GIS Exercise #2 Examining the Isanti-Chisago Closed Landfill Remediation Efforts

Background:
In our first GIS exercise you got practice carrying out routine tasks in ArcMap and in using some of the critical functions of the software. In this exercise you will apply your developing GIS skills to explore the efforts of the Minnesota Pollution Contol Agency's efforts to contain pollutants within the Isanti-Chisago closed landfill near Cambridge, MN.

You will display and examine two groundwater datasets from monitoring wells within and outside the boundaries of the landfill. The datasets show measured levels of three contaminants of interest: arsenic, lead, and vinyl chloride. The first dataset was collected just before the remediation system (cascade aeration system, settling pond, wetlands) was installed in the landfill (March, 1996). The second is the most recent available dataset for the landfill (September, 2008). By the end of the exercise we will want to be able to visually show what difference (if any) the remediation system has made over the 13 years it has been in use.

Objectives:
1. To build further skills and familiarity with ArcGIS.
2. To apply GIS to answer an environmental question of interest—whether the remediation system has improved groundwater conditions over the long term.

Data Files:
All files that you will need for this exercise are available on the course Blackboard site (Labs→GIS landfill exercise folder). **You should first make a folder on your desktop and download each of these files into that folder.**
- IClandfill.jpg (hi-resolution satellite image from Google Earth Pro),
- Cambridgeareatopo.zip (old-school topographic map from MN DNR Data Deli),
- ICwells.xls (excel spreadsheet with well data for the landfill from 1995 and 2008)

Tasks:
I am assuming a certain level of knowledge based on your previous exercise with GIS. If you have forgotten how to carry out some of these tasks (and get totally stuck), please refer to your previous GIS lab handout which walks you through the various steps in a detailed fashion. This is also posted in the folder for this lab on the Blackboard site. Of course, you can always ask for my help as well.

1. First, unpack the .zip file that contains the topo map and then find the appropriate file (map_drg024im3, Raster dataset) using ArcCatalog. In ArcCatalog make sure both the satellite photo and the topo map files are on a common projection (spatial reference). All datasets for this project should be:
    NAD_1983_UTM_Zone_15N

2. Next, open these two files as layers in ArcMap. You need to georeference the satellite photograph of the landfill (IClandfill.jpg) to the topographic map of the greater area (Cambridge.drg). Remember that the file you are georeferencing (in this case the .jpg file) needs to be at the top of your ArcMap menu on the left side of your screen. Once the satellite photo is georeferenced it will be your base map and you can remove the topo map layer.

3. At this point, get my attention so I can check your progress.

4. Take the well dataset (ICwells.xls) and convert it into 2 usable files (1 shallow well data set, 1 deep well data set) that display the well locations on your basemap of the landfill area. Make sure to define the coordinate system for each of these!

5. After you have displayed the wells, see if you can figure out how to display the name of each well for easy reference. Ask me for help with this if necessary.

6. Use the groundwater elevations (wtr lvl) for the shallow wells to make a contour map that shows the general direction of groundwater flow in and around the landfill. Show me your completed work.

7. Display As, Pb, and vinyl chloride data for both the shallow and deep wells as graduated or proportional symbols for both 1995 and 2008 (use properties→symbology to do this). Make note of any spatial patterns in these concentrations (i.e. where concentrations are clearly highest and lowest).

8. Figure out a way to display the data in a fashion that shows how effective the MPCA has been in their effort to prevent contaminated water from getting into wells outside of the property. I will expect you to use the provided datasets in such a way that your finished product can clearly illustrate how the levels of metals and VOCs have *changed* in the study area since the remediation effort started. Before you proceed, get my attention to explain how you will do this.

Questions
1. Which wells show the biggest change in each of the contaminants over the 13 year time period? Which show little or no change for the contaminants?

2. Overall, does it appear that the remediation is working to reduce the levels of these contaminants at the shallow and deep wells?   Explain whether the system appears to be having a small or significant effect for each of the three contaminants we are examining: As, Pb, and vinyl chloride. You can also comment on whether the data are inconclusive.

3. Does this method of examining the groundwater chemistry provide a definitive answer on the effectiveness of the landfill remediation? What are some other variables that are probably important in influencing the measured concentrations of these contaminants?