

# BASINS EXERCISE

## **Overview**

This exercise was created for the Fox-Wolf Watershed Alliance - Stormwater 2003 Conference. Funding was provided by the University of Wisconsin – Sea Grant Institute and UW – Land Information Computer Graphics Facility. The authors are Brea Lemke and David Hart.

This exercise was designed as an introductory exercise to EPA’s BASINS 3.0 program. The assumptions are that this exercise will be presented to land use or water resource professionals or municipal officials that have little or no experience in stormwater modeling and its connectivity to Geographic Information Systems (GIS).

The software needs for this exercise are ESRI’s ArcView 3.x and EPA’s BASINS 3.0. Internet connection is also needed to download the data used in this exercise.

## **Obtain Data for a Subbasin**

- 1) First, determine what watershed(s) are to be analyzed. In this example we will analyze the Upper Rock Watershed in Dane County.

Hydrologic units, including watersheds are denoted by EPA by a hydrologic unit code (HUC). Each HUC consists of two to eight digits based on the four levels of classification in the hydrologic unit system. To determine the HUC for the Upper Rock watershed, go to BASINS web site at: <http://www.epa.gov/OST/BASINS/gisdata.html>

- 2) Select the “Locate your Watershed” webpage  
(located at: <http://cfpub.epa.gov/surf/locate/index.cfm>)
- 3) Surf the Watersheds by using the “Clickable State Maps” to locate the watershed.

Click on the State of Wisconsin then click on the city of Madison. This will bring you to the Upper Rock watershed. Notice the HUC number is 07090001.  
(located at: [http://cfpub.epa.gov/surf/huc.cfm?huc\\_code=07090001](http://cfpub.epa.gov/surf/huc.cfm?huc_code=07090001))

- 4) The core GIS data for this watershed is bundled and is located under the BASINS parent download directory: <http://www.epa.gov/waterscience/ftp/basins>
- 5) Select “GIS Data” then select “HUC.”  
(located at: [http://www.epa.gov/waterscience/ftp/basins/gis\\_data/huc/](http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/))
- 6) Click on the link for the Upper Rock watershed or “07090001”  
(located at: [http://www.epa.gov/waterscience/ftp/basins/gis\\_data/huc/07090001/](http://www.epa.gov/waterscience/ftp/basins/gis_data/huc/07090001/))
- 7) Notice the data available for this Hydrologic Unit is:  
    DEMG.exe, core.exe, dem.exe, and pcs3.exe.  
    Download each of these files and save to your hard drive.

## **Extract GIS Data**

- 1) Extract GIS data using Start → Programs → BASINS → BASINS 3.0 Web Extraction Tool
- 2) Click on the button to “Select Archives and Extract”
- 3) Navigate to the location where you stored EPA’s downloaded data. Select one of four files (i.e. 07090001\_core.exe).

A self-extracting program will run to decompress the file.

- 4) Another screen will appear asking if the data should be projected. Make a decision if you want to project the data. This is useful if you want to add local data. For this example we will project the data to a custom projection for Dane County Coordinates. Choose “Custom Projection” then enter the following information into the projection information area.

Projection: Custom Lambert Conformal Conic  
Spheroid: GRS 80  
Central Meridian: -89.42222222  
Reference Latitude: 41.75  
Standard Parallel 1: 43.23055556  
Standard Parallel 2: 42.90833333  
False Easting: 811000  
False Northing: 0

- 5) A screen will appear stating that “All new files are reprojected.” Click “Ok.”
- 6) Repeat this procedure for each of the other three files.
- 7) Notice that each time a note will appear either by a message that states “All new files are reprojected.” or, at the bottom of the main program screen, a message is displayed that states if the file “was extracted successfully.”

## **Create GIS Project**

- 1) Open BASINS Project Builder, located under Start → Programs → BASINS
- 2) Select the “Dataset to be used”. In this example, select the HUC for the Upper Rock Watershed: “07090001”.
- 3) Designate the “ArcView Project File Name” as “Upper\_Rock\_Analysis”.
- 4) Select “Create”.
- 5) A window will appear stating that the “BASINS project was created successfully.” Choose “No” to opt not to “open the project now.”

## **Build & Analyze GIS Project**

- 1) Build GIS data using Start → Programs → BASINS → BASINS
- 2) A window will appear prompting the user to open a project. Navigate to the directory where the data was stored and where the file “Upper\_Rock\_Analysis” was saved.
- 3) ArcView / BASINS 3.0 will open with the data focused on the Upper Rock Watershed. Examine the data and GIS themes that are in the project.
- 4) In most cases it is appropriate to add local data to assist with the analysis of local watersheds.
- 5) Save the project.

## **BASINS Target, Assess, and Data Mining Tools**

This extension includes Target, Assess, and Data Mining tools to identify watersheds and point source discharges that are potential concerns.

**TARGET** is a watershed targeting tool that allows environmental managers to make a broad-based evaluation of a watershed’s water quality and/or point source loadings. It operates on a large area such as a region or a state.

**ASSESS** operates on a single watershed (cataloging unit) or a limited set of watersheds and focuses on the status of specific water quality stations or discharge facilities and their proximity to water bodies.

**DATA MINING** is a tool that facilitates the building of dynamic links between the map interface and related data tables, allowing the user to visualize and retrieve BASINS water quality data, point source loading data, and bacteria monitoring station data.

### **TARGET Module:**

In this example we will use the Target Water Quality command to create a view showing the 85th percentile statistical summary of mercury data collected between 1995 and 1997 for each watershed in the study area.

1) To load this extension, Select File → BASINS Extensions. The BASINS Extension Manager window will appear. Under the “Select an Extension Category” choose “Assess”. Place a checkmark in (by selecting) the box representing the “Target, Assess, and Data Mining” Extension.

After closing the Extensions window, notice ArcView has an additional command line “Assess” in-line with the “File” and “Edit” commands.

2) Set map units to feet and distance units to miles. This can be done under the “View” command, then select “Properties”.

3) To perform an analysis for Water Quality, navigate to “Assess” and select “Target Water Quality”.

*Analysis of Target Permitted Discharges can be performed through steps similar to the following instructions.*

*Tip: The Target Command analyzes the entire extracted study area. Selection of the analysis area is not needed.*

4) A series of windows will appear to inquire the specifics of the analysis. In the first window, you are asked to select a monitoring period for this Target analysis. Choose “From 1995 to 1997”.

5) The following next screen asks for a monitoring parameter to evaluate. Select “Mercury, Total”.

6) Next select the monitoring data statistic as “85<sup>th</sup> %”.

7) The following window asks for a specific “threshold value for comparing to monitoring data”. The threshold value can be input as a regulatory water quality standard, a discharge standard, or a project-specific value. The current or default value is zero. The threshold value will be used to summarize the number of times the value is exceeded based on the monitoring data statistical summaries. Click “OK” to keep the value at “0”.

*Tip: Water quality criteria for selected parameters are available in BASINS under the Water Quality Criteria Lookup Table, which can be activated under the Lookup menu. See the BASINS Help for more information.*

8) The Target analysis ends by generating three screens that summarize the results. First, a map will display the average monitoring value computed for each watershed (hydrologic cataloging unit) based on the user-specified parameter, statistical summary, and threshold value.

Second, a bar chart depicts the distribution of cataloging units with respect to the number of stations exceeding the selected threshold value.

Third, another bar chart summarizes the distribution of cataloging units with respect to the average monitoring values.

*Tip: Target Analysis is very effective in comparing the results of two or more watersheds.*

## **ASSESS Exercise:**

This example will walk through the use of the Assess Water Quality tool to create a view depicting the 85<sup>th</sup> percentile statistical summary of chloride data collected between 1995 and 1997 for the watershed in our study. We will also examine the use of the Assess Permitted Discharges command to identify the chloride dischargers for 1998.



- 1) From the Cataloging Unit Boundaries theme, select a watershed for analysis using the Select Features button.
- 2) Under the Assess pull-down menu, select “Assess Water Quality”.
- 3) In the next screen, choose the monitoring period to be “From 1995 to 1997”.
- 4) In the screen asking for a “monitoring parameter to evaluate” select “Chloride, Total in Water”.
- 5) Choose “85<sup>th</sup> %” for the “monitoring data statistic”.

Two output windows will appear and summarize the results of this analysis:

- Water quality stations ranked according to the average monitoring value for the selected time period, selected water quality parameter, and corresponding statistical summary data will appear on a map.
- A bar chart will display the distribution of the stations based on the monitoring value.

*Tip: Use overlays of other BASINS data layers (e.g., land use, Permit Compliance System) to establish a preliminary relationship between in-stream water quality conditions and other upstream sources.*

- 6) Examine the map and use the Identify tool to examine the data for specific stations.
- 7) Return to the “BASINS View”.
- 8) From the Assess pull-down menu, select “Assess Permitted Discharges”.
- 9) In the series of windows that follows, select the “discharge year” as “1998”. Choose the “discharge parameter to evaluate” as “Chloride”.
- 10) Examine the map and table which summarize the results of this analysis.

## **DATA MINING Exercise:**

This exercise will demonstrate how to do a simple analysis of water quality stations at a site-specific level.

1) Highlight the “Water Quality Station” theme. This can be done by clicking on the theme name.

Note: A similar analysis can be done for the Bacteria Station, or Permit Compliance System themes.

2) Zoom into a specific project site area, where analysis is desired. Zoom-in far enough so that individual water quality stations can be identified.



3) Select the Data Mining Feature tool button. Use this function to create a box around the water quality stations, thus selected the stations to be analyzed.

Note: The *Data Mining Tool* can operate on an unlimited number of monitoring stations, it is best to limit the selected stations to a reasonable number to maximize the functionality of the tool.

The Data Mining Tool will determine the number of water quality stations that you have selected. Click “Yes” to confirm and continue the operation.

Data Mining will build relational data tables that correspond to the selected stations. The following tables and maps will be linked:

- Water Quality Station Table
- Water Quality Parameter Table
- Water Quality Data Tables (one table for each statistical summary table).
- Water Quality Data Mining View

*Data Mining analysis of bacteria stations will generate a similar set of tables with bacteria data. PCS Data Mining analysis will generate up to six permitted discharges data tables for the years 1991 through 1996 that include annual loading rates.*

*Tip: Only the data tables that contain data for the selected station(s) or facilities will be displayed. For example, if water quality data are available for only 1975 to 1989 for the selected station(s), only three water quality data tables will be displayed in the Data Mining results (1975-1979, 1980-1984, and 1985-1989).*

4) Close all the windows except the project APR view to exit *Data Mining*.

*Tip: Data tables and maps generated by Data Mining will be overwritten every time this function is run; therefore, the results will not be permanently saved when the project is saved.*

## **BASINS Lookup Extension**

The Lookup Module includes interpretive information for water quality criteria, SIC (Standard Industrial Classification) codes, STORET agency codes, and projection parameters. The lookup table of water quality criteria provides key threshold values that are useful in using the TARGET tool. The lookup table for the map projection is a helpful reference to determine the map projection parameters. The agency codes lookup table assists in the identification of the source of BASINS monitoring data. The SIC codes lookup table is a useful reference to identify the classification of a point source discharger.

For this example we will simply look at the projection parameters lookup table.

- 1) To load this extension, select “File”, then “BASINS Extensions”. The BASINS Extension Manager window will appear. Under the “Select an Extension Category” choose “Reports”. Place a checkmark in (by selecting) the box representing the “Lookup” Extension.
- 2) Notice that a new command “Reports” will be added in the main command line. Click on “Reports” then select “Projection Parameters”.
- 3) A window will appear identifying the parameters of the data projection. Click “OK” when finished viewing.

## **BASINS Report Extension Without Spatial Analyst**

BASINS Watershed Report Extension (option that does not Require Spatial Analyst) includes the following reports: Point Source, Water Quality, TRI Air Emission Land Use Distribution, State Soil Characteristic, and Watershed Topographic Reports.

*Note: One version of the Watershed Report Extension requires Spatial Analyst. This extension includes land use distribution and topographic reports for watersheds. Spatial Analyst is required to run these reports.*

In this example we will examine the Point Source Inventory Report. This report provides a summary of discharge facilities in a given watershed. The report relies on the EPA Permit Compliance System (PCS) database to identify permitted facilities in the selected study area and summarizes their discharge loading for a given pollutant. A discharge loading summary is provided for a given year.

- 1) Load the extension by selecting “File”, then “BASINS Extensions”. The BASINS Extension Manager window will appear. Under the “Select an Extension Category” choose “Reports”. Place a checkmark in (by selecting) the box representing the “Reports without Spatial Analyst” Extension.
- 2) In the “BASINS View” window, select the watershed for which the Point Source Inventory Report is being created. Be certain the “Cataloging Unit Boundaries” is active (highlighted) then use the Select Features tool.

- 3) Under the Report pull-down menu, select “Point Sources” command.
- 4) A “Report Generator” window will appear. Under the “Discharge Year” prompt, choose “1999”. Under the “Monitoring Parameters” select “Copper”. Set the “Map (Title)” as “Copper Point Sources”. Click “Ok”.
- 5) In the next window, you will be asked to create a name for the selected study area directory. Change the default name to “Upper\_Rock\_Boundary”.

Note: The report files are saved in the default directory: \Basins\WcReport\Catalogi\Reports\.

- 6) The Point Source Inventory Report will generate two tables and a map layout.

The first table, “Point Source Inventory - Summary by subwatershed" provides a list of all discharge facilities within the watershed and corresponding information such as location (city, subwatershed, and reach number), status (major vs. minor facility), and Standard Industrial Classification (SIC) number.

The second table, “Point Source Load - Summary by subwatershed," provides the list of discharge facilities that actually discharged the selected pollutant for the selected year.

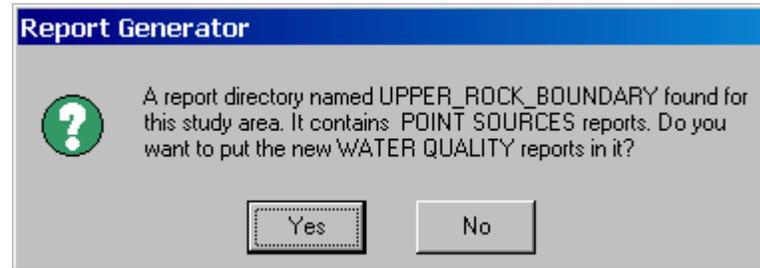
The map layout details the locations of all discharge facilities within the watershed. Unique map symbols are given to distinguish the facilities that discharged the selected pollutant for the given year, from those facilities that did not. The Reach File network is also depicted on the map for reference purposes. Also included is a map inset to identify the general location of the selected watershed.

Select the “Map Layout” window. From the “File” menu, choose “Print”. Adjust the “Page Setup” and the “Print Setup” for your specific printer.

*Tip: The subwatershed ID listed in the reports corresponds to the unique ID number automatically assigned to the subwatershed by the delineation tool or watershed boundary import utility. The subwatershed ID corresponds to a cataloging unit number (eg. 05010007) if the report generator was run using the cataloging unit theme or an RF1 or RF3 segment ID for user delineated or imported watershed boundary themes (eg. RF1 = 05010007020 or RF3 = 5010007\_035\_4.93).*

- 7) Close the text and map layout windows.
- 8) Open the “BASINS View” window. Again, select the Upper Rock Watershed from the “Cataloging Unit Boundaries” theme.
- 9) Under the “Reports” pull-down menu, select “Water Quality”.
- 10) The “Report Generator” screen will appear. Select the years “1970-1974”. Under the “Monitoring Parameters” select by highlighting “ Nitrate Nitrogen, Total”. “Create the Map Title” as “Nitrate Nitrogen, 1970-1974”. Click “OK”

11) Another “Report Generator” screen will be displayed. Click “Yes”.



12) Examine the Water Quality Station Inventory table, the Water Quality Summary by Station table, and the Map Layout.

## Other BASINS Features:

### **BASINS PLOAD Extension**

PLOAD - A Tool for Estimating Non-Point-Source and Point-Source Pollutant Runoff.

PLOAD estimates nonpoint loads (NPS) of pollution on an annual average basis, for any user-specified pollutant. The user may calculate the NPS loads using either the export coefficient or the EPA's Simple Method approach. Optionally, best management practices (BMPs), which serve to reduce NPS loads, and point source loads may also be included in computing total watershed loads. Finally, there are several product alternatives that may be specified to show the NPS pollution results as maps and tabular lists, and to compare multiple sessions.

The PLOAD application requires pre-processed GIS and tabular input data as listed below:

- GIS landuse data
- GIS watershed data
- GIS BMP site and area data (optional)
- Pollutant loading rate data tables
- Impervious terrain factor data tables
- Pollutant reduction BMP data tables (optional)
- Point source facility locations and loads (optional)

PLOAD was designed to be generic so that it can be applied as a screening tool in a wide range of applications including NPDES stormwater permitting, watershed management, or reservoir protection projects. Its organization and structure of the application facilitates modification and customization. It was designed to be an analytical tool for end users.

*(BASINS 3.0 documentation)*

...To do this analysis for presentation... I will have to spend more time understanding pollutant loading rate data tables... etc. ... If we need more time for the BASINS exercise, I can further this section.

## **BASINS Manual Watershed Delineation Extension**

This extension provides a set of tools for manually delineating and editing watershed subbasins, stream networks and outlets. These themes can be used as input to models.

## **BASINS Automatic Delineation Extension**

This extension provides a set of tools for automatic (based on DEM) delineating and editing watershed subbasins, stream networks and outlets. These themes can be used as input to models. This extension requires Spatial Analyst Extension ver.1.1 or later.

## **BASINS LandUse, Soils Class, and Overlay Extension**

This extension provides a set of tools for reclassifying and overlaying land use and soil themes. The overlay is applied over boundary theme (subbasin theme) The overlay result allow to determine soil and land use combination for each subbasin This extension requires Spatial Analyst Extension ver.1.1 or later.

## **BASINS LandUse Reclassify Extension**

This extension provides a tool to reclassify land use shape themes based on user selections.

## **BASINS Grid Projector Extension**

This extension provides a set of tools for reprojecting and datum converting grid data. This extension requires Spatial Analyst Extension ver.1.1 or later.

