Exercise 1: Introduction to ArcGIS Software
Synopsis of Class 3, GIS in Water Resources, Fall 2012

In this class, you are going to see a "hands-on" demonstration of how to use ArcGIS. At the end of this exercise, you should be able to create a map of a set of observation sites, create a graph of data measured at those sites, present the map and the graph in a single-page Word Processor document, and share your map package in ArcGIS Online. Graphs or charts can be created in ArcGIS, but nicer ones can be created in Excel, so we'll do the graphing task both ways so that you can compare the results.

In ArcMap, there are two environments in which you deal with map data: the data view and the layout view. The *data view* is used nearly all the time for creating map displays and querying the information when you want to explore the information yourself. The *layout view* is used when you want to publish a formal map with a legend, scale bar, north arrow, title, and so on.

In the data view in ArcMap, by default the contents of the map are displayed on the right hand side, and on the left hand side is a *table of contents*, which lists the map *layers,* presented in *data frames*. In this exercise, you'll deal first with thematic layers that are simple feature classes showing points of measurement of pan evaporation and polygons of the Texas counties and state boundary. Each data frame has *properties* which define the type of information it contains, the coordinate system, and how the data should be symbolized or displayed. ArcMap distinguishes which layers are of points, lines and areas, and orders them with points displayed first, then lines, then areas, in the table of contents. This defines the order in which they are presented in the map display. When we add a GIS layer, the data frame will acquire the coordinate system parameters that are embedded in that map layer. ArcMap can display different layers that have different coordinate systems/projection 'on-the-fly projection' which means that it can display data stored in one coordinate system as if it were in another coordinate system. The new projection is used for temporary display and query purposes only; the actual data is not altered.

A tab in ArcMap invokes ArcCatalog, which is like a Windows Explorer for geographic data. This enables you to investigate the contents of a folder of geographic data and to *preview* each layer individually before the data are displayed in ArcMap. There is a *geography preview*, which shows a map of the data and a *table preview*, which shows its attributes, the tabular data. Layer *properties* provide a description of the layer, a definition of its spatial coordinate system, and the specification of the format and name of each of its attribute fields. You can see how GIS information is tightly controlled – this is necessary so that information from disparate sources can be synthesized in a proper manner.

New data can be constructed within ArcCatalog. The process begins by defining an empty instance or template of the data structure that is desired (e.g. shapefile or geodatabase), and then loading information into the template from external sources. Within a geodatabase, a *feature dataset* is a folder containing a set of feature classes that have a single coordinate system which is applied to all information as it is loaded. A coordinate system has two parts – horizontal coordinates and vertical coordinates. A *horizontal coordinate* system defines the latitude and longitude (ϕ, λ), or easting and northing (x,y) coordinates. A *vertical coordinate* system defines the values of the elevation, or z, coordinate.

In addition to point, line and area feature classes, another kind of map layer what we will work with in this class is a basemap published in ArcGIS Online. A *basemap* is a precompiled image map that synthesizes authoritative information from many sources using a single cartographic scheme across multiple spatial scales from global to local. This method of multiscale map display was pioneered by Google Earth and has been adopted by ESRI for publishing many different kinds of maps, such as topography, soils, roads, and orthophoto imagery. Behind the scenes, this rapid map display is constructed by a *caching* process in which ArcGIS Server is used to draw a map at many different scales, in which each map is divided spatially into tiles and stored on disk. When you call for display of a particular area of the earth at a particular map scale, the server recalls and displays just the processed tiles needed to cover that area at the required resolution. Basemaps are very helpful for providing spatial context for GIS data so that you can see what else is in the vicinity of your data.

Once you have a feature class displayed on a map, you will want to find out more information about them. A simple way to do this is just to click on a feature with the "identify" tool, and a popup window gives the attributes of that feature. A more complex method is to make a *feature selection* according to location or attribute criteria. In doing a *selection by attributes*, you open an attribute table and construct a query on a particular attribute field so as to select a particular feature (such as by selecting its name), or a range of features (such as all polygons which have area larger than a specified value). In doing a *selection by location*, you either select a set of features by manually drawing a box around them on the screen, or you nominate one feature class as the target layer, and a second as the source layer, and apply spatial rules to select features from the target layer that have a spatial relationship with the source layer (such as "all features lying within…"). This functionality for querying by location and attribute makes GIS a powerful tool for examining spatial and location dependent information.

Graphs or charts can be developed within ArcMap by plotting values shown in the attribute table of a feature class. Data from features selected in a map, are also shown as being selected in the resulting graph, so the graph and the map are dynamically linked. This is useful because it allows you to see where a particular (e.g. anomalous) value comes from. Excel provides the capacity to develop nicer looking charts, and Excel has the capability to read the attribute tables of an ESRI shape file which are stored with the extension .dbf, which is short for dBase file. ArcGIS can also read Excel worksheets as tables directly. In this way, Excel and ArcGIS can both be applied to the same data, and each can be used for the purpose for which it is best suited – ArcGIS for making maps and examining geographic relationships, and Excel for doing tabular calculations and plotting graphs.

A formal map is created using a *map layout*, which involves a separate set of menu choices than in the data view. These include tools for positioning elements of the layout, such as the map itself, the north arrow, legend, scale bar, title, and any ancillary items that you may need in your map. Map Layouts can be exported from ArcGIS as files (i.e. emf), or they can be screen captured from ArcMap, and pasted into a Word document, and similarly graphs from Excel can be placed into a Word document. In this manner, you can create a report containing both a map and a chart as this exercise requires. Once this is done, you can share your map and data in ArcGIS online. To do this, you first need to sign in to your account in ArcGIS Online from ArcMap. Under File tab, select 'share as', and choose the 'map package'. It is important to fill out detailed information about your map document before you publish your map package.