Defining a Projection/Coordinate System in ArcGIS using ArcToolbox

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There are many shape files that have no explicit projection defined for them (i.e., they have no .prj file telling the ArcGIS program what projection the layer is in). For these layers to work properly in ArcMap, it is necessary to define the projection explicitly using the instructions below. But remember, all shapefiles are in some projection, whether it is defined for them or not! This is important to understand before defining a projection for a shapefile. You cannot pick just any projection, or the projection you would like it to be in. You have to know what projection it is actually in, and then define it as such. If you do not know what projection the shapefile is in, you need to look for metadata or contact the data producer. You can also try guessing, but it is much more efficient to know for sure from the producer of the data.
To define a projection for a shapefile, you should use Arc Toolbox. You need to have write permission to the file to do this. The process described below will add a new file with the extension *.prj* to the GIS data layer that must accompany the rest of the files that go into a shape file.

The Define Projection tool works both from the ArcCatalog and the ArcMap interface. You can have the file open in ArcMap while using the tool in ArcMap or in the Arc Catalog Window within Arc Map. However, you CANNOT have the file open in ArcMap while using the tool in ArcCatalog. Use one interface or the other, but don't have the file open in both!

1. Open *Arc Toolbox* (in *ArcMap* or *ArcCatalog* choose **Geoprocessing-Arctoolbox** (or click on the red *Arc Toolbox Window* icon)
2. Go to **Data Management Tools – Projections and Transformations** and click on **Define Projection**
3. In the *Define Projection* dialog box under *Input Dataset or Feature Class*, click on the folder icon to navigate to the folder where your shape file is located and click **Add** (if you are in ArcMap and the shape file is already displayed, you can simply click on the little arrow and choose the open file)
4. In the *Coordinate System* box, click on the icon to the right – this will bring up the *Spatial Properties* dialog box.
5. There are two common methods for selecting a coordinate system:
   1. If you have other files on the computer with the target coordinate system already defined, you can click on the **Import** button, navigate to the defined shape file and have it use that same coordinate system for the undefined shape file as well (find it and click **Add**)
   2. Or press **Select -Projected Coordinate System** and choose the coordinate system to apply - for MassGIS data, you would choose *Projected Coordinate System - State Plane - NAD 83 - NAD 83 State Plane Massachusetts Mainland...*, then click on **Add**.

If you see a yellow warning icon that the layer already has a projection defined, click **Cancel** and check that a) the file is not already open in another window or session, and b) that it has no projection defined yet (i.e., no .prj file exists).

6. Assuming all seems correct, press **OK** and wait for the process to finish. Your GIS data layer is now defined, and will appear in your layers.