APPENDIX B: Connecting Exercise 4 to Exercise 5: Required Information Before Beginning Hydrology Calibration

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Exercise 4 was designed to provide a basic overview of WinHSPF. We launched WinHPSF from BASINS for a group of six subwatersheds. We walked through WinHSPF and provided basic explanations for many of the tools and modules within the model; however, we made very few changes to the input file. Before you attempt to calibrate a WinHPSF model, you need to "personalize" the input file so that it more accurately characterizes the watershed of interest. This includes adjusting things such as reach properties and point source information. We will adjust the values of many site-specific parameters such as Manning's n, overland slope, and reach channel geometry. In Exercise 5, you will open a new input (*.uci*) file that has these changes already made (this was done in order to save time). This appendix explains the changes that have been made to *WestPat.uci* in order to create *hyd_man.uci* (the input file you will use in Exercise 5). This appendix is written so that if you have just completed Exercise 4, you can follow these steps to create a **.uci* file similar to *hyd_man.uci*.

Reach Editor

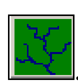
A. F-Tables – The following discusses sources of F-table information.

a. Cross section studies
b. Stage-discharge relationships at gaging stations
c. Calculations using Manning's equation and others- see description below.

The F-Tables are function tables used to generate flow calculations in WinHSPF. These tables denote flow characteristics for each individual reach channel and show the relationship between depth, area, volume, and outflow. If you launch WinHSPF from BASINS, the F-tables are estimated for individual reaches using information from various shapefiles. This information includes area, length, slope of overland flow, and other topographical characteristics. These estimates are generally inaccurate, but they provide functional initial inputs.

It is best to gather data for your watershed's individual reaches and then use cross-sectional characteristics to populate the F-Tables by either estimating the stage-discharge relationship with an equation such as the Manning's equation and then entering them manually or by using the "Import From Cross Section" tool. In our model, we replaced the default F-tables with F-tables calculated with methods similar to those explained in this section.

Import From Cross Section Tool

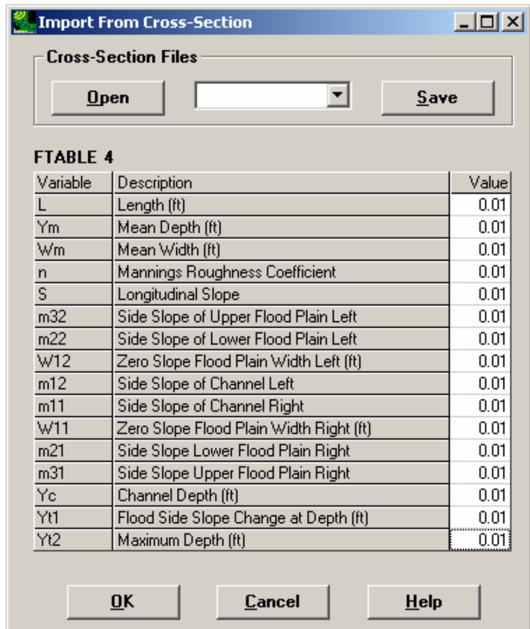
1. In WinHSPF, click the "Reach Editor" button, .

2. Click the "F-tables" button, 

.

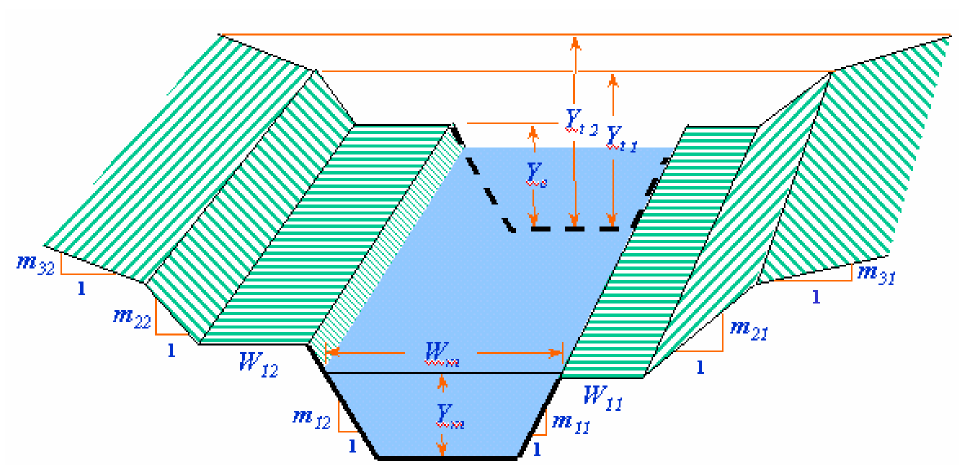
3. Click the import button, 

. The following window will appear:



Variable	Description	Value
L	Length (ft)	0.01
Ym	Mean Depth (ft)	0.01
Wm	Mean Width (ft)	0.01
n	Mannings Roughness Coefficient	0.01
S	Longitudinal Slope	0.01
m32	Side Slope of Upper Flood Plain Left	0.01
m22	Side Slope of Lower Flood Plain Left	0.01
W12	Zero Slope Flood Plain Width Left (ft)	0.01
m12	Side Slope of Channel Left	0.01
m11	Side Slope of Channel Right	0.01
W11	Zero Slope Flood Plain Width Right (ft)	0.01
m21	Side Slope Lower Flood Plain Right	0.01
m31	Side Slope Upper Flood Plain Right	0.01
Yc	Channel Depth (ft)	0.01
Yt1	Flood Side Slope Change at Depth (ft)	0.01
Yt2	Maximum Depth (ft)	0.01

The variables in this window correspond to the following:

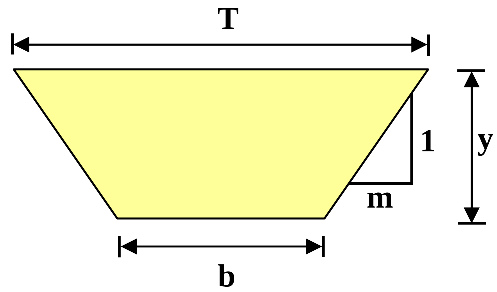


Cross-sectional data can be stored as BASINS "Trapezoidal" files (*.ptf*). Click the "Open" button in the "Import From Cross-section" frame to open an existing *.*ptf* file. Click the "Save" button to save your values – this will create a new *.*ptf* file.

Calculating stage discharge relationships manually.

Natural channels such as streams and rivers are typically trapezoidal in shape with the following dimensions:

Top width, T
Base width, b
Side Slope, m
Depth, y



Note: For rectangular cross-sections, m=0, and T = b. For triangular cross sections, b = 0.

Note: One way to use the geometry of the channel to populate the F-tables is described in the BASINS User's Manual on pages 10.4-8 - 10.4-11. This method uses the Import option to import stream characteristic data necessary for calculating F-tables.

In some cases it is easiest to make the calculations by hand using either Manning's equation or other open-channel equations that calculate flow as a function of depth. You can calculate stage-discharge relationships and corresponding surface areas and volumes with the equations below.

Surface Area

The surface area of the reach is the area of water in contact with the atmosphere. This is estimated by multiplying the top-width (T) by the length (L) of the reach.

$$SA = T * L$$

The top width (T) is a function of depth and can be estimated using the following equation:

$$T = b + 2my$$

Volume

The volume in a reach is also a function of depth and can be estimated by multiplying the surface area (SA) by the depth of water (y) in the reach.

$$V = SA * y$$

Discharge

The relationship between flow rate and depth can be approximated by the following stage-discharge relationship:

$$y = \alpha \cdot Q^{\beta}$$

The empirical constants, α and β, can be estimated with flow data using a log-log curve or acquired from the USGS for certain reaches that have previously-determined rating curves. When these parameters are not available, the relationship between flow rate and depth can be approximated using Manning's equation.

Manning's Equation

$$Q = \frac{c}{n} A^{5/3} R_h^{2/3} \sqrt{S_0}$$

c = empirical constant (c = 1 for metric units, or c=1.486 for English units)
n = Manning's roughness coefficient = 0.04 – 0.05 for winding streams
A = cross-sectional area, L^2
R_h = hydraulic radius, L
S_0 = slope of channel, L/L

- *Cross-Sectional Area, A*

  This is different than the surface area calculated above. The cross-sectional area of a trapezoidal channel can be estimated by:

$$A = by + my^2$$

- *Hydraulic Radius,* R_h

$$R_h = \frac{A}{WP}$$

WP is the wetted perimeter of the channel and can be estimated for a trapezoidal cross-section by:

$$WP = b + 2y\sqrt{m^2 + 1}$$

- *Channel slope, S_0*
  This can be estimated by dividing the change in elevation by the length of the reach. (If these parameters are unknown, they can be estimated using ArcView.)

$$S_0 = \frac{\Delta Elevation}{L}$$

Meteorological Data Editor

A. Weather Data

You can often obtain meteorological data that is more representative of your watershed than the data included in the BASINS' WDM Weather Data files (see Exercise 3 for more information). In order to incorporate such data, you need to import various data sets into a WDM file, and within the *.*uci* file, specify which **.wdm* file contains the weather information. When using the default BASINS' weather data, the **.uci* file will have a **.wdm* file for output and one for weather data. It is possible to have your weather data in your project **.wdm* file. In the West Branch Patuxent case, we imported the weather data we wished to use to our project **.wdm* file.

***Weather Data sources*:**

- National Climatic Center - http://www.ncdc.noaa.gov/ or http://www.ncdc.noaa.gov/ol/climate/climatedata.html
- Regional Climate Centers – www.ncdc.noaa.gov/regionalclimatecenters.html
- Western Region Climate Center - http://wrcc.sage.dri.edu/wrccmssn.html

Point Source Editor

A. Point source data

It is often possible to find point source data from local data repositories or directly from a discharger. This data, such as data from a wastewater treatment plant, is often more accurate or better-measured than the calculated loads from the BASINS point source database. When implementing such data, you need do the following:

1. Import the point source data into your project *.*wdm* file (see Exercise 3). Make sure that the "scenario" for this time series is PT-OBS (or PT-***).

2. Add the point source to your model in WinHSPF (see Exercise 4).

Input Data Editor

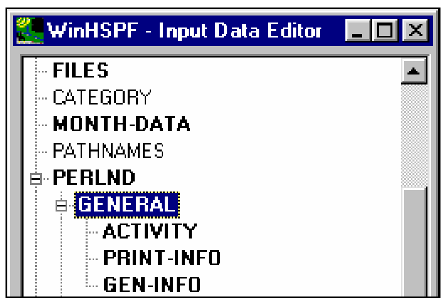
This appendix defines each of the variables associated with the hydrologic portion of WinHSPF. This was included to help you understand how each parameter interacts with other parameters and how individual and groups of parameters affect the model.

A. PERLND

GENERAL

This section contains general information about the modules selected in the "Control Cards." Some of the inputs will be left as defaults while others need to be entered for the site-specific area.

1. Click on the "+" next to GENERAL.



2. **Double-Click** GENERAL → ACTIVITY.

   Note: Notice that there is "1" in each cell for each pervious land segment where a module has been activated in the "Control Cards" window. Users can activate (1) or deactivate (0) modules in this window or the "Control Cards" window. This window allows the user to deactivate a module for an individual pervious land segment where the "Control Cards" will not.

3. Click OK.

4. **Double click** GENERAL → PRINT-INFO.

   Note: HSPF permits the user to vary the printout level (maximum frequency) for the active sections of an operation; "2" means every PIVL intervals, "3" means every day, "4" means every month, "5" means every year, "6" means never. We will leave the print intervals as the default (months). It should be noted that this print interval changes the format of the output in the **.out* file not in the **.wdm* timeseries we generally look at.

5. Click OK.

6. **Double click** GENREAL → GEN-INFO. This table shows information about input and output units. We will leave the defaults.

IUNITS1 -Indicates the system of units for data in the input time series; 1 means English units, 2 means Metric units.
OUNITS- Indicates the system of units for data in the output time series; 1 means English units, 2 means Metric units.
PUNIT(1) - Indicates the destinations of printout in English units. A value 0 means no printout is required in English units. A non-zero value means printout is required in English units and the value is the Fortran unit no. of the file to which the printout is to be written. Note that printout for each Pervious Land Segment can be obtained in either the English or Metric systems, or both (irrespective of the system used to supply the inputs).
PUNIT(2) - Indicates the destinations of printout in Metric units. A value of 0 means no printout is required in Metric units. A non-zero value means printout is required in Metric units and the value is the Fortran unit no. of the file to which the printout is to be written. Note that printout for each Pervious Land Segment can be obtained in either the English or Metric systems, or both (irrespective of the system used to supply the inputs).

7. Click OK.

8. Click on the "-" sign next to GENERAL to contract the list.

ATEMP

The purpose of ATEMP is to modify the input air temperature to represent the mean air temperature over the land segment. This module section is used by both PERLND and IMPLND (HSPF V.12 Manual). This section will be a review since this information was entered previous to doing hydrology calibration.

1. **Double click** PERLND → ATEMP → ATEMP-DAT.

ELDAT – The difference in elevation between the temperature gage and the pervious land segment; it is used to estimate the temperature over the pervious land segment by application of a lapse rate. It is positive if the pervious land segment is higher than the gage, and vice versa.
AIRTMP - The air temperature over the pervious land segment at the start of the RUN.

Note: You need to enter values for this table if you are modeling either snow or any water quality consituent.

Because we are modeling neither snow nor any water quality constituents at this time, we will not change the values in the ATEMP table. The following steps explain how to obtain values for ELDAT.

2. Open *Patuxent.apr* in BASINS.

1 All definitions in this computer session were taken from WinHSPF.

3. Turn "on" the *WDM Weather Data Stations* theme.

4. Using the "Identify" tool, click the weather station selected for use in the WinHSPF model. The elevation you are given in the "Identify" box is the elevation of the WDM Station.

5. Turn "on" the *L_washdc* theme.

6. "Activate" the *DEM* theme (or any other elevation data theme).

7. Using the "Identify" tool, click around one land use in the given watershed and find the mean elevation for that land use.

   Note: There are better, more comprehensive ways to calculate the mean elevation for a landuse using the Summarize Zones tool within Spatial Analyst.

8. Calculate the ELDAT values with the following equation:

   ELDAT = (mean elevation) **–** (weather station elevation)

9. Enter the given values in the "ELDAT" window for each landuse.

10. Click OK.

11. **Double click** ATEMP to contract the list.

PWATER

This portion of the model contains the information and tables required for the water budget.

1. **Double click** PWATER → PWAT-PARM1.

2. Click BASIC. This table contains the first group of PWATER parameters; it contains flags that allow the user to the method in which the water budget is calculated.

   CSNOFG - If CSNOFG is 1, section PWATER assumes that snow accumulation and melt is being considered. It will, therefore, expect that the time series produced by section SNOW are available, either internally (produced in this RUN) or from external sources (produced in a previous RUN). If CSNOFG is 0, no such time series are expected. See the functional description for further information.
   RTOPFG - If RTOPFG is 1, routing of overland flow is done in exactly the same way as in HSPX, ARM and NPS. A value of 0 results in a new algorithm being used. A value of 2 results in the use of a surface recession constant (and HWTFG must be 1). UZFG - If UZFG is 1, inflow to the upper zone is computed in the same way as in HSPX, ARM and NPS. A value of zero results in the use of a new algorithm, which should be less sensitive to changes in DELT.

VCSFG - Value of 1 means vary interception storage capacity monthly; 0 means use annual value.
VUZFG - Value of 1 means vary upper zone nominal storage monthly; 0 means use annual value.
VNNFG - Value of 1 means vary Manning's n for the overland flow plane monthly; 0 means use annual value.
VIFWFG - Value of 1 means vary interflow inflow parameter monthly; 0 means use annual value.
VIRCFG – Value of 1 means vary interflow recession constant monthly; 0 means use annual value.
VLEFG - Value of 1 means vary lower zone E-T parameter monthly; 0 means use annual value.
IFFCFG - Method for computing INFFAC, the effect of frozen ground on infiltration; 1 means use original method based on amount of ice in the snow pack (as enhanced by the new parameters FZG and FZGL in table-type PWAT-PARM5); 2 means base INFFAC on temperature of the lower soil layer (section PSTEMP must be active).
HWTFG - If HWTFG=1, then high water table conditions (wetland) are prevalent on the land segment, and different algorithms are used for some processes.
IRRGFG - Irrigation module flag; 0 means not used; 1 means demand is input timeseries IRRDEM; 2 means demand is calculated based on crop demands; 3 means demand is specified by schedule in table-type IRRIG-SCHED.

Notice that the flags for RTOP, UZFG, VCS, VLE, and IFFC are “on” (values are “1”).

3. Turn “on” (change the values to “1”) the flags for VUZ and VNN for the agriculture land segment. The PWAT-PARM1 table should look like the following:

OpNu	Description	CSNOFG	TOPFG	UZFG	VCSFG	VUZFG	VNNFG	VIFWFG	VIRCFG	VLEFG	IFFCFG	WTFG	RRGFG
101	Forest Land	0	1	1	1	0	0	0	0	1	1	0	0
102	Urban or Built-up La	0	1	1	1	0	0	0	0	1	1	0	0
103	Agricultural Land	0	1	1	1	1	1	0	0	1	1	0	0
104	Barren Land	0	1	1	1	0	0	0	0	1	1	0	0
105	Wetlands	0	1	1	1	0	0	0	0	1	1	0	0
106	Water	0	1	1	1	0	0	0	0	1	1	0	0

4. Click APPLY.

5. Click OK.

6. **Double click** PWATER → PWAT-PARM2. This table contains the second group of PWATER parameters. Most of these parameters are key calibration parameters (discussed in Exercise 5).

Note: In the steps below, we will open the tables containing key calibration parameters. Before you start to calibrate your model, you should estimate these parameters based on your watershed’s characteristics; you may need to adjust them during the calibration process, but it is best if they represent the conditions in your watershed as accurately as possible (in other words, don’t try to find numbers that merely “work”; try to find values that truly represent your watershed).

FOREST - The fraction of the PLS which is covered by forest which will continue to transpire in winter. Input only if CSNOFG=1.
LZSN - The lower zone nominal storage.
INFILT - An index to the infiltration capacity of the soil.

LSUR - The length of the assumed overland flow plane.
SLSUR - The slope of the assumed overland flow plane.
KVARY - Parameter which affects the behavior of groundwater recession flow, enabling it to be non exponential in its decay with time.
AGWRC - The basic groundwater recession rate. If KVARY is zero and there is no inflow to groundwater (rate of flow today/rate yesterday).

7. Look at the LSUR column. Equations for estimating this parameter are discussed in *EPA BASINS Technical Note 6.* http://www.epa.gov/waterscience/BASINS/tecnote6.pdf

8. Look at the SLSUR column.

Note: You can estimate values for SLSUR using the "DEM 16020102" theme and the Identify tool in BASINS. For each land use category, click around to find the high and low elevations and then divide the difference by the length of the flow path. (SLSUR = (Average elevation of high points – average elevation of low points)/average flow path length) Make sure your units are consistent. You can also use the Summarize Zones tool within BASINS (if you have Spatial Analyst) to estimate the elevation values.

9. Change the values in the PWAT-PARM2 table to the following (some values won't need adjustment):

OpNum	Description	FOREST	LZSN	INFILT	LSUR	SLSUR	KVARY	AGWRC
101	Forest Land	0	3.5	0.25	300	0.0351	0	0.96
102	Urban or Built-up La	0	3.5	0.25	350	0.0321	0	0.96
103	Agricultural Land	0	3.5	0.25	350	0.0324	0	0.96
104	Barren Land	0	3.5	0.25	350	0.03	0	0.96
105	Wetlands	0	3.5	0.25	500	0.01	0	0.96
106	Water	0	3.5	0.25	500	0.01	0	0.96

10. Click APPLY.

11. Click OK.

12. **Double click** PWAT-PARM3. This table contains the third group of PWATER parameters. Many of these parameters are key calibration parameters.

PETMAX -The air temperature below which E-T will arbitrarily be reduced below the value obtained from the input time series. Input only if CSNOFG=1.
PETMIN -The temperature below which E-T will be zero (regardless of the value in the input time series). Input only if CSNOFG=1.
INFEXP - The exponent in the infiltration equation.
INFILD - The ratio between the maximum and mean infiltration capacities over the pervious land segment.
DEEPFR -The fraction of groundwater inflow that will enter deep (inactive) groundwater and, therefore be lost from the system (as it is defined in HSPF).
BASETP - The fraction of remaining potential E-T that can be satisfied from base flow (groundwater

outflow), if enough is available.
AGWETP - The fraction of remaining potential E-T that can be satisfied from active groundwater storage if enough is available.

13. We will not make any changes to this table. Click OK.

14. **Double click** PWAT-PARM4. This table contains the fourth group of PWATER parameters. Many of these are key calibration parameters.

CEPSC - The interception storage capacity.
UZSN - The upper zone nominal storage.
NSUR - Manning's n for the assumed overland flow plane.
INTFW - The interflow inflow parameter
IRC - The interflow recession parameter. Under zero inflow, this is the ratio of interflow outflow rate today/rate yesterday.
LZETP - The lower zone E-T parameter. It is an index to the density of deep-rooted vegetation.

15. Change the values in the PWAT-PARM4 table to the following (some values may not require adjustment):

OpNum	Description	CEPSC	UZSN	NSUR	INTFW	IRC	LZETP
101	Forest Land	0	1.2	0.35	1	0.85	0
102	Urban or Built-up La	0	0.5	0.2	1	0.85	0
103	Agricultural Land	0	0.01	0.01	1	0.85	0
104	Barren Land	0	0.5	0.25	1	0.85	0
105	Wetlands	0	1.2	0.35	1	0.85	0
106	Water	0	1.2	0.35	1	0.85	0

16. Click APPLY.

17. Click OK.

18. **Double click** PWAT-STATE1. This table is used to specify the initial water storages.

CEPS - The initial interception storage.
SURS - The initial surface (overland flow) storage.
UZS - The initial upper zone storage.
IFWS - The initial interflow storage.
LZS - The initial lower zone storage.
AGWS - The initial active groundwater storage. If HTWFG is 1, then a negative value indicates groundwater storage below the base elevation BELV.
GWVS - The index to groundwater slope; it is a measure of antecedent active groundwater inflow.

19. Change the values in the PWAT-STATE1 table to the following (some values may not require adjustment):

OpNum	Description	CEPS	SURS	UZS	IFWS	LZS	AGWS	GWVS
101	Forest Land	0	0	1.5	0	7.5	1	0
102	Urban or Built-up La	0	0	0.6	0	7.5	1	0
103	Agricultural Land	0	0	0.5	0	7.5	1	0
104	Barren Land	0	0	0.6	0	7.5	1	0
105	Wetlands	0	0	1.5	0	7.5	1	0
106	Water	0	0	1.5	0	7.5	1	0

20. Click APPLY.

21. Click OK.

22. **Double click** MON-INTERCEP.

    Note: This table contains monthly values of interception storage capacity at the start of each month. This table is only required if VCSFG is set to 1.

23. Click OK.

24. **Double click** MON-LZETPARM. Monthly values of lower zone E-T parameters at start of each month. This table is only required if VLEFG in Table-type PWAT-PARM1 is set to 1.

25. Change the values in the MON-LZETPARM table to the following:

OpNum	Description	LZEJAN	LZEFEB	LZEMAR	LZEAPR	LZEMAY	LZEJUN	LZEJUL	LZEAUG	LZESEP	LZEOCT	LZENOV	LZEDEC
101	Forest Land	0.3	0.3	0.3	0.4	0.7	0.7	0.7	0.7	0.6	0.5	0.4	0.3
102	Urban or Built-up La	0.2	0.2	0.3	0.3	0.4	0.6	0.6	0.6	0.4	0.3	0.2	0.2
103	Agricultural Land	0.1	0.1	0.1	0.1	0.25	0.55	0.65	0.65	0.55	0.25	0.15	0.1
104	Barren Land	0.1	0.1	0.1	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.15	0.1
105	Wetlands	0.3	0.3	0.3	0.4	0.7	0.8	0.8	0.8	0.6	0.5	0.4	0.3

26. Click APPLY.

27. Click OK.

28. **Double click** MON-UZSN. This table is required only if VUZFG is set to 1 in the PWAT-PARM1 table. Recall that we set VUZFG to 1 for agriculture land.

29. Enter the following monthly UZSN values for the agriculture land segment:

OpNum	**Description**	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
103	Agricultural Land	0.4	0.4	0.4	0.4	0.37	0.5	0.5	0.5	0.33	0.4	0.4	0.4

Note: WinHSPF will disregard the values in this table for all land uses segments other than “Agriculture Land” since we specified monthly values for only agriculture land.

30. Click APPLY.

31. Click OK.

32. **Double click** MON-MANNING. This table contains monthly values for NSUR; it is required only if VNNFG was set to 1 in the PWAT-PARM2 table. Recall that we set VNNFG to 1 for agriculture land.

33. Enter the following monthly NSUR values for the agriculture land segment:

OpNum	Description	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
103	Agricultural Land	0.1	0.1	0.1	0.08	0.08	0.08	0.08	0.09	0.09	0.1	0.1	0.1

34. Click APPLY.

35. Click OK.

36. **Double click** MON-LZETPARM. This table contains monthly values for LZETP; it is required only if VLEFG is 1 in the PWAT-PARM1 table.

37. Change the values in the MON-LZETPARM table to the following:

OpNum	Description	LZEJAN	LZEFEB	LZEMAR	LZEAPR	LZEMAY	LZEJUN	LZEJUL	LZEAUG	LZESEP	LZEOCT	LZENOV	LZEDEC
101	Forest Land	0.3	0.3	0.3	0.4	0.7	0.7	0.7	0.7	0.6	0.5	0.4	0.3
102	Urban or Built-up La	0.2	0.2	0.3	0.3	0.4	0.6	0.6	0.6	0.4	0.3	0.2	0.2
103	Agricultural Land	0.1	0.1	0.1	0.1	0.25	0.7	0.7	0.7	0.55	0.25	0.15	0.1
104	Barren Land	0.1	0.1	0.1	0.1	0.25	0.25	0.25	0.25	0.25	0.25	0.15	0.1
105	Wetlands	0.3	0.3	0.3	0.4	0.7	0.8	0.8	0.8	0.6	0.5	0.4	0.3
106	Water	0.3	0.3	0.3	0.4	0.7	0.8	0.8	0.8	0.6	0.5	0.4	0.3

38. Click APPLY.

39. Click OK.

B. IMPLND

GENERAL

As with the PERLND section, this portion of the model contains general information about the modules that were selected in control cards. Some of the inputs are the defaults; others were entered for the site-specific area.

1. **Double click** IMPLND → GENERAL → ACTIVITY. A window will appear with the following table:

OpNum	Description	ATMPFG	SNOWFG	IWATFG	SLDFG	IWGFG	IQALFG
101	Urban or Built-up La	1	0	1	0	0	0

Note: Notice that there is "1" in each cell for each impervious land segment where a module has been activated in the "Control Cards" window. Users can activate (1) or deactivate (0) modules in this window or the "Control Cards" window. This window allows the user to deactivate a module for an individual pervious land segment (Control Cards will not).

4. Click CANCEL.

5. **Double click** GENERAL → PRINT-INFO.

Note: HSPF permits the user to vary the printout level (maximum frequency) for the various active sections of an operation: "2" means every PIVL intervals, "3" means every day, "4" means every month, "5" means every year, "6" means never. We will leave the default print interval as it is (months).

6. Click OK.

7. **Double click** GENERAL → GEN-INFO. This table shows information about input and output units. We will leave the defaults values.

IUNITS[2] -Indicates the system of units for data in the input time series; 1 means English units, 2 means Metric units.
OUNITS-Indicates the system of units for data in the output time series; 1 means English units, 2 means Metric units.
PUNIT(1) - Indicates the destinations of printout in English units. A value 0 means no printout is required in English units. A non-zero value means printout is required in English units and the value is the Fortran unit no. of the file to which the printout is to be written. Note that printout for each Pervious Land Segment can be obtained in either the English or Metric systems, or both (irrespective of the system used to supply the inputs).
PUNIT(2) - Indicates the destinations of printout in Metric units. A value of 0 means no printout is required in Metric units. A non-zero value means printout is required in Metric units and the value is the Fortran unit no. of the file to which the printout is to be written. Note that printout for each Impervious Land Segment can be obtained in either the English or Metric systems, or both (irrespective of the system used to supply the inputs).

8. Click OK.

9. Click the "-" sign next to GENERAL to contract the list.

ATEMP

The purpose of ATEMP is to calculate the mean air temperature (using the input air

2 All definitions in this computer session were taken from WinHSPF.

temperature time series) for the land segment (HSPF Version 12 Manual). This module section is used for both PERLND and IMPLND.

1. **Double click** ATEMP → ATEMP-DAT.

   Note: This table shows the data required for the temperature section for the impervious land segment we are modeling.

   ELDAT – The difference in elevation between the temperature gage and the ILS; it is used to estimate the temperature over the impervious land segment by application of a lapse rate. It is positive if the land segment is higher than the gage, and vice versa.
   AIRTMP - The air temperature over the impervious land segment at the beginning of the simulation.

2. In the ELDAT column, enter the same values in this window as for "Urban or Built-up Land" in the pervious land block.

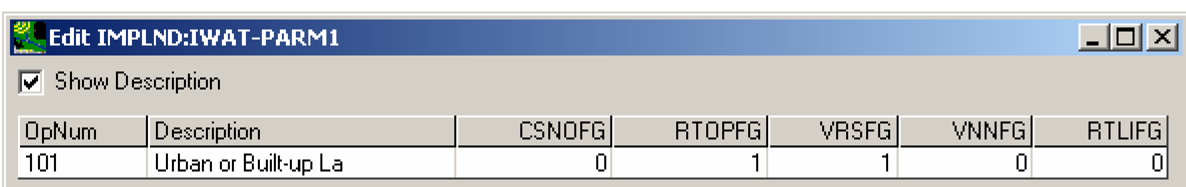
3. Click APPLY.

4. Click OK.

IWATER

This portion of the model contains all the information required for the water budget.

1. **Double click** IWATER → IWAT-PARM1. This table contains the first group of IWATER parameters that consists of flags that allow the user to vary how the water budget is calculated. The following window will appear:



OpNum	Description	CSNOFG	RTOPFG	VRSFG	VNNFG	RTLIFG
101	Urban or Built-up La	0	1	1	0	0

CSNOFG - If CSNOFG is 1, section IWATER assumes that snow accumulation and melt is being considered. It will, therefore, expect that the time series produced by section SNOW are available, either internally (produced in this RUN) or from external sources (produced in a previous RUN). If CSNOFG is 0, no such time series are expected. See the functional description for further information.
RTOPFG - If RTOPFG is 1, routing of overland flow is done in exactly the same way as in HSPX, ARM and NPS. A value of 0 results in a new algorithm being used. A value of 2 results in the use of a surface recession constant (and HWTFG must be 1).
VRSFG – If VRSFG is 1 means vary retention storage capacity monthly; 0 means use annual value.
VNNFG - If VNNFG is 1 means vary Manning's n for the overland flow plane monthly; 0 means use annual value.
RTLIFG – If RTLIFG is 1, any lateral surface inflow to the ILS will be subject to retention storage; if it is 0, it will not. Click OK. We will leave the other flags as default values.

2. Click CANCEL.

3. **Double click** IWAT-PARM2. This table contains the second group of IWATER parameters. Most of these parameters are key calibration parameters that will be discussed in Exercise 5.

   LSUR - The length of the assumed overland flow plane.
   SLSUR - The slope of the assumed overland flow plane.
   NSUR - The Manning's n for the overland flow plane.
   RETSC - The retention (interception) storage capacity of the surface.

4. Enter the following values into the IWAT-PARM2 table (some values won't require adjustment):

OpNum	Description	LSUR	SLSUR	NSUR	RETSC
101	Urban or Built-up La	150	0.0132	0.05	0

5. Click OK.

6. **Double click** IWAT-PARM3.

   Note: This table contains the third group of PWATER parameters. These parameters are key calibration parameters.

   PETMAX -The air temperature below which E-T will arbitrarily be reduced below the value obtained from the input time series. Input only if CSNOFG=1.
   PETMIN -The temperature below which E-T will be zero regardless of the value in the input time series. Input only if CSNOFG=1.

7. Click OK.

8. **Double click** MON-RETN. This table contains monthly values of retention storage capacity at beginning of each month. This table is required only if VRSFG in Table-type IWAT-PARM1 is 1.

9. Enter the following monthly values for retention storage:

OpNum	Jan	Feb	March	April	May	June	July	Aug	Sept	Oct	Nov	Dec
101	0.037	0.037	0.049	0.049	0.049	0.065	0.065	0.065	0.049	0.049	0.049	0.037

10. Click APPLY.

11. Click OK.

12. **Double click** IWAT-STATE1.

RETS - The initial retention storage.
SURS - The initial surface (overland flow) storage.

Note: Because we specified monthly values for RETS (VRSFG is "1" in the PWAT-PARM1 table), WinHSPF will disregard the values for RETS in this table.

Note: We will leave the value of SURS as "0" since the initial overland flow storage on the impervious land segment is negligible.

13. Click OK.

C. RCHRES

1. **Double click** HYDR → HYDR-PARM1.

VCONFG - A value of 1 for VCONFG means that F(VOL) outflow demand components are multiplied by a factor which is allowed to vary.
AUX1FG - A value of 1 for AUX1FG means subroutine AUXIL will be called to compute depth, stage, surface area, average depth, top width, and values for these parameters will be reported in the printout. A value of 0 suppresses the calculation and printout of this information.
AUX2FG - A value of 1 for AUX2FG means average velocity and average cross sectional area will be calculated, and values for these parameters will be reported n the printout. A value of 0 suppresses the calculation and printout of this information. If AUX2FG is 1, AUX1FG must also be 1.
AUX3FG - A value of 1 for AUX3FG means the shear velocity and bed shear stress will be calculated. These are used in the calculation of deposition and scour of sediment (inorganic and organic). AUX3FG may only be turned ON (=1) if AUX1FG and AUX2FG are also =1.
ODFVF1 - 5 - The value specified for ODFVF1 determines the F(VOL) component of the outflow demand. A value of 0 means that the outflow demand does not have a volume dependent component. A value greater than 0 indicates the column number in RCHTAB which contains the F(VOL) component. If the value specified for ODFVF1 is less than 0, the absolute value indicates the element of array COLIND( ) which defines a pair of columns in RCHTAB which are used to evaluate the F(VOL) component. Further explanation of this latter option is provided in the functional description of the HYDR section in Part E. A value of ODFVF1 can be specified for each exit from a RCHRES.
ODGTF1 - 5 - The value specified for ODGTF1 determines the G(T) component of the outflow demand. A value of 0 means that the outflow demand does not have such a component. A value greater than 0 indicates the element number of the array OUTDGT( ) which contains the G(T) component. A value of ODGTF1 can be specified for each exit from a RCHRES.
FUNCT1-5 - FUNCT1 determines the function used to combine the components of an outflow demand; 1 means use the smaller of F(VOL) and G(T), 2 means use the larger of F(VOL) and G(T), and 3 means use the sum of F(VOL) and G(T).

2. Change the values in the column AUX1FG to "1."

3. Change the values in the column AUX2FG to "1."

4. Change the values in the column AUX3FG to "1."

Note: These auxiliary flags are required if any water quality constituent is modeled in the future.

5. Click APPLY.

6. Notice that the values in the "ODFVF1" column to "4."

Note: ODFVF1-5 refers to outflow that are read in as a function of volume. The number "4" refers to the location of the outflow information. ODFVF2-5 are "0" because we only have one exit.

Note: ODGTF1–5 correspond to outflows that are read in as a time series.

7.

8. Click OK.

9. **Double click** HYDR-PARM2. The following list gives explanations of the parameters:

FTBW-WDM - Table dataset number for the F-Table that contains the geometric and hydraulic properties of the RCHRES.
FTBU - The user's number for the F-Table that contains the geometric and hydraulic properties of the RCHRES. I FTBW is zero, the F-Table is found in the FTABLES Block. If FTBW is positive, FTBU is the number of the tables within that dataset.
LEN - The length of the RCHRES.
DELTH is the drop in water elevation from the upstream to the downstream extremities of the RCHRES. (It is used if section OXRX is active and reaeration is being computed using the Tsivoglou-Wallace equation; or if section SEDTRN is active and sand load transport capacity is being computed using either the Toffaleti or Colby method.)
STCOR is the correction to the RCHRES depth to calculate stage. (Depth + STCOR = Stage)
KS is the weighting factor for hydraulic routing. Choice of a realistic KS value is discussed in the functional description of the HYDR section in Part E.
DB50 is the median diameter of the bed sediment (assumed constant throughout the run). This value is used to calculate the bed shear stress if the RCHRES is a lake, or calculate the rate of sand transport if the Colby or Toffaleti methods are used.

10. Change the values in the DELTH and STCOR columns to the following:

OpNum	DELTH	STCOR
1	56	0
2	80	0
3	35	0
4	20	0
5	4	0
6	90	0

11. Click APPLY.

Note: We will not change FTBW because we are using the F-tables entered in the Reach Properties Editor.

Note: Care should be exercised in selecting a value because as KS increases from 0.0 to 1.0, there is an increasing risk that the computation of outflow rates will become unstable. Theoretically, a value of 0.5 gives the most accurate results if oscillations do not occur. The default value of 0.0 has zero risk, but produces less accurate results. Be very careful if a nonzero value is used; generally, you should not select a value greater than 0.5

Note: DB50 should be adjusted if you are modeling sediment transport.

12. Click OK.

13. **Double click** HYDR-INPUT. The following list gives explanations of the parameters in this table:

VOL is the initial volume of water in the RCHRES.
ICAT is the initial category of water in the RCHRES.
COLIN1-5 - The value of COLIN1-5 for an exit indicates the pair of columns used to evaluate the initial value of the F(VOL) component of outflow demand for the exit.
OUTDG1-5 - The array OUTDG1-5 specifies the G(T) component of the initial outflow demand for each exit from the RCHRES.

14. Change the values in the HYDR-INPUT table to the following:

OpNum	Description	VOL	ICAT	COLIN1	COLIN2	COLIN3	COLIN4	COLIN5	OUTDG1	OUTDG2	OUTDG3	OUTDG4	OUTDG5
1	Western Branch Patux	10		4	4	4	4	4	0	0	0	0	0
2	Southwest Branch Wes	15		4	4	4	4	4	0	0	0	0	0
3	South Collington Bra	15		4	4	4	4	4	0	0	0	0	0
4	South Reach, Western	30		4	4	4	4	4	0	0	0	0	0
5	Western Branch Patux	5		4	4	4	4	4	0	0	0	0	0
6	North Collington Bra	15		4	4	4	4	4	0	0	0	0	0

15. Click APPLY.

16. Click OK.

You are ready to start calibrating (Exercise 5). There are many other types of local information that can be added to the model if available. Keep in mind that the parameters covered in this appendix are the minimal site-specific inputs.