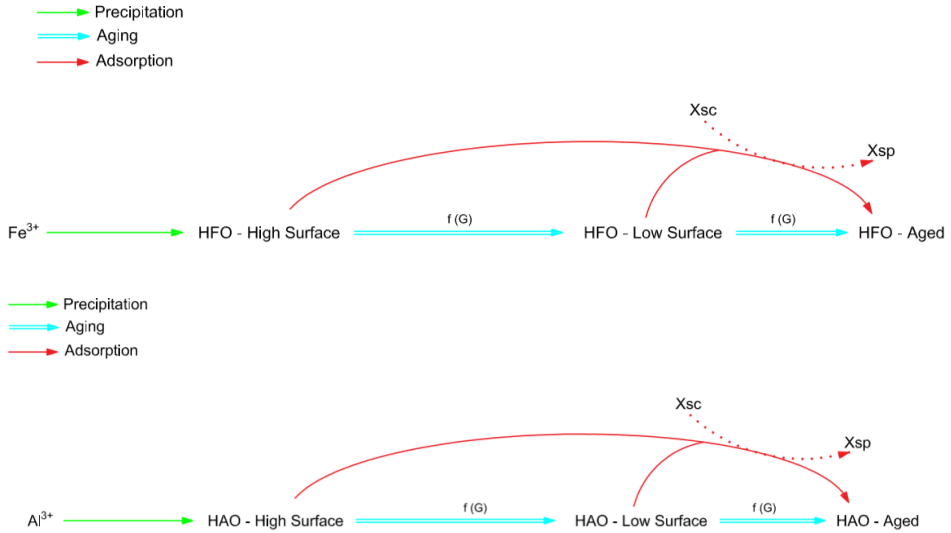
Model Addition – CEPT

- **Option to model colloidal COD / metal interactions**
  - Model can convert non-settleable colloidal COD to settleable particulate COD in the presence of hydrated metal oxides (HMO)
  - Process will also reduce potential adsorption of P on HMO
  - Ideal or model clarifier can then be used to mimic increased solids and BOD removal



Manual reference:

Model Reference > Chemical Precipitation Reactions > Modeling Metal-Colloidal Coagulation Reactions

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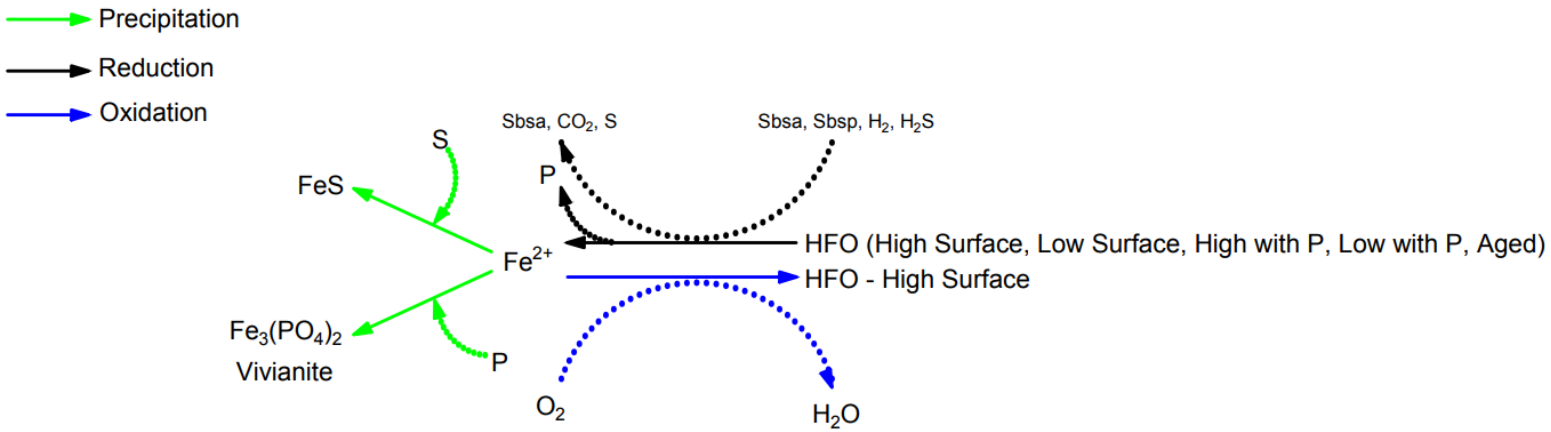
Model Addition – Iron RedOx

- **Option to model iron oxidation / reduction reactions**
  - New ferrous input (as either ferrous chloride or ferrous sulfate)
  - Ferrous oxidized to ferric in aerobic environments
  - Ferric reduced to ferrous in anaerobic environments
  - Option to track iron-based precipitates {*i.e.* FeS and vivianite [$Fe_3(PO4)_2$]}



Manual reference:

Model Reference > Chemical Precipitation Reactions > Iron RedOx Reactions and Precipitation of Vivianite and FeS

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Model Addition – Options for P Recovery

- **Improved tracking of Ca^{2+} and Mg^{2+}**
  - Previously Ca^{2+} and Mg^{2+} only available throughout the flowsheet *via* input of soluble influent concentrations
  - Underestimated the amounts entering digesters *via* solids streams limiting the amounts of potential precipitates
  - Model updated to include Ca^{2+} and Mg^{2+} in biomass (taken up as part of "synthesis ISS") and influent degradable solids (X_{SP})
- **Additional sinks for P**
  - Vivianite formation
  - Struvite formation as in previous versions of BioWin but no longer Mg^{2+} limited!
  - Calcium phosphate precipitate (as Brushite)
  - ***Lowers return stream soluble PO4 to levels typically observed***

Manual reference:

Model Reference > Chemical Precipitation Reactions > Precipitation of Brushite, Hydroxy-Apatite and Struvite

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Model Addition – Cellulose

- **Cellulose tracking**
  - Influent unbiodegradable particulate material split into two components: cellulose and non-cellulose
  - Separate COD:VSS ratios for each
  - Helps to fine-tune sludge production and digester performance
  - Enables modelling of cellulose recovery

Manual references:

1. Model Reference > Biological/Chemical Models > Activated Sludge Processes > Growth and Decay of Ordinary Heterotrophic Biomass > Stoichiometric Parameters
2. Model Reference > Definition of Non-State Variables

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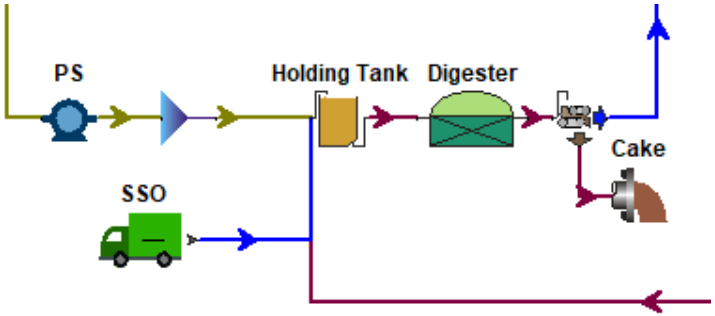
Model Addition – SSO

- **New input for SSO**
  - State variable (COD_P-X_{EO}) for adding particulate degradable COD (*e.g.* Source Separated Organics)
  - ***Has specific COD:VSS;*** added as a separate input to avoid conflicts with municipal wastewater characteristics
  - Option to include N and P
  - Constant or time-varying, as with any BioWin input



Manual references:

1. Model Reference > Biological/Chemical Models > Hydrolysis, Biological adsorption, Ammonification and Assimilative denitrification
2. Model Reference > Definition of Non-State Variables

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Usability Upgrade – Drawing Toolbar

- **UNDO** button!! Use for accidental element deletion, moving, *etc.*
- Buttons for copying pipe format from one pipe to others
- Buttons for aligning flowsheet elements (vertical or horizontal centers)
- Buttons for spacing flowsheet elements evenly (vertically or horizontally)
- Buttons for flipping flowsheet element images (horizontally or vertically)
- Button for copying selected element(s)

Manual reference:

General Operation > Main Simulator Window > Toolbars > Flowsheet Tools

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Usability Upgrade – Report to Excel

- Automatic rapid generation and export of data, charts, *etc.* to Excel
- Ideal for generating Mass Balance tables to use in PFDs
- Preconfigured templates are customizable
- Can incorporate "post-BioWin" calculations (*e.g.* MLVSS/MLSS, COD/BOD) using Excel formulas
- Option for including both steady state and dynamic simulation databases
- Can include BioWin charts – these are converted to Excel charts with data

- Report to Word still available

Manual reference:

Data Output (charts, tables, reports) > Creating Project Reports > Creating an Excel Report

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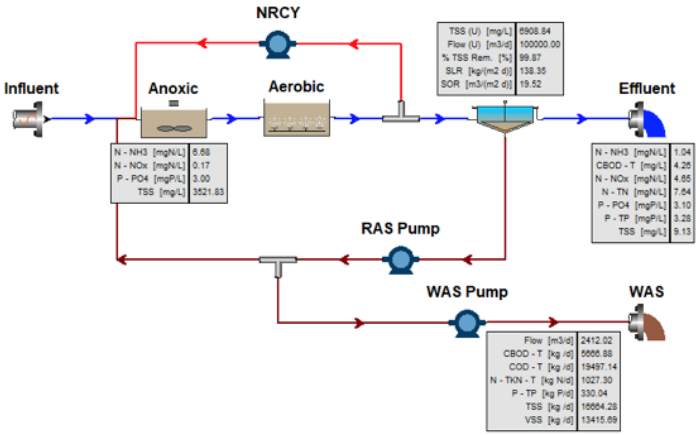
Usability Upgrade – Report to Excel

BioWin Mass Balance Summary



Pipe Name	FLOW m3/d	COD kg/d	cBOD kg/d	TSS kg/d	VSS kg/d	TKN kg/d	NH_4-N kg/d	NO_X-N kg/d	TP kg/d	PO_4-P kg/d
	Mass Rate									
F-01	100,000.0	50,000	24,521	22,271	19,771	4,000	2,640	0	650	325
F-02	497,588.0	2,066,615	606,634	1,752,419	1,413,482	110,671	3,325	86	35,265	1,491
F-03	497,588.0	2,044,829	592,708	1,742,104	1,402,492	107,991	516	2,314	35,265	1,545
F-04	197,588.0	811,984	235,359	691,775	556,918	42,882	205	919	14,003	613
F-05	97,588.0	3,652	416	891	717	291	101	454	320	303
F-06	100,000.0	808,332	234,943	690,884	556,201	42,591	104	465	13,683	310
F-07	100,000.0	808,332	234,943	690,884	556,201	42,591	104	465	13,683	310
F-08	97,588.0	788,835	229,276	674,220	542,785	41,564	101	454	13,353	303
F-09	2,412.0	19,497	5,667	16,664	13,416	1,027	2	11	330	7
F-10	2,412.0	19,497	5,667	16,664	13,416	1,027	2	11	330	7
F-11	300,000.0	1,232,845	357,349	1,050,329	845,575	65,109	311	1,395	21,262	931
F-12	300,000.0	1,232,845	357,349	1,050,329	845,575	65,109	311	1,395	21,262	931

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Usability Upgrade – Report to Excel

BioWin Tankage Summary
Volume Units: m3

Reactors	Name	Volume
	Aerobic	40,000.0
	Anoxic	10,000.0
	Group Total	**50,000.0**

Secondary Clarifiers	Name	Volume
	Clarifier	20,000.0
	Group Total	**20,000.0**

Total Volume for All Units **70,000.0**

BioWin Reactor Summary
All airflows reported at 20 deg C and 1 atm

Bioreactor

Tank Name	AREA m2	DEPTH m	VOLUME m3	DIFFUSERS #	AIRFLOW m3/hr (20C, 1 atm)	DO mg/L	SOTR kg/hr	SOTE %	OTR kg/hr	OTE %	OUR mg/L/hr	MLSS mg/L	MLVSS mg/L	NH_4-N mg/L	NO_2-N mg/L	NO_3-N mg/L	NO_x-N mg/L	PO_4-P mg/L	pH ---	TOTAL MASS kg	MLVSS / MLSS --
Anoxic	2,222	4.50	10,000.0	0	0	0.0	0	100.0	0	100.0	0.0	3,522	2,841	6.7	0.0	0.2	0.2	3.0	6.99	35,218	80.7%
Aerobic	8,889	4.50	40,000.0	21,680	49,292	2.0	4,195	30.5	1,393	10.1	33.8	3,501	2,819	1.0	0.3	4.3	4.7	3.1	6.86	140,044	80.5%
Average					49,292	2.0	4,195	30.5	1,393	10.1	33.8	3,511	2,830	3.9	0.2	2.2	2.4	3.1			80.6%
Total	11,111		50,000.0	21,680	49,292		4,195		1,393											175,262	

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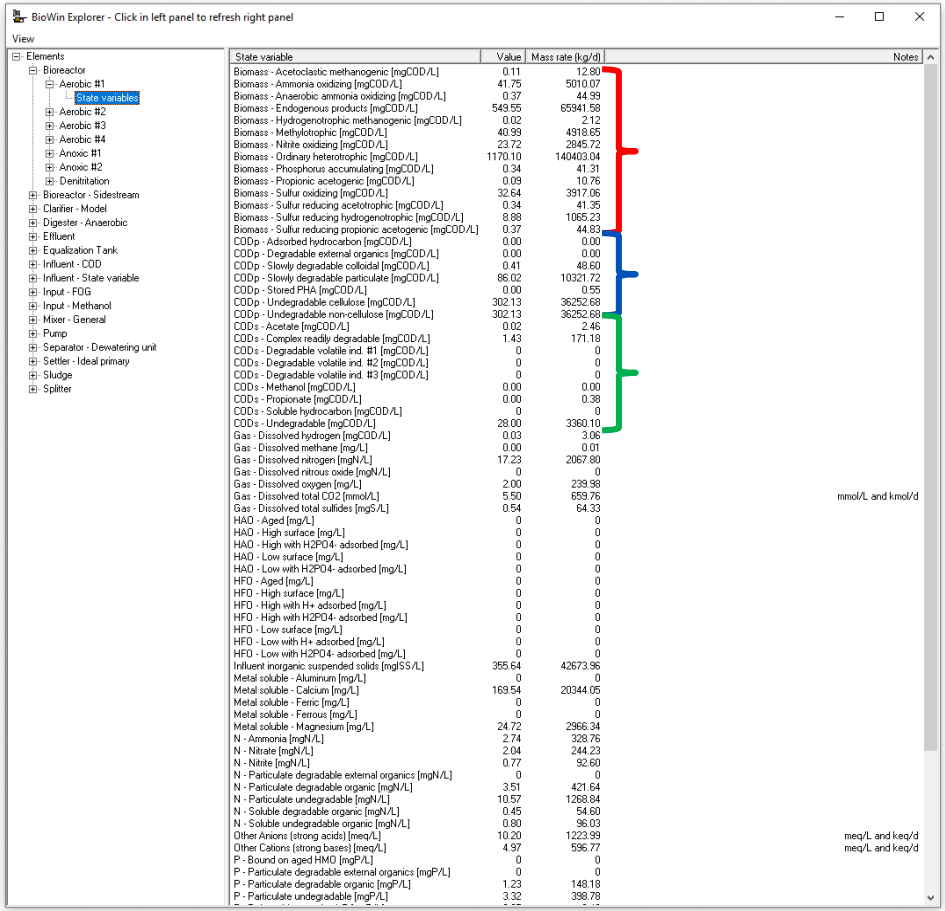
Usability Upgrade – Variable Naming & Sorting

- Variables and parameters renamed for improved consistency
- Allows for simpler alphabetical sorting



Manual reference:

Model Reference > Definition of Non-State Variables

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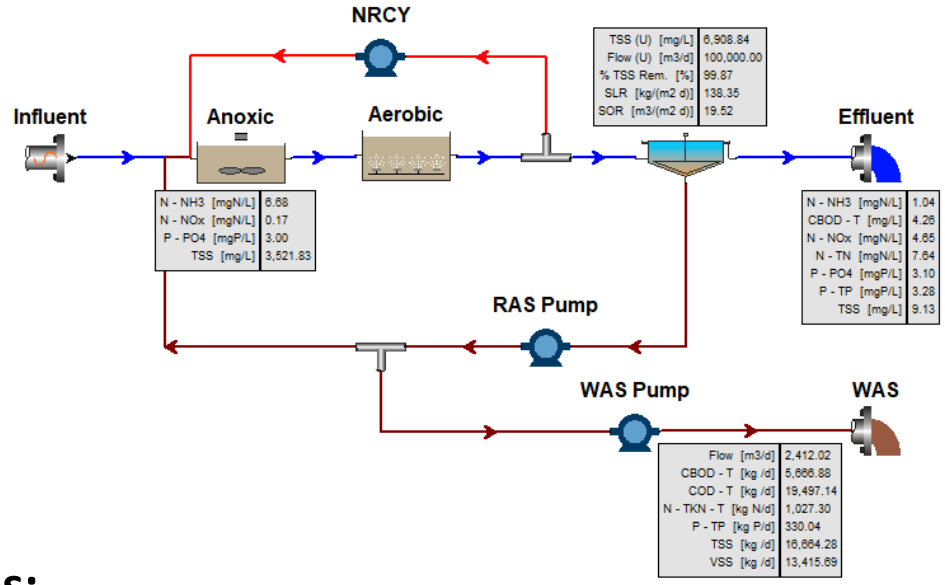
Usability Upgrade – Flowsheet Tags

- **Customizable element-specific information**
  - Information updates with simulations
  - Can contain state, combined, and element-specific variables



Manual references:

1. General Operation > Customizing BioWin > Customizing the Project Appearance > Drawing Board
2. General Operation > Customizing BioWin > Customizing the Work Environment > Default tags
3. General Operation > Managing BioWin Projects > Setting Project Options > Drawing Board Options

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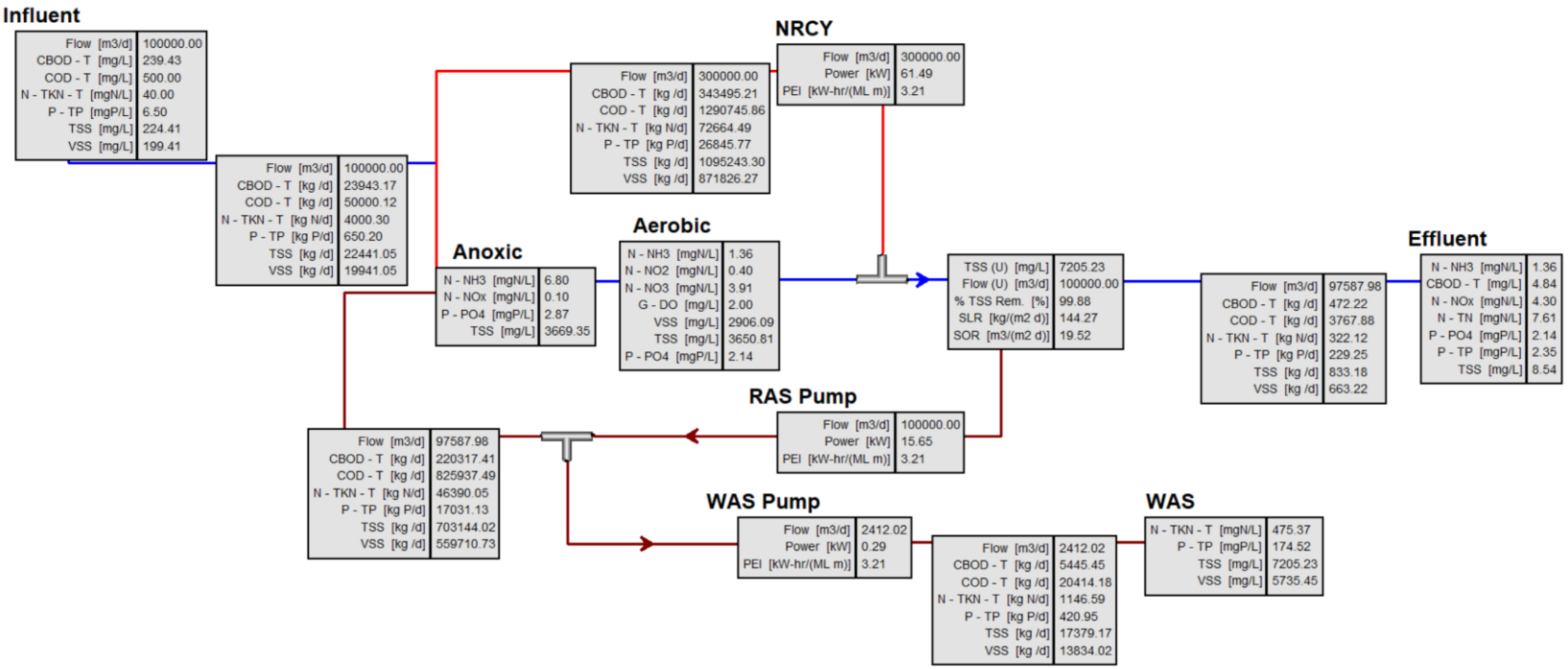
Usability Upgrade – Flowsheet Tags

- **Customizable element-specific information**
  - Can control location (above, below elements)
  - Can replace flowsheet icons if desired



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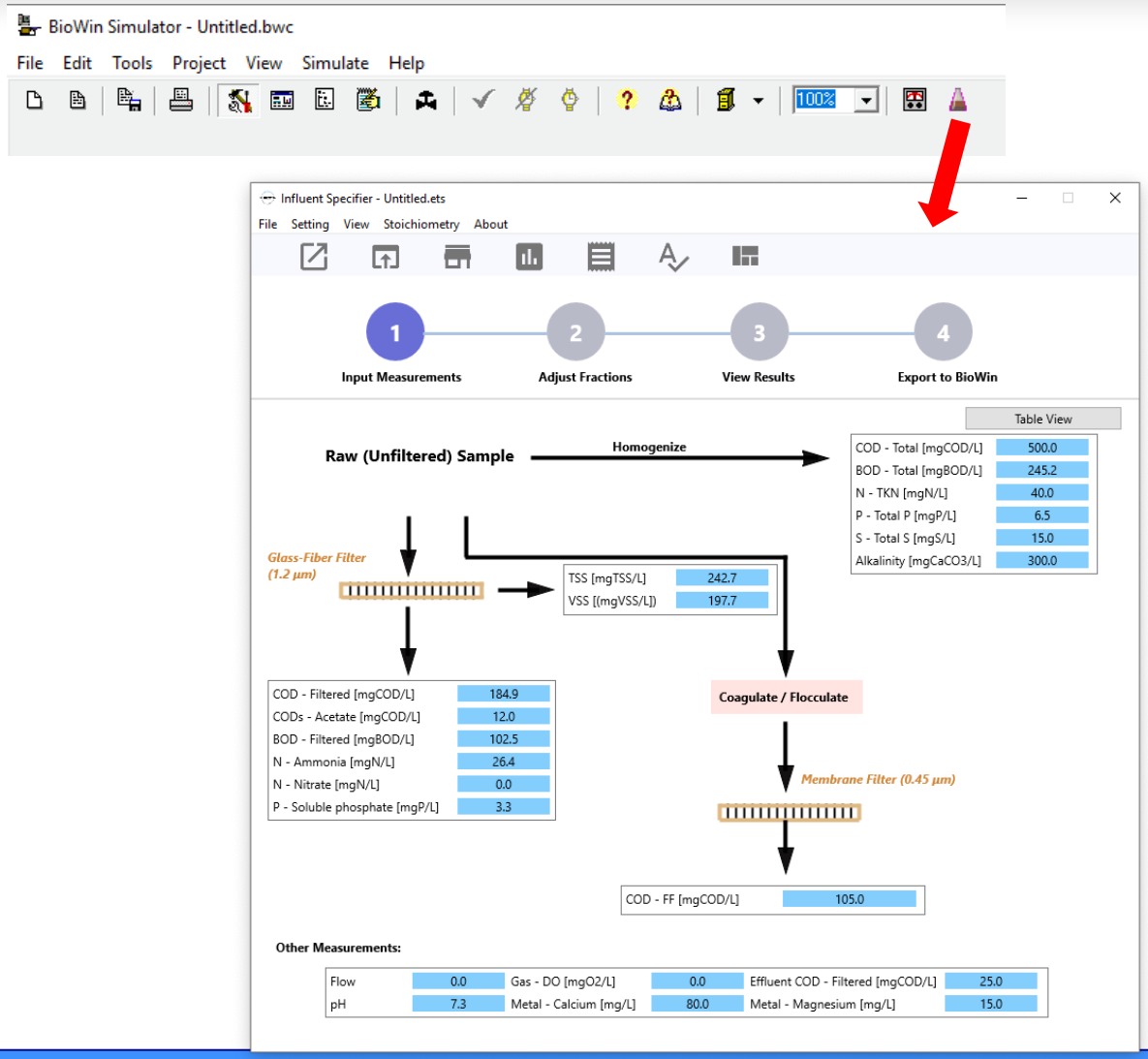
Usability Upgrade – Integrated Influent Specifier



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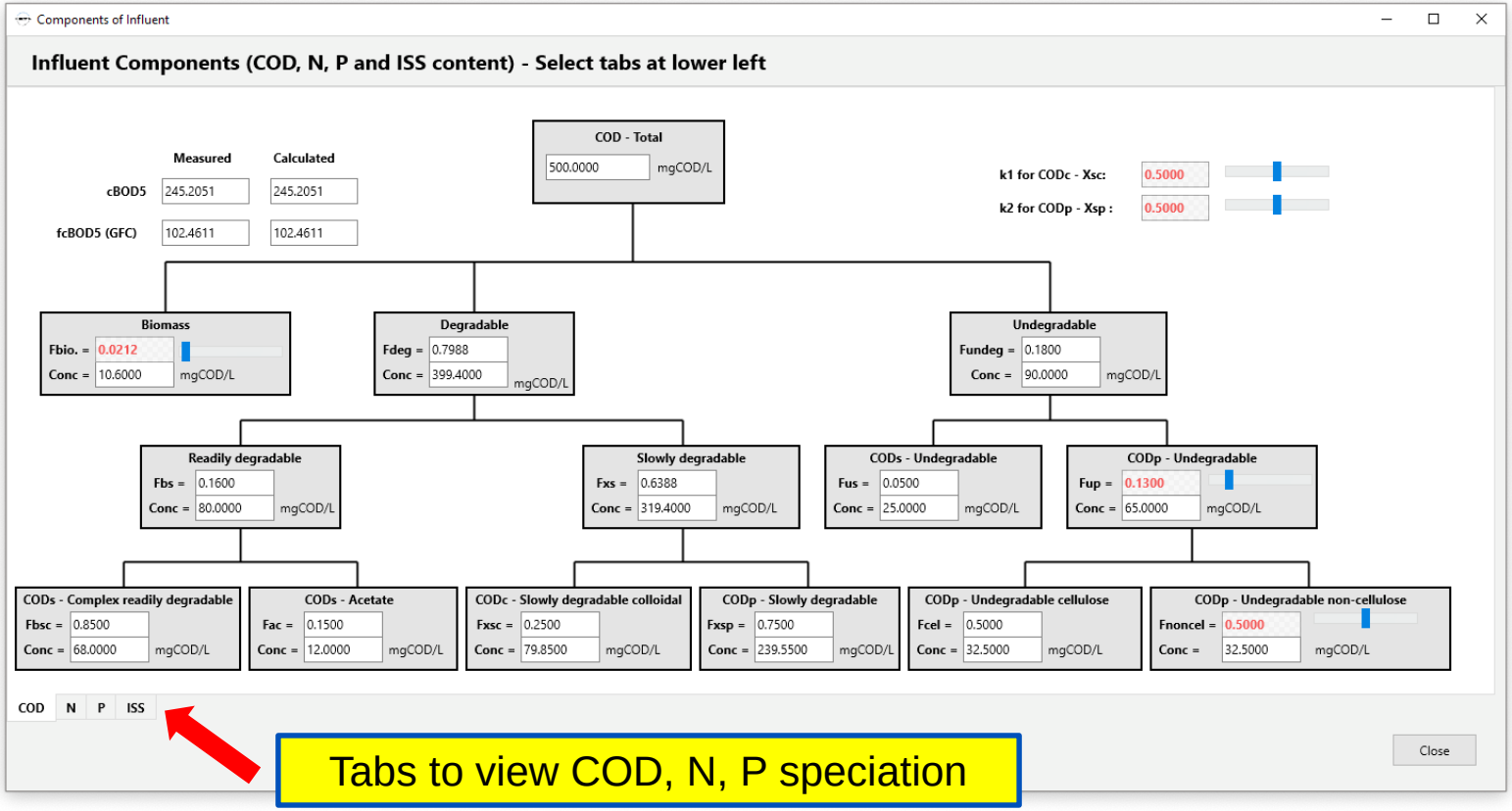
Usability Upgrade – Integrated Influent Specifier



Tabs to view COD, N, P speciation

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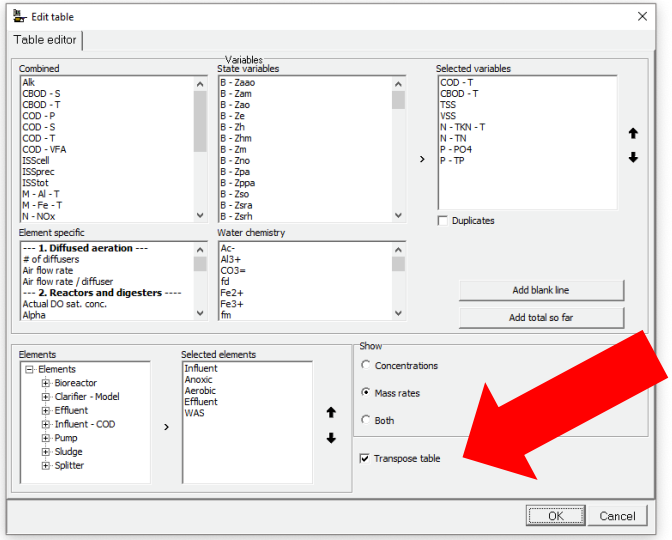
Usability Upgrade – Transpose Tables

Elements	COD - Total [kg /d]	BOD - Total Carbonaceous [kg /d]	Total suspended solids [kg /d]	Volatile suspended solids [kg /d]	N - Total Kjeldahl Nitrogen [kg N/d]	N - Total N [kg N/d]	P - Soluble PO4-P [kg P/d]	P - Total P [kg P/d]
Influent	50,000.12	24,520.56	22,271.22	19,771.22	4,000.30	4,000.30	325.10	650.20
Anoxic	2,066,615.31	606,633.78	1,752,419.23	1,413,482.37	110,671.03	110,756.71	1,491.33	35,265.05
Aerobic	2,044,828.86	592,708.01	1,742,104.19	1,402,492.50	107,991.14	110,305.17	1,544.55	35,265.05
Effluent	3,652.17	416.10	890.51	716.91	291.45	745.29	302.92	320.16
WAS	19,497.14	5,666.88	16,664.28	13,415.69	1,027.30	1,038.52	7.49	330.04



Elements	Influent	Anoxic	Aerobic	Effluent	WAS
COD - Total [kg /d]	50,000.12	2,066,615.31	2,044,828.86	3,652.17	19,497.14
BOD - Total Carbonaceous [kg /d]	24,520.56	606,633.78	592,708.01	416.10	5,666.88
Total suspended solids [kg /d]	22,271.22	1,752,419.23	1,742,104.19	890.51	16,664.28
Volatile suspended solids [kg /d]	19,771.22	1,413,482.37	1,402,492.50	716.91	13,415.69
N - Total Kjeldahl Nitrogen [kg N/d]	4,000.30	110,671.03	107,991.14	291.45	1,027.30
N - Total N [kg N/d]	4,000.30	110,756.71	110,305.17	745.29	1,038.52
P - Soluble PO4-P [kg P/d]	325.10	1,491.33	1,544.55	302.92	7.49
P - Total P [kg P/d]	650.20	35,265.05	35,265.05	320.16	330.04

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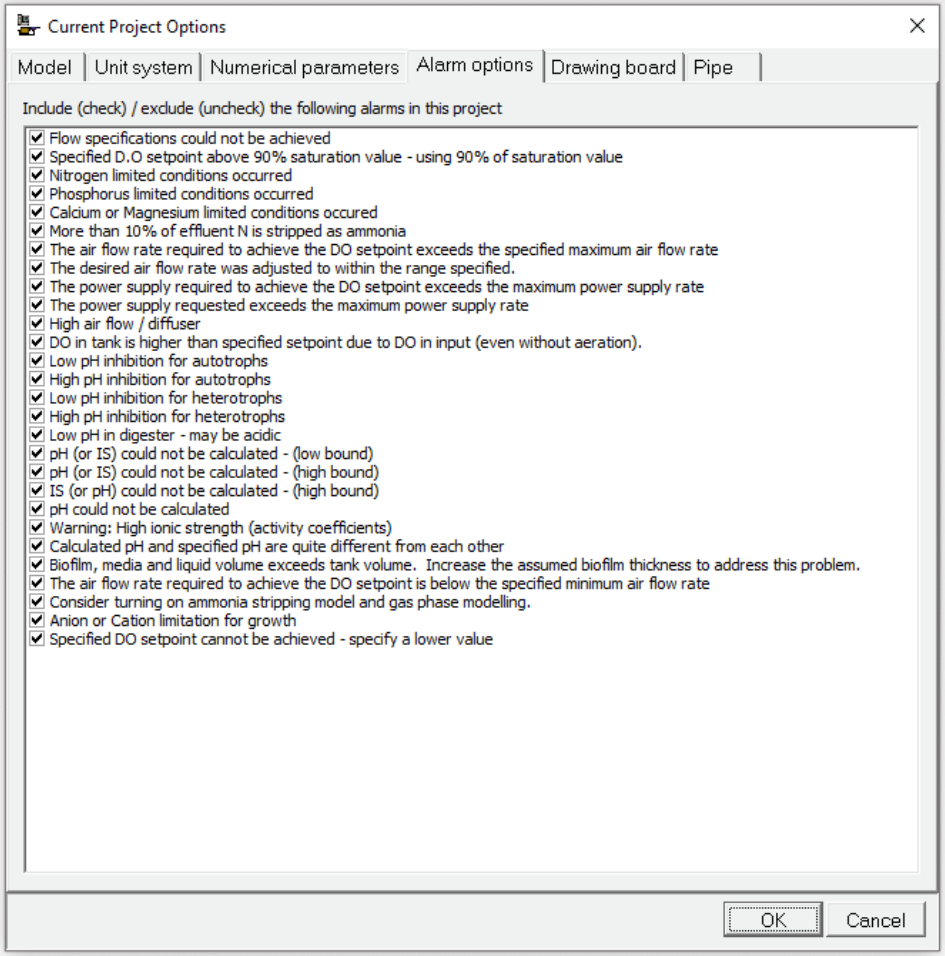
Usability Upgrade – Optional Alarms

- As part of the project options, select which alarms are active



Manual reference:

General Operation > Managing BioWin Projects > Setting Project Options > Alarm Options

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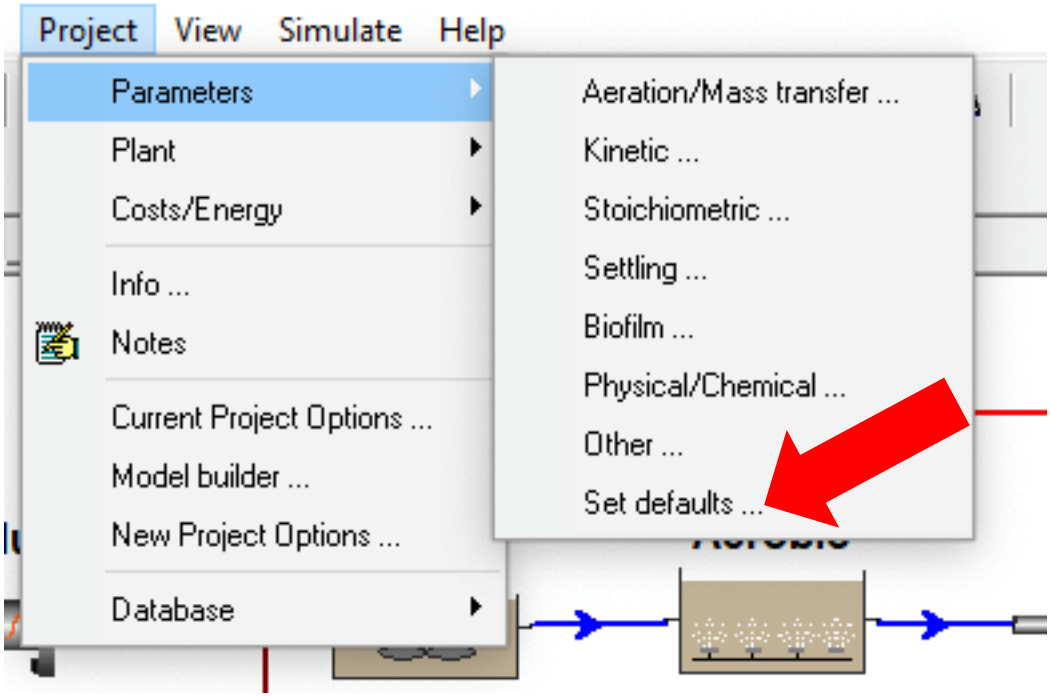
Usability Upgrade – Set All Parameters to Default

- Use to upgrade older models to Version 6



Manual reference:

General Operation > Managing BioWin Projects > Specifying Project Model Parameter Values

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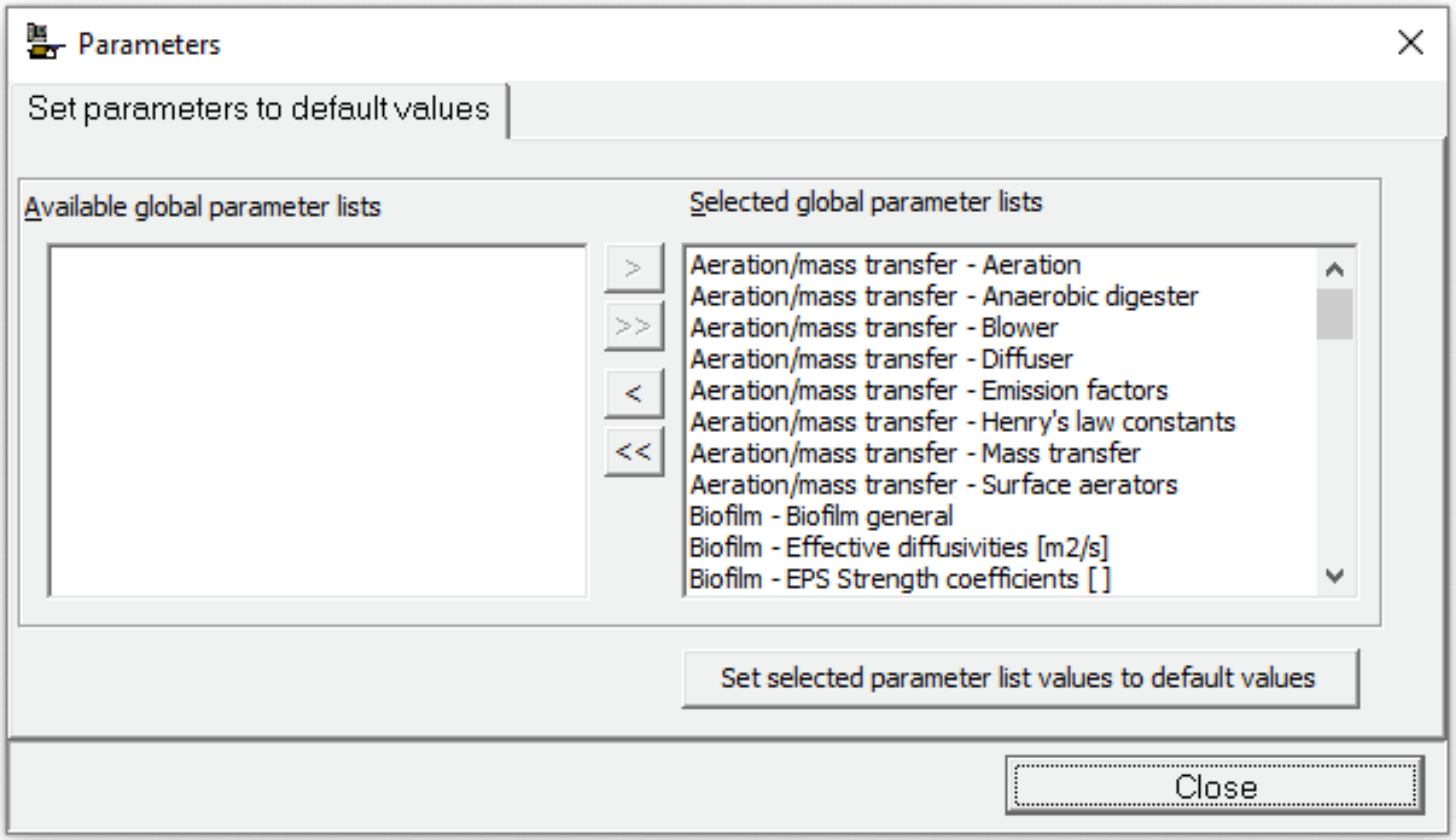
Usability Upgrade – Set All Parameters to Default

- Specify which parameter sets to update



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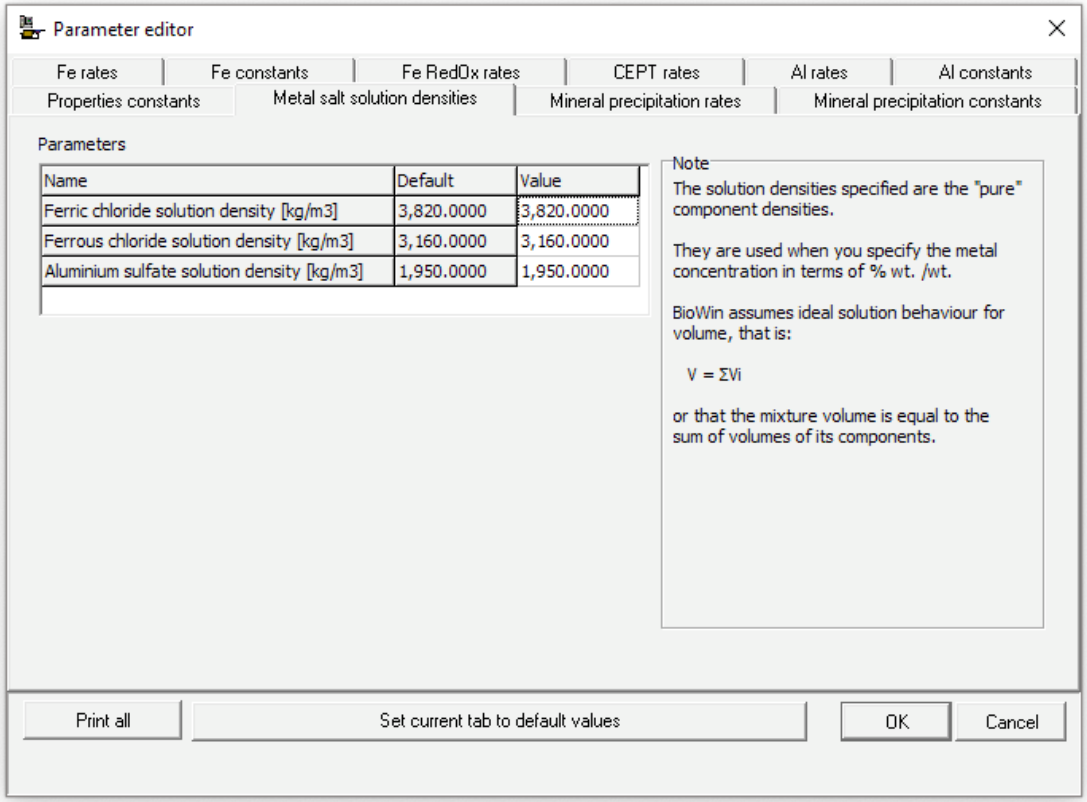
Usability Upgrade – Solution Densities

- For metal salt input streams



Manual reference:

Model Reference > Chemical Precipitation Reactions

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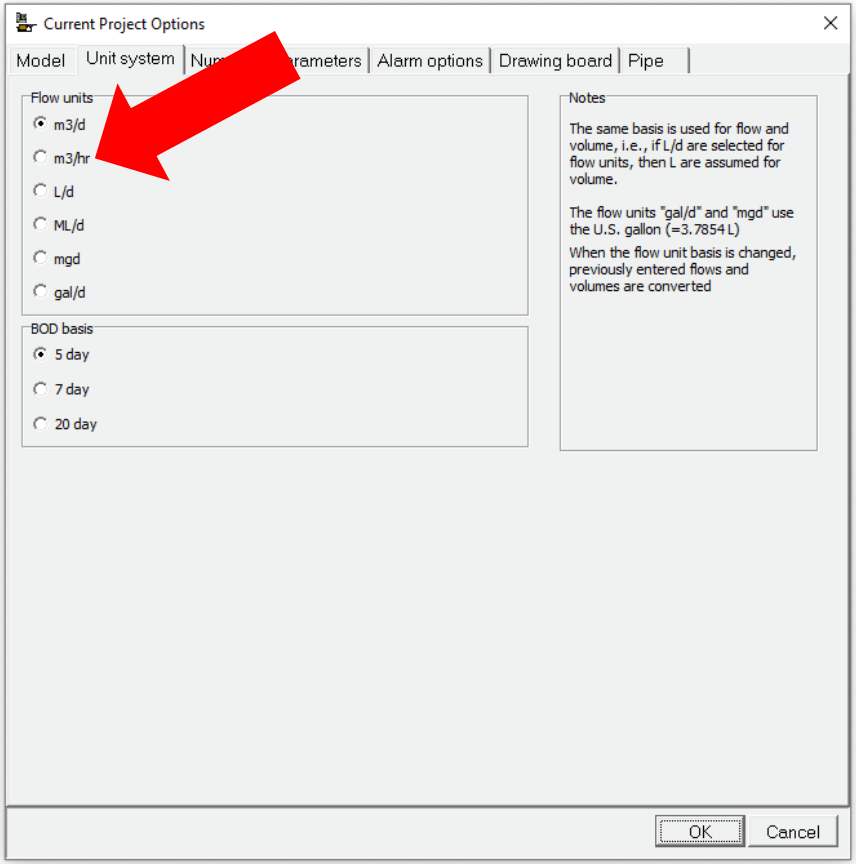
Usability Upgrade – Additional Flow Units

- Cubic meters per hour option for smaller systems



Manual reference:

General Operation > Managing BioWin Projects > Setting Project Options > Unit System

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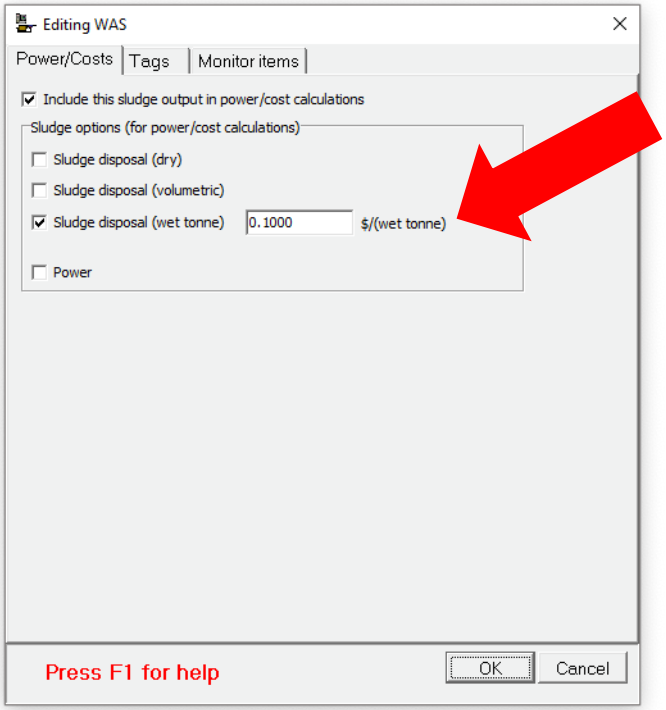
Usability Upgrade – $ per wet tonne sludge costs

- Third sludge disposal cost option added



Manual reference:

Operating Costs in BioWin > Operating Costs > Sludge

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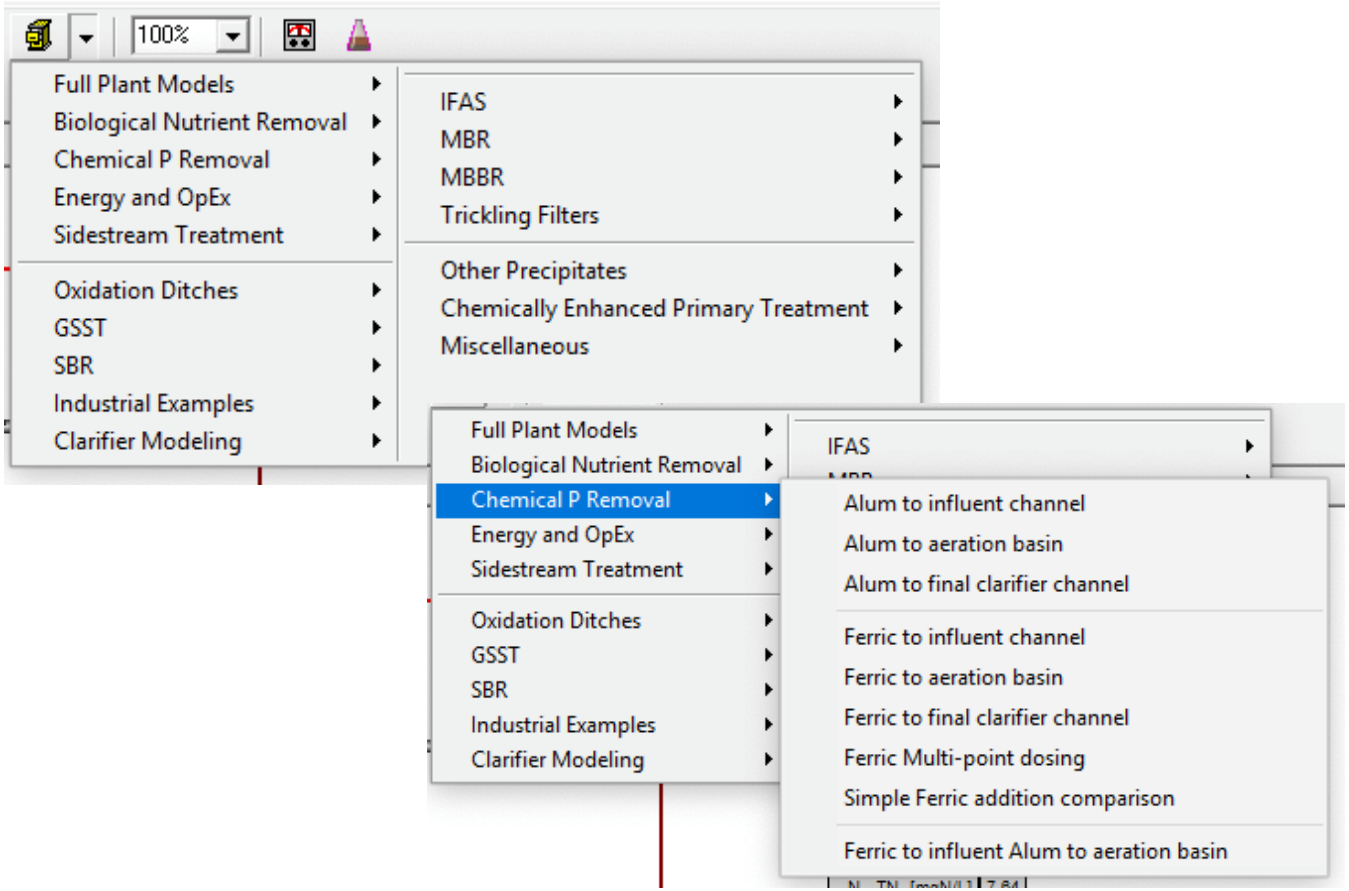
Usability Upgrade – More Examples!!

- BioWin Cabinet reorganized and greatly expanded with additional examples



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Enjoy Using BioWin 6.0

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