

*** Files needed for exercise: MD_FQHCs.dbf, MD_Counties.shp, MD_Hospitals.dbf

Goals: The goals of this exercise are to practice using projection tools from ArcToolbox and to work through common projection issues and solutions in ArcMap.

Skills: After completing this exercise, you will be able to display point level data from a table, define projections, project data, and adjust the data frame coordinate system.

Viewing Spatially Referenced Data in a Table

- 1. Open a **new blank map** in ArcMap.
- Click the Add Data button . browse to the Working_with_Spatial_Data_Exercise_Data folder and add *MD_FQHCs.dbf*. Right click on the file in the Table of Contents and select Open to view the data. This is a table of federally qualified health center service locations in the state of Maryland.

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Ν	ID_FQHCs				×
Г	FACILITY_N	CMS_PROV_5	CMS_PROV_6	CMS_PROV_7	(
E	GOLDSBORO MEDICAL CENTER	316 Railroad Ave	Goldsboro	MD	2_
E	DENTON MEDICAL CENTER	609 Daffin Ln	Denton	MD	2
L	FEDERALSBURG MEDICAL CENTER	215 Bloomingdale Ave	Federalsburg	MD	2
E	TOTAL HEALTH CARE, INC	1501 Division St	Baltimore	MD	2
L	PARK WEST MEDICAL CENTER, INC	319 W Belvedere Ave	Baltimore	MD	2
L	PARK WEST MEDICAL CENTER, INC	3319 W Belvedere Ave	Baltimore	MD	2
L	FAMILY HEALTH CENTERS OF BALTIMORE	631 Cherry Hill Rd	Baltimore	MD	2
L	TRI-STATE COMMUNITY HEALTH CENTER	130 W High St	Hancock	MD	2
L	HIGHLANDTOWN COMMUNITY HEALTH CENTER	3700 Fleet St Ste 200	Baltimore	MD	2
L	THREE LOWER COUNTIES COMM SERVICE INC	30413 Mount Vernon Rd	Princess Anne	MD	2
L	MATILDA KOVAL MEDICAL CENTER	2323 Orleans St	Baltimore	MD	2
L	BELAIR ROAD FAMILY HEALTH CENTER	3120 Erdman Ave	Baltimore	MD	2
L	GREATER BADEN HEALTH SERVICES	13605 Baden Westwood Rd	Brandywine	MD	2
L	NANJEMOY HEALTH SERVICES	4375 Port Tobacco Rd	Nanjemoy	MD	2 🔻
Ľ	(III.			•	•
	I → → I 📄 💷 (0 out of 84 Selected)				
1	/ID_FQHCs				

3. Each record has spatial information attached; the address, city, state, zip, latitude and longitude are geographic references, meaning that these facilities can be located in space.

Displaying X/Y Data

1. You can turn this tabular data into a spatial dataset. There are many ways to do this, one way is to right-click on the *MD_FQHCs.dbf* table and choose **Display XY Data.** This will use the latitude and longitude coordinates in the table to locate the FQHCs in space.



2. In the window that opens, ArcMap will have already selected X for the X Field and Y for the Y Field. It also says the coordinate system is unknown. You should know (from checking data documentation from the data source) that the coordinate system for the data is World Geodetic System (WGS) 1984, so let's tell ArcMap this. Click on the Edit button.

Display XY Data		×			
A table containing X and Y coordinate data can be added to the map as a layer					
Choose a table fr	rom the map or browse for another table:				
MD_FQHCs	s	- 6			
Specify the field	ds for the X, Y and Z coordinates:				
X Field:	X	•			
Y Field:	Y	•			
Z Field:	<none></none>	•			
Coordinate Sys Description: Geographic C Name: GCS	stem of Input Coordinates Coordinate System: _WGS_1984	*			
Show Detai	ils Edit.				
$\boxed{\ensuremath{\mathbb V}}$ Warn me if the resulting layer will have restricted functionality					
About adding XY	data OK Ca	ncel			

 In the Spatial Reference Properties window, browse in the folder tree to Geographic Coordinate Systems > World and select WGS 1984. This should change the current coordinate system box to WGS 1984. Once you have verified this, click OK.



Spatial Reference Properties	- ×-
XY Coordinate System	
〒 -	
ITRF 2000 ITRF 2005 ITRF 2008	*
NSWC 9Z-2 WGS 1966 WGS 1972	
 WGS 1972 TBE WGS 1984 	
Current coordinate system:	· ·
GCS_WGS_1984 WKID: 4326 Authority: EPSG	*
Angular Unit: Degree (0.0174532925199433) Prime Meridian: Greenwich (0.0) Datum: D_WGS_1984 Spheroid: WGS_1984 Semimajor Axis: 6378137.0 Semiminor Axis: 6356752.314245179 Inverse Elattening: 298.257223563	
	~
OK	Cancel

- 4. Back in the Display XY window, you should see that the coordinate system of input coordinates is now WGS 1984 instead of unknown. Click **OK**.
- 5. The data points should now be displayed on the map in a layer in your Table of Contents called *MD_FQHCs Events*. This is a temporary layer; you need to make it permanent.
- 6. Right click on the events layer and go to Data > Export Data. You should choose to Export: All features, with this layer's source data. Click the folder icon and save your shapefile with an appropriate name in your exercise data folder. Click OK. This will save the data as a file on your computer, instead of a temporary file saved only in the computer's memory.



Export Dat	a 🗾
Export:	All features
Use the sa	ame coordinate system as:
this lay	ver's source data
🔘 the da	ta frame
the fea (only a	ature dataset you export the data into pplies if you export to a feature dataset in a geodatabase)
Output fe	ature dass:
R:\Proje	cts\CDC\GIS_Surveillance\Phase_9\Training_content\GISI_
	OK Cancel

 Choose Yes to add your new layer to the Table of Contents. At this point, you no longer need the original .dbf file, or the events layer you made previously. Right click on MD_FQHCs.dbf and MD_FQHCs Events and Remove them.

Defining Projections

Next, add the *MD_Counties* shapefile from the exercise data folder. You should get a pop up message saying the data has **unknown spatial reference information**. This may happen if the data did not have any coordinate system information originally or if the .prj file was lost or deleted. The data will display, but this should alert you that you need to *define the projection* for this piece of data before you use it for any analysis or mapmaking. Click **OK**.



🔔 Unknown Spatial Reference	×
The following data sources you added are missing spatial reference information. This data can be drawn in ArcMap, but cannot be projected	ed:
MD_Counties	^
<	
Don't warn me again in this session Don't warn me again ever OK	

2. To define a projection, you will use **ArcToolbox**. If ArcToolbox is not visible on your ArcMap

layout, you can open it by clicking the solution. ArcToolbox has hundreds of different tools. For now, let's look for the **Define Projection** tool. It is located under **Data Management Tools**, in the **Projections and Transformations** toolset.

ArcToolbox	Π×
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🗄 🗞 Attachments	
🗄 🗞 Data Comparison	
표 🗞 Distributed Geodatabase	
🗄 簐 Domains	
🕀 🗞 Feature Class	
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🗄 🗞 Fields	
표 🗞 File Geodatabase	
🕀 🗞 General	-
🗄 🗞 Generalization	=
표 🗞 Geodatabase Administration	
표 🗞 Geometric Network	
🗄 🗞 Graph	
🗄 🗞 Indexes	
🗄 🗞 Joins	
🗄 🗞 LAS Dataset	
🕀 🗞 Layers and Table Views	
🗄 🗞 Package	
🗄 🗞 Photos	
🖃 🗞 Projections and Transformations	
🕢 🇞 Feature	
🕢 🐝 Raster	
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🔨 Create Custom Geographic Transformatior	1
Create Spatial Reference	
C Scheric Projection	-



- Double click on the tool. A tool dialog box will open. It will tell you what is required for the tool to do its job. In this case, only two fields are required. In the Input Dataset or Feature Class field, click the dropdown arrow and choose MD_Counties.
- 4. Click the button next to the Coordinate System field to open the Spatial Reference Properties. This window should look familiar from earlier in this exercise. We contacted the file provider, so we know that the projected coordinate system should be North American Datum (NAD) 1983 (2011) (Meters). Browse to Projected Coordinate Systems > State Plane > NAD 1983 (2011) (Meters) > NAD_1983_2011_StatePlane_Maryland_FIPS_1900. Click OK. Check that your dialog looks like the image below.

Notine Projection	- • ×
Input Dataset or Feature Class	^
MD_Counties	I 🖻
Coordinate System	
NAD_1983_2011_StatePlane_Maryland_FIPS_1900	11
	Ţ
OK Cancel Environments	Show Help >>

5. Click **OK** to run the tool. You may or may not get a warning message alerting you that this data and your map have different coordinate systems. Even if you don't get a warning, you should be aware that there may be an issue because you have added data with two different coordinate systems to the map. You can close the completion window.



Define Projection		8
Completed	Close]
	<< Details)
Close this dialog when completed successfully		
Start Time: Tue Feb 17 09:38:06 2 Succeeded at Tue Feb 17 09:38:06 (Elapsed Time: 0.13 seconds)	2015	
WARNING 000632: Datum conflict bet map and output.	ween	

6. Take a look at your map. This is an example of data projecting on-the-fly. The counties were projected on-the-fly to match the display of the points that were already in the map. Even though the two layers appear to overlay perfectly, they have <u>different</u> underlying coordinate systems, which is a problem for running analyses. You can check to see that they have different coordinate systems by right clicking on each layer and going to **Properties >** Source tab. This is something you will fix next.

Changing Projections

- It would be best for both layers to have the same coordinate system, ideally a projected coordinate system that is well suited to Maryland. Both layers already have a defined coordinate system, so to <u>project</u> the coordinate system you will use the **Project** tool.
- You could go looking for this tool in ArcToolbox, but let's try a different approach. Click the Search tab on the right side of the ArcMap window. You can search for keywords on this screen. Type in Project. You want the Project (Data Management) tool.





- 3. Click on the tool to open the tool dialog box.
- 4. For the **Input Dataset**, choose your point dataset of FQHCs. The **Output Dataset** will be a new shapefile. Save it in your exercise data folder and name it something logical.
- 5. For the **Output Coordinate System**, remember we defined a statewide system appropriate

specifically for Maryland. We will use that to make sure they are consistent. Click the button to open up the **Spatial Reference** dialog. Browse to **Layers** > **NAD_1983_2011_StatePlane_Maryland_FIPS_1900**. Click **OK**.

6. Check to make sure your dialog box looks like the image below and then click **OK** to run the tool and wait for it to finish.



🔨 Project	_		2	×
Input Dataset or Feature Class MD_FQHCs		•	6	^
Input Coordinate System (optional) GCS_WGS_1984				
Output Dataset or Feature Class R:\R72330\Projects\CDC\GIS_Surveillance\Phase_9\Training_content\GISI_SHD\Working_With	_Spatia	l_Data	6	
Output Coordinate System NAD_1983_2011_StatePlane_Maryland_FIPS_1900			P	
Vertical (optional)				
Geographic Transformation (optional)			~	
WGS_1984_(ITRF08)_To_NAD_1983_2011			÷	
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Preserve Shape (optional)				
Maximum Offset Deviation (optional)				
Unknor	vn		~	
				×
OK Cancel Environments		Show H	elp >>	

7. This tool creates a new shapefile that is automatically added to your table of contents. You can check that it has the new coordinate system by going to **Properties > Source tab**.



Layer Properties		×
General Source Selection Display	Symbology Fields Definition Query La	bels Joins & Relates Time HTML Popup
Extent Top: Left: 185230.868640 m Bottom:	230941.895857 m Right: 570294.20989 27801.057814 m	2 m
Data Source Data Type: Shapefile: Geometry Type: Coordinates have Z values: Coordinates have measures: Projected Coordinate System: Projection: False_Easting: False_Northing: <	Shapefile Feature Class R:\R72330\Projects\CDC\GIS_Surveillance\F Polygon No No NAD_1983_2011_StatePlane_Maryland_FIP Lambert_Conformal_Conic 400000.00000000 0.00000000 Set Da	>hase_9\Tr: S_1900 > ta Source
	[OK Cancel Apply

- 8. You can now remove your original FQHCs point layer.
- 9. What do you notice about the map after both layers have been projected into Maryland's state system? Did the map change?

Changing Data Frame Coordinate Systems

- Remember that you always want the Data Frame to be in the same coordinate system as the data. Your data is now in Maryland's state system, but is the data frame? To see what coordinate system the data frame is in, right click in the white space on your map and go to Data Frame Properties > Coordinate System tab.
- Currently, the data frame is in WGS 1984. This is because the very first piece of data you
 added to this project was in WGS 1984, and this set the data frame coordinate system. This
 will project all data we have in the workspace to WGS 1984 "on the fly".



3. Let's change the data frame coordinate system to be in Maryland's state system like the rest of the data. In the **Coordinate System tab**, browse in the folder tree to find Maryland's system in meters, select it, and click **OK**.

Data Frame Properties	5							
Annotation Groups	Extent Indicators	Frame	Size and	Position	Product Library			
General Data Fram	ne Coordinate Sy	stem	lumination	Grids	Feature Cache			
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	NAD 1983 (2011) StatePla	ane Louisia	na North	FIPS 1701 (🔺			
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	NAD 1983 (2011) StatePia	ane Maine	East FIPS	1902 (Mat			
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	NAD 1983 (2011) StatePl:	ane Massar	husetts F	IPS 2001 (N			
	NAD 1983 (2011) StatePla	ane Massac	husetts is	I FIPS 2002			
l l	NAD 1983 (2011) StatePla	ane Michia	an Centra	I FIPS 2112			
l l	NIAD 1002 (2011) C+-+-DI	ono Michia	an North	EIDC 2111 / Y			
<					>			
Current coordinate	system:							
NAD_1983_2011_	StatePlane_Maryla	nd_FIPS_	1900		^			
WKID: 6487 Auth	ority: EPSG							
Projection: Lambe	ert_Conformal_Conic	:						
False_Easting: 40	0000.0							
False_Northing: 0 Central Meridian:	-77.0							
Standard_Parallel	_1: 38.3							
Standard_Parallel	2: 39.45							
Latitude_Of_Origi	in: 37.666666666666	666						
Linear Onic, Meter	(1.0)				*			
Transformations	s							
		0	K	Cancel	Apply			

4. You should immediately notice the map display changes. Maryland is noticeably taller and looks less stretched. The data frame now has the same coordinate system as the data so everything is displaying as it should and you are ready to run analyses.





Projecting Data When Exporting

- Add the last piece of data, *MD_Hospitals.dbf*. This file contains a list of hospitals in Maryland. Use the X and Y coordinates in the table to **Display XY Data**. The coordinates are in the Geographic Coordinate System GCS_WGS_1984. (You can refer back to **Displaying X/Y Data** section)
- Remember that the new *Events* layer of hospitals is not permanent it must be exported to a shapefile. Right click on the Events layer and select **Data > Export Data**.
- 3. ArcMap can project data for you in the export process. Consider your options carefully: do you want to export features using the same coordinate system as 1) this layer or 2) the data frame? In this case you could do either. You just set the data frame coordinate system to Maryland's standard state system, which is the system you want your data to be in, so you can select the same coordinate system as the data frame.

Export Data	×					
Export: All features	\sim					
Use the same coordinate system as:						
⊖ this layer's source data						
the data frame						
 the feature dataset you export the data into (only applies if you export to a feature dataset in a geodatabase) 						
Output feature dass:						
a\Working_with_Spatial_Data_Exercise_Data\MD_Hospitals_prj.shp						
OK Cancel						

4. Save your shapefile with a logical name and click OK to export it. Be sure to add it to your map and remove the *Events* layer. This is a quick and easy way to project your data.