

Name: _____

Hydrologic-Environmental Assessment

Skills Involved

1. Downloading and examining National Hydrography Dataset (NHD) data from the USGS.
2. Downloading and examining point data from the EPA.
3. Downloading and examining water quality and streamflow data from the USGS.
4. Performing environmental assessment within a GIS environment.

Problem:

The EPA wants you to prepare a report on the effect that mines and landfills in the Upper Kootenai watershed could potentially have on the water quality there.

You will first need the National Hydrography Dataset (NHD) for the Upper Kootenai Sub-basin (or watershed).

NHD data is stored by watershed number. You will need this number to access the NHD data. There are a number of places to obtain watershed numbers, but one of the best is EPA's Surf Your Watershed site:

<http://www.epa.gov/surf/>

Select: Locate Your Watershed.

On the next screen, select "Locate By Geographic Unit", and using the Watershed Name, enter Upper Kootenai, as follows:

Find Place
Search all the geographic navigation tables in Surf Your Watershed. Insert the name of your city, river, county, or state ([example](#))

Places
Use USGS's Geographic Names Information System to locate your watershed by querying on lakes, airports, rivers, parks, schools and more.

Locate by geographic unit by entering in your zip code, state, county, tribal nation, watershed number or stream name.
Watershed Name (Name associated with 8 digit HUC code) ▼

Your Entry:

1) What is the Sub-basin number for this watershed?

- 2) Examine the map. In what part of Montana is this watershed located?
- 3) What other state does this watershed cross into?

Now that you know the watershed number, you are ready to download the watershed vector spatial data.

Access the NHD site:

<http://nhd.usgs.gov>

You will be using “medium” resolution NHD data.

- 4) Examine the documentation on the NHD site. At what scale was the medium resolution data collected?

Select “Data” in the left panel.

Note that you have 2 choices through which to download the NHD data: (1) through the map interface, and (2) through an FTP site.

The screenshot shows the USGS National Hydrography Dataset (NHD) website. The header includes the USGS and EPA logos, with the text "National Hydrography Dataset" below the EPA logo. A navigation menu on the left contains buttons for "NHD Home", "Technical References", "Data" (which is highlighted with a red arrow), "Tools", "Applications", "Tutorial Series", "Technical Support", and "Maintenance". The main content area has a blue header "NHD Data" and a sub-header "NHD Data Availability". Below this is a yellow button that says "Go to the NHD viewer". At the bottom of the main content area, there is a "NEW!" announcement: "Pre-staged personal geodatabases by subregion are now available on the ftp site <ftp://nhdftp.usgs.gov/SubRegions>. Select the High, Local, or Medium folder. The geodatabases will be kept up-to-date and have a naming convention of NHD<resolution><4 digit subregion number>.zip."

If you wish to download using the map interface, use the following procedures. Note that this method is slower but may be more convenient for downloading several watersheds in a map-based intuitive interface. When the file is ready (which may be several minutes or several hours depending on web traffic), you will receive an email indicating the URL where the data is available for pick up.

For this lesson, use the FTP method, and skip to the next page in this lesson. However, you may wish to have the map-based download procedures for your future use. They are provided below.

Map-Based Download:

Polygon Extracts can be created using one of the following reference polygon layers: Subbasins, Counties, 108th Cong Dists, or one of the USGS Quad index layers. You must select one of these reference layers. You must have one of the following reference polygon layers "Active" in order to use the tool: Subbasins, Counties, 108th Cong Dists, or one of the USGS Quad index layer. NOTE: IF YOU RECEIVE A MESSAGE THAT SAYS: 'layer isn't available at this scale' YOU MUST ZOOM IN MORE FIRST, and THEN GO BACK.

- 1 - Zoom In to choose which reference layer and area you want to extract. To do this, click the Zoom In tool on the left and draw a square on the image in the area you are interested in.
- 2 - Click on the Hydrologic Units tab in the layer list on the right.
- 3 - Click in the square boxes of the layers (ie. Subbasins) to make them appear.
- 4 - Click in the circle to make the subbasin layer "Active."
- 5 - Click the "Redraw Map" at the bottom right of the screen.
- 6 - Click the Polygon Extract button on the tools menu to the left.
- 7 - Click inside the reference polygon (ie. Subbasin (watershed)) for which NHD data you wish to extract.

Note: With the map-based method, you may select multiple subbasins. Up to 5 high-resolution NHD subbasins, or 10 medium resolution NHD subbasins may be extracted at once by selecting "Polygon Extract" and drawing a box that "touches" multiple subbasins.

A separate window will be displayed listing the reference layers that you selected.

- 8 - Select your desired NHD Resolution (ie. High, Medium or Local).
Note: High and Local Resolution are not yet available in certain parts of the USA.

9 - Select your desired extract format (ie. Geodatabase or NHDGeoinArc) by clicking in the box next to it.

10 - Type in your email address, then click the Extract button.

A zip file containing either a personal geodatabase or NHDGeoinArc will be created and stored on a FTP site. An email will be sent to you with instructions on where to download the file. Please be patient.

FTP-Based Download:

To download via the File Transfer Protocol (FTP) site:

Go to the site: <ftp://nhdftp.usgs.gov/SubRegions/>

Select "Medium" resolution.

On the next screen, find the file NHDM1701.ZIP. Note that this will include all watersheds beginning with 1701.

Download this file and unzip.

Examine the resulting files in Windows Explorer or in ArcCatalog.

5) In what ESRI format is the NHD data stored in?

Access ArcMap and start a new map document.

Add Data and move inside your new geodatabase, go to Hydrologic Units.

Add SubRegion, Basin, and SubBasin. Label each of these layers on the names of the subregions, basins, and subbasins.

6) Which layer contains the largest geographic areas?

Add Data again, move up one level, and add HydroNet.

7) In your ArcMap table of contents, what 2 feature classes were added with HydroNet?

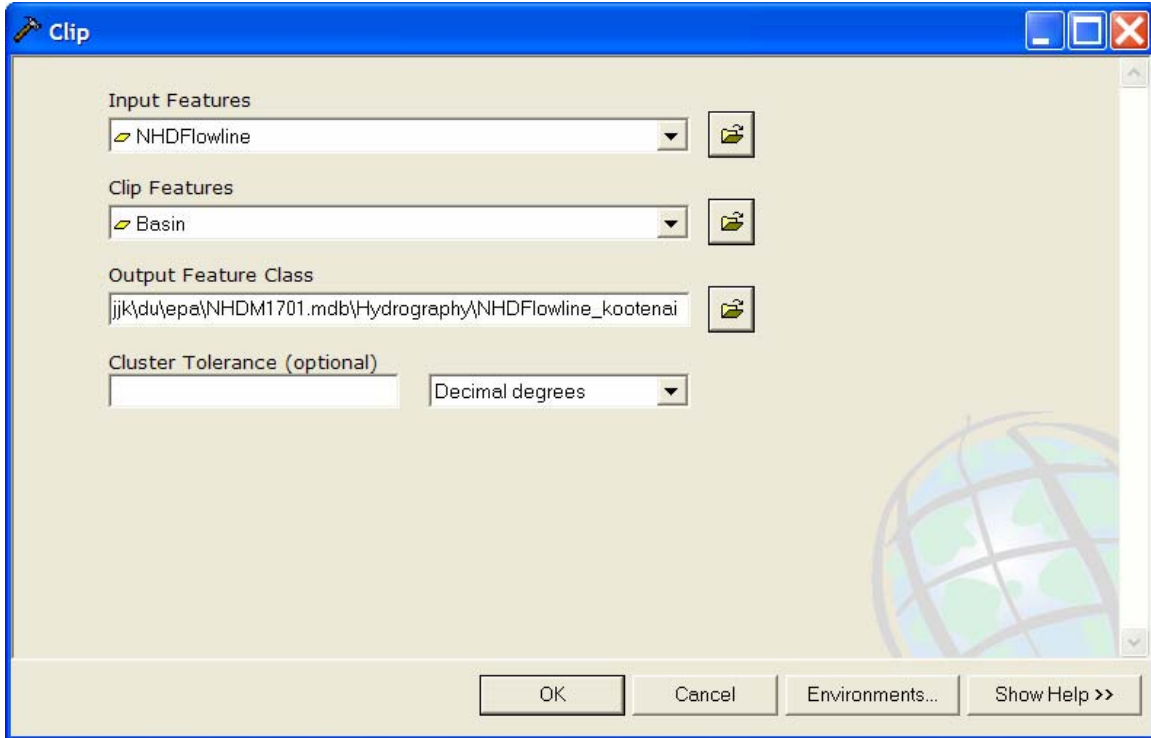
Turn off your HydroNetJunctions. Save your map document.

It may be helpful to change the symbology for the boundaries of the polygons to answer the following question.

8) What 3 **basins** have you downloaded NHD data for?

Select the Kootenai basin using the "select feature" button.

Use the ArcToolbox Clip function to clip the NHD Flowlines to the Kootenai Basin, naming your output feature class NHDFlowline_kootenai, as shown below:



Examine the attribute table of your new NHD flowlines for the Kootenai Basin.

9) What is the name of the longest stream, in kilometers, in the basin you are analyzing?

Examine this river on your map.

10) Why is this stream segment longer than even the Kootenai River, which runs through more terrain in this basin?

The point source data from the EPA is now needed.

Go back to the EPA Surf Your Watershed web site that you were examining earlier for the Upper Kootenai.

In the upper part of the screen, shown below, click on the word "water" after the word "EPA Home."









On the next page that appears, under Current Information, select "Map Your Waters."

Now you should be on the page: <http://www.epa.gov/waters/>

Click on “Geography” in the left panel.

Scroll down to the following table near the bottom of the page:

Georeferencing to the NHD Reach Address Database			Reach Address			
Map Symbol	Description	OW Program	Program System ID	(Street Name)	(House number)	
				Reach Code	Begin Position	End Position
	Monitoring Site	Water Quality Monitoring	STORET-A	01080105000001	60%	-
	Point Source Discharge	Water Permits	PCS-B	01080105000002	85%	-
	Drinking Water Supply	Safe Drinking Water	SDWIS-C	01080105000005	55%	-
	Designated Use Water	Water Quality Standards	WQS-D	01080105000005 01080105000003 01080105000001	0% 0% 0%	100% 100% 100%
	Assessed Water	305(b) Water Quality	NAD-E	01080105000002	0%	100%
	Impaired Water	303(d) Listed Waters	TMDL-F	01080105000002	30%	100%

In this table, under the column “OW Program,” select “Water Quality Monitoring.”

Now, you should be on the STORET data site:

<http://www.epa.gov/waters/data/prog.html#STORET>

Under the column “Program Database” on the screen that appears, select STORET. This is one of the EPA’s water quality data sites. You should be on this page:

<http://www.epa.gov/storet/dbtop.html>

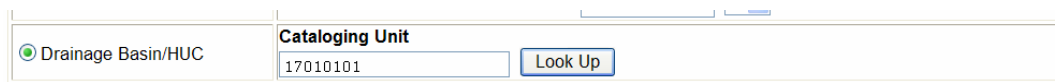
On the screen that appears, select “Browse or Download Modernized STORET Data.”

Under STORET station descriptions, select “Stations by Geographic Location:”

STORET Station Descriptions

Stations by Geographic Location

Next, select by drainage basin, and enter the watershed number that you are investigating:



<input checked="" type="radio"/> Drainage Basin/HUC	Cataloging Unit <input type="text" value="17010101"/>	<input type="button" value="Look Up"/>
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Select “continue” at the bottom of the page.

Now, you should be at:

http://oaspub.epa.gov/stormodb/DW_STATION_COUNT

Select “Continue” until you receive notice that your downloadable file is ready. Name it Kootenai_storet.txt and place it in the folder where you are working. Note: If the site is down, check the file in the eCollege Doc Sharing area.

Use WordPad to open your STORET text file that you just downloaded.

Recall that one way to bring x-y coordinate data into ArcGIS from a text file is to delimit, or separate, each field by a tab, or comma.

11) What character separates most of your data?

Therefore, you’ll need to do some editing on this file before you can import it to ArcGIS.

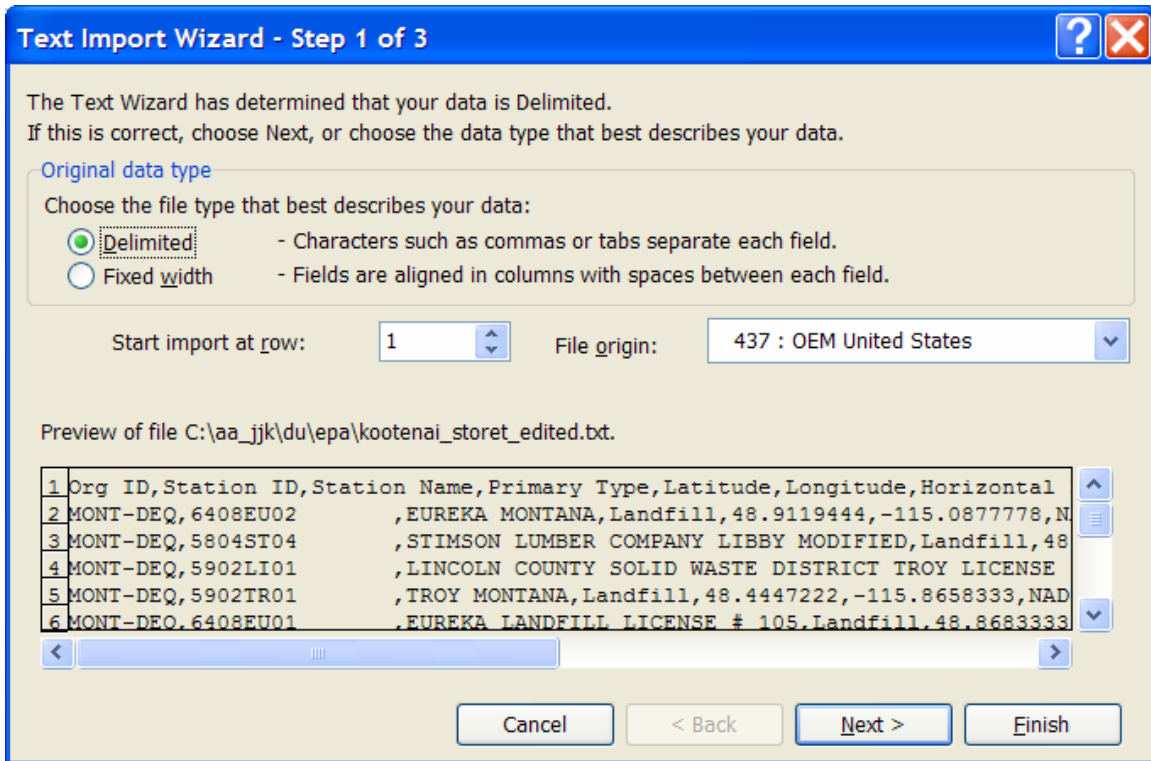
First, notice that there *are* a few commas in the file. These will interfere with the correct delimitation, so perform a REPLACE on all commas, replacing them with a blank space. **Then** replace the character you indicated in answer 11) above with a comma.

Save your file as Kootenai_storet_edited.txt

Your data will import more smoothly into ArcGIS if you bring it into Excel and save as a DBF (Database Format).

Open Microsoft Excel and open your text file.

Pay careful attention to the text import wizard (below), making sure to choose the fact that you have a delimited file (step 1 of 3), and that it is delimited by commas (step 2 of 3).



Import all columns under the "general" format.

Once it imports into Excel, access the two columns containing the latitude and longitude values. Format these two columns as "number" with 5 decimal places.

12) Why is this formatting step necessary?

Highlight all of your data in the spreadsheet and save as Kootenai_edited.xls – an Excel spreadsheet (in case you need to return to it).

Next, because ArcGIS cannot import Excel files, save your spreadsheet as a DBF4 file: Kootenai_edited.dbf Indicate "yes" when you receive warning that you are not saving in Microsoft format.

Close Microsoft Excel and go back to your ArcMap session where you are working with the watershed.

Add your new DBF file into your ArcMap session. Open the table and check it.

Perform a SUMMARY on the Primary Type (Primary_TY) field and open the resulting table.

13) How many landfills exist, and how many mines/mine discharge sites exist?

Use Tools→ Add XY data to map your water quality data. Assign it the Geographic Coordinate System: GCS_North_American_1983.

Export this data set as a shapefile.

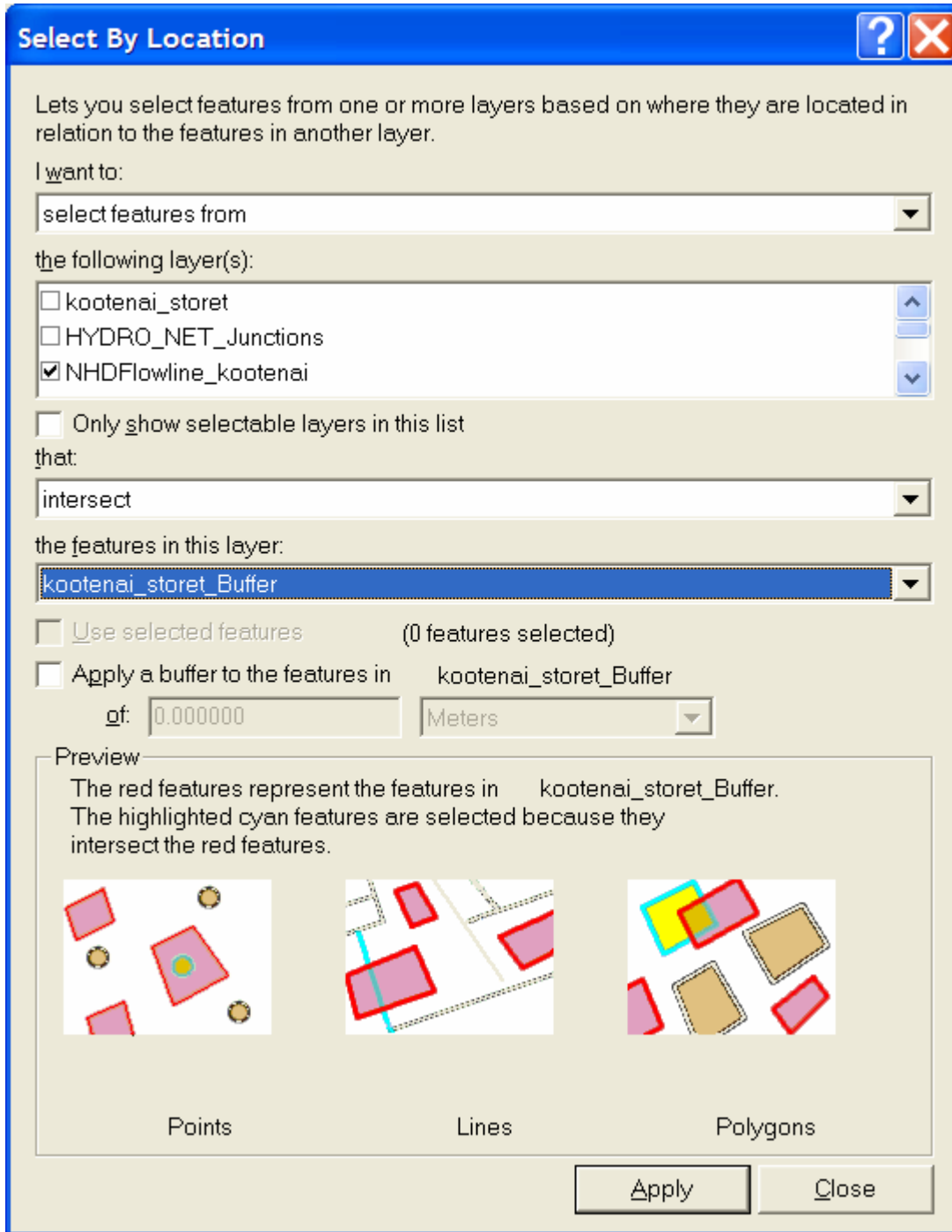
14) Describe the spatial distribution of the landfills and the mine drainage site in the Upper Kootenai watershed, indicating which rivers they are on or near.

Set the Data Frame's Properties –Display Units – to *meters*.

Select the landfills and mines/mine drainage discharge sites.

Buffer these features by 200 meters.

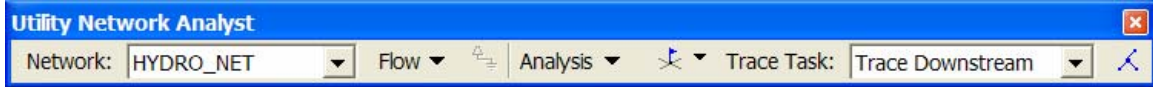
Use Selection By Location and select the streams that intersect the areas of concern (i.e. the buffers around the landfills and mines), as follows:



15) How many streams are selected?

Zoom into the area where the 3 landfills exist near the confluence of the Kootenai River, Callahan Creek, and O'Brien Creek.

Go to View → Toolbars, and access the Utility Network Analyst tool:



Make the original NHD Flowline layer visible.

Under Flow, select Display Arrows. Change color and size if you wish.

16) Describe the direction that the streams in this area of the 3 landfills flow.

Click on the junction flag tool (the flag), and add it to the junction of the Kootenai River and Callahan Creek. Make the Task: Trace Downstream. Click on Solve (the symbol on the far right of the toolbar).

17) Into what country does the Kootenai flow?

Next, trace upstream from the same point.

18) Approximately what percentage of the land of the Upper Kootenai basin, based on your visual inspection, do these rivers upstream from these landfills cover?

19) Describe the hydrographic relationship between the landfills and mine drainage area that you are examining, mentioning which ones are upstream from the others, and which streams connect them.

Access the Terraserver tool and download a DOQ for the area covered by the three landfills. Make the DOQ permanent, if you wish, saving it as a TIFF.

20) Can you see the landfills on the DOQ? Which looks like the largest of the three?

Next, download a DRG in this area.

21) What is the name of the small town just a few kilometers to the north of these 3 landfills?

22) Create a layout and paste it into these lab sheets. Include the DRG and/or DOQ, along with the streams, the landfills, and any other pertinent data you feel needs to be included.

Go back to your map view. You are interested in the current flow of the Kootenai River in this area. Access the USGS stream gage at:

http://waterdata.usgs.gov/mt/nwis/uv/?site_no=12301933&PARAMeter_cd=00060,00065,00010

Add this point to your map as a graphic.

Or, alternatively, go to water.usgs.gov → Real Time → Select Montana → Statewide Streamflow Table → Search for "Kootenai" → Select this stream gage.

23) What is the current gage height here?

You need to know exactly where this gage is in relationship to your study area. Under "Available data for this site", select Site Map:

Site Map for Montana
USGS 12301933 Kootenai River bl Libby Dam nr Libby MT

Available data for this site: site map GO

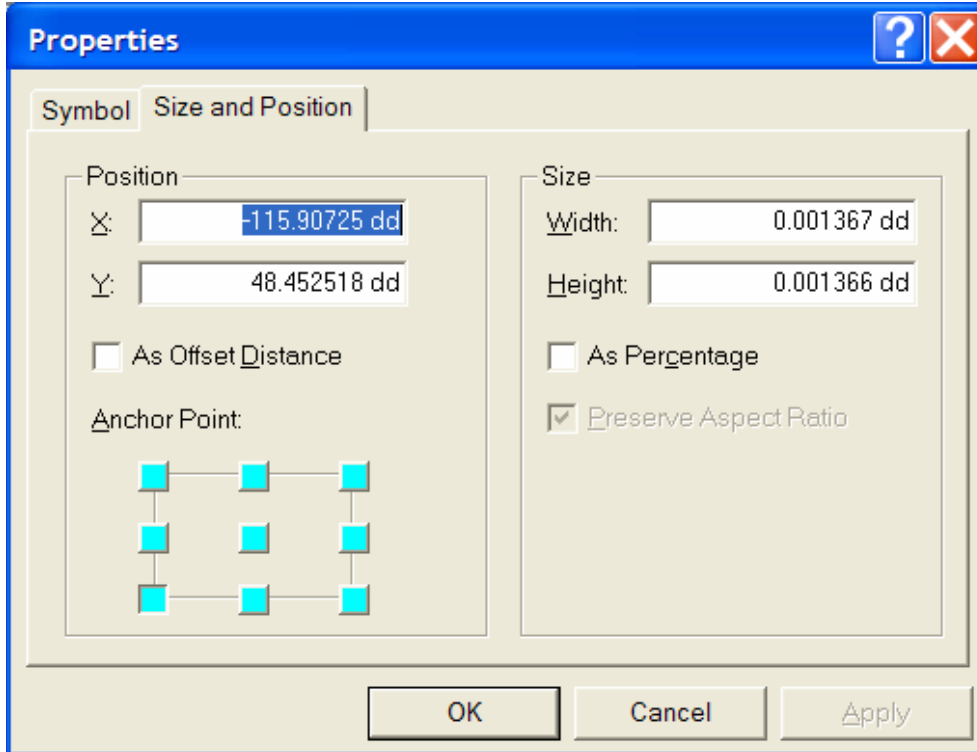
Lincoln County, Montana
Hydrologic Unit Code 17010101
Latitude 48°24'03", Longitude 115°19'11" NAD27
Drainage area 8,985.00 square miles
Gage datum 2,100 feet above sea level NGVD29

Location of the site in Montana.	Site map.

24) Convert this number (degrees minutes seconds) to decimal degrees, and show your work below.

Add this point to your map as a graphic in the correct location, as follows.

On the Draw toolbar, click on the square to turn it into a dot. Click on the map, and before moving it, right click on it. Tab to the Size and Position and see the dialog box, as below, replacing the x and y positions with those you calculated above.



25) Is the gaging station upstream or downstream from the 3 landfills you were examining earlier?

26) Why is the gaging station not shown exactly on the Kootenai River?

Download a DOQ at this location.

27) What physical feature is the Kootenai River running through at or near the gaging station?

On the USGS gaging station web page, change the request to "water quality—Discrete Samples."

28) Describe how you could create a point shapefile for the gaging station here in ArcGIS that contains all of the water quality information in the table currently on your screen.

29) Summarize in a few sentences what you have learned about using USGS-EPA NHD and EPA tabular data in a problem-solving environment using GIS in this lesson.

30) What other variables might you consider using in a study such as this? Based on these additional variables, what other public domain data would you need to make more study more complete?

*** End of Lesson ***