

1. Review of GIS Basics

1.1 Basic GIS concepts

1.2 Vector data model

1.3 Attribute tables

1.4 Feature selection

1.5 Clip, intersect, union, and buffer

1.6 Merge, dissolve, and spatial join

1.7 Feature editing

1.8 Projection

ArcMap Document (Module1.mxd)

The screenshot shows the ArcMap application window titled "Module1 - ArcMap". The interface includes a menu bar (File, Edit, View, Bookmarks, Insert, Selection, Geoprocessing, Customize, Windows, Help), a toolbar with various icons, and a status bar at the bottom displaying coordinates (-93.308 20.715 Decimal Degrees). On the left side, there is a "Table Of Contents" pane showing a list of layers. The main map area displays a map of the United States with various data layers overlaid, including cities (green dots), powerlines (orange lines), roads (brown lines), and county boundaries (blue lines).

Labels with red arrows pointing to specific components in the ArcMap interface:

- Menu**: Points to the File menu.
- Toolbars**: Points to the toolbar below the menu.
- Table of contents**: Points to the Table Of Contents pane on the left.
- Data frame**: Points to the map area on the right.
- Layers**: Points to the list of layers in the Table Of Contents pane.

The Table Of Contents pane lists the following layers:

- ☒ CITIES
- ☒ Powerline
- ☐ DentonRoads
- ☒ USA_ROADS
- ☐ citylim
- ☒ COUNTIES
- ☐ County1990
- ☐ LAKES
- ☐ Parcels

1.1 Basic GIS concepts

- What is GIS?
- Is the City of Denton a point or a polygon in a GIS?
- List three GIS data sources
- List three GIS applications
- Map projection (What? Why? How?)
- Coordinate system
- “Define” and “Project”
- What is datum?
- What is metadata?
- Symbology and classification
- Identify, find, measure, bookmark, and hyperlink
- Feature selection (spatial and attribute)
- Logical operators - AND, OR, NOT, XOR

1.1 Basic GIS concepts (cont.)

- Select by attributes
- Select by location
- Selection operations
 - create new selection
 - add to current selection
 - remove from current selection
 - select from current selection
- Tables: Records and Fields
- Table operations: Join and Relate
- Data types for fields
- Calculate and summarize field values

1.1 Basic GIS concepts (cont.)

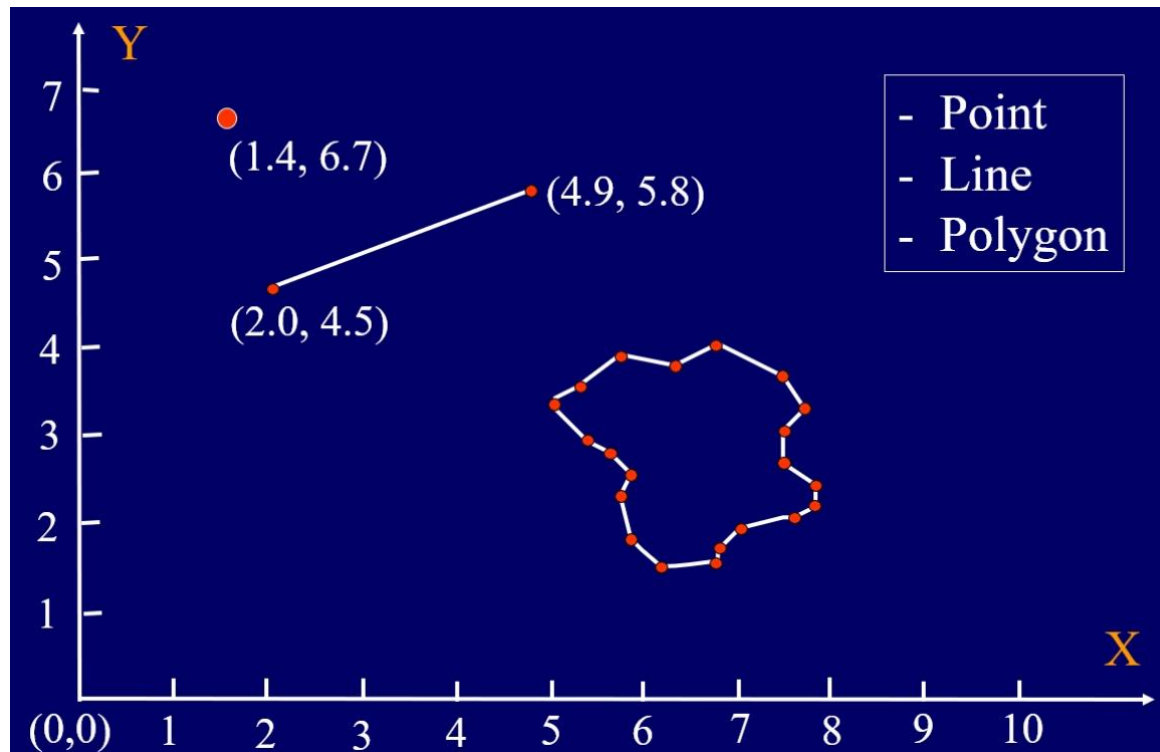
- ArcCatalog
 - Create new geodatabase, shapefile, dBase table, etc.
 - Show contents, preview, and metadata.
 - Search data by name & location, geography, date, and keywords.
- Geoprocessing - Split, clip, union, intersect, buffer, dissolve.
- Geocoding
- Map making - colors, layouts, map elements, ...
- Editing shapefile
- Two more questions:
 - Why are maps like fish?
 - What do John Wayne and a map key have in common?

Video: What is a GIS? (3'43")

1.2 Vector data model

Vector data includes points, lines, and polygons -

- Point: A single X, Y coordinate pair.
- Line: A connected series of X, Y pairs.
- Polygon: A series of X, Y pairs with the same beginning and ending point.



1.2 Vector data model (cont.)

Depending on the scale of your map, you can use different vector data types (point, line, or polygon) to represent features or phenomena. For example:

- The City of Denton can be a point on a map of USA, and a polygon on a land use map of Denton County.
- A tornado path near the City of Denton can be a line feature on a map of Texas tornadoes, and a polygon feature on a map of property damage for the City of Denton.

Video: Vector data model (2'27")

1.3 Attribute tables

Columns: Fields

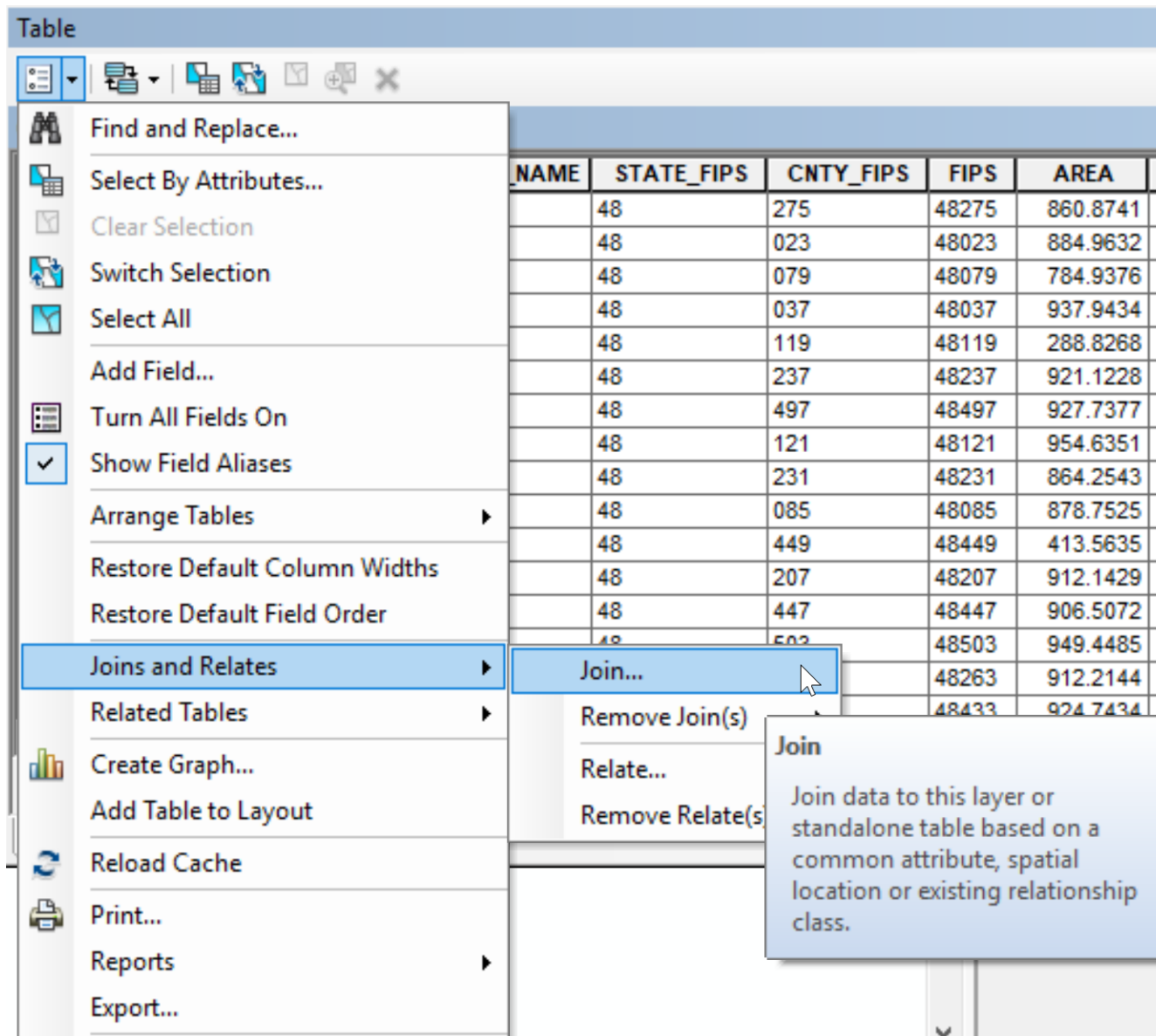
Rows: Records

FID	Shape	NAME	STATE_NAME	STATE_FIPS	CNTY_FIPS	FIPS	AREA	POP1990	POP1999	POP90_SQMI	HOUSEHOLDS
2336	Polygon	Knox	Texas	48	275	48275	860.8741	4837	4176	6	1887
2337	Polygon	Baylor	Texas	48	023	48023	884.9632	4385	4139	5	1906
2338	Polygon	Cochran	Texas	48	079	48079	784.9376	4377	3921	6	1430
2357	Polygon	Bowie	Texas	48	037	48037	937.9434	81665	83970	87	30595
2385	Polygon	Delta	Texas	48	119	48119	288.8268	4857	4981	17	1901
2392	Polygon	Jack	Texas	48	237	48237	921.1228	6981	7579	8	2725
2397	Polygon	Wise	Texas	48	497	48497	927.7377	34679	45884	37	12175
2398	Polygon	Denton	Texas	48	121	48121	954.6351	273525	401394	287	101984
2401	Polygon	Hunt	Texas	48	231	48231	864.2543	64343	72177	74	24075
2402	Polygon	Collin	Texas	48	085	48085	878.7525	264036	455820	300	95805
2404	Polygon	Titus	Texas	48	449	48449	413.5635	24009	25712	58	8508
2405	Polygon	Haskell	Texas	48	207	48207	912.1429	6820	6131	7	2753
2406	Polygon	Throckmorton	Texas	48	447	48447	906.5072	1880	1716	2	790
2407	Polygon	Young	Texas	48	503	48503	949.4485	18126	17756	19	7101
2408	Polygon	Kent	Texas	48	263	48263	912.2144	1010	877	1	399
2409	Polygon	Stonewall	Texas	48	433	48433	924.7434	2013	1762	2	806

0 (0 out of 3140 Selected)

COUNTIES

1.3 Attribute tables (cont.) – table operations



The screenshot shows the 'Table' window in ArcGIS. The 'Joins and Relates' menu is open, displaying options for joining and relating data. The 'Join...' option is highlighted, and a tooltip is visible explaining the function.

Table

NAME	STATE_FIPS	CNTY_FIPS	FIPS	AREA
	48	275	48275	860.8741
	48	023	48023	884.9632
	48	079	48079	784.9376
	48	037	48037	937.9434
	48	119	48119	288.8268
	48	237	48237	921.1228
	48	497	48497	927.7377
	48	121	48121	954.6351
	48	231	48231	864.2543
	48	085	48085	878.7525
	48	449	48449	413.5635
	48	207	48207	912.1429
	48	447	48447	906.5072
	48	502	48503	949.4485
	48		48263	912.2144
	48		48433	924.7434

Joins and Relates

- Join...
- Remove Join(s)
- Relate...
- Remove Relate(s)

Join

Join data to this layer or standalone table based on a common attribute, spatial location or existing relationship class.

1.4 Feature selection – select by attributes

Table

COUNTIES

FID	Shape	NAME
2389	Polygon	Los Angeles
3085	Polygon	Cook
2822	Polygon	Harris
2381	Polygon	San Diego
2316	Polygon	Orange
854	Polygon	Kings
2299	Polygon	Maricopa
3072	Polygon	Wayne
841	Polygon	Queens
2927	Polygon	Dade
2470	Polygon	Dallas
989	Polygon	Philadelphia
81	Polygon	King
1628	Polygon	Santa Clara
833	Polygon	New York
1991	Polygon	San Bernardino
657	Polygon	Cuyahoga
525	Polygon	Middlesex
877	Polygon	Allegheny
845	Polygon	Suffolk
825	Polygon	Nassau
1531	Polygon	Alameda
2926	Polygon	Broward
815	Polygon	Bronx
2851	Polygon	Bexar
2292	Polygon	Riverside
2469	Polygon	Tarrant

POP1990 **POP1999**

8863164	9284693
5105067	5192105
2818199	3259207
2498016	2832478
2410556	2773325
2300664	2267441
2122101	2871024
2111687	2111966
1951598	2011699
1937094	2180128
1852810	2080570
1585577	1418886
1507319	1674255
1497577	1664869
1487536	1559756
1418380	1657998
1412140	1372530
1398468	1431134
1336449	1258889
1321864	1379690
1287348	1303725
1279182	1422291
1255488	1533636
1203789	1197204
1185394	1372238
1170413	1512000
1170103	1383309

Select By Attributes

Layer: **COUNTIES**

☐ Only show selectable layers in this list

Method: Create a new selection

"FID"
"NAME"
"STATE_NAME"
"STATE_FIPS"
"CNTY_FIPS"

= < > Like
> > = And
< < = Or
_ % () Not
Is In Null Get Unique Values Go To:

SELECT * FROM COUNTIES WHERE:
"POP1999" >= 1000000

Clear Verify Help Load... Save... OK Apply Close

(33 out of 3140 Selected)

1.4 Feature selection – select by attributes (cont.)

Module1 - ArcMap

Select By Attributes

Layer:

USA_ROADS

☐ Only show selectable layers in this list

Method: Create a new selection

"ADMN_CLASS"
"TOLL_RD"
"RTE_NUM1"
"RTE_NUM2"
"ROUTE"

=

<>

Like

"Interstate 5"
"Interstate 8"
"Interstate 10"
"Interstate 12"
"Interstate 15"
"Interstate 16"

>

>=

And

<

<=

Or

_

%

()

Not

Is

In

Null

Get Unique Values

Go To:

SELECT * FROM USA_ROADS WHERE:
"ROUTE" = 'Interstate 10'

Clear

Verify

Help

Load...

Save...

OK

Apply

Close

Number of features selected: 23

g Customize Windows Help

10

B I U A

3D Analyst

Highway I-10 is selected

1.4 Feature selection – select by location

(selecting counties that I-10 passes through)

Select By Location

Select features from one or more target layers based on their location in relation to the features in the source layer.

Selection method:
select features from

Target layer(s):

- ☐ CITIES
- ☐ DentonRoads
- ☐ USA_ROADS
- ☐ citylim
- ☒ COUNTIES
- ☐ County1990
- ☐ LAKES
- ☐ Parcels
- ☐ STATES
- ☐ Denton_Footprints

☐ Only show selectable layers in this list

Source layer:
USA_ROADS

☒ Use selected features (23 features selected)

Spatial selection method for target layer feature(s):
intersect the source layer feature

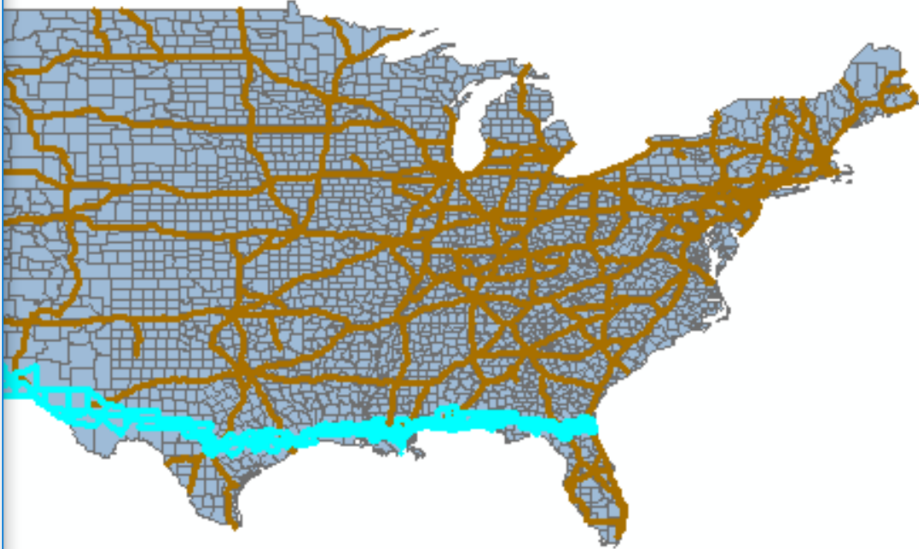
☐ Apply a search distance
0.050000 Decimal Degrees

[About select by location](#)

Customize Windows Help

10 B I U A

3D Analyst



-106.919 31.946 Decimal Degrees

1.4 Feature selection – select by location (cont.)

Table

COUNTIES

	FID	Shape	NAME	STATE_NAME	STATE_FIPS	CNTY_FIPS	FIPS	AREA	POP1990	POP1999
▶	2389	Polygon	Los Angeles	California	06	037	06037	4115.7485	8863164	9284693
	2822	Polygon	Harris	Texas	48	201	48201	1741.4574	2818199	3259207
	2299	Polygon	Maricopa	Arizona	04	013	04013	9193.7166	2122101	2871024
	1991	Polygon	San Bernardino	California	06	071	06071	20174.723	1418380	1657998
	2851	Polygon	Bexar	Texas	48	029	48029	1254.7105	1185394	1372238
	2292	Polygon	Riverside	California	06	065	06065	7294.8538	1170413	1512000
	2787	Polygon	Duval	Florida	12	031	12031	775.6378	672971	744609
	2537	Polygon	Pima	Arizona	04	019	04019	9229.3262	666880	802797
	2617	Polygon	El Paso	Texas	48	141	48141	993.5534	591610	714104
	2824	Polygon	Orleans	Louisiana	22	071	22071	213.6224	496938	461304
	2872	Polygon	Jefferson	Louisiana	22	051	22051	336.4746	448306	449913
	2765	Polygon	East Baton Rouge	Louisiana	22	033	22033	465.4568	380105	394579
	2718	Polygon	Mobile	Alabama	01	097	01097	1262.4071	378643	400775
	2804	Polygon	Escambia	Florida	12	033	12033	664.1032	262798	284547
	2820	Polygon	Jefferson	Texas	48	245	48245	969.6736	239397	241378
	2849	Polygon	Fort Bend	Texas	48	157	48157	893.4158	225421	353375
	2770	Polygon	Leon	Florida	12	073	12073	703.6332	192493	219081
	2795	Polygon	Calcasieu	Louisiana	22	019	22019	1090.1668	168134	181715
	2771	Polygon	Harrison	Mississippi	28	047	28047	592.1764	165365	180097
	2805	Polygon	Lafayette	Louisiana	22	055	22055	262.7742	164762	189049

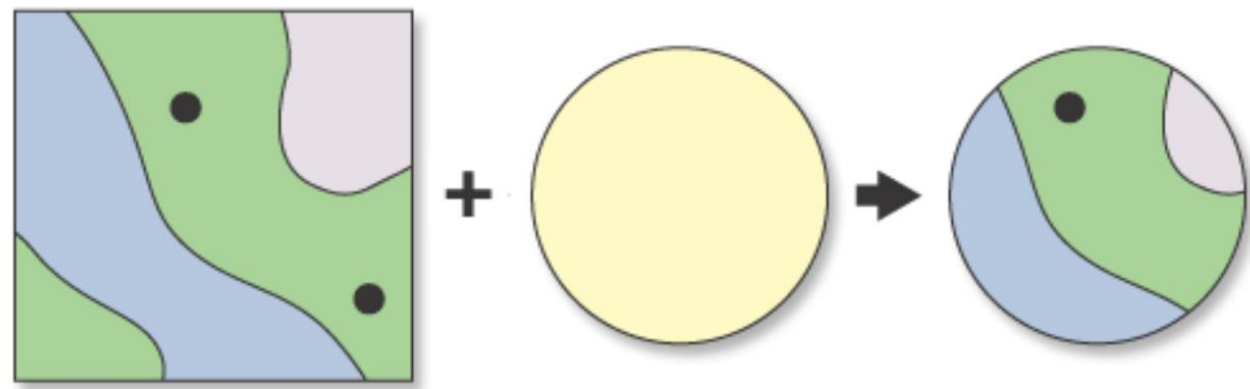
(73 out of 3140 Selected)

COUNTIES

There are 73 counties that I-10 passes through.

1.5 Clip, intersect, union, and buffer

Clip



INPUT

CLIP FEATURE

OUTPUT

(Esri)

Clip

● Input Features

● Clip Features

● Output Feature Class

XY Tolerance (optional)

Decimal degrees

Clip

Extracts input features that overlay the clip features.

Use this tool to cut out a piece of one feature class using one or more of the features in another feature class as a cookie cutter.

OK

Cancel

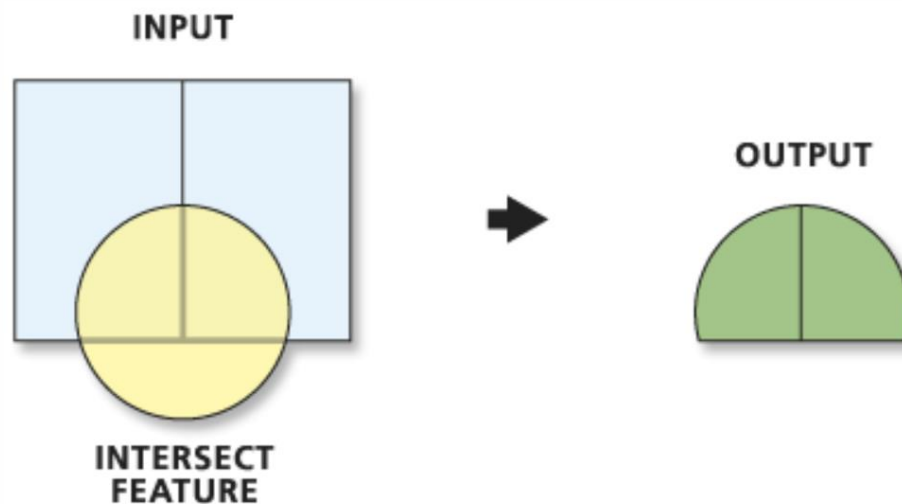
Environments...

<< Hide Help

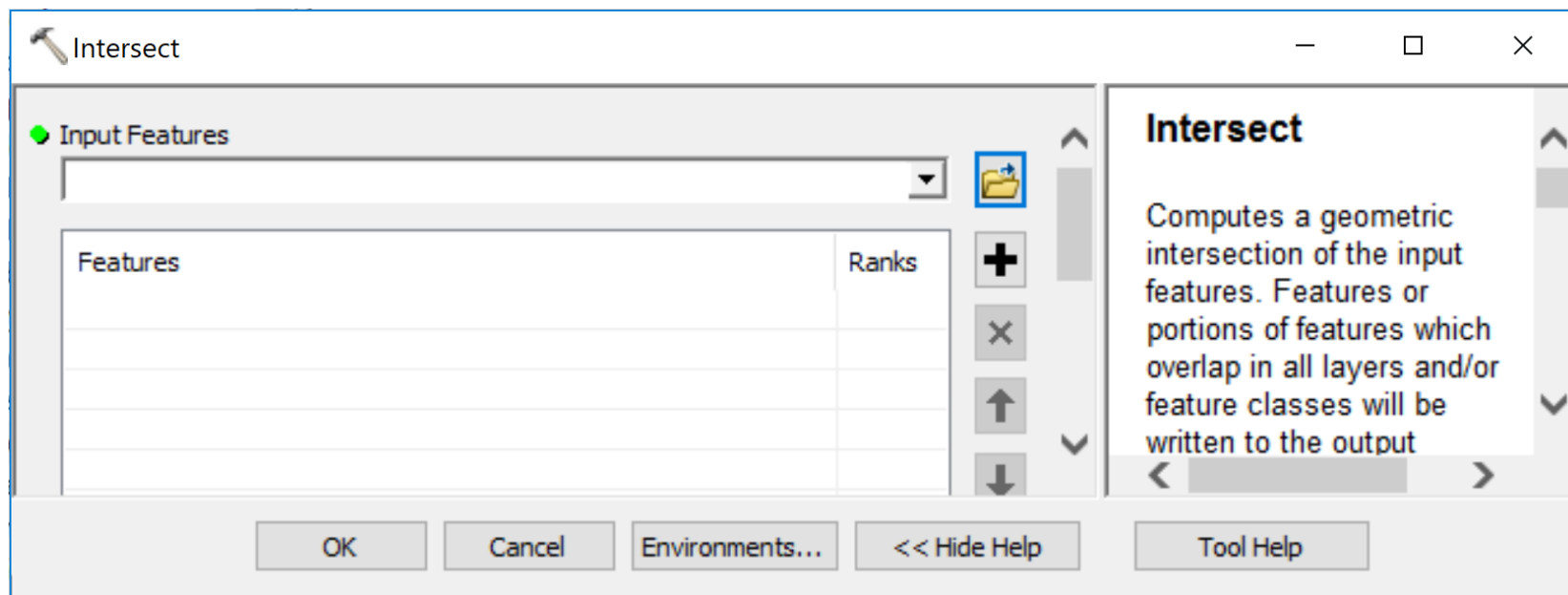
Tool Help

1.5 Clip, intersect, union, and buffer (cont.)

Intersect

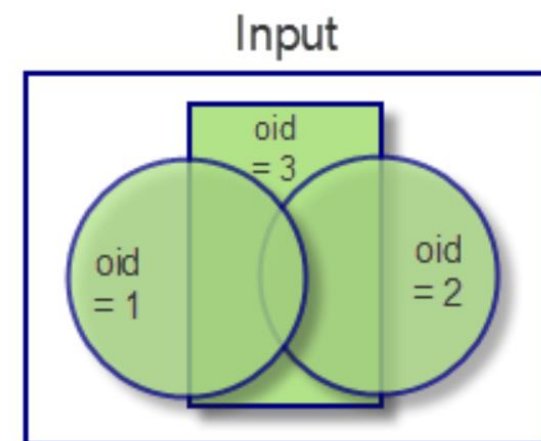


(Esri)

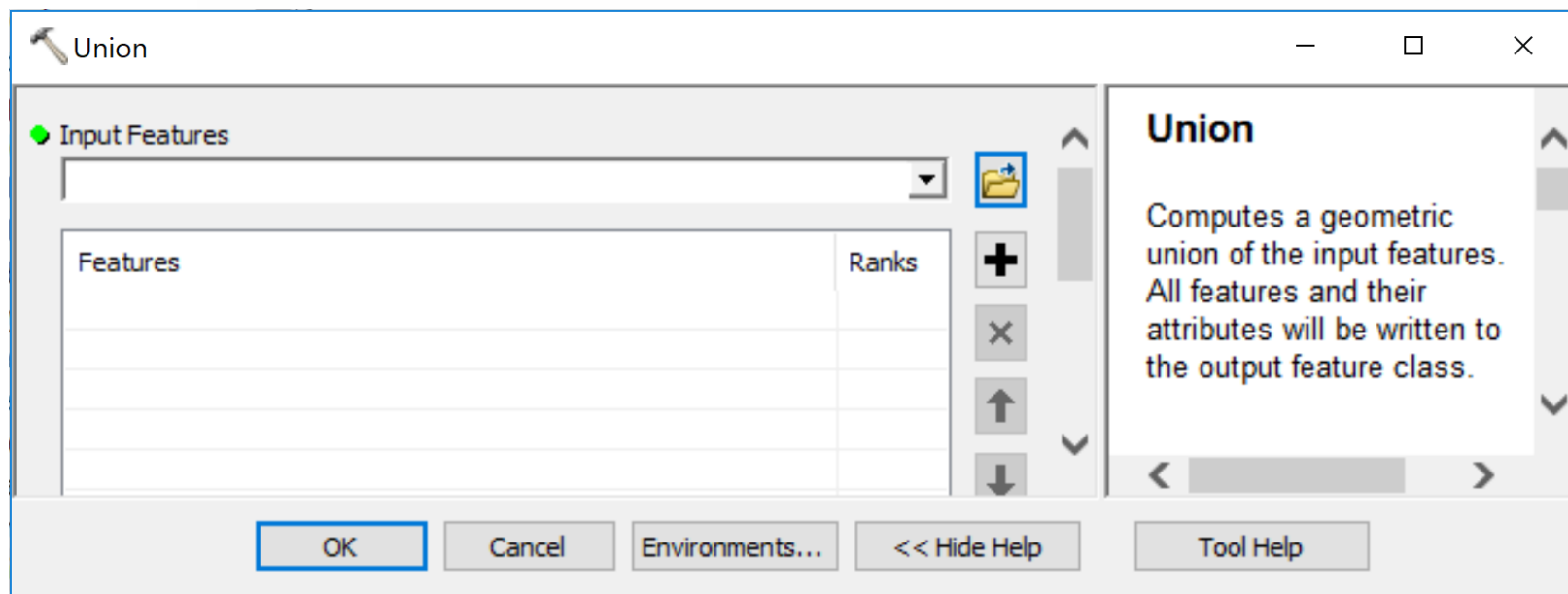
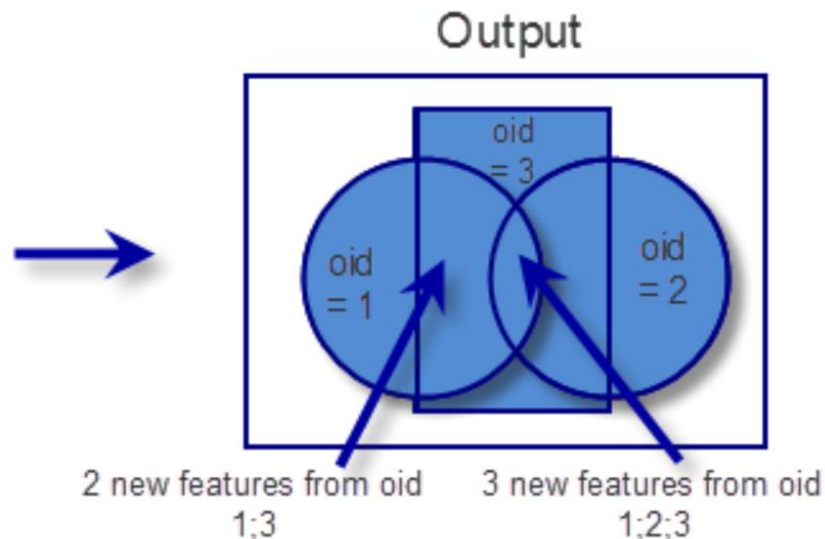


1.5 Clip, intersect, union, and buffer (cont.)

Union

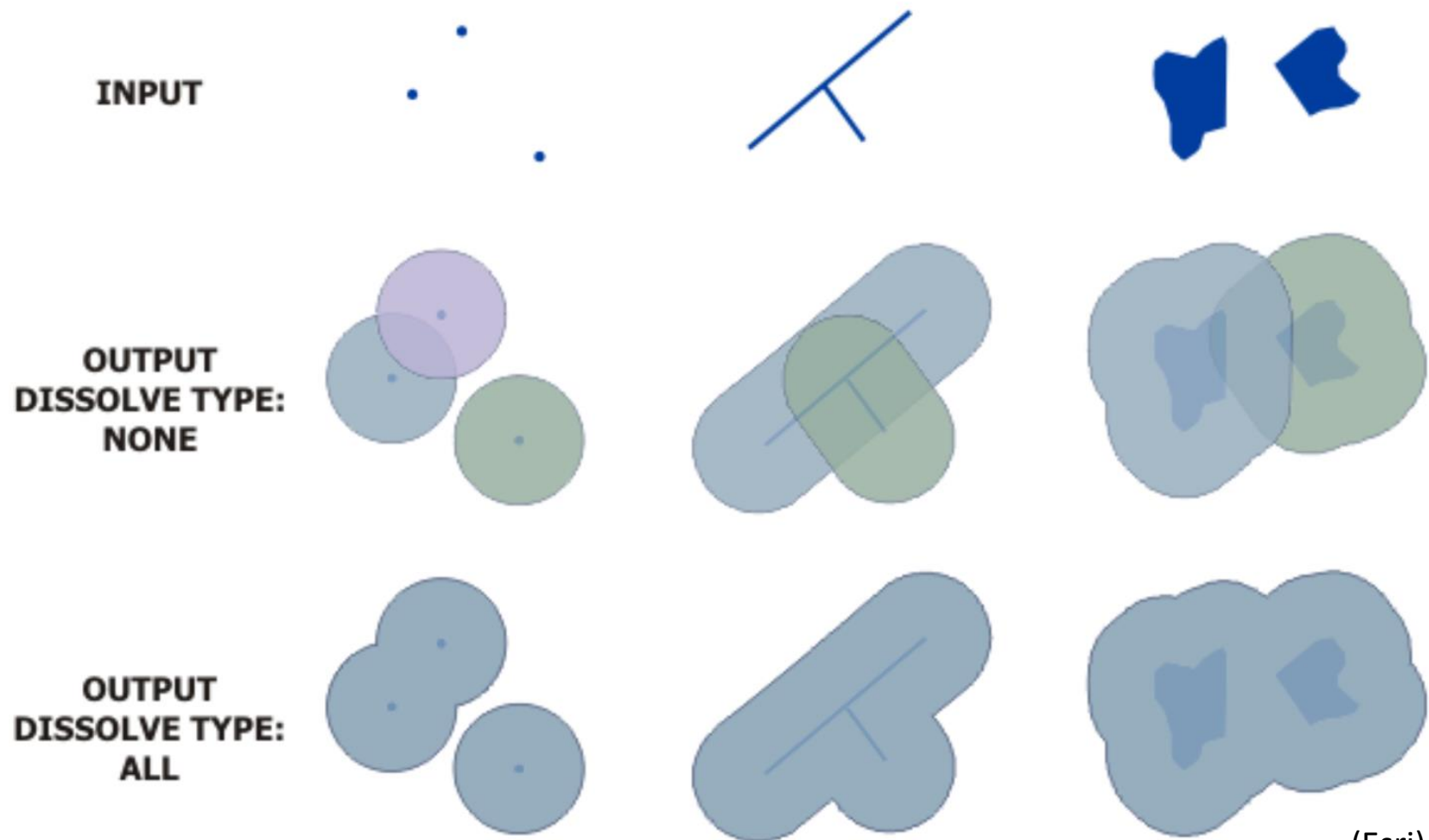


(Esri)



1.5 Clip, intersect, union, and buffer (cont.)

Buffer



1.5 Clip, intersect, union, and buffer (cont.)

Buffer

The screenshot shows the 'Buffer' tool dialog box. The left pane contains the configuration options, and the right pane shows a preview of the tool's function.

Buffer

Creates buffer polygons around input features to a specified distance.

INPUT

OUTPUT

DISSOLVE TYPE:
NONE

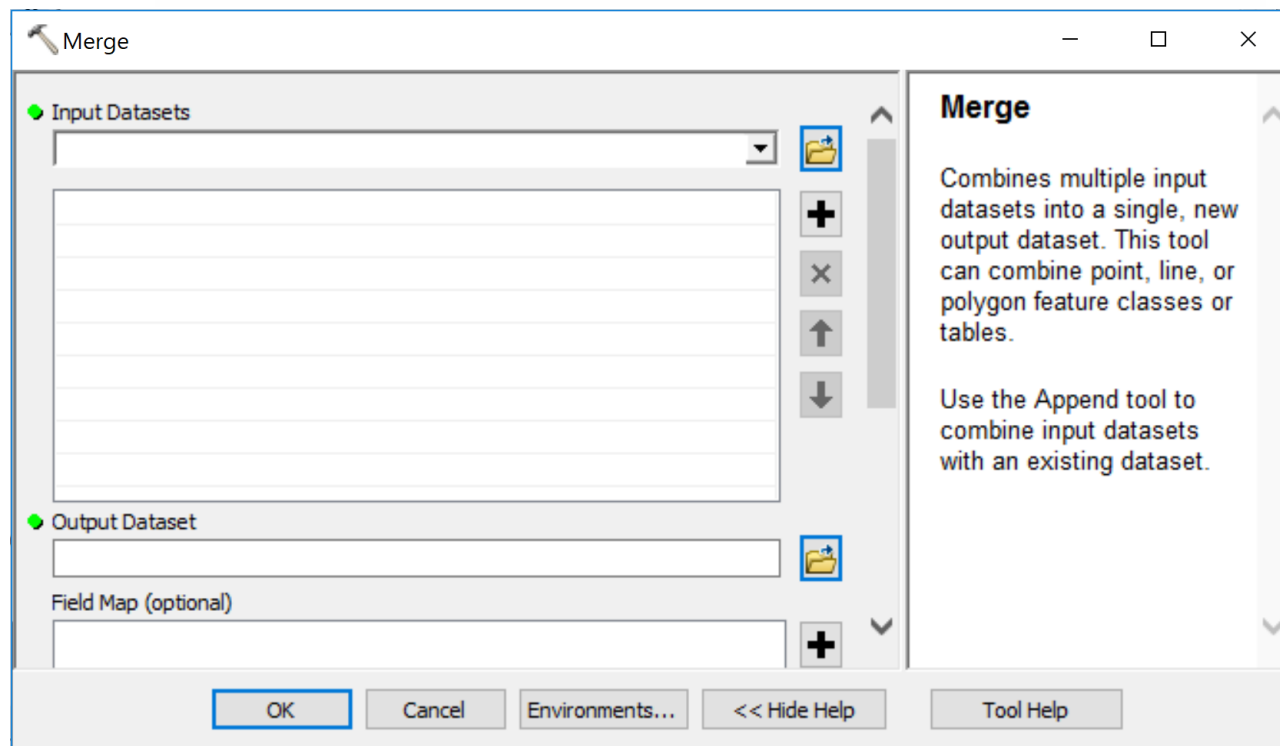
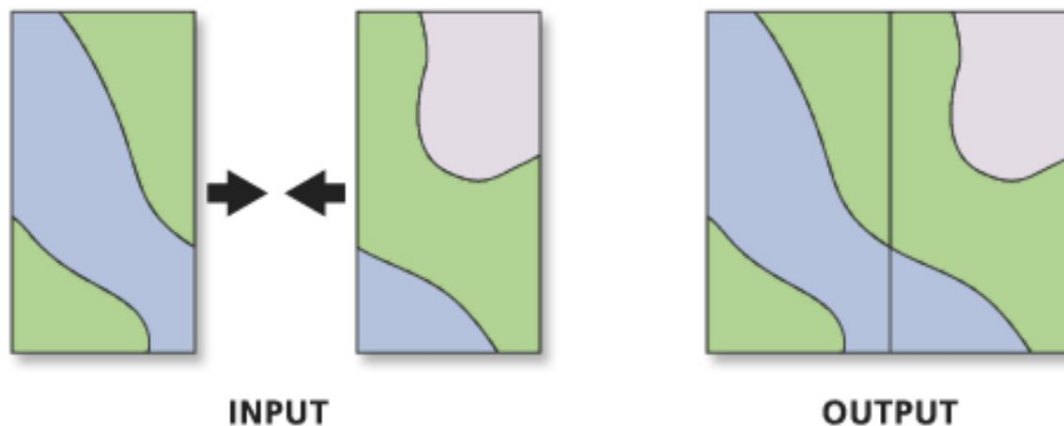
Configuration Options:

- Input Features:** [Empty dropdown]
- Output Feature Class:** [Empty text box]
- Distance [value or field]:**
 - ☒ **Linear unit**
 - [Empty text box]
 - Decimal degrees
 - ☐ **Field**
 - [Empty dropdown]
- Side Type (optional):** FULL
- End Type (optional):** ROUND
- Method (optional):** PLANAR
- Dissolve Type (optional):** NONE
- Dissolve Field(s) (optional):** [Empty text box]

Buttons: OK, Cancel, Environments..., << Hide Help, Tool Help

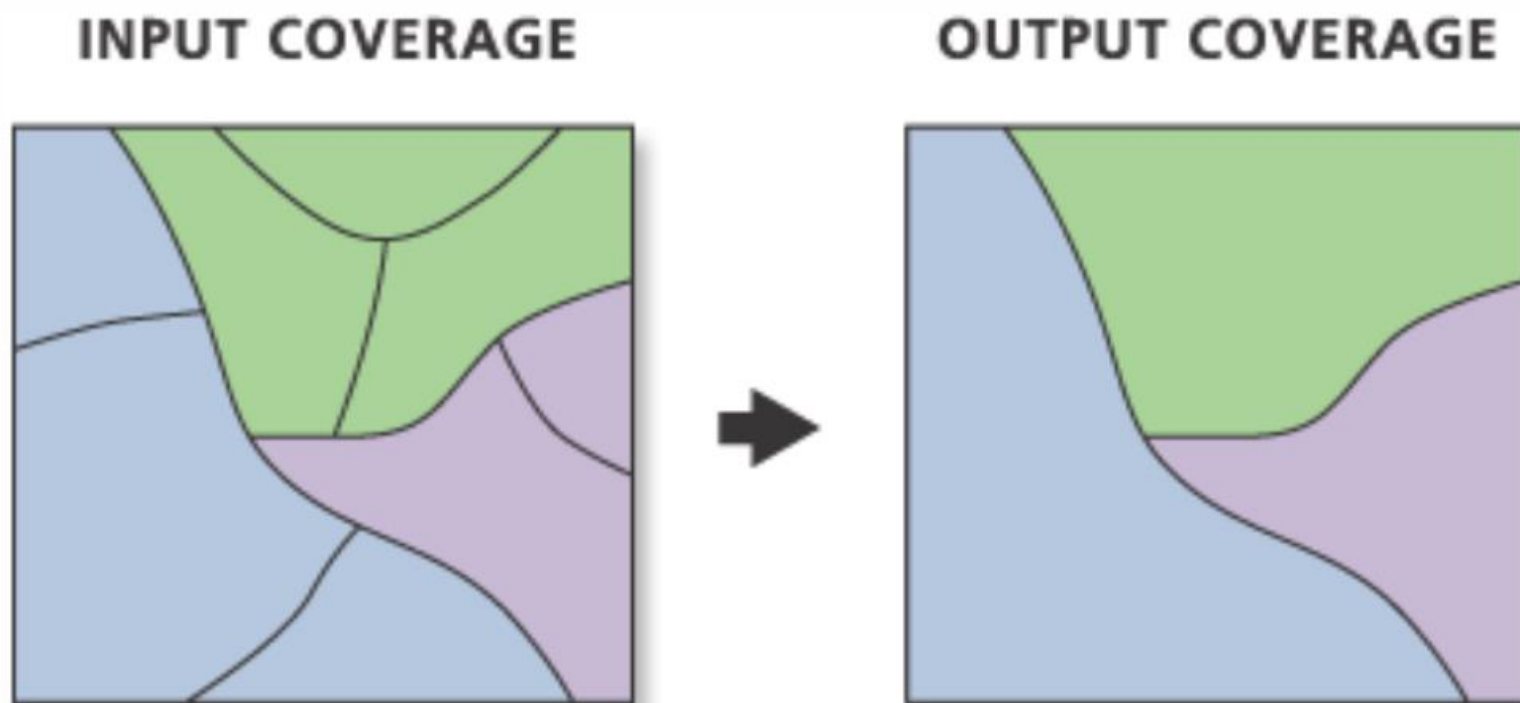
1.6 Merge, dissolve, and spatial join

Merge



1.6 Merge, dissolve, and spatial join (cont.)

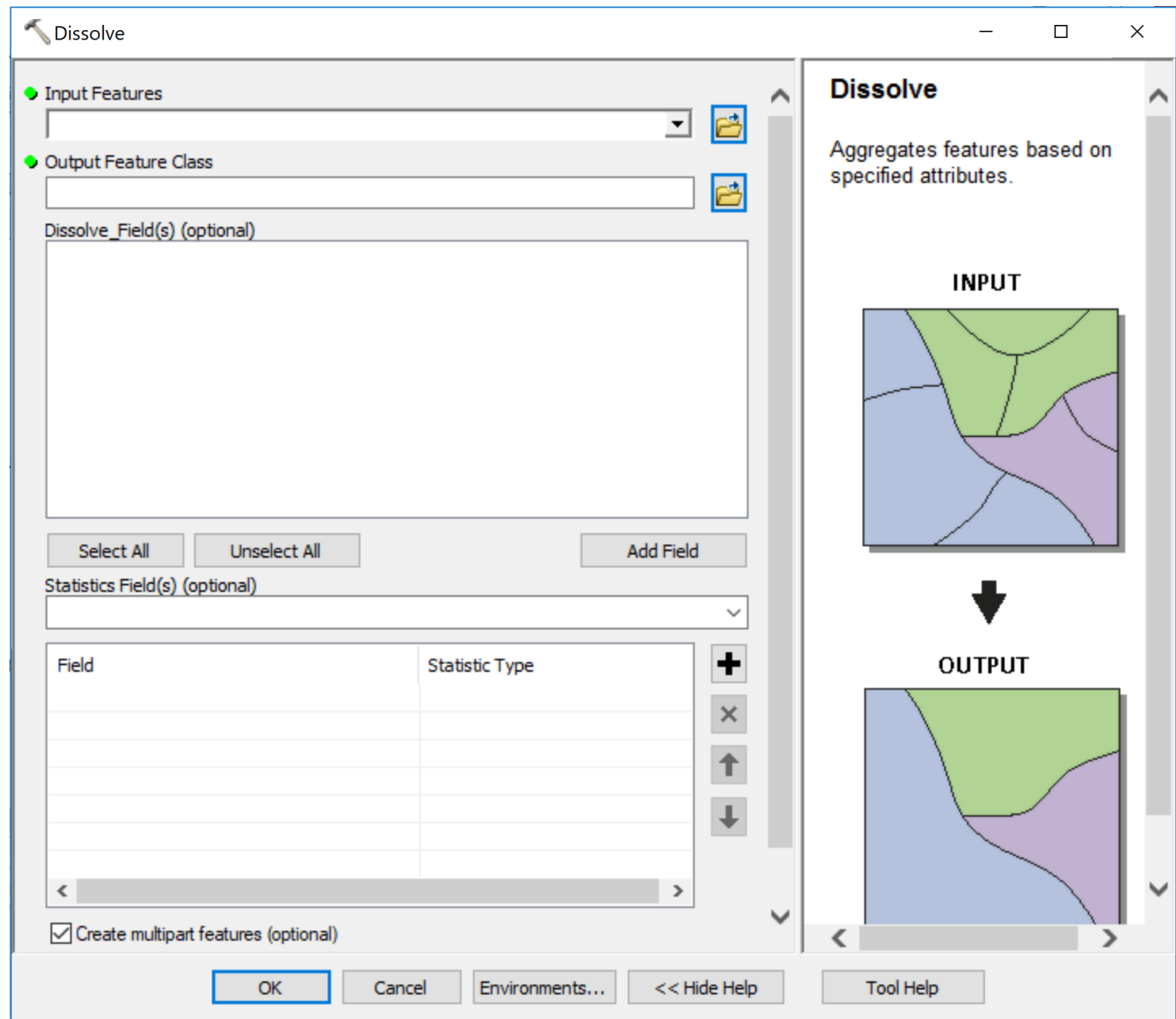
Dissolve



(Esri)

1.6 Merge, dissolve, and spatial join (cont.)

Dissolve



1.6 Merge, dissolve, and spatial join (cont.)

Spatial join

Spatial Join

Target Features

Join Features

Output Feature Class

Join Operation (optional)
JOIN_ONE_TO_ONE

☒ Keep All Target Features (optional)

Field Map of Join Features (optional)

Match Option (optional)
INTERSECT

Search Radius (optional)

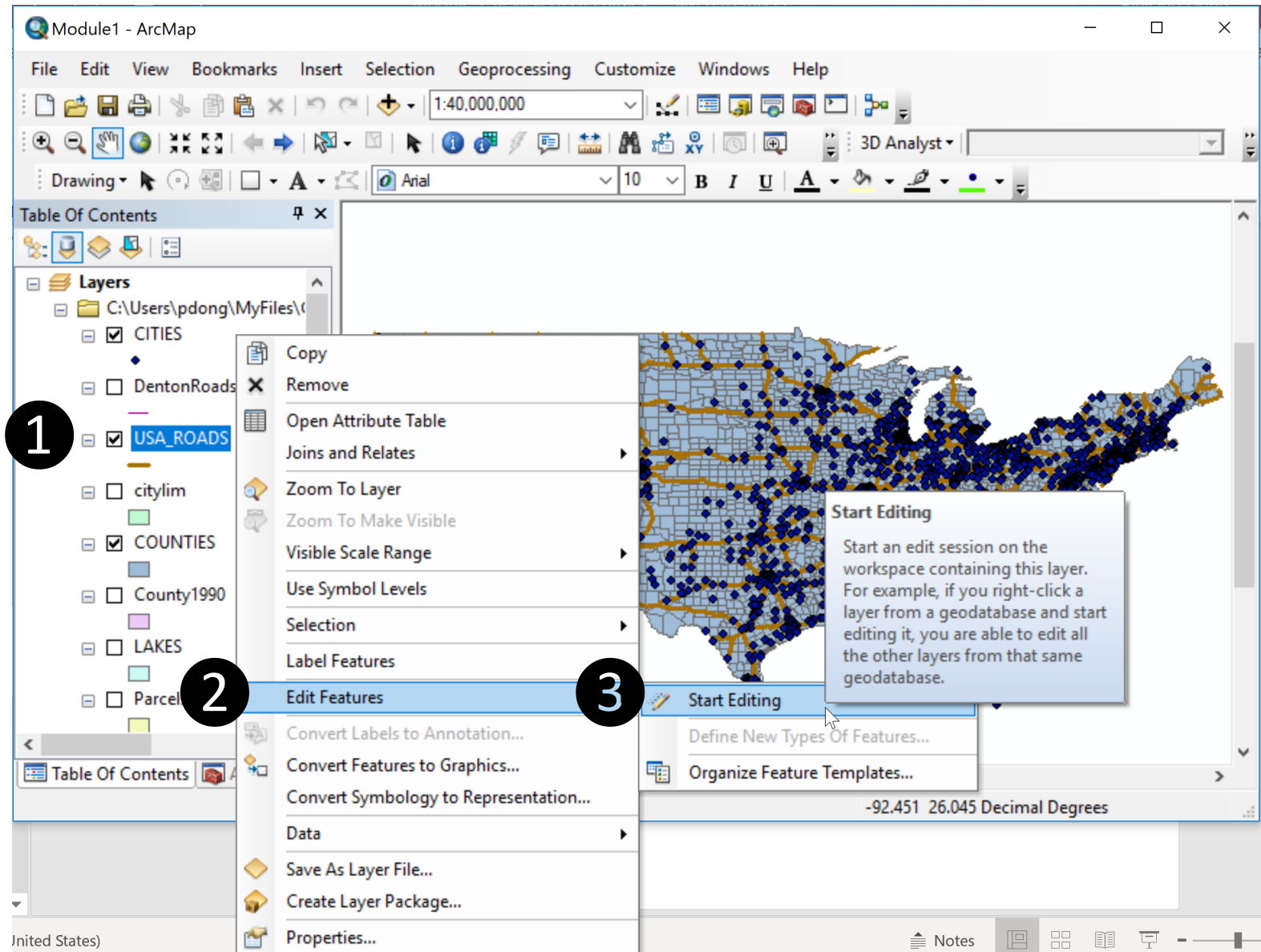
Distance Field Name (optional)

Spatial Join

Joins attributes from one feature to another based on the spatial relationship. The target features and the joined attributes from the join features are written to the output feature class.

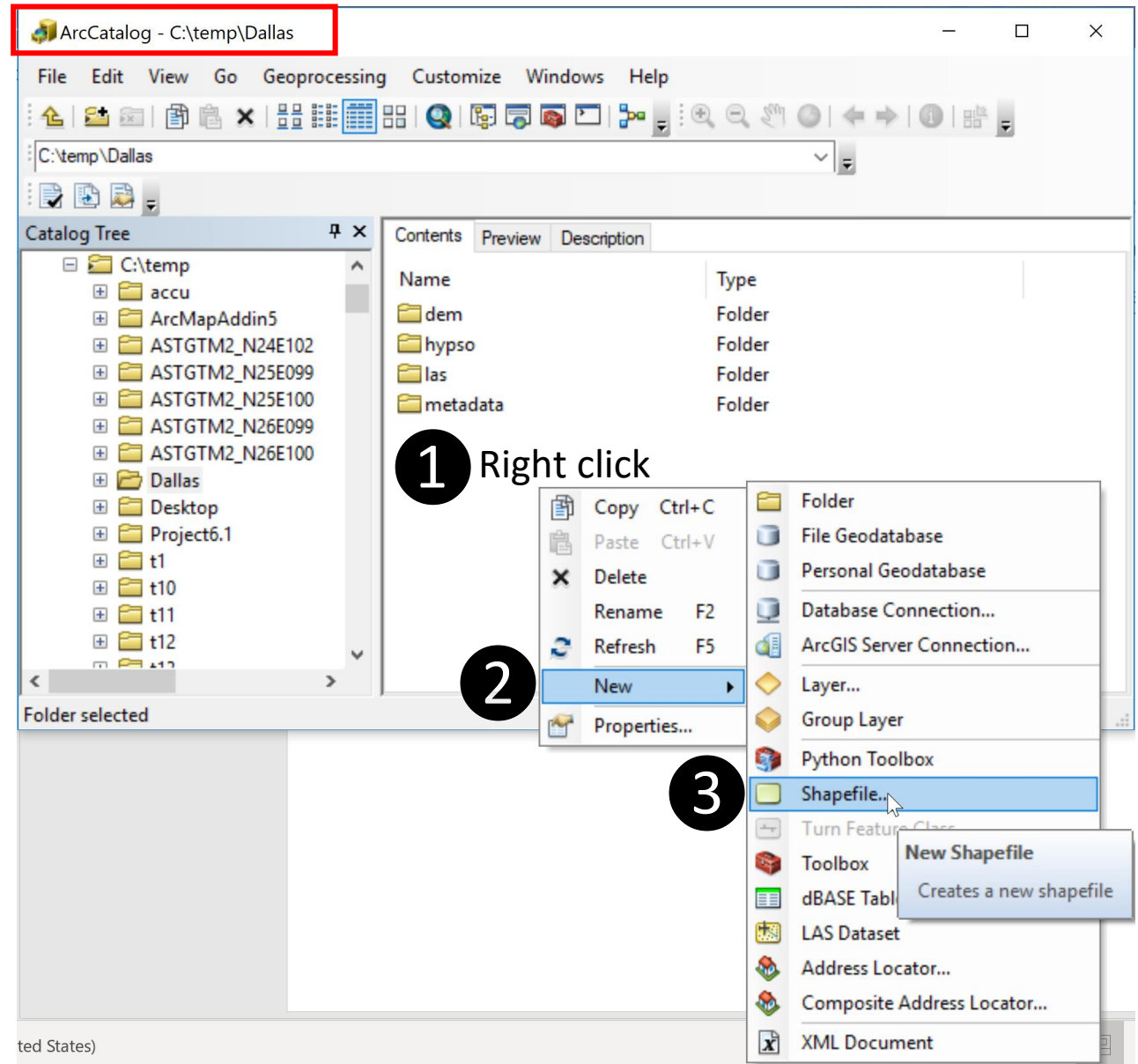
OK Cancel Environments... << Hide Help Tool Help

1.7 Feature editing – editing an **existing** feature class

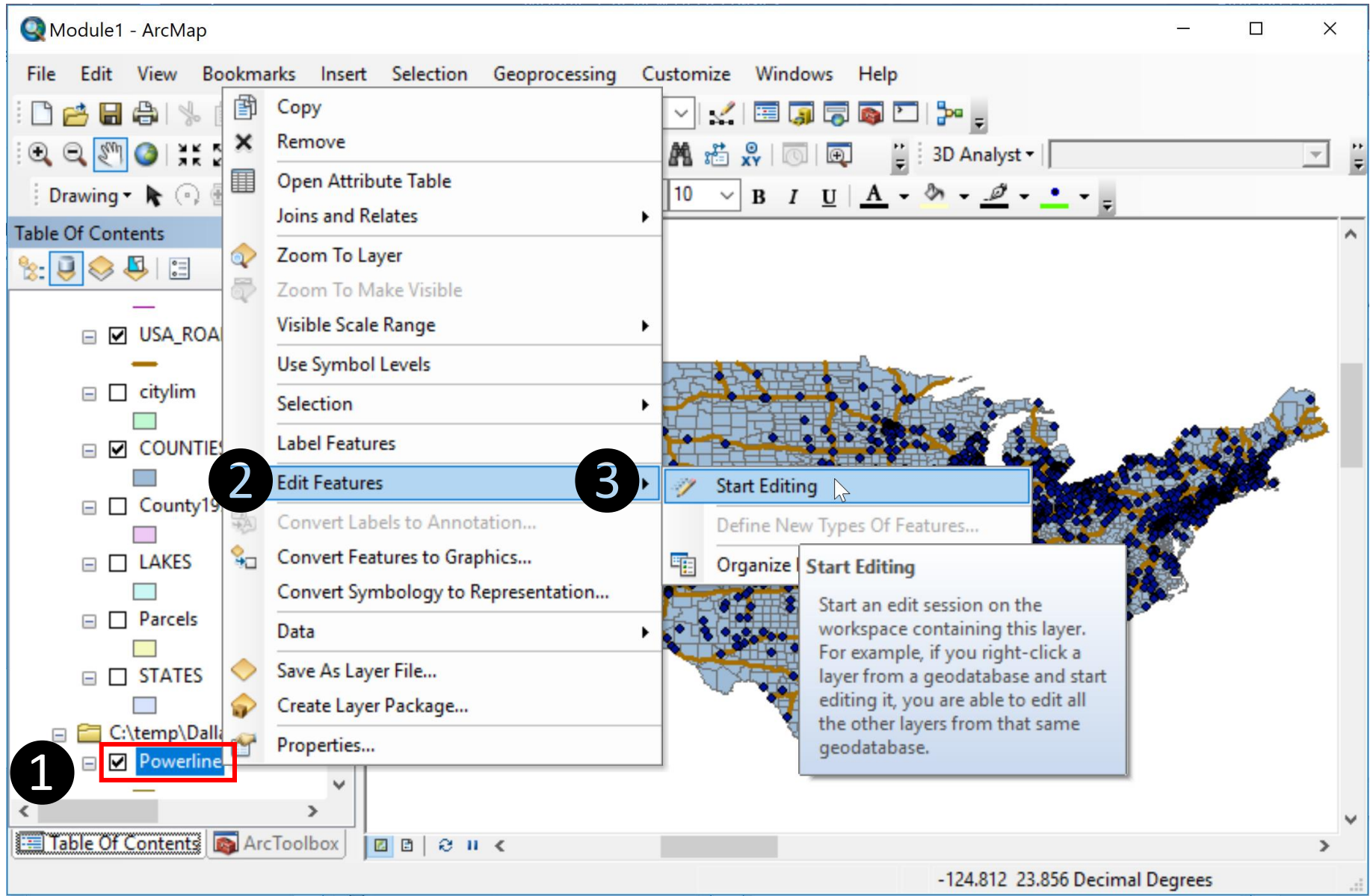


1.7 Feature editing – editing a new feature class (1)

Creating a new feature class



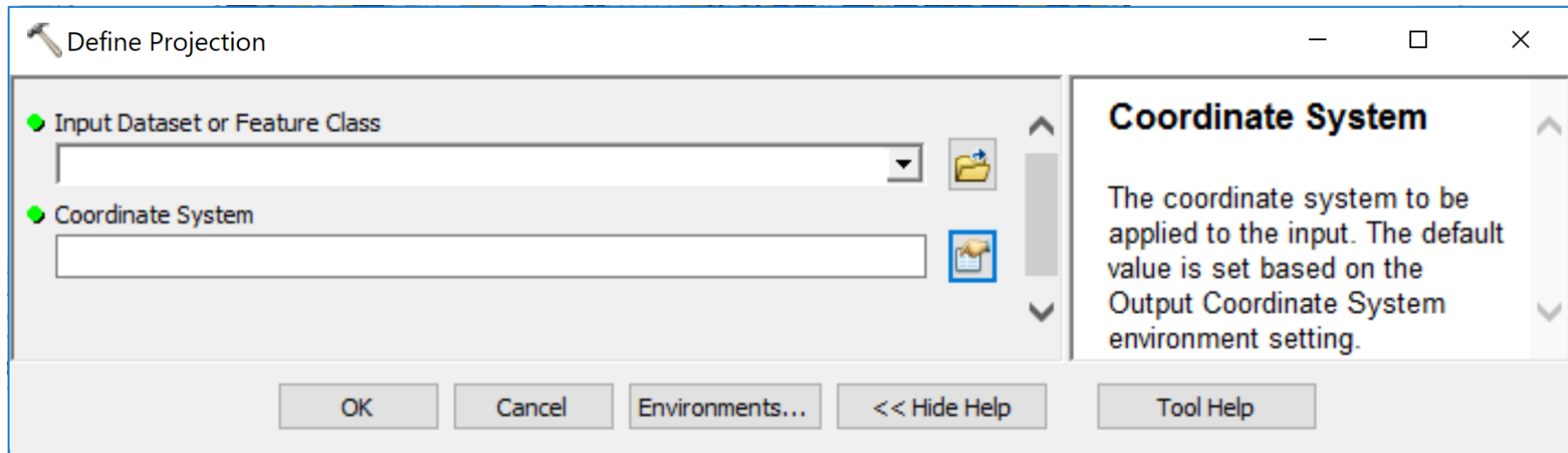
1.7 Feature editing – editing a new feature class (3)



1.8 Projection

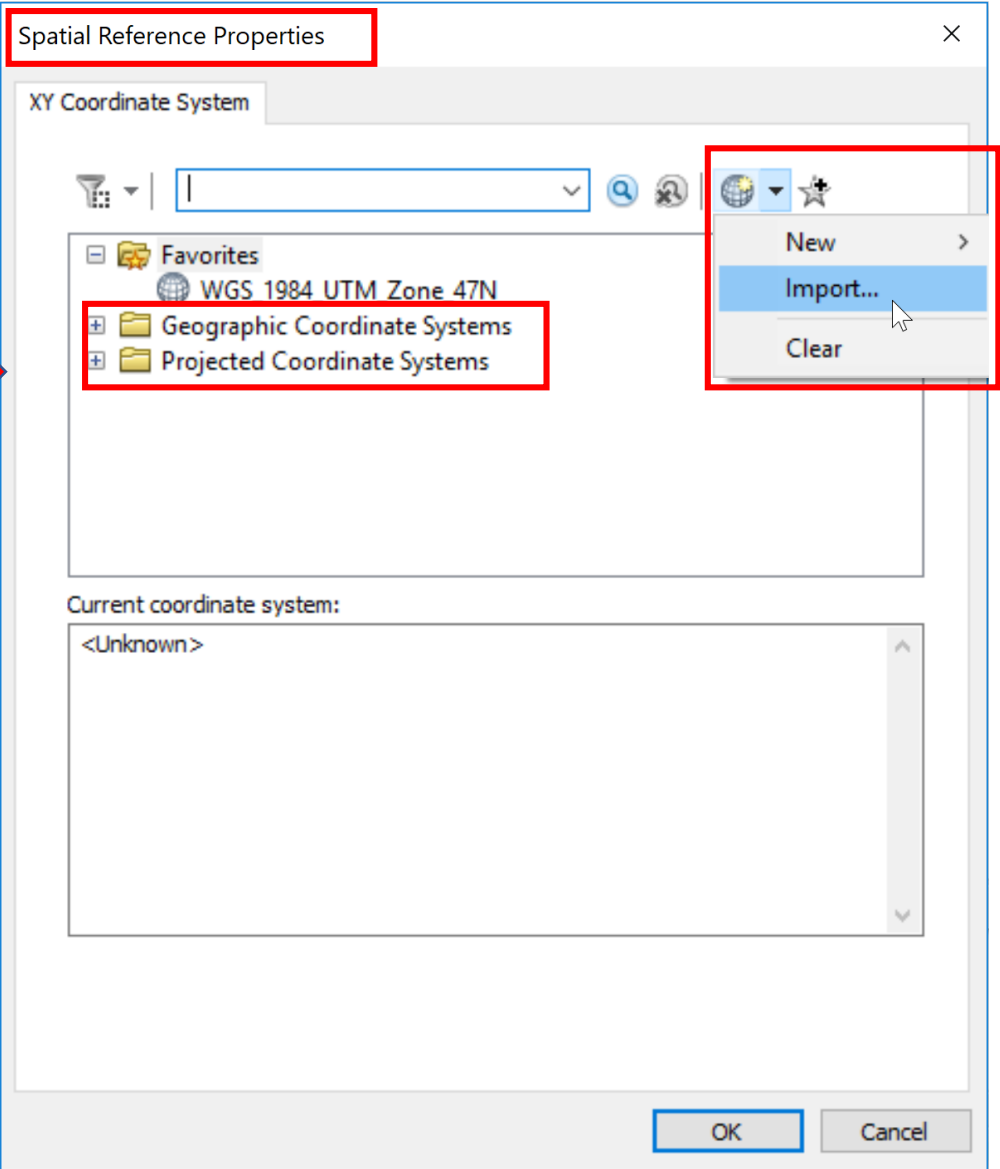
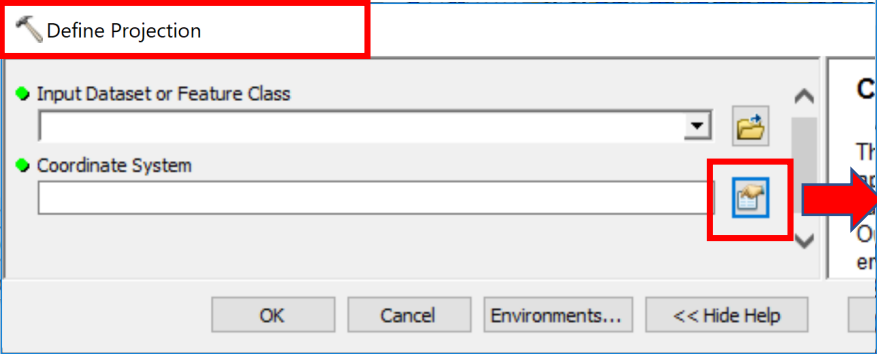
ArcToolbox → Data Management Tools → Projections and Transformations

If an input dataset or feature class does not have a projection, you need to define a projection using “Define Projection”.

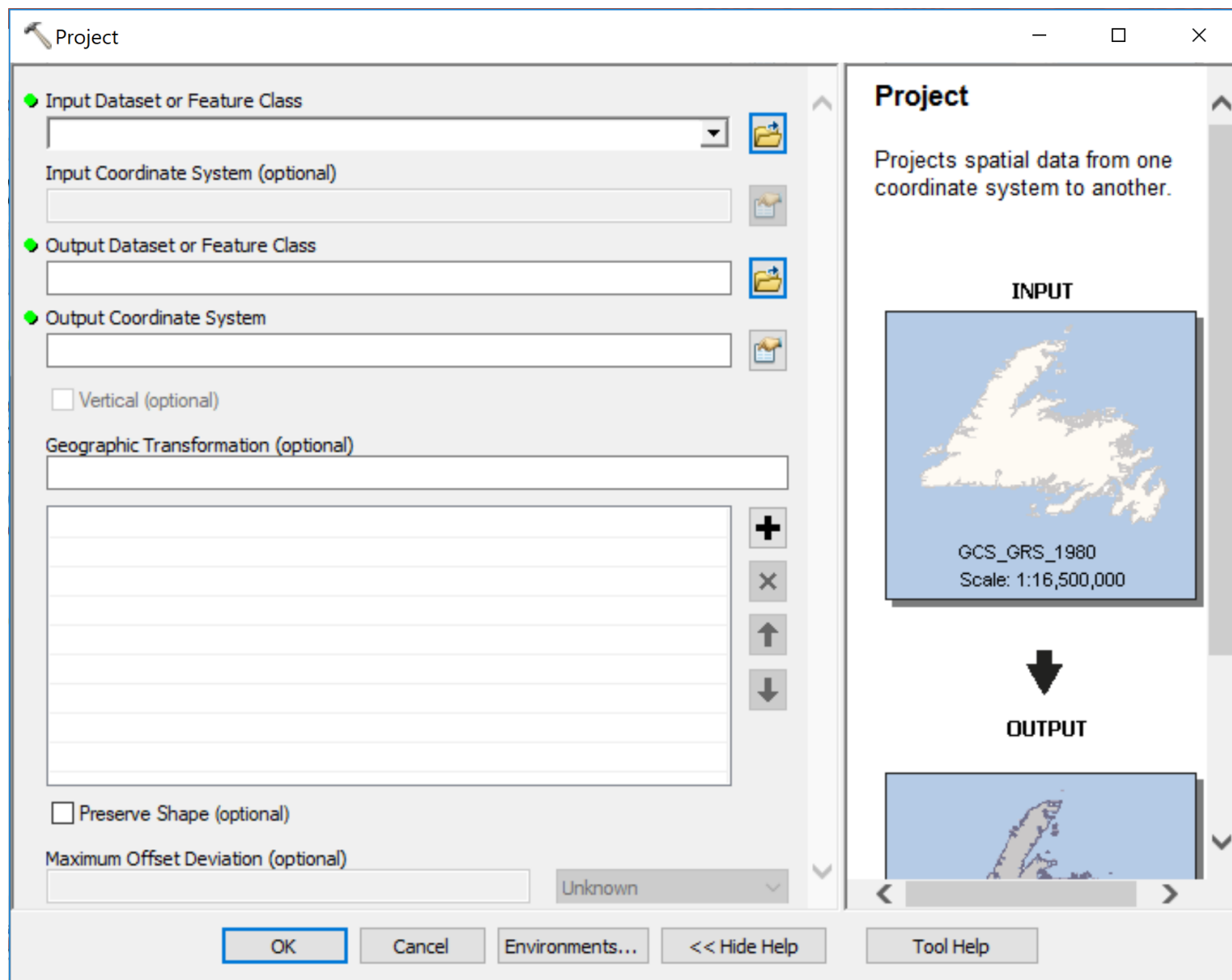


1.8 Projection (cont.)

Define Projection



1.8 Projection (cont.)



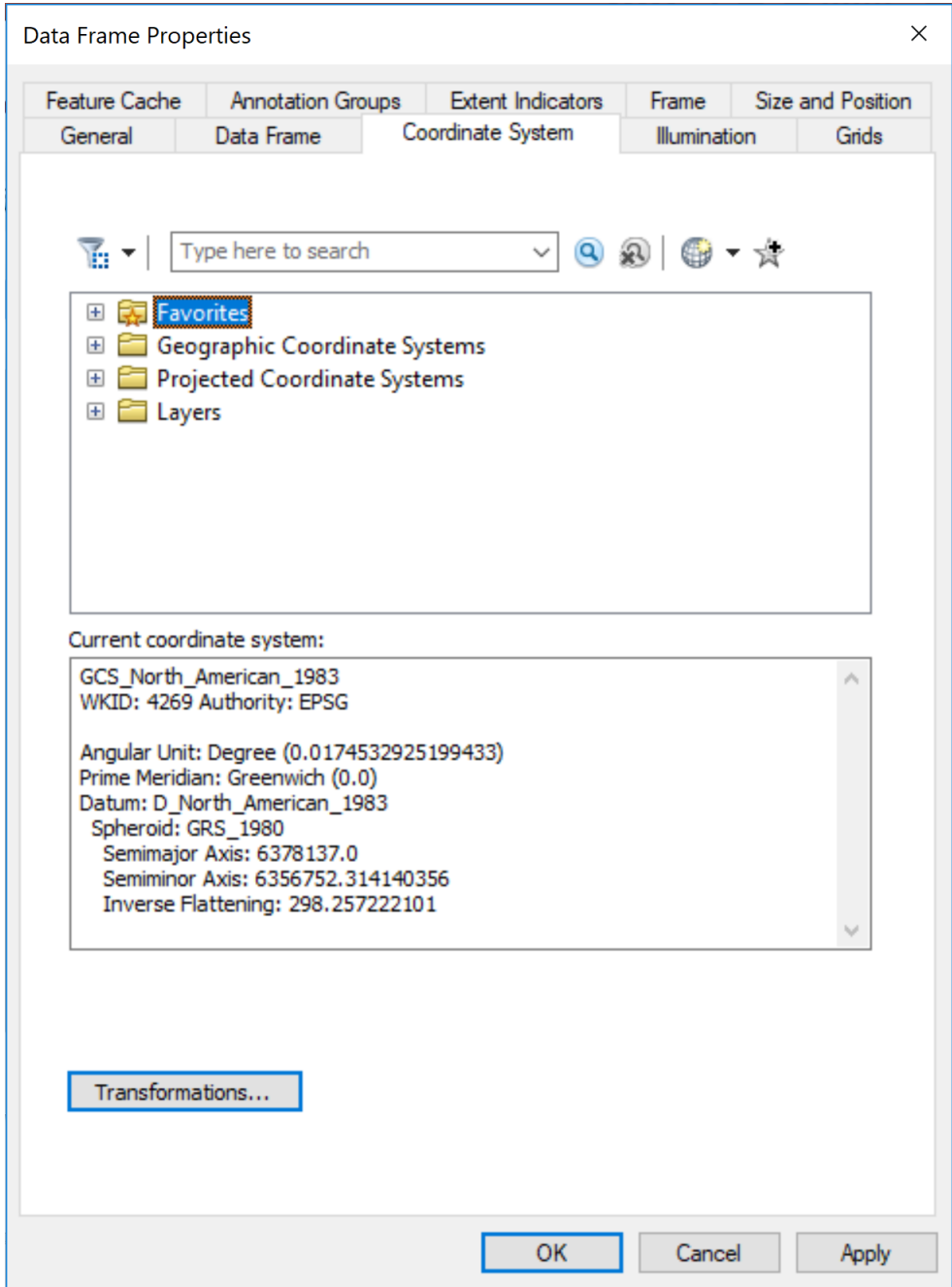
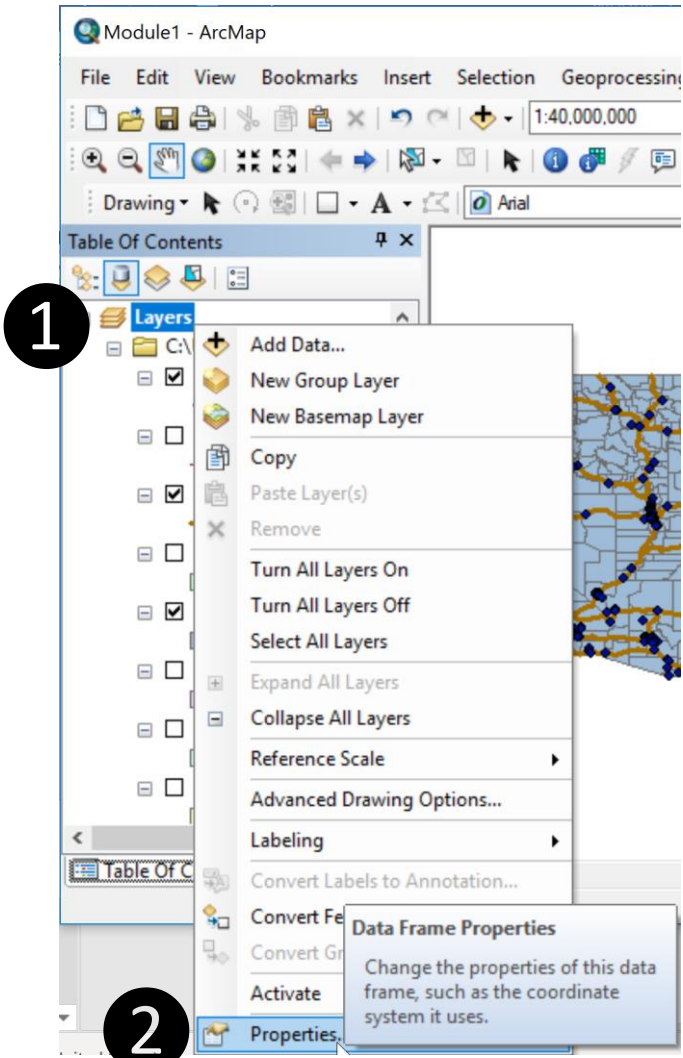
1.8 Projection (cont.)

On-the-fly Projection

- (1) The first layer added to ArcMap defines the data frame's coordinate system (projected, geographic, or none).
- (2) If the data frame has a projected or geographic coordinate system, any new data layer that has projected or geographic coordinate system will be projected on the fly to match data frame.
- (3) The data frame's coordinate system can be changed (see next slide).
- (4) Changing the coordinate system of a data frame doesn't alter the coordinate systems of the source data in the data frame.

1.8 Projection (cont.)

Data frame properties



Review

1.1 Basic GIS concepts

1.2 Vector data model

1.3 Attribute tables

1.4 Feature selection

1.5 Clip, intersect, union, and buffer

1.6 Merge, dissolve, and spatial join

1.7 Feature editing

1.8 Projection

Additional Readings

- Geospatial Analysis (Sections 1.1, 1.3 and 1.4):

<http://www.spatialanalysisonline.com/HTML/index.html>

- What is geocoding?

<http://desktop.arcgis.com/en/arcmap/10.6/manage-data/geocoding/what-is-geocoding.htm>

- What are map projections?

<http://desktop.arcgis.com/en/arcmap/10.6/map/projections/what-are-map-projections.htm>