ES341 Fundamentals of GIS **GIS Data Management for Watersheds in Western Oregon**
Winter 2013 **Class Project / Due: Wednesday of Finals Week**

The term "watershed" describes an area of land that drains downslope to the lowest point. The water moves by means of a network of drainage pathways (Fig. 1, see attached sheets). Making management decisions about a watershed is an important responsibility; decisions must be based on a solid understanding of the characteristics of the watershed and how physical processes shape watershed conditions. Geographic Information Systems is a tool that is widely used in watershed management across the U.S., and particularly in the Pacific Northwest.

The objective of this project is to compile a complete set of GIS vector map themes, digital elevation models, and DRG's for a select watershed in western Oregon. In addition you will calculate some basic watershed parameters from your GIS compilation and create a report providing an overview of the physical and biological characteristics of your watershed, including a two-page summary and set of published maps. The learning outcome is application of GIS skills to a real world problem, and synthesizing concepts and experience gained in the course.

Student Teams	**Assigned Coast Range Watersheds (Winter 2013 = 22 active students, Feb. 25)**
Missy/Marci (The Martians)	1. Gales Creek Watershed (Tualatin Basin, Washington County)
Greg/Symone (Empty Crack'n)	2. Beaver Creek-Waldport Bay-Vingie Creek (Alsea Basin, Lincoln Co.)
OPEN (Sorry Ass Losers)	3. Lower Coquille Watershed (Coquille Basin, Coos County)
Doug/Kevin (L2WS)	4. Lower Coast Fork Willamette River (Willamette Basin, Lane County)
Marshal/Chris (Disco Ninjas)	5. Sixes River Basin (Sixes River, Curry County)
Steph/Karla (Spatial Shenanigans)	6. Lower Siletz Watershed (Siletz-Yaquina Basins, Lincoln County)
Laura/Brian (The Mappers)	7. Mill Creek/Umpqua River Watershed (Umpqua Basin, Douglas County)
Kara/Andrew (Spicy Vajitas)	8. Kilchis River Watershed (Wilson-Trusk-Nestucca Basin, Tillamook Co)
Vicki/Beeb (Fighting Mongoose)	9. West Fork Millicoma River (Coos Basin, Coos County)
Chris/Spencer (Flying Squirrels)	10. Necanicum River (Necanicum Basin, Clatsop County)
Dave/Kathryn (Overburden)	11. Yamhill River (Yamhill Basin, Yamhill County)
Zander/Willie (Eh?)	12. Lower Siuslaw Watershed (Siuslaw Basin, Lane County)

Instructions: All final project materials will be submitted as a separate portfolio binders. Make sure you organize your final projects by Task No., and clearly label the sections in order of appearance below.

Task 1. Using the Coast Range Watersheds theme from the class website (under the final project section), find all of the sub-basins that are contained within your assigned watershed.

Task 2. Identify the County(ies) in which your watershed (and related subbasins) is (are) contained.

Task 3. Identify all of the USGS 7.5-minute quadrangles that contain portions of your watershed.

Task 4. Using ArcMap, select your watershed sub-basins from the Coast Range Watershed theme and convert them to a new, stand-alone shape file.

> Task 4A. Create a map layout, with name, title, scale, north arrow, legend, etc. Print your new watershed subbasin theme map.

Task 5. Using ArcToolbox, dissolve your sub-basin polygons into one large watershed polygon for your site.

> Task 5A. Create a map layout, with name, title, scale, north arrow, legend, etc. Print your new consolidated watershed boundary theme map.

Task 6. Using ArcMap and the 1:24000 State Quadrangle polygon theme from the class web site (under the final project section), select all of the quads that contain your watershed footprint. Convert the selected quadrangles to a new, stand-alone shape file that can be used as an overlay on your watershed footprint.

> Task 6A. Create a map layout, with name, title, scale, north arrow, legend, etc. Print your new quadrangle map with watershed footprint overlay.

Task 7. Using ArcToolbox and the "Coast Range Streams" theme from the class web site (under the final project section), clip the stream coverage so that it forms an overlay within your watershed footprint.

> Task 7A. Create a map layout, with name, title, scale, north arrow, legend, etc. Print your new watershed footprint theme map with stream pattern overlay.

Task 8. Use the ArcMap table manager and your newly created watershed themes to determine the following watershed parameters:

Total Drainage Area (sq. meters) _____
Total Drainage Area (sq. km) _____
Total Length of Watershed (sq. km) _____
Total Width of Watershed (sq. km) _____
Watershed Length/Width Ratio _____

Total No. of Subbasins in Watershed _____

Average Area of Subbasins in Watershed _____

Total No. of Stream Segments or Tributaries in Watershed _____

Total No. of First Order Stream Segments _____

Total No. of Second Order Stream Segments _____

First Order Stream Frequency (Total No. / Drainage Area) _____

Task 9. For your selected watershed, use the GIS web links on the class web site (plus any others that you may find) to download, clip, mosaic, and assemble the following GIS themes:

USGS DRG (raster)	Soils (vector)	DOQ imagery (raster)
USGS DEM (raster)	Vegetation (vector)	Oregon Wetlands Cover
Bedrock Geology (vector)	Roads (vector)	Streams (vector)
Annual Rainfall/Precipitation (raster)	Streams (vector)	

9-1. As you are searching web sites for GIS data, keep track of the more interesting / successful sites that you encounter. Save, list, and print the URL addresses of your top 8 web links that you find useful in compiling your final project data.

Parameters and other tasks:

9-2. Define projections for all of your data files (create *.prj files and print them out to include in your project portfolio).
9-3 Convert all map themes to UTM meters, Zone 10 North (NAD_1927)
9-4 Clip each vector file so that each theme perfectly overlays the watershed boundary footprint.
9-5 Using layout with student names, quadrangle name, map theme title, scale, north arrow, legend, print the following and assemble in a neat looking package to include in each of your portfolios:

Printout for each watershed

A.	Quad DRG's	D. Soils on DEM	G. Streams on precipitation
B.	Quad DEM's	E. Bedrock on DRG's	H. Streams on vegetation
C	Vegetation with polygons labeled	F. Roads on bedrock	I. Wetlands with polygons labeled

Task 10. Using the class web site resources and download links, find and assemble all of the Digital Orthophoto Quads for your watershed (Mr. Sid files are the most compact and easiest to use). Using layout with student names, quadrangle name, map theme title, scale, north arrow, legend, print the DOQ's to include in each of your portfolios.

Task 11. Using ArcView Spatial Analyst, your assembled DEM's, and watershed themes, calculate the following watershed parameters:

Minimum Watershed Elevation (feet) _____
Maximum Watershed Elevation (feet) _____
Minimum Slope (decimal degrees) _____
Maximum Slope (decimal degrees) _____

Task 12. Each team member independently create their own summary report with the following elements:

I. Title page, with names, class information.
II. Two-page written text summary with Section Headings providing an overview of the location, physiographic, geologic, and hydrologic characteristics of your watershed. The watershed summary should include the following items, in well organized paragraphs, under the following section headings:
    a. Watershed name, general location, county (this should include an figure with the state of Oregon outline as a location map, and your watershed area highlighted)
        i. Figures:
            1. Map of Oregon with watershed location
    b. Physiography: general description of landscape, elevation range, significant topographic features, summary of elevation data you collected in Task 11 above, climate/precip, vegetation types

i. Figures
    1. Quad DRGs
    2. Quad DEMs
    3. Quad DOQs
    4. Climate map
    5. Vegetation map

c. General Geology: summary of the types of bedrock and soils found in your watershed
    i. Figures
        1. Geologic Map
        2. Soil Map

d. Hydrologic Summary: summary of the hydrologic data you collected in Tasks 8 above.
    i. Figures
        1. Watershed outlines and stream overlays

III. Figures and Maps: Your report should include your project output maps, as listed above, pasted into the poster template. The easiest way to do this is to export *.jpg files from the ArcMap layout manager, then "insert pictures" into powerpoint and onto the poster template. Each map should be labeled with a figure caption and referred to in the body of your text in section II above.

Task 13. Copy/Save/Compile all of your GIS themes, shapefiles, grids, raster graphics, and poster *.ppt file onto your public P:\folder. Organize your data folders according to projection and theme topic. Include an MS-word document that provides a list of the GIS files you have compiled, a brief explanation of what the files are comprised of, and a list of projections. This word document will serve as a summary of your metadata. Create a web link to access your P:\drive, one member of each team email the professor with team member info, project name, and URL link to public folder in which data resides. Instructor will download your data and post to the class web page for posterity sake.

ES341 FINAL PROJECT SUBMISSION INSTRUCTIONS (TASK 13)

Updated March 18, 2013

The Final Project involves two basic types of products: (1) map layouts-report-answers to questions and (2) geoprocessed data layers. As such, to accomplish digital submission of the final project, we will use a combination of ES341 Moodle upload for item 1 above (in *.PDF format) and your student "public html" P:\ drive on your network login for item 2 (data layers). Given the large file sizes, the P:\drive will be used for data files; while all other final project materials will be compiled in PDF format and uploaded to Moodle. A detailed list of submission instructions follows, arranged by project task no.

I. Moodle Upload of Published Maps and Report Materials in combined PDF Format (i.e. one report document), with the following organization:

Title Page: "ES341 Final Project: GIS Analysis of the *Watershed Name Here*"; student name, date

Table of Contents

- Task 2-3. List of Counties and 7.5-Minute Quadrangles in Study Area
- Task 4A. Location map of study area and sub-basins
- Task 5A. Location map of sudy area with dissolved sub-basin polygons
- Task 6A. Location map of watershed boundary with 7.5-min quadrangle overlay
- Task 7A. Watershed Boundary with Stream Network Overlay
- Task 8. Summary list of watershed parameters
- Task 9-1. List of top 8 web links used in compiling your final project data
- Task 9 Published Map Products
  - Mosaic Quad DRGs for watershed
  - Mosaic Quad DEMs for watershed
  - Vegetation with labeled polygons
  - Soils on DEM
  - Bedrock on DRGs
  - Roads on Bedrock
  - Stream on Precipitation
  - Streams on Vegetation
  - Wetlands with labels
- Task 10. Map of Mosaic DOQs
- Task 11. Summary list of watershed elevation and slope data
- Task 12. Watershed Summary Report According to Outline Listed

Upload your final project PDF document to the following class Moodle Topic:

"Week 11 Final Project Submission Part 1 - Published Maps and Report"

http://online.wou.edu/mod/assignment/view.php?id=44686

II. GIS Data Products

For each team member separately, copy your final project data layers to your P:\drive. Create an ES341 folder, with subfolders labeled as follows; copy your vector and raster data into each subfolder according to the appropriate theme:

P:\ES341\DRG
P:\ES341\DEM
P:\ES341\Geology
P:\ES341\Climate
P:\ES341\Soils
P:\ES341\Veg
P:\ES341\Roads
P:\ES341\Streams
P:\ES341\DOQ
P:\ES341\Wetlands

Test your web link to make sure the files are accessible via web browser. Your default URL is www.wou.edu\~*username*

Watershed Fundamentals

INTRODUCTION

Making decisions about a watershed is an important responsibility; decisions must be based on a solid understanding of the characteristics of the watershed and how physical processes shape watershed conditions. This section provides basic background information on watershed functions and processes to help users understand the assessment procedure and the results of the assessment process. Watershed "processes" refer to those natural physical, chemical, and biological mechanisms that interact to form aquatic ecosystems. For example, the input and routing of water, ***sediments***,[1] and large wood through stream channels involve many inter-related processes occurring both in-channel and upslope.

WHAT IS A WATERSHED?

The term "watershed" describes an area of land that drains downslope to the lowest point (Figure 1). The water moves by means of a network of drainage pathways that may be underground or on the surface. Generally, these pathways converge into a stream and river system that becomes progressively larger as the water moves downstream. However, in some arid regions, the water drains to a central depression such as a lake or marsh with no surface-water exit.

Watersheds can be large or small. Every stream, tributary, or river has an associated watershed, and small watersheds aggregate together to become larger watersheds. It is a relatively easy task to delineate watershed boundaries using a topographical map that shows stream channels. The watershed boundaries will follow the major ridge-line around the channels and meet at the bottom where the water flows out of the watershed, commonly referred to as the mouth of the stream or river.

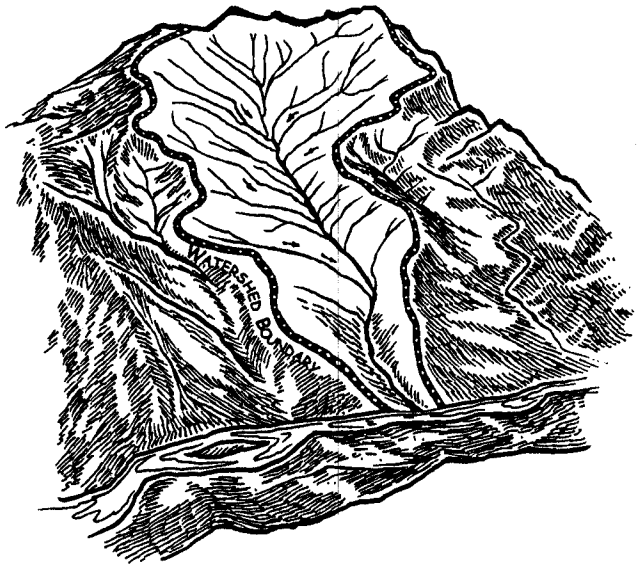

Figure 1. Watershed is an area of land that drains downslope to the lowest point.

The ***connectivity*** of the stream system is the primary reason why aquatic assessments need to be done at the watershed level. Connectivity refers to the physical connection between tributaries and the river, between surface water and groundwater, and between wetlands and these water sources. Because the water moves downstream in a watershed, any activity that affects the water quality, quantity, or rate of

[1] Terms found in bold italic throughout the text are defined in the Glossary at the end of this component.

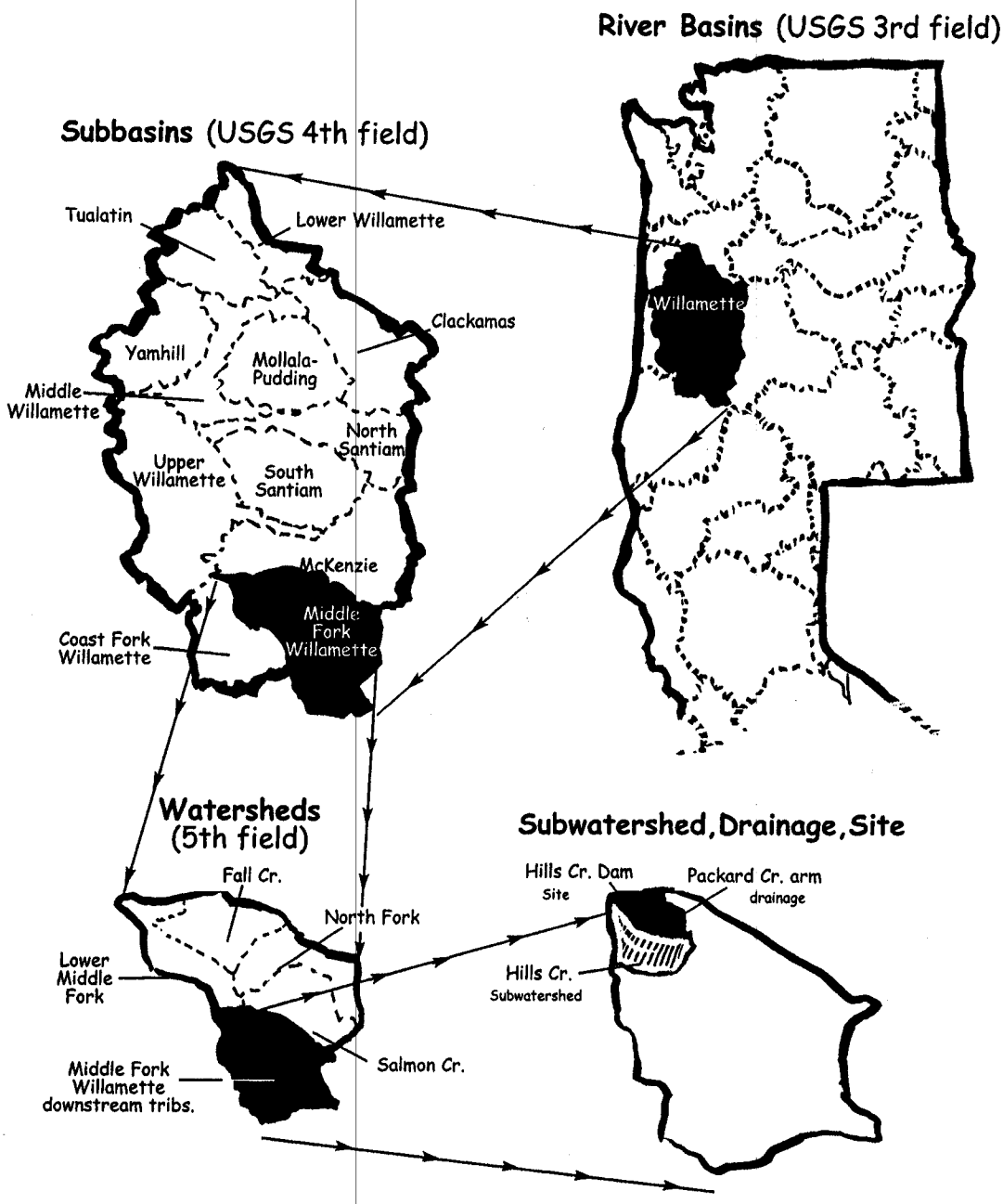

Figure 2. Suggested terminology for watershed descriptive terms based on USGS hydrologic "fields." These fields correspond to the following terms: river basin (3rd field), sub-basin (4th field), and watershed (5th field). In the figure, the Willamette River Basin is divided into sub-basins including the Middle Fork Willamette, which is divided into watersheds including the Middle Fork Willamette downstream tributaries. This watershed then includes a subwatershed, drainage, and site, as seen in the lower right of the figure.