

## GEO/EVS 425/525 Unit 5

### Overview of Vector Images

So far in this course, you have concentrated on raster images. In this exercise, you will deal with several sorts of vector images and explore the differences between raster and vector images.

Vector images represent *objects*, just as raster images represent *space*. Vector objects do not need to take up all of the space in the image (although they may), just as raster images do not need to distinguish specific objects. All vector images are stored in Arc/Info Arc Coverage format by ERDAS Imagine. There are three types of vector coverage: Point, Line, and Polygon. Point vectors are just that – the objects represented are individual points. Line vectors are polylines: they begin and end at nodes, and straight line segments connect the nodes via intermediate vertices. A given line may connect thousands of points, but it remains a line. Polygon vectors are irregular polygons of various sizes. Typically they are formed from lines which intersect at nodes. A polygon may be formed by a single line which begins and ends at a single node, or it may comprise many lines in which one line begins at a node where another ends. Typically, points, lines, and polygons are handled in separate files, but they need not be. Obviously, point vectors and line vectors cannot even begin to express all of the space in an image. Polygon vectors can, but they often do not.

The statement that “all vector images are stored in Arc/Info Arc Coverage format by ERDAS Imagine” is deceptively simple. The Arc Coverage format is fairly complex, and each image constitutes several files in two directories. As a result, you have to use some special tools to deal with vector files. These are found in the buttons under the “Vector” icon on the main Imagine Control Panel. ***To operate on vector files in Imagine, you MUST use these tools.***

#### Point Vectors

Copy the SHSCHOOLS vector file into your X: drive and then open it. To copy a vector file, you must use the vector tools built into Imagine. Click on the “Vector” button on the main Imagine Control Panel and click on “Copy Vector File.” Your input file is Q:SHSCHOOLS; your output file is X:SHSCHOOLS.

When you have copied the file on your X: drive, open the point vector file SHSCHOOLS. Remember that vector files are stored in Arc Coverage format; their icons are fuzzy green things. This image shows the locations of all schools in the Shaker Heights, Ohio quadrangle. Let’s make the points easier to see. Click on Vector-Viewing Properties. Note that “points” is checked, and that the default “point” designator is a small blotch. Click on the pop-up to the right of the blotch window, and choose “other” from the choices presented to you. Click on the black filled circle, and then click on the pop-up to the right of the black color blotch at the right of the window. When the color palette opens, pick an interesting color (but not black, yellow, or blue). Then change the size of the circle from 2.0 points to around 4. Click on OK. When the window closes, click on “Apply” in the Viewing Properties window. What happens to the points?

Note that the Viewing Properties window has no “OK” button. It will remain open until you click on the “Close” button, to let you design an image that is easiest for you to interpret. When you like the nature of your dots, click on “Close.” You are asked whether you wish to save the symbology to a file. Choose to do so. When naming your file, you have two choices: to give the symbology the same name as the file and to give it a different name. Give it the same name: SHSCHOOLS.EVS. *Note that you have to type in the “.EVS”.* If you don’t, the program will go into the SHSCHOOLS directory and invite you – again – to pick a name. You want the .EVS file on your X: drive.

Use the eraser icon to remove the file from your viewer. Now open it again. The dots are as you changed them, because when Imagine finds a symbology (\*.evs) file in its vector working directory with the same name as a vector file being loaded into a viewer, it automatically uses the symbology file.

Let's look some more at the symbology file. In the viewer, click on Vector-Symbology. The symbology window opens, but it contains no records. Click on Automatic-Unique Value. This will create a unique symbol for each item you choose. The Unique Value dialog opens, asking that you select an attribute to use for the symbology value. Choose "Board", which indicates the school system to which the school in question belongs. Check the "Generate New Styles" box to generate the new symbols, and click OK. The symbology dialog fills with the newly generated styles. When you click "Apply", these symbols are applied to the viewer. Pick one of the school systems. Click on its row number in the "Row" column to select the record. The record will turn red. Click on the symbol. The symbol dialog opens. Click on "other." When the Other dialog opens, click on "filled black circle", change the color to something more striking than it currently is, and increase the size a couple of points. Click on OK and Apply. What happens to the dots?

Now right-click in the "Row" column of the symbology table to bring up the hidden functions. Select All rows. Then click in the symbol field of one of the rows to open the symbol dialog. Again click on "other". When the Other dialog opens, click on the popup beside the "Menu" field to open the various menus available to you, and choose USGS. Within the USGS menu, choose the school symbol. Increase its size to about 10 points or so, click on OK and Apply. What happens now to the dots? Again click on the row column of one of the school systems to select it, then click on the symbol field, then "other". Change the color to something more striking, then click on OK and Apply.

Close the symbology dialog. You will be asked if you want to save it. Choose to do so. You don't need to choose a name, since you are saving the new symbology to the default location of the image in your viewer. Erase the SHSCHOOLS image from the viewer and then reload it. Your new symbology is automatically used.

## Line Vectors

Load the SHSTREAMS file from the Q: drive into your viewer. Within Vector Options, choose to Clear the Viewer so that only the streams file is there. This is an image of the hydrologic objects in the Shaker Heights quadrangle. The stream at the top of the image is Doan Brook; the one in the center of the image is Mill Creek; the one at the lower left is the Cuyahoga River, and the one at the lower right is Tinkers Creek.

Click on Vector-Attributes. There are none! Close the Vector Attribute table. Open VectorInfo by clicking on the third icon from the left on the viewer's icon bar. You will notice that the image consists of 247 arcs and no polygons. There is also a cryptic note, "The coverage has Edit Masks. Use BUILD or CLEAN to restore topology." You did not see this with the point vector file, because point images do not have topology. Basically, the edit masks represent an indication to the software that topology has not been built and that the file has been edited since the last topology building (if, indeed, topology has ever been built), and 'topology' means is that the software knows how lines are connected to each other, and how polygons are constructed from the arcs that comprise them. "Build" is a relatively simple module that constructs polygons from arcs; "Clean" is a more comprehensive program that can build topology for both line and polygon files. "Build" also builds its topology *within* the original file, while "Clean" can build topology within a new file. "Clean" can also cause problems for you that "Build" does not. Nevertheless, you will use Clean in this instance. Click on Vector-Clean from the main Imagine Control Panel. Your input file is Q:\SHSTREAMS, and your output file is X:\SHSTREAMS. Be sure that you indicate that you are Cleaning a *line* file. Also, be sure that the "Fuzzy Tolerance" is set to 0! This is very important.

Now open the SHSTREAMS file from your X: drive, clearing the viewer in the process. Again look at the Vector-Attributes. Most of the attributes in the table are bookkeeping items, but one attribute that you can easily recognize is the length of the arc. Two columns are filled almost entirely with zeros: LPOLY# and RPOLY#. These are the columns which indicate which polygon is to the left and to the right of the arc in question. Since this is a line file, almost all of these are zero, since there is no polygon to the left or to the right of the arcs.

The next thing you will do with this image is to create a symbology that will make it more readable. Click on Vector-Viewing Properties. Note that the only style checked is "Arcs", since this is a line vector. Click on the popup beside the Arc style, and choose "other" to go to the Other dialog. Click on the color popup, change the "Outer Color" to blue (or whatever else suits your fancy for showing streams), and increase the width of the line to about 2 points. Click on OK and Apply. Your streams are now blue and very legible. Close the Viewing Properties dialog, and when you are asked if you wish to save the symbology, choose to do so. Note that again, you do not have to specify a name.

Go back to the Vector Attribute table. Select some of the arcs by clicking on their row column so that the arc's record turns yellow. Are any of the streams represented by a single arc? How do you think you would label an individual stream within the attribute table?

## Polygon Vectors

Open SHSOILS from the Q: drive in your viewer, clearing the display. This file is a soils map for the Shaker Heights quadrangle, showing all of the soils in the quadrangle. Unlike many polygon files, this one covers all of the space in the quadrangle.

Again, look at the Vector- Attributes. This file does have attributes! Again, you will recognize attributes of length, as well as some bookkeeping items. You might wonder why a polygon file would have *length* as an attribute rather than some more polygon-ish feature such as area. Click on View on the menu bar of the Vector Attribute Table. You can view the attributes for points, lines, polygons, and tics. You are looking, by default, at the *lines* attributes. Click to view the Points attributes. You can see the coordinates of the points, but you can also see indications for area and perimeter, and there is a label for the soils. The reason is that the points referenced in this attribute table are what is called Label Points. These are points that represent a polygon as a whole, and these statistics are from the entire polygon. Now click to view the Polygons attributes. The table does not change, and when you click again on View, you find that you are still looking at the point attribute table. There is a very simple reason for this: Arc Coverages include several different files in the directory representing the coverage. The file AAT.ADF is the Arc Attribute Table, while the PAT.ADF is the Point Attribute Table / Polygon Attribute Table. As far as the Arc Coverage is concerned, the attributes for the points and the polygons are identical: the points *represent* the polygons, at least for labeling and attribute purposes.

Now look at Vector-Viewing Properties. "Arcs" are checked, indicating that one can view the arcs. Check "Points" so that you can view the label points. If you want to, you can also check "Attributes" to label the soils, and choose to display the attribute MUSYM, the mnemonic symbol for the soil. When you click on "Apply", the points and the symbols will appear. You may not be able to read the symbols when the whole quadrangle is displayed, but you will be able to read them easily if you zoom in on an area of the map.

What you cannot turn on is "Polygons." The "polygons" are grayed out. Look at VectorInfo. Two things will tell you what is wrong. First, no polygons are listed as existing in the file. Second, there is the message, "The coverage has Edit Masks. Use BUILD or CLEAN to restore topology." While the basic statistical polygon information is stored along in the Point information, the topology of the polygons does not exist until the file has been Cleaned or Built. Again, use Vector-Clean to build the topology of the image. Your input file is Q:SHSOILS; your output file is X:SHSOILS. Be sure that you are Cleaning a polygon file – and be very certain that the Fuzzy Tolerance is set to 0! When the file has been Cleaned, open the new file in your viewer and look at VectorInfo. There are now 500 polygons, and you are told that the file has not been edited since the last BUILD or CLEAN.

Click on Vector-Viewing Properties. "Polygons" is no longer grayed out, so that you can now check the polygon box and apply it. Since the map includes all of the area of the quadrangle, the entire image should turn blue. This, of course, isn't very useful. Try the same trick you used earlier. Click on Vector-Symbology from the viewer's menu bar. An empty symbology table opens. Click on Automatic-Unique Value on the symbology table, and choose MUSYM as the attribute against which to apply the new

colors. When the new colors appear, click on Apply, and see what happens.

Let's concentrate, for the moment, on the most urbanized soils. These are the ones labeled Ua, Ub, Uc, UeA, UmB, UnB, and UoB. Go to these soils in the symbology table. Click on one of the color swatches corresponding to the soil in question, and choose "Other." Click on the "Custom" tab, and choose "Use Pattern." Choose the "cross-hair" Symbol pattern, and click on OK. When you have changed all of the urban soil patterns to the cross-hair, Apply the symbology. If you wish to highlight some of the less urbanized (but still non-natural) soils, choose the "road" Symbol pattern for the EsC, LuC, MmB, and MxB soils. Save your symbology when asked, as you are exiting.

## Mixed Applications

Open all three of your vector coverages with the SHSOILS on the bottom and SHSCHOOLS on top.

**This image should be included in your portfolio for this unit.**

Now open SHPERV.IMG in the same viewer. This is an image which estimates the percentage of the land surface which is pervious. Attribute values range from 0% (completely impervious) to 100% (completely pervious). From what you can see, do the vector images overlay the raster image properly? To see this better, click on View-Arrange Layers. Right-click on both SHSOILS and SHSCHOOLS and click on "Layer Visibility" in each case. This leaves the image in the viewer, but does not show it. Click on "Apply." Are the rivers in the right place?

Imagine, for example, that you wish to locate a treatment-storage-disposal facility to serve businesses located on the Shaker Heights quadrangle. By Ohio law, these facilities need to be located more than 2,000 feet from a school. What areas on the quadrangle are more than 2,000 feet from a school? Load SHSCHOOLS into the viewer, and click on Vector-Enable Editing. You need to add an attribute to the attribute table. Click on Edit-Column Attributes, and click on the "New" button. Give the new attribute a suitable name (e.g. "exist"), and declare it to be a single-precision integer. Click on OK. Click on the column header for your new variable, and then right-click it to open hidden functions. Choose "Formula." Your formula is '1'. When you Apply this, the number 1 will be put into the column for each school. Close the Vector Attribute table. Do you know why you did this? (How does the "Search" algorithm work? You used in the previous exercise). Now choose Interpreter-GIS Analysis-Search. The input image is SHSCHOOLS. Be sure you list it as a point file. Give the output file a suitable name. Make sure you specify the raster cell as the same size as SHPERV.IMG or SHRESID.IMG (What is the raster size of these images?). For your search distance, bear in mind that 1 meter = 0.3048 feet. How many pixels, then, is equivalent to 2,000 feet? Check the box to "Use Attribute as Value", and choose the attribute you just added to the table and set equal to unity. Check OK. When you load the new file into the viewer, you will see that a considerable portion of the quadrangle meets the criterion.

Now let us add a second criterion: the site for the facility must be less than 50% residential. Load the image SHRESID.IMG into the viewer, clearing the viewer. This is an image showing an estimate of the percentage of developed land use as residential, from 0% (totally commercial) to 100% (totally residential). Open the Raster Attribute editor, and change the color of all areas above 50% residential to red (or some other equally notable color). The remaining areas, shown in shades of gray, are at least 50% commercial and thus are available for locating the facility. Now load the image showing areas more than 2,000 feet from a school into the same viewer. Open the Raster Attribute editor, and change the opacity of all areas greater than 2,000 feet to 0. Save this image. The areas now visible as gray-scale are potentially available as locations for your facility. **This image should be included in your portfolio for this unit.**

In Unit 2, you examined what land uses existed within a buffer zone around streams in the Gainesville, GA area. Let's look closer to home. What levels of development are found within 2,000 feet of streams in the Shaker Heights quadrangle? Choose Interpreter-GIS Analysis-Search. Use SHSTREAMS as your input image, and construct an image showing areas within 2,000 feet of streams. As before, you will have to add a field to the Vector Attribute table set to unity, and you will have to set the various

parameters of the search as in your previous instance. Load the new image into your viewer and use the Raster Attribute Editor to change the opacity of all areas *within* the 2,000 foot buffer zone to 0. Save this image. Then load SHPERV.IMG into the viewer and use View-Arrange Layers to place it on the bottom. You can now see the areas within the buffer. **This image should be included in your portfolio for this unit.**

To extract some statistics of land use around the streams in this quadrangle, click on Interpreter-GIS Analysis-Recode from the main Imagine Control Panel. Take the map you have just constructed as you input, and give a suitable name to your output. When you have entered your file names, click on "Setup Recode" and recode everything within the buffer zone as 1 and everything outside as 0. When this operation has finished, click on Vector-Raster to Vector. Your new raster image is your input. Give a suitable name to your output file (it can be the same). This operation will convert the raster image to a vector. Finally, click on Vector-Zonal Attributes. Your vector image is the one you have just made; your raster image is SHPERV.IMG. Choose the *union* of the two images, and choose to extract the Maximum, Minimum, Mean, and Standard Deviation. Open the Vector Attribute Editor on your 2000-foot buffer image. These attributes can now be found there. As you click on different polygons, can you see the relationship between the statistical values found in the attributes and what you know about land uses in the watersheds in question?

### Question to Consider

1. The images you will include in your portfolio for this unit show graphically how you might identify and communicate suitability of certain areas for particular sorts of development. Can you think of a better way to communicate this information? Are there maps that might be more illustrative? Are there tables you would like to have? What sorts of manipulations would you like to be able to do to do the best job of communicating your results?

### Portfolio

1. Your composite image of SHSCHOOLS, SHSTREAMS, and SHSOILS, showing the symbologies you developed for each of these images.
2. Your map showing areas in the Shaker Heights Quadrangle suitable for location of a hazardous waste storage, treatment, or disposal facility, highlighting areas more than 2,000 feet from a school and greater than 50% commercial development.
3. Your map showing patterns of perviousness of land within 2,000 feet of streams on the Shaker Heights quadrangle