Exercise Bathtub I. (basics, 25 to 45 minutes)
NOTE: THIS EXERCISE REQUIRES ADVANCED MODE IN BATHTUB (The default with V6.14).

Some background:
We will use the 3-segment default case and explore some basic assumptions and specifications (i.e. averaging period). We'll see how BathTub can quickly evaluate the effect of controlling a point-source input to a lake.

1. **START BathTub**

2. **LOAD THE DEFAULT CASE (Bathtub does this automatically, but you may want to check that the proper case HAS been loaded)**

a. Run the model with the <RUN> button

b. Select "Plot" on the main menu; look at the longitudinal pattern and the error bounds on the predictions. The segments are plotted by their numeric designation (i.e., if segment 1 is upstream, that will be on the left of the plot).

c. Try out the Run > Load Response menu selection – this will be quite useful later.
This will bring up a "blank" form. You then select the response of interest (TOTAL P is the default) and then hit the RUN button (upper left).

1) You can view the trophic response to changes in a specific TRIBUTARY load
2) You can look at the response within an individual reservoir SEGMENT.
3) You can alter the range of the load you wish to view
4) You can also choose to alter the load by changing EITHER the inflow VOLUME or the inflow CONCENTRATION. Remember that load is Volume x Concentration and it makes a difference which one is driving the load.

3. **EXAMINE THE WATER BALANCE**

a. add a reservoir outflow:

Edit > Tributaries > ADD
Segment will be 01 Near Dam
Trib. Type will be 04 – Reservoir Outflow (use drop down list to set)
Ignore watershed area
Insert a flow rate (observed) of 250.

b. Click OK and run the model

c. <List> Mass Balances (overall) – look at the "Advective Outflow" for the "overall" (perfect balance is show by ZERO advection, how far off is our water balance?).
THIS IS SOMETHING YOU SHOULD ALWAYS CHECK IF POSSIBLE
Bathtub's predictions all rely on a reasonably accurate water balance. This is a good place to start trapping errors.

4. **EXAMINE THE INFLUENCE OF AVERAGING PERIOD**

a. While you are still in your screen for List > Mass Balances – overall
Note the hydraulic residence time (1.2y)
Note the nutrient residence time (0.42 years)
Note the turnover ratio (2.4).
Is a one-year averaging period appropriate here?

b. Return to main menu and Edit > Global Variables to change the Variable "averaging period" from 1 yr to 5 years, click on OK and then RUN the model again.

c. Again: List > Mass Balances > Overall, DO NOT CLOSE EXCEL, (Minimize or Pull it out of the way if you want), but go back to the BathTub Window and List > hydraulics and morphomety

(you can save the worksheet with a new name or do a screen grab for future reference). You might optionally look at predicted values. On the main menu again: List > Predicted or Plot. If you PLOT, the red square symbols on plots are the predicted values. There is a pull down menu of variables to plot.

d. Now switch to an averaging period of .1 yr, run the model and compare to the previous run.

e. What was influenced by this change (Hint: look at precipitation, evaporation, dispersion, residence times, and nutrient retention)? How big a deal is this?

Note: Precipitation, Evaporation and Storage gain must be expressed as PER averaging period – See Edit > global variables. BathTub does not really change anything based on the "averaging period" – except that it ASSUMES you have entered precipitation, evaporation, and storage change on a PER averaging period basis – and unless you changed these variables to reflect the new averaging period, then you get a slightly different result with your differing "averaging periods". Remember – Averaging period is mainly for YOU the user to consider, not for BathTub to use in its calculations.

5. **ADD A POINT SOURCE TO THE NEAR DAM SEGMENT**

a. In the main menu, Edit > Tributaries
Click on Add
Name it "Treatment Plant"
Select segment 03 (NEAR DAM)
Select a Tributary type of POINT SOURCE
Give it a Flow Rate of 10
Total P concentration of 2000 (2 mg/L)

b. Run the Model
Check the water balance

c. Run the load responses (Main Menu: Run > Load Response).
You will select the treatment plant as the tributary and "near-dam" as the segment. Because flow is minimal, it should not matter whether you alter flow or concentration to change the load. If the TP load from the plant is reduced by half, what effect will that have on major algal blooms (i.e., Scroll the pull down variable choices to "frequency of blooms > 20 ppb") in the near-dam segment? What about minor blooms (10 ppb)? Why should the effect differ between bloom levels?

6. **TAKE A QUICK LOOK AT ALTERNATIVE MODEL CHOICES (more detail on these later).**

a. Use Main Menu: PLOT to see the predicted phosphorus values. Use the "Copy Chart" button on the Plot screen to copy the plot to the clipboard, then you can paste it into Word, WordPad, or whatever program you like to hold onto it for a moment.

b. Edit > Model Selections. Change the total phosphorus model to (4) Canfield & Bachmann reservoir model. Click OK and then RUN the model.

c. Plot again and compare the results to the previous model results. The difference is substantial. We'll talk more later about choosing among the available models.

WE'RE DONE WITH BATHTUB EXERCISE ONE.
ANY QUESTIONS?