# Watershed Analysis Lab – U.S.G.S. Regression Equations for Peak Discharge

This lab will familiarize the user with the use of GISHydro2000 to extract topographic, land use, and soils data for the performance of a basic hydrologic analysis. The lab assumes the user has general familiarity with the use of the ArcView interface. This lab also serves as a launching point for a more involved analysis using the TR-20 hydrologic model as much of the information needed to run this model is prepared in the process of determining the USGS equations.

### <u>Task</u>

Determine the range of peak discharges for the 2- 500-year flood events at USGS gage 01650500 (Northwest Branch at Colesville, MD). Also determine the hydrograph corresponding to the 2-year event. Use the USGS peak discharge equations from Dillow's (1996) report and the hydrograph method from Dillow's (1997) report. Along the way, you should determine the basin statistics such as drainage area, average curve number, % forest cover, etc.

#### Step One – Locate Watershed Outlet and Select Quads

Starting from the opening "Maryland View" within GISHydro2000, load the "usgsgages.shp" theme to this view and build a query to locate the gage: 01650500. Load in the "nhd\_streams.shp" theme and zoom to the area draining to the selected USGS streamgage. You can use the label tool with the "Quads Available" theme active to determine the needed quadrangles as shown below:



Now click the "Q" button to begin the data extraction step. This will produce the following file dialogue:

340 Quads Available	4 Quads Selected	Pick Tool
abbottstown aberdeen accident airville alexandria amaranth anacostia annapolis	kensington beltsville clarksville sandy_spring	Select DEM Data 30m DEMs Select Landuse Data 1997 MOP Landuse Select Soils Data SSURGO Soils
SSURGO soils data NOT M Processing Parameters Perform Processing. V Bu Enter Threshold Area (pixels)	rn Streams.	elected quad. Hydrologic Condition © Good) © Fair

You can use either the "Pick Tool" or scroll through the list of quads at left to select the necessary quads to cover this watershed. Select the DEM's, land use and soils necessary. Note that we have chosen SSURGO soils acceptably since all of Montgomery county is covered by this highest quality soil description. Press the "Apply" button and data extraction/processing will commence. In a few minutes (times vary depending on area covered and processor speed) you will be presented with the "Area of Interest" view.

### **Step Two - Delineate the Watershed**

You can either cut and past the "usgsgages.shp" theme from the "Maryland View" to the "Area of Interest" or simply load the theme anew into this view. You will need to do so in order to correctly located the desired watershed outlet. Now zoom in tight to the watershed outlet. The view might look something like that shown below:



Select the "W" tool and click on the blue stream pixel closest to the indicated gage location. This will initiate a watershed delineation resulting in the creation of a new theme in the "Area of Interest" view called "A Watershed" unless you have modified the name of this theme in the "Hydro: Properties" list.

#### **Step Three – Determine Basin Composition**

Select menu choice: "Hydro: Basin Composition". After a few moments of calculation two tables will appear called: "Distribution of Land Use and Curve Numbers Use" and "Distribution of Land Use by Soil Group". The contents of these tables can also optionally be sent to an output file for later reporting. These tables summarize the curve number used and detail the land uses and their spread across the four hydrologic soil groups.

#### **Step Four – Determine Basin Statistics**

Before the USGS Regression equations can be calculated, it is necessary to determine the values of the predictor variables to these equations such as drainage area and percent forest cover. This is done by selecting the "Hydro: Basin Statistics" menu choice. After a few moments of calculation, you should be greated with the following dialogue box which can, again, be sent to an output file if desired:

Uutlet Location:	Piedmont	
Drainage Area	21.2 square miles	
Channel Slope:	22 feet/mile	
Impervious Area:	20% ********	
IMPERVIOUS Calculated dis USGS Urban	AREA IN WATERSHED EXCEEDS 15%. charges should be modified using Equations.	
Time of Concentr	ation: 4.9 hours	
Rasin Relief	419 feet	
Dasin'n felier.		
Average CN:	72	
Average CN: % Forest Cover:	72 27	
Average CN: % Forest Cover: % Storage:	72 27 0	

#### **Step Five – Determine Peak Discharges**

Peak discharges are next calculated using the "Hydro: Peak Discharges" menu choice. In

this case, because we are working in the vicinity of an existing	💐 Watershed contains USGS Gage(s).	×
USGS gage, GISHydro2000 will prompt you with the dialogue	Please select gage for Tasker analysis adjustment.	ОК
shown to the right:	1650500	Cancel

You may choose either neither or the displayed gage. Choosing the displayed gage will force an adjustment of the USGS peak discharges according to the statistical model developed by Gary Tasker of the USGS. You will then see the following dialogue box

which may optionally be sent to a file for later reporting.

This dialogue presents not only the predicted 2through 500-year flows, but also the 50, 67, 90, and 95 percent confidence intervals on these flows. These confidence intervals are determined using the program developed by Tasker. Note that if adjustments are made for proximity to any USGS gage, then the predicted discharges will differ somewhat from what would be calculated based on the USGS peak discharge regression equations alone.

Q	U.S	.G.S. P	eak Flo	w Estin	nates					×
	àeogra -Piec	aphic Pro Imont (10	ovince(s): 00.0% of	area)						-
	Q(2): Q(5): Q(10): Q(25): Q(50): Q(100)	1260 2280 3290 5050 6810 : 9050	) cfs ) cfs ) cfs ) cfs ) cfs ) cfs ) cfs							
	Area V Return Perioc 2 5 10 25 50 100 500	/eighted h 50 PE l lower 1200 2120 3020 4550 6060 7950 14500	Predictic RCENT upper 1330 2450 3590 5600 7650 10300 19900	on Interva 67 PE lower 1170 2050 2900 4340 5740 7480 13500	als (from RCENT upper 1370 2540 3730 5880 8080 10900 21500	[asker] 90 PE lower 1110 1910 2670 3920 5120 6600 11600	RCENT upper 1440 2720 4060 6510 9050 12400 25000	95 PE lower 1080 1850 2550 3720 4820 6180 10600	RCENT upper 1480 2820 4240 6870 9610 13300 27200	T
				[	OK					

#### <u>Step Six – Determine 2-year Hydrograph</u>

The final step is to calculate the hydrograph associated with the 2-year peak discharge determined above (1260 cfs, in this case). Select the "Hydro: Calculate Hydrograph" menu choice. You will see the dialogue box shown to the right which lists the hydrograph peaks determined in the previous step. These peaks, along with other basin properties are then used to determine the ordinates and time increments of the associated hydrograph using the methodology developed by Dillow (1997). The

elect a Return Period (Peak Discharge)	OK
2 - year peak (1260 cfs)	Cancel
5 - year peak (2280 cfs)	
10 - year peak (3290 cfs)	
25 - year peak (5050 cfs)	
50 - year peak (6810 cfs)	
100 - year peak (9050 cfs)	
500 - year peak (17000 cfs)	

result is the dialogue shown on the next page which may also be written to an output file for reporting purposes.

🍭 Calibra	ted Hydrograph		×
Calibra Simulated Time (hrs) 0.26 0.51 0.77 1.02 1.28 1.53 1.79 2.05 2.30 2.56 2.81 3.07 3.32 3.58 3.84 4.09 4.35 4.60 4.86 5.11 5.37 5.63 5.88 6.14 6.39 6.65 6.90	ted Hydrograph Peak-Flow Hydrograph for: Discharge (cfs) 0 0 0 76 101 139 176 239 315 403 504 605 706 806 907 995 1071 1134 1184 1222 1247 1260 1235 1210 1159 1084	2 - year peak (1260 cfs)	
7.16 7.42 7.67	1084 1008 932 857 700 0K		•

## **Results**

In the spaces provided, enter the peak discharges and associated confidence intervals calculated for the Northwest Branch Watershed.

Return Period	Peak Q (cfs)	95% Lower CI	95% Upper CI
5-yr			
100-yr			