GY461 Applied GIS I: Environmental
Yosemite Valley Project

I. Introduction

The first GY461 project is derived from the following scenario:

> You have just been hired as a GIS consultant by the National Park Service to produce a map of Yosemite Valley in Yosemite National Park, CA. The specifications for the map are as follows:
>
> 1. All features of the map should be based on two USGS 7.5 minute topographic quadrangles that cover the project area:
>
> Yosemite Falls (southern portion of project area)
> Half Dome (northern portion of project area)
>
> For this project you will be given the two topographic maps in raster TIF format but they will both need to be georeferenced into the NAD27 UTM zone 11 system.
>
> 2. The GIS map project should be based on the NAD27 UTM zone 11 system. Units will be in meters.
>
> 3. The project area is a rectangular area with UTM coordinates:

	UTM X	UTM Y
Southwest corner:	269000	4177000
Southeast corner:	276000	4177000
Northeast corner:	276000	4183000
Northwest corner:	269000	4183000

> The entire project area should be covered by a "Land Use" polygon topology layer with the following properties:

Feature	Fill Color	RGB values
Camping Area	Light green	201, 237, 069
Developed Area	Burgundy	214, 133, 137
Valley Area	Pink	255, 190, 232
Water Area	Cyan	151, 219, 242
Wilderness Area	Gray	156, 156, 156

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A second polygon topology layer "Water Bodies" will separately contain any body of water that has measurable area. These will consist of mainly the Merced River and several lakes within the Yosemite Valley area. Smaller streams will not be digitized. Use the following parameters for "Water Bodies":

Feature	Fill Color	RGB values
Water Area	Cyan	151, 219, 242

Areas in Yosemite Valley where multiple buildings are grouped together are to be considered a "developed" area and should be enclosed by a "Developed Area" polygon. Camping areas are to be enclosed by a polygon in a similar fashion.

The Yosemite Valley camping area is separated from the rest of the National park wilderness park by a "dash-dot-dash" black patterned boundary line. The Yosemite Valley camping area polygon will contain all of the "Camping Area" and "Developed Area" polygons.

4. An annotation layer named "Annotations" will be used to label all polygons. A black filled triangle will be used to mark developed areas, while a green filled triangle will be used for campground areas. Other polygons will be left unlabelled. All text labels will be black, and centered above the triangle.

5. An arc (line) layer named "Linear Features" will contain line work that delineates boundaries between polygons, and to display trails and roads. Use the following symbology:

Linear Feature	Line Pattern	ESRI Line	RGB
Campground boundary	dash-dot-dash	City (1)	(62,149,78)
Developed boundary	dash-dot-dash	Military Inst. (1)	(148,17,111)
Minor road	thick continuous	Highway Ramp (1)	(142,25,115)
Pipeline	dot on line	Aqueduct (4)	(0,0,0)
Primary road	very thick continuous	Highway (3.4)	(250,52,17)
Project boundary	thick continuous	Major Road (3)	(0,0,0)
Trail	dashed	Dashed 4:1	(0,0,0)
Water boundary	continuous	Coastline (.5)	(10,147,252)
Wilderness boundary	dash-short-dash	Dashed 1 long 1 short	(0,0,0)

6. A "Point Features" point layer will contain the corners of the project area. The corners will be marked with red crosses.

7. A point layer for each quadrangle ("Half Dome Reference Points" & "Yosemite Falls Reference Points") that contains reference latitude and longitude coordinates as magenta "cross-in-circle" symbols. These symbols are used to verify that the USGS topographic base maps are correctly georeferenced.

II. Step 1- Create the Reference Points Spreadsheets

In this step two spreadsheets will be created that contains the latitude and longitude coordinates of all of the 2.5 minute reference marks on the two USGS topographic base maps:

1. Half Dome
2. Yosemite Falls

Once completed each spreadsheet can be exported to a DBF file, and ArcGIS can then plot the coordinates as reference points. The layout of the "HalfDomeReferencePoints.xls" spreadsheet can be viewed in **Figure 1**. The spreadsheet in **Figure 1** contains the 16 reference points for the Half Dome quadrangle. You should note that the longitude values are all negative because California (an the rest of North America) is in the western hemisphere. In addition, the decimal longitude and latitude values are calculated with spreadsheet formulas. Note that points 1 through 12 outline the border of the quadrangle, and the last four coordinates (13-16) are the interior 2.5 minute crosses inside the quadrangle. Proceed to create a spreadsheet file equivalent to **Figure 1** and save it as "HalfDomeReferencePoints.xls" in the folder:

c:\ArcGIS_Data\{your initials}\Yosemite\
(Use File Explorer to create folder)

Note that the values in the Longitude and Latitude columns are calculated from formulas- make sure that you understand how to construct the formulas from our class discussion. Use the menu option "File" > "Save As" to save a copy of the spreadsheet in DBF file format to the above folder.

You will need to construct an equivalent spreadsheet for the Yosemite Falls map. To do this refer to **Figure 2**, which is a close-up view of the southwest corner of that quadrangle taken with ArcCatalog (later we will download this quadrangle to your folder and browse it with ArcCatalog). The first 12 latitude and longitude coordinates proceed counterclockwise from this point at 2.5 minute increments. Use this information to make a sketch of where the reference marks are located and label them with the appropriate values. Have your instructor check the values and then proceed to construct a spreadsheet and save it as "YosemiteFallsReferencePoints.xls", and then save a copy to:

c:\ArcGIS_Data\{your initials}\Yosemite\YosemiteFallsReferencePoints.dbf

ArcMap has the ability to project latitude and longitude coordinates into virtually any map projection system, therefore, it is relatively easy to use the latitude and longitude reference points DBF file even though the UTM system is being used for the map project At this time start ArcMap form the desktop. Open a new blank map project file, and then right click on "Layer" in the left window. Select the "General" tab from the window, and fill it in as in **Figure 3**. Next, select the "Coordinate System" tab and fill it in as in **Figure 4**. The coordinate system NAD 27 UTM zone 11N can be set by selecting "Predefined" > "Projected Coordinate Systems" > "UTM" > "NAD 1927" > "NAD 1927 zone 11N".

At this point you can now import the latitude and longitude reference points from the Half Dome and Yosemite Falls quadrangles. Select the "Add XY Data" from the "Tools" menu. When prompted for a file select the "HalfDomeRefPoints.dbf" file that should be in your "ArcGIS_Data" folder. Setup this dialog window as displayed in **Figure 5**. To choose the correct coordinate system, select "Geographic Coordinate Systems" > "North America" > "North American Datum 1927.prj". After selecting the "OK" button you should now see the reference points in the display window. You may have to increase the size of the symbol to see it easily- **Figure 6** contains the Half Dome reference latitude-longitude points as they should appear (point size = 18 points) after a successful import. Save the current project file as "YosemiteValley.mxd" to your folder.

III. Check/Add the Georeference Information of the Half Dome and Yosemite Falls Quadrangles

Whenever you download or are given a raster image, you should always check the georeferencing information before using it. Nothing is more frustrating than spending hours tracing linework from a raster base map only to discover too late that the georeference information (i.e. world file) was incorrect. First you need to download the raster data from the following web site:

http://www.usouthal.edu/geography/allison/gy461/YosemiteValleyProject.exe

The downloaded file is a self-extracting ZIP file, therefore, you should download it to you folder when prompted, and then use file explorer to double click on the EXE file, and that should extract these files to your folder:

o37119f5.tif: the Half Dome, CA topographic raster file
o37119g5.tif: the Yosemite Falls, CA topographic raster file

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Note that you did not receive any TFW files when the ZIP archive was extracted so you must georeference these 2 maps yourself before proceeding. You can quickly verify that this is a problem by loading the raster files and viewing them in ArcCatalog. Start ArcCatalog and navigate to your folder where you have downloaded the raster TIF files and then click on the Half Dome raster (o37119f5.tif). In the right window set the tab to preview, then use the zoom-in tool (magnifying glass with a "+" sign) to drag a window around the southwest corner (similar to **Figure 2**). Note that in **Figure 2** one of the x coordinate UTM tic marks can be seen- "269" just to the right of the corner. This tic mark should read very close to "269000" meters for the x coordinate if you make the cursor line-up with it. In fact, because of the missing world file the x coordinate reads "33702", which is clearly not a valid UTM x coordinate for this raster quadrangle. This means that we will have to manually georeference both the Half Dome and Yosemite Valley raster files. You can close ArcCatalog at this time.

Next we will georeference the Half Dome quadrangle. First, start ArcMap and load the "YosemiteValley.mxd" file if it is not already active. Right-click on the tool bar gray area and then select "Georeferencing" to turn on that tool bar. Now use the "Add Data" tool (yellow file icon with a black cross on it) to add the "o37119f5.tif" raster to the project file. You should still see the reference points imported in the previous step, but not the raster file. In the Georeferencing tool bar make sure that the active layer is "o37119f5". From the toolbar select the "Georeferencing" > "Fit to display" menu sequence. This will have the effect of forcing the raster to fit the geographic area of the reference points. The display should appear similar to **Figure 7**. Note that the reference point symbols have been changed to a cross-in-circle, the size is set to 18, and the color is magenta to increase visibility. Also note that currently none of the reference marks line up with the equivalent marks on the raster graphic. Using the zoom-in tool drag a window around the southwest portion of the map area so that you can see the southwest reference point and the southwest corner of the raster map. Using the "add control points" tool (2nd from right icon on the georeference tool bar) set a control point first on the southwest corner of the raster map and then on the southwest most control point. An example of this process is displayed in **Figure 8**. When you set the 2nd point the raster map will shift to align with the reference point. Proceed to align the other 3 corners and one of the interior reference marks for a total of 5 control points. Note that you can use any of the zoom tools on the "Tools" toolbar to adjust the display during the georeferencing operation. Remember that for maximum accuracy you need to zoom in to a window that barely contains the two points that you are attempting to align.

When you are finished generating the 5 control points click on the "View Link Table" tool on the Georeferencing tool bar (right-most tool icon). **Figure 9** displays the results of a 5-point georeferencing session with a RMS (root mean square) result of 2.4 meters. This value is the average fit of the 5 alignment points, and should be less than 7 meters for a 1:24,000 scale map so this session was successful. Select the "Save" button and save the georeference information to

"HalfDomeGeoRefFit.txt" in your folder. This text file can be used to recreate the georeference in case the world file is ever lost. Since the georeference information is successful we need to create the world file, which will always have the same primary name as the TIF raster but with a TFW extension. Under the "Georeferencing" drop-down menu select "Update Georeference". This writes the TFW file information back to the folder that the "o37119f5.tif" file was loaded from - these two files should from now on always be kept together in the same folder.

To verify that the world file works correctly remove the "o37119f5.tif" file from the project by right-clicking on its name in the left layer window and then selecting "remove". You should realize that this action does not erase the file, it simple removes any reference to it from the project file. Now use the "Add data" button from the main button bar to add the "o37119f5.tif" file to the project file. This time, because there is a matching "o37119f5.tfw" file in the same folder, the raster file will be aligned (i.e. georeferenced) with the control points. Congratulations! You have just completed your first georeference operation. Now repeat the georeference procedure for the Yosemite Valley quadrangle, but you will want to remove the Half Dome reference points to reduce clutter and prevent confusion. When you have successfully georeferenced the "o37119f5.tif" and "o37119g.tif" raster files save your project file and have your instructor review your results before proceeding.

Although you have created a "world file" (o37119f5.tfw) that aligns the raster file with the UTM coordinate system, you have not actually indicated to ArcGIS the name of that coordinate system. This is why if you keep working with the raster file you may see error messages stating that the raster has an unknown coordinate system. To formally set the coordinate system follow these steps:

1. Save an close the ArcMap "Yosemite Valley" project. You must do this because ArcMap "locks" any other application from modifying any file that it uses in a project.

2. Start ArcCatalog and navigate to the folder that contains the georeferenced raster image. Highlight the file name with a left-click, and then right-click on the name and select "Properties" from the popup menu.

3. Scroll down through the properties grid until you see "spatial reference" system. Click on the "unknown" and set the coordinate system to UTM NAD27 zone 11.

4. Close ArcCatalog, start ArcMap and load the project file. You should no longer receive any error messages about an unknown coordinate system for the raster file.

IV. Create a Geodatabase to Contain the Yosemite Valley Project Map

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For a variety of reasons the new Geodatabase file format is superior to the older shape file format used by earlier versions of ArcGIS so we will be using that format as much as possible for this project. You should know that the Geodatabase file format is nothing more than a Microsoft Access database file that contains all of the mapping information in a single file, but with many internal tables. One of the biggest advantages of the new format is that it dramatically reduces the number of files needed for a detailed mapping project so its easy to keep the project properly organized. On the other hand, its takes a bit more time to initially setup the Geodatabase file before you can use it. Before we create the file we need to plan what exactly will be stored in the Geodatabase. Below are the layers that will in the Geodatabase, and the different categories that each feature may be classified as:

Layer (Feature Class)	Geometry	Categories
Land Use Features	Polygon	Campground_Area, Developed_Area, Valley_Area, Wilderness_Area
Water Bodies	Polygon	Water_Area
Linear Features	Line	Campground_Boundary, Developed_Boundary, Minor_Road, Primary_Road, Project_Boundary, Trail, Water_Boundary, Wilderness_Boundary
Point Features	Point	N/A
Annotations	Annotation	Campground, Developed

When creating a feature class (i.e. a layer) you should also define a field named “Type” that will contain the classification label for each polygon, line, point or annotation item in the map project. To create a geodatabase start the ArcCatalog application from the desktop and navigate the folders in the left window until you can highlight your Yosemite project folder. Use the menu sequence “File > New > Personal geodatabase” (**Figure 10**) to create and name the database. You should note that the project folder “YosemiteValley” is highlighted in the left window before this menu selection is made. The default name is “New Personal Geodatbase.mdb”. Change the name to “YosemiteValley.mdb”. The “.mdb” extension is used because this file is a Microsoft Access file. After renaming the geodatabase, highlight it in the left window by left clicking. Then use the menu sequence “File > New > Feature Class” (**Figure 11**) to begin creating a new feature class. We will create the “LinearFeatures” feature class first. Fill in the first two window dialogs as displayed in **Figures 12** and **13**. The 3rd dialog is where you must specify the type of geometry for the feature class, as well as its coordinate system and XY domain. For this feature class the geometry needs to be changed from the default “Polygon” to “Line”, so click on “Geometry” and set the field to “Line”. At this point verify that your dialog window appears like **Figure 14**. Now you need to set the coordinate system to UTM NAD27 zone 11, the system used by the 2 base maps. Find the cell containing “Spatial Reference System” in the left column, and then click on the right cell on that row containing ellipses (i.e. several dots). This will generate the **Figure 15** dialog window. Click on the “Select” button to

begin selecting the proper spatial coordinate system. Proceed to make the selections indicated in **Figures 16, 17, 18** and **19** to set the spatial reference system to UTM NAD27 zone 11 north. After selecting the "Add" button the dialog should appear similar to **Figure 20**. Now select the "XY domain" tab in this dialog and set it to the values in **Figure 21**. Selecting the OK button will now set the spatial reference correctly and return you to the original dialog. Now you should add a "Type" field to this feature to hold your classification data- simply enter "type" below the "", and set the type of field to "text". The default settings for the "text" field are fine for our project. The dialog should now appear like **Figure 22.** Select the "Finish" button to create the new feature class in the geodatabase. ArcCatalog will now display the "LinearFeatures" feature class as a sub-folder in the main window.

You can now use ArcCatalog to create the additional feature classes needed for this project:

Feature Class	Geometry	Classification Field names & Type
LandUseFeatures	Polygon	Type (Text)
WaterBodies	Polygon	Type (Text)
PointFeatures	Point	Type (Text)
AnnotationFeatures	Point	Type (Text); Label (Text)

All of the above feature classes (i.e. layers) should have exactly the same spatial reference coordinate systems and XY domains. Note that in the **Figure 20** Dialog window there is a "Import Settings" button option to "grab" the settings from an existing feature class. It's a good idea to import the settings from the first "LinearFeatures" feature class when creating new features so use this button to import the spatial reference and XY domains.

V. Add (Sketch) Linear Features to Map Project

Start ArcMap and load the "YosemiteValley.mxd" project file. Both of the raster DRG files should display - at this time turn off the "Yosemite Valley" quadrangle (o37119g.tif) so that only the Half Dome quadrangle is displayed (uncheck the small square immediately to the left of the raster file name in the layer window). Our initial step will be to define the boundary of the project area as given to us by the NPS specification at the beginning of this document. We will use the corner UTM coordinates given to us to exactly draw in the border. Using the add data button from the main ArcMap toolbar add all of the feature class layers that you defined with ArcCatalog. After adding these feature layers the ArcMap window should appear like **Figure 23**.

In order to add or edit data to the geodatabase you must be in edit mode, and to do that you must have access to the editor toolbar. At this time right-click on the gray toolbar area above the ArcMap display window. If the editor toolbar is unchecked, check it at this time. You can leave the editor toolbar in "floating" mode (default), or click and drag the toolbar to dock it (your

preference). The editor toolbar is visible and docked on the left side of the window in **Figure 23**.

Look for the drop down list titled "Editor", and select "Start Editing". This selection puts ArcMap in edit mode. You will see the cursor change to a triangular shape when the pointer is in the main window area. At this time it's important to understand how ArcMap is working:

1. When you select "File > Save" you are saving the mxd project file that contains links to other files (raster, geodatabase, etc.), but not the actual data.

2. When you select "Editor > Save edits" you are actually saving additions/changes that you have made to the geodatabase file (mdb).

At this point you need to add a reference point into the point feature layer that is the southwest corner of the project area. We know the exact UTM coordinates because they were in the original specifications so we want to be able to type in the coordinates. Make sure the point features layer is highlighted in the layer window, and set the "Task" box in the Editor toolbar to "Create new features", and make the "Target" the "point features" layer. Click on the sketch tool in the Editor toolbar and move the pointer to the map area. The pointer will change to a blue circle and cross combination. Right-click the map area to activate the context popup window, and then left click on "Absolute XY". A window will popup requesting the X and Y coordinates- enter the southwest corner coordinates and then press "enter". A highlighted (blue) marker will appear on the map. You may wish to turn off the raster layer to make the point more visible. In addition you should change the point symbol to make it more visible- double click on the point symbol in the layer window and select a marker that is 18 points in size, magenta color, and is a circle & cross combination. Proceed to use the same method to enter the other 3 corner points. After finishing make sure that you select "Editor > Save edits", and then clear the highlighted last point with "Selection > Clear Selections". Also, right-click on the point feature layer name and select "Zoom to layer", and then turn the Half Dome raster on. Your display should appear similar to **Figure 24**.

You are almost ready to sketch the project area border but first you should set up the snapping environment so that when you insert a vertex for the border line it goes exactly on top of the reference point (if your not in edit mode set that first). Select "Editor > Snapping" from the editor toolbar. A new window will appear on the screen- adjust it so that it appears like **Figure 25**. Note that the snapping environment has the "snap to" vertex set for the point feature layer that contains the corner reference points, and for any newly sketched vertices. Set the "Task" option in the editor toolbar to "Create New Features", and the "Target" to the "Linear Features" layer. Now select the sketch tool from the editor toolbar and move it close to the southwest corner reference point. When the pointer "snaps" to the center of the point left-click to set the

initial vertex. Proceed to set corner vertex points for the border at the SE, NE, NW and back to the SW corner to complete the line making sure that the pointer "snaps" to the corner reference point each time. Right-click and select "Finish Sketch" to finish the border. You should now see the border connected to all 4 corner points. Note that the border is highlighted in cyan because you just created it. Be careful at this point not to inadvertently left click on the map- this will start a new line. Switch from sketch mode to edit mode by selecting the arrow tool (i.e. the edit tool) left of the sketch tool on the editor toolbar. Move the pointer over the still highlighted border, and right-click to pop up a context menu. One of the items on the menu will be "Attributes"- select this and then left click in the "Type" field to change it from "<Null>" to "Border". The result should look similar to **Figure 26**. Next right-click on the "Linear Features" layer and select "Properties" form the context menu. Select the "Symbology" tab, and then click on "Categories" in the left side of the dialog window. Next left click on the "Add Values" button in the lower left portion of the window, select "Border", and then click "OK". This will add the "Border" line category to the legend for that layer, and give it a default color and line type. Double-click on the line symbol in the "Symbol" column (left of the word "Border", and then set the line to a black color and 2 point width. Now click "OK" on the symbology dialog window, and then remove the highlight still on the border with "Selection > Clear selected features". You should now see a black border aligned with the corner reference points similar to **Figure 27**.

You can now proceed to sketch all of the remaining line work. Remember to use the snapping modes to always snap line work to a vertex, end, or edge when necessary. For example, you need to start each bank of the Merced River exactly on the project border so the beginning and ending vertex of each bank will be a "snap" to the edge of the border. If you don't understand this concept at this point seek help from your instructor- it's very important that you fully understand the snapping concept before investing a lot of time sketching the line work. Make sure that you classify each line as you add it to the project according to the labels specified by the NPS. Each time a new category is added to the linear features layer add the matching legend properties as per the specifications in the introduction. Note that you will almost surely need some direction from your instructor on exactly which water bodies have enough "area" to be considered polygons, and how to define the developed and campground areas. Make sure you understand the goals of the project before investing a lot of time sketching line work.

VI. Add (Sketch) Polygon Features to Project

Before attempting this step verify that you have completed sketching all of the wilderness, campground, developed and water area boundaries. It's a good idea to let your instructor check the line work before proceeding. These linear features will be used as "cutting edges" to partition a starting single polygon into the various polygon areas specified in the introduction. Basically the wilderness boundary separates the Yosemite Valley area from the rest of the National Park

wilderness. Within the Yosemite Valley polygon groups of man-made cabins and other structures will define the developed areas. Campground areas are defined by typical minor road patterns and labels on the raster base map. Water polygons are the Merced River and lakes of significant area. Single-line small streams are not to be sketched as polygons.

The first step in the polygon creation process is to create the initial project polygon anchored at the 4 corner reference points. If you are not in edit mode, activate it at this time, and use "Editor > Snapping" to bring up the snapping window. Make sure that snapping to point feature vertices is checked. Set the editor task to "Create new features", and the editor target to polygon features. Select the sketch tool and set points at all 4 corners and then right-click and select "Finish sketch". You should now see the entire project area fill with a default color. If not, something is wrong so seek your instructor for help.

The new polygon is highlighted at this time (boundary is cyan) so it makes sense to go ahead and label it at this time. Since most of the project area is "Wilderness_Area" we will use this label. Select the edit tool and right-click inside the polygon. Change the "Type" field value to "Wilderness_Area". Use the layer properties dialog window to setup a legend for polygon features that includes a "Wilderness_Area" category that has a gray color (RGB= 156,156,156) with no outline (see NPS specs). After you clear the selection highlight your ArcMap window should appear as in **Figure 28**. Make sure that you use "Editor > Save Edits" to save your new work.

In this next step we will use the wilderness boundary line work as a cutting edge to cut up the initial project polygon into wilderness versus valley areas. Using the "zoom in" tool zoom so that you can see one of the wilderness boundary lines in some detail. In edit mode use the edit tool to left click on the initial polygon. If you zoomed to where you can see the edge of the initial polygon it will highlight at this time. Now set the task to "Cut polygon features" and the target to "Polygon features". Select the sketch tool, and move the cursor over the wilderness boundary line in the linear features layer. Right-click on that line, and select from the context menu the "Replace Sketch" option (**Figure 29**). This essentially copies the wilderness boundary line as if you had just sketched it. Now right-click again and select "Finish Sketch". ArcMap should verify that the polygon is cut into 2 separate polygons by highlighting along the wilderness boundary (i.e. both polygons are now highlighted). Your window should appear similar to **Figure 30** at this point. Proceed to use this method to "slice and dice" the initial polygon until all of the wilderness versus valley polygons are defined. Then create a legend category for the Land Use polygon features layer that includes the valley area specification. Your map should now appear similar to **Figure 31**. You should now proceed to define all polygons from the linear features line work. Don't forget to classify each polygon with an attribute, and when you add a new category define it in the legend as per the specifications at the beginning of this document. Periodically use "Editor > Save Edits" to save your geodatabase work.

As you define Land Use polygons with the "Cut Polygon Features" task assign the label "Water_Area" to any water body polygons. These polygons will be moved to the "Water Bodies" polygon features layer in a later step. Note that there are 3 islands within the Merced River that should have a boundary around them to use as a "cutting edge". The islands will be classified as "Valley Area".

VII. Adding Annotation

The names of campgrounds and developed areas should be added as items in the "Annotation Features" layer. Remember that when the annotation feature class was defined you added a "Label" text field in addition to the "Type" field. The "Type" field should contain either "Campground" or "Developed", whereas the "Label" field should contain the actual name of the area being labeled. For example in the west portion of Yosemite Valley you will find a developed area named "Yosemite Lodge" - use this name from the base map to label the developed area. To start the process put ArcMap in edit mode and then zoom in to the area that needs an annotation label. Set the task on the editor toolbar to "Create New Features", and set the target to "Annotation". Select the sketch tool and then place the cursor where you want the annotation to appear. Left click to insert a marker symbol. While the new symbol is still highlighted, right-click and then open the "attributes" option from the context menu. Fill in the "Type" and "Label" field as shown in **Figure 32**. Even after filling in the "Type" and "Label" fields and closing the attribute table you will still not see a label plotted next to the symbol because the labeling of this layer has not yet been activated. To activate labels, right click on "Annotation Features" and select "properties" from the popup menu. Then select the "Labels" tab, and set the values as displayed in **Figure 33**. Make sure that the label field is set to "Label". Click on the "Placement Properties" button and select the "Placement" tab. Set the placement to the "Top center" option as displayed in **Figure 34**. After clicking "OK" to all open dialog windows you should then see labels plotted above the symbol markers. As discussed in the introduction, set the campground symbology to a green solid triangle (size=18), and developed areas should be marked with a black solid triangle. To make labels more visible you may need to give the labels a background color to make them stand out against the base map. Unfortunately the steps to activate this feature are too numerous to list here so it will be demonstrated in class.

VIII. Editing Polygon and Line Topology

Several situations may develop in the process of building this project that may require special editing techniques. These are discussed in separate sections below.

Moving Vertices

After sketching lines and/or polygons you may discover a mis-alignment compared to the base

map features. Generally this can be corrected by simply moving one or more vertices to new positions. Consider **Figure 35**. In this window the editor toolbar has already been set to a task of "Modify Feature" with target set to "Linear Features". Using the Edit Tool left click on the line feature that is mis-aligned. The entire line will highlight with a blue (cyan) color with vertices displayed as green squares (**Figure 35**). To move the vertex position the cursor over the green square and drag (hold down the left mouse button while moving the mouse) the vertex to a new position and then release the left button. Click elsewhere or use "Selection > Clear Selections" to force ArcMap to redraw the line.

Inserting Vertices

You may find that you need to insert extra vertices along a line feature to "smooth" it out so that it matches the base map. To do this set the current task on the editor toolbar to "Modify Feature" and the target to the "Linear Features" layer. With the edit tool left click on the line to highlight it. All of the vertices will also highlight as green squares. At any point between 2 existing vertices right click to popup the context menu and then select "Insert vertex". A new vertex will be inserted at the point where the right click was made.

Merging Features

Any two items of the same geometry can be merged using the editor toolbar. For example, if you need to merge two adjacent polygon features set the current task to "Modify Feature" and the target "Polygon Features". Left click on the 1st polygon, and then hold down the shift key and left click on the 2nd polygon. Click on the "Editor" drop down menu and select "Merge". The two items will be merged.

Splitting a Line Feature

To split an existing linear feature set the current task to "Modify Feature" and target to "Linear Features". Left click on the line to split so that it is highlighted. The vertices should also highlight as green squares. Select the "Split" tool (the tool immediately to the right of the current target), and then left click on the line to split it at that point. If you wish to split the line exactly at a vertex you should set a snap mode before selecting the split tool.

IX. Layout and Printing

Preparation for printing a hard copy begins by selecting the "File > Page and Print Setup" menu options. **Figure 36** displays the settings to use for this dialog. Note that you should choose the HP 2600n color laser printer (i.e. the one in the 137 lab), and set the orientation to landscape.

Also, you should make sure that ArcMap is using the printer media size, and that it will scale map elements proportionally to changes in media size (these check boxes are "checked" in **Figure 36**).

After the page and printer setup is complete, select "View > Layout View" to begin constructing the layout. The layout is intended to show you the positional relationship between the printer media and the elements of the map including the legen, scale bar, etc. Initially you will see an outer exterior rectangle with a "drop shadow" behind it. This represents the output media sheet. Immediately inside this rectangle is a light gray rectangle that represents the "hardware" margin of the media. If any map elements fall outside this rectangle they will be truncated against that border (i.e. the printer cannot plot outside this border). The interior rectangle that contains the map is the initial frame window that ArcMap estimates based on the data view window scale and the media size.

Right click on the map frame rectangle and select "properties" from the popup context menu. Select the "Data Frame" tab, and then set the scale from "automatic" to 1:48,000. Next select the "Grid" tab and then add a grid using the "New Grid" button. This grid should be a "Graticule" grid (i.e. displays latitude and longitude reference lines). Set the label format to "Degrees, minutes, seconds", and set the latitude and longitude intervals to 0.025 increments.

At this point you can begin to add the below elements using the "Insert" menu:

1. North Arrow
2. Scale Bar
3. Scale Text
4. Title
5. Legend

Try to match the **Figure 37** layout as close as possible and then save your project file. You may then proceed to print a hard copy with "File > Print". It is a good idea to let your instructor review the layout before actualy sending it to the printer. Also make sure that you send this print job to the HP Color Laser 2600n printer- not the HP Designjet 5500 plotter.

GY461 Applied GIS I: Environmental
Yosemite Valley Project

Yosemite Valley Queries (Turn in this page with maps)

Name: _____

The NPS representative that requested the Yosemite Valley map also needs the following questions answered after the digital GIS version is completed. You should use the query builder option combined with the calculate values and statistics options in the attribute tables to produce the below answers:

1. How many acres are contained within the:
   Campground areas:_____
   Developed areas: _____
   Yosemite Valley area within project boundary: _____
   Wilderness Areas within project boundary: _____

2. The NPS needs to replant the all of the campgrounds with a disease-resistant turf grass, however, doing so is not cost-effective unless the individual area to be re-planted is larger than 12 acres (i.e. exclude any area <= 12.0 acres). How many acres of new grass sod should the NPS order? _____

3. How many miles of minor roads are present in the Yosemite Valley area? _____

4. How Many Miles of trails are located within the study area? _____

5. Which campground area has the largest acreage? _____

6. Excluding the Radio Facility and Water Tank Area, which developed area has the smallest acreage? _____

7. Use a definition query to print a map of the project area displaying only the developed and campground areas in the land use feature class (i.e. other polygons in the land use polygon feature class are suppressed). All other features should print as in the initial project map.