
Introduction to ArcGIS Pro



RICE

Fondren Library
GIS/Data Center

Objectives

1. Familiar with GIS terms and concepts
2. Navigate ArcGIS Pro software
3. Know where to go for further assistance

Road map

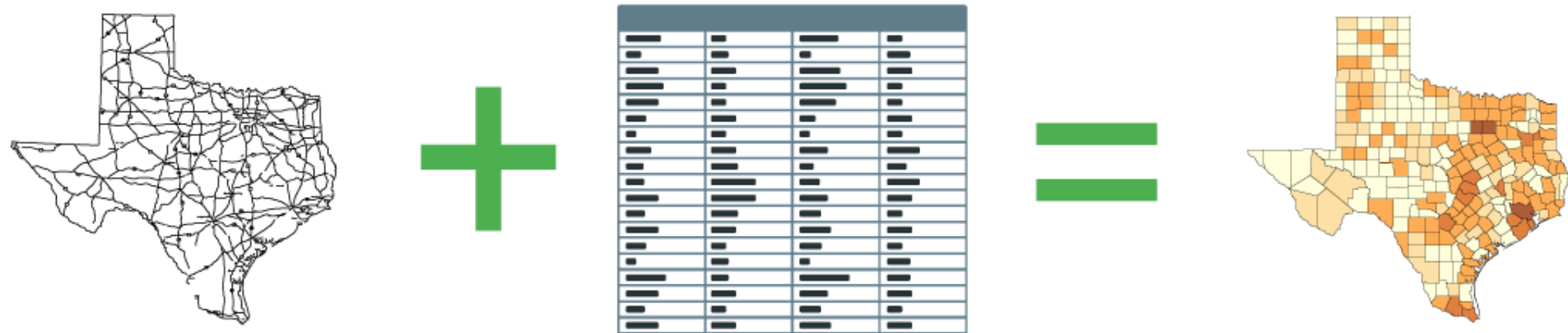
GDC → GIS overview → Examples of GIS → **Hands-on workshop**

GIS/Data Center

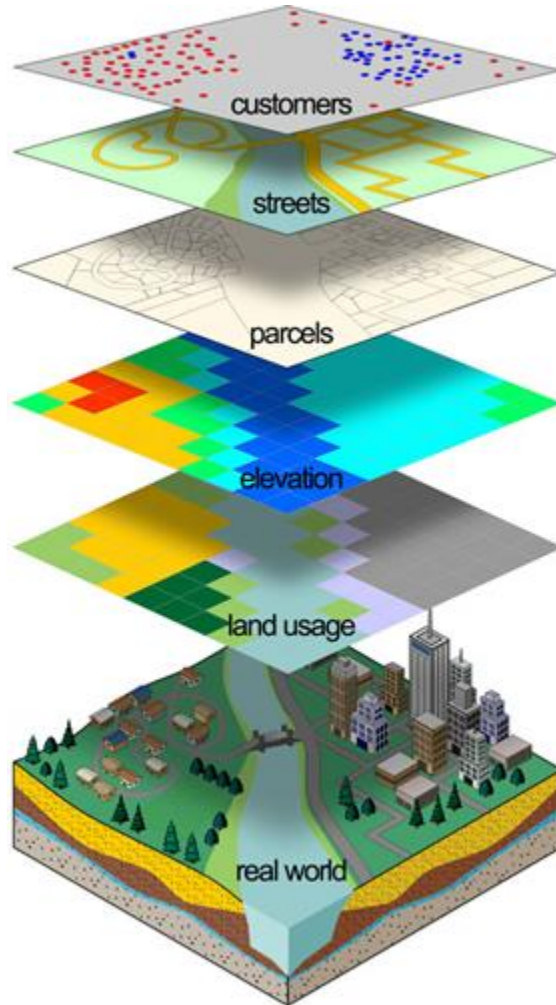
Fundamentals

What is GIS?

A geographic information system (GIS) is a system designed to create, store, manipulate, analyze, manage, and visualize spatial data.



What is GIS?



GIS components

Software

- Esri ArcGIS, QGIS, ERDAS IMAGINE, ENVI

Hardware

- Desktops, servers, smartphones, tablets, GPS devices

Data

- Publicly available, purchased, created

People

- GIS professional, data providers, and audiences

Methods

- Workflows; plans and rules for how technology is applied

GIS functions

Visualization

- Getting information by looking at a map

Geospatial analysis

- Performing detailed analysis regarding the spatial relationships between and within datasets

Geospatial data management

- Organizing and updating spatial information

GIS data

Components → Types → Formats → Coordinate systems

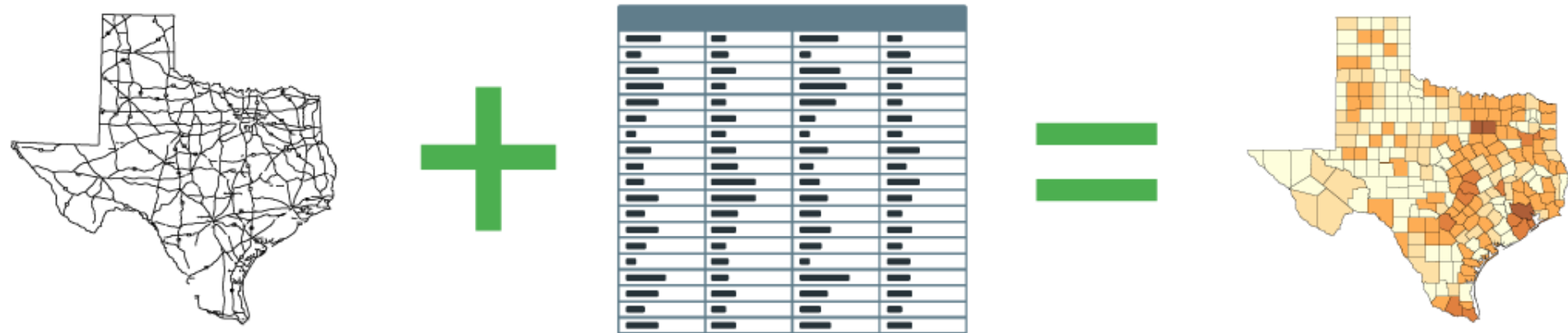
GIS data components

Features

- Graphic spatial representation of real-world physical features

Attributes

- Non-spatial data describing the features



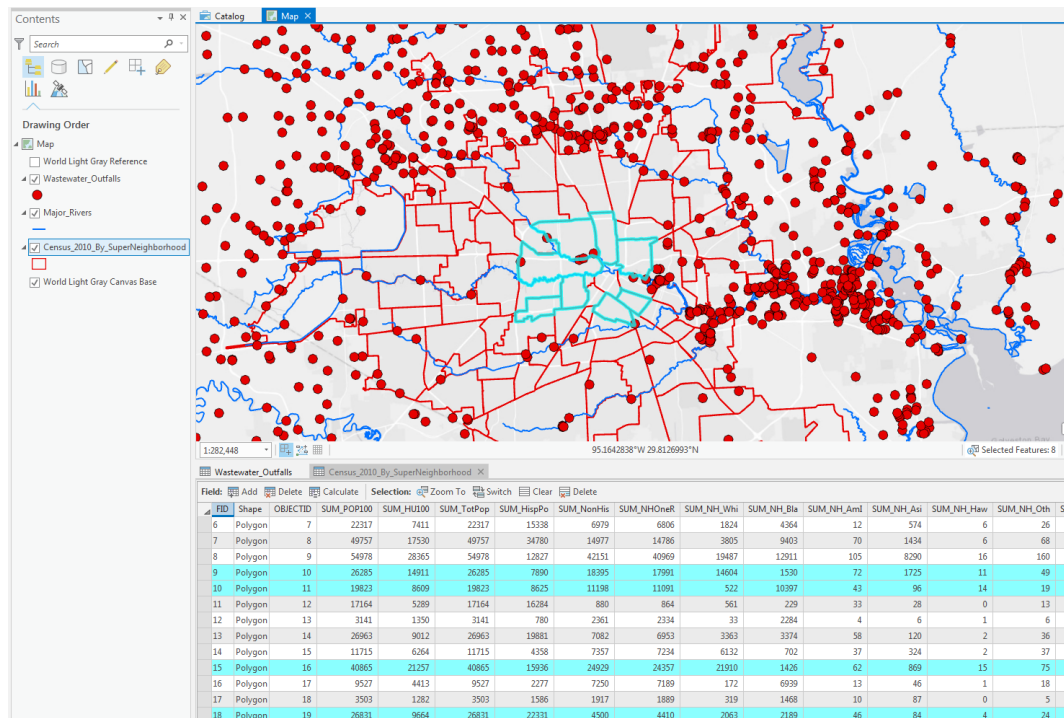
GIS data components

Features

- Graphic spatial representation of real-world physical features

Attributes

- Non-spatial data describing the features



Symbolize data by attributes

The screenshot displays a GIS application interface. The main map shows a city area with superneighborhoods color-coded based on total population. The Symbology pane on the right is configured for the 'Census_2010_By_SuperNeighborhood' layer, using a 'Graduated Colors' method with 'Natural Breaks (Jenks)' and 5 classes. The data table at the bottom provides the underlying population data for each superneighborhood.

Contents Pane:

- Map
- World Light Gray Reference
- Wastewater_Outfalls
- Major_Rivers
- Census_2010_By_SuperNeighborhood**
 - SUM_TotPop / Shapearea
 - ≤0.00004675
 - ≤0.0001205
 - ≤0.0001943
 - ≤0.0002848
 - ≤0.0005566
- World Light Gray Canvas Base

Symbology Pane:

- Layer: Census_2010_By_SuperNeighborhood
- Symbology: Graduated Colors
- Field: SUM_TotPop
- Normalization: Shapearea
- Method: Natural Breaks (Jenks)
- Classes: 5
- Color scheme: [Color gradient]

Data Table:

FID	Shape	OBJECTID	SUM_POP100	SUM_HU100	SUM_TotPop	SUM_HispPo	SUM_NonHis	SUM_NHOneR	SUM_NHWhi	SUM_NH_Bla	SUM_NH_Aml	SUM_NH_Asi	SUM_NH_Haw	SUM_NH_Oth
0	Polygon	1	3881	2104	3881	711	3170	3091	1353	1396	11	321	1	9
1	Polygon	2	13471	5120	13471	10603	2868	2798	1063	1623	21	78	2	11
2	Polygon	3	16716	3664	16716	3266	13450	13347	6092	6562	29	355	1	308
3	Polygon	4	2497	1133	2497	603	1894	1880	15	1853	5	6	0	1
4	Polygon	5	49277	31563	49277	7311	41966	41129	34063	2291	69	4551	11	144
5	Polygon	6	33973	15192	33973	15914	18059	17769	4920	12080	80	638	5	46
6	Polygon	7	22317	7411	22317	15338	6979	6806	1824	4364	12	574	6	26
7	Polygon	8	49757	17530	49757	34780	14977	14786	3805	9403	70	1434	6	68
8	Polygon	9	54978	28365	54978	12827	42151	40969	19487	12911	105	8290	16	160
9	Polygon	10	26285	14911	26285	7890	18395	17991	14604	1530	72	1725	11	49
10	Polygon	11	19823	8609	19823	8625	11198	11091	522	10397	43	96	14	19
11	Polygon	12	17164	5289	17164	16284	880	864	561	229	33	28	0	13
12	Polygon	13	3141	1350	3141	780	2361	2334	33	2284	4	6	1	6

Select data by attributes

Contents

- Map
- World Light Gray Reference
- Wastewater_Outfalls
- Major_Rivers
- Census_2010_By_SuperNeighborhood**
 - SUM_TotPop / Shapearea
 - ≤0.00004675
 - ≤0.0001205
 - ≤0.0001943
 - ≤0.0002848
 - ≤0.0005566
 - World Light Gray Canvas Base

Geoprocessing

Select Layer By Attribute

Parameters | Environments

Layer Name or Table View
Census_2010_By_SuperNeighborhood

Selection type
New selection

Expression
SUM_TotPop is Greater Than 60000

✓ The SQL expression is valid.

Add Clause

Invert Where Clause

Wastewater_Outfalls | **Census_2010_By_SuperNeighborhood**

Field:	Add	Delete	Calculate	Selection:	Zoom To	Switch	Clear	Delete	Highlighted:	Unselect	Reselect	Zoom To	Switch	Clear	Delete
FID	Shape	OBJECTID	SUM_POP100	SUM_HU100	SUM_TotPop	SUM_HispPo	SUM_NonHis	SUM_NHOneR	SUM_NHWhi	SUM_NH_Bla	SUM_NH_Aml	SUM_NH_Asi	SUM_NH_Haw	SUM_NH_Oth	SU
43	Polygon	44	75724	30285	75724	43244	32480	31627	9838	10280	105	11208	40	156	
50	Polygon	51	60857	19004	60857	31148	29709	29328	2139	26146	76	892	3	72	
52	Polygon	53	102235	35498	102235	47966	54269	52936	8596	25589	163	18348	30	210	

Click to add new row.

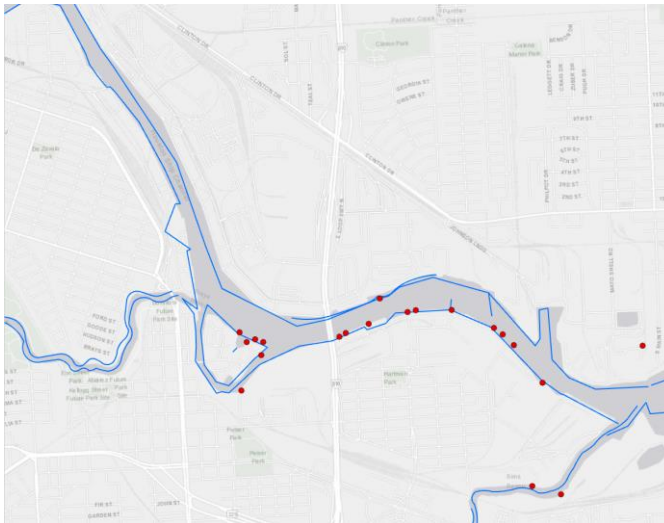
Run

✓ Select Layer By Attribute Completed successfully

Data types

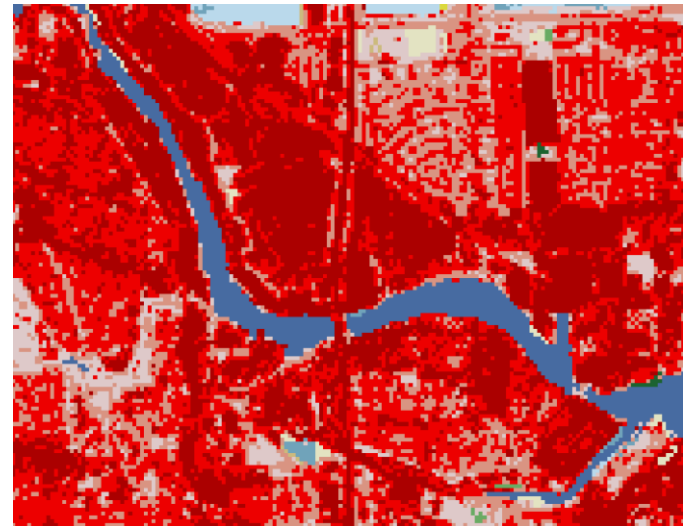
Vector

- Uses points, lines, and polygons to represent real features on the earth's surface. Ideal for discrete themes with definite boundaries.
- Examples: light poles, roads, buildings



Raster

- Composed of a continuous grid of cells that represent a value for a portion of the earth's surface. Ideal for continuous themes of change
- Examples: elevation, rainfall



Vector data - points

The screenshot displays a GIS interface with a map of wastewater outfalls (red points) and a data table. The map shows a dense distribution of red points across a geographic area, with a scale of 1:309,414 and coordinates 95.5385874°W 29.5944045°N. The data table below the map lists 14 records for the 'Wastewater_Outfalls' layer.

OBJECTID_1	Shape	TCEQ_Permit_Numbr	GIS_Outfall_ID	Outfall_Number	Source	Latitude	Longitude	Year_Active	EPA_Permit_Number
1	Point	WQ0011388001	11388-001.001	001	TCEQ	29.907434	-95.073441	2010	TX0054151
2	Point	WQ0011395001	11395-001.001	001	TCEQ	30.224731	-95.434263	2010	TX0022005
3	Point	WQ0011401001	11401-001.002	002	TCEQ	30.142208	-95.471082	2010	TX0054186
4	Point	WQ0011404001	11404-001.001	001	TCEQ	30.092384	-95.554492	2010	TX0026255
5	Point	WQ0011406001	11406-001.001	001	TCEQ	30.031776	-95.302955	2010	TX0056537
6	Point	WQ0011409001	11409-001.001	001	TCEQ	30.00679	-95.51829	2010	TX0046817
7	Point	WQ0014830001	14830-001.001	001	TCEQ	29.876071	-95.625227	2010	TX0104795
8	Point	WQ0011414002	11414-002.001	001	TCEQ	29.946298	-95.368581	2010	TX0033189
9	Point	WQ0011419001	11419-001.001	001	TCEQ	30.451004	-95.564711	2010	TX0027391
10	Point	WQ0011437001	11437-001.001	001	TCEQ	30.412544	-95.927655	2010	TX0092649
11	Point	WQ0011444001	11444-001.001	001	TCEQ	30.037656	-95.416643	2010	TX0046736
12	Point	WQ0014886001	14886-001.001	001	TCEQ	30.01667	-95.329927	2010	TX0097209
13	Point	WQ0014896001	14896-001.001	001	TCEQ	29.963507	-95.743331	2010	TX0129852
14	Point	WQ0000443000	00443-000.007	007	TCEQ	29.363885	-94.925863	2010	TX0003522

Vector data - lines

The screenshot displays a GIS interface with a map of wastewater outfalls and a data table. The map shows a network of blue lines representing outfalls on a light gray background. The interface includes a 'Contents' panel on the left, a 'Symbology' panel on the right, and a data table at the bottom.

Contents Panel:

- Map
- World Light Gray Reference
- Wastewater_Outfalls
- Major_Rivers
- Census_2010_By_SuperNeighborhood SUM_TotPop / Shapearea
 - ≤0.00004675
 - ≤0.0001205
 - ≤0.0001943
 - ≤0.0002848
 - ≤0.0005566
- World Light Gray Canvas Base

Symbology Panel:

- Wastewater_Outfalls
- Single Symbol
- Symbol: Red circle
- Label: [Empty text box]
- Description: [Empty text box]

Data Table:

OBJECTID_1	Shape	TCEQ_Permit_Numbr	GIS_Outfall_ID	Outfall_Number	Source	Latitude	Longitude	Year_Active	EPA_Permit_Number
1	Point	WQ0011388001	11388-001.001	001	TCEQ	29.907434	-95.073441	2010	TX0054151
2	Point	WQ0011395001	11395-001.001	001	TCEQ	30.224731	-95.434263	2010	TX0022005
3	Point	WQ0011401001	11401-001.002	002	TCEQ	30.142208	-95.471082	2010	TX0054186
4	Point	WQ0011404001	11404-001.001	001	TCEQ	30.092384	-95.554492	2010	TX0026255
5	Point	WQ0011406001	11406-001.001	001	TCEQ	30.031776	-95.302955	2010	TX0056537
6	Point	WQ0011409001	11409-001.001	001	TCEQ	30.00679	-95.51829	2010	TX0046817
7	Point	WQ0014830001	14830-001.001	001	TCEQ	29.876071	-95.625227	2010	TX0104795
8	Point	WQ0011414002	11414-002.001	001	TCEQ	29.946298	-95.368581	2010	TX0033189
9	Point	WQ0011419001	11419-001.001	001	TCEQ	30.451004	-95.564711	2010	TX0027391
10	Point	WQ0011437001	11437-001.001	001	TCEQ	30.412544	-95.927655	2010	TX0092649
11	Point	WQ0011444001	11444-001.001	001	TCEQ	30.037656	-95.416643	2010	TX0046736
12	Point	WQ0014886001	14886-001.001	001	TCEQ	30.01667	-95.329927	2010	TX0097209
13	Point	WQ0014896001	14896-001.001	001	TCEQ	29.963507	-95.743331	2010	TX0129852
14	Point	WQ0000443000	00443-000.007	007	TCEQ	29.363885	-94.925863	2010	TX0003522

Vector data - polygons

The screenshot displays a GIS interface with a map of Houston, Texas, showing wastewater outfalls as red and orange polygons. The map is overlaid on a light gray reference grid. The interface includes a 'Contents' panel on the left, a 'Symbology' panel on the right, and a data table at the bottom.

Contents Panel:

- World Light Gray Reference
- Wastewater_Outfalls** (Selected)
- Major_Rivers
- Census_2010_By_SuperNeighborhood SUM_TotPop / Shapearea
 - ≤0.00004675
 - ≤0.0001205
 - ≤0.0001943
 - ≤0.0002848
 - ≤0.0005566
- World Light Gray Canvas Base

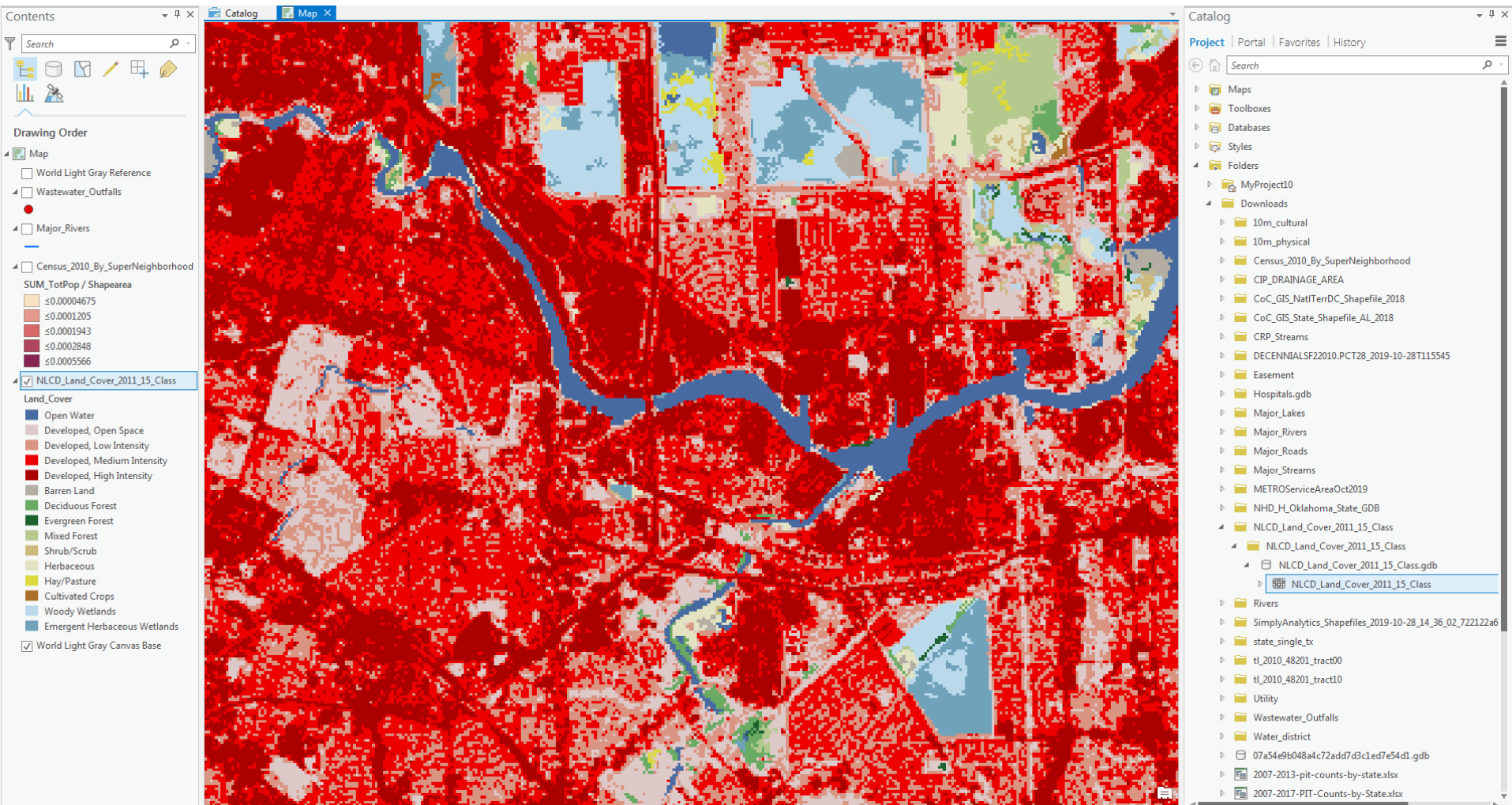
Symbology Panel:

- Wastewater_Outfalls
- Symbology: Single Symbol
- Symbol: Red circle
- Label: [Empty text box]
- Description: [Empty text box]

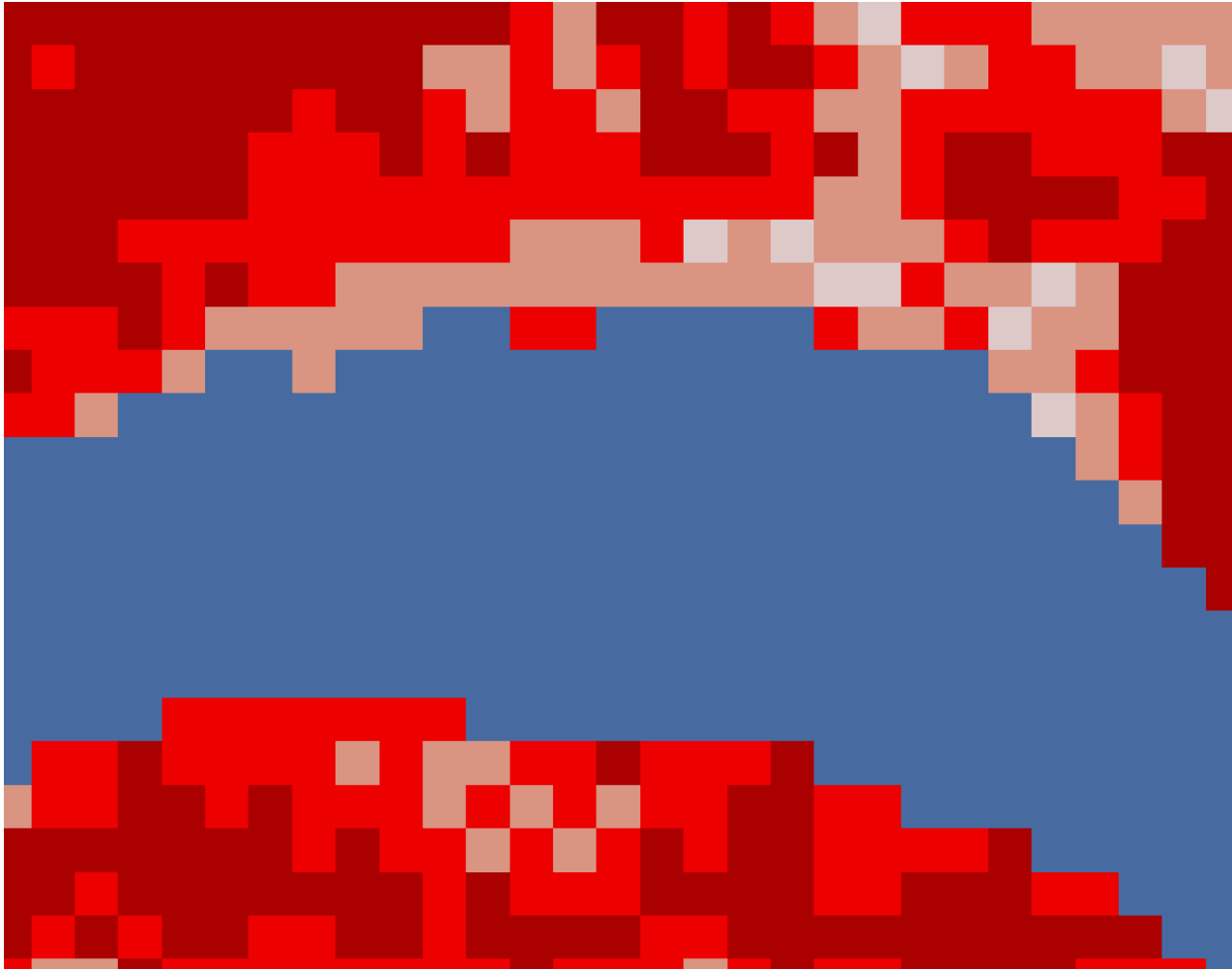
Data Table:

OBJECTID_1	Shape	TCEQ_Permit_Numbr	GIS_Outfall_ID	Outfall_Number	Source	Latitude	Longitude	Year_Active	EPA_Permit_Number
1	Point	WQ0011388001	11388-001.001	001	TCEQ	29.907434	-95.073441	2010	TX0054151
2	Point	WQ0011395001	11395-001.001	001	TCEQ	30.224731	-95.434263	2010	TX0022005
3	Point	WQ0011401001	11401-001.002	002	TCEQ	30.142208	-95.471082	2010	TX0054186
4	Point	WQ0011404001	11404-001.001	001	TCEQ	30.092384	-95.554492	2010	TX0026255
5	Point	WQ0011406001	11406-001.001	001	TCEQ	30.031776	-95.302955	2010	TX0056537
6	Point	WQ0011409001	11409-001.001	001	TCEQ	30.00679	-95.51829	2010	TX0046817
7	Point	WQ0014830001	14830-001.001	001	TCEQ	29.876071	-95.625227	2010	TX0104795
8	Point	WQ0011414002	11414-002.001	001	TCEQ	29.946298	-95.368581	2010	TX0033189
9	Point	WQ0011419001	11419-001.001	001	TCEQ	30.451004	-95.564711	2010	TX0027391
10	Point	WQ0011437001	11437-001.001	001	TCEQ	30.412544	-95.927655	2010	TX0092649
11	Point	WQ0011444001	11444-001.001	001	TCEQ	30.037656	-95.416643	2010	TX0046736
12	Point	WQ0014886001	14886-001.001	001	TCEQ	30.01667	-95.329927	2010	TX0097209
13	Point	WQ0014896001	14896-001.001	001	TCEQ	29.963507	-95.743331	2010	TX0129852
14	Point	WQ0000443000	00443-000.007	007	TCEQ	29.363885	-94.925863	2010	TX0003522

Raster data



Raster data



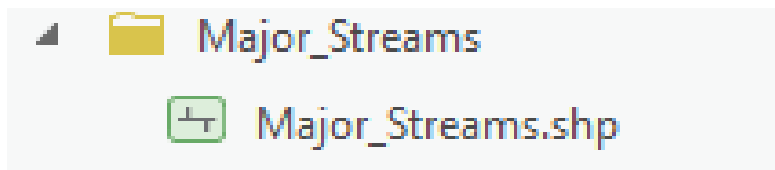
Data formats

Feature class

- Vector storage data format; points, lines, polygons
- Homogenous collection of common features

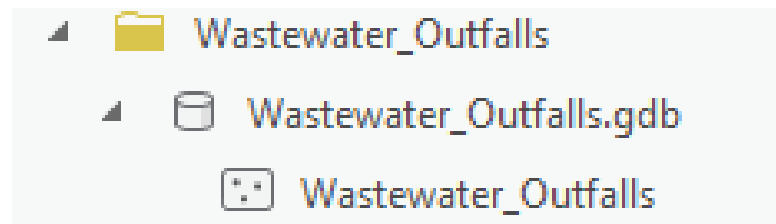
Shapefile feature class

- Open source

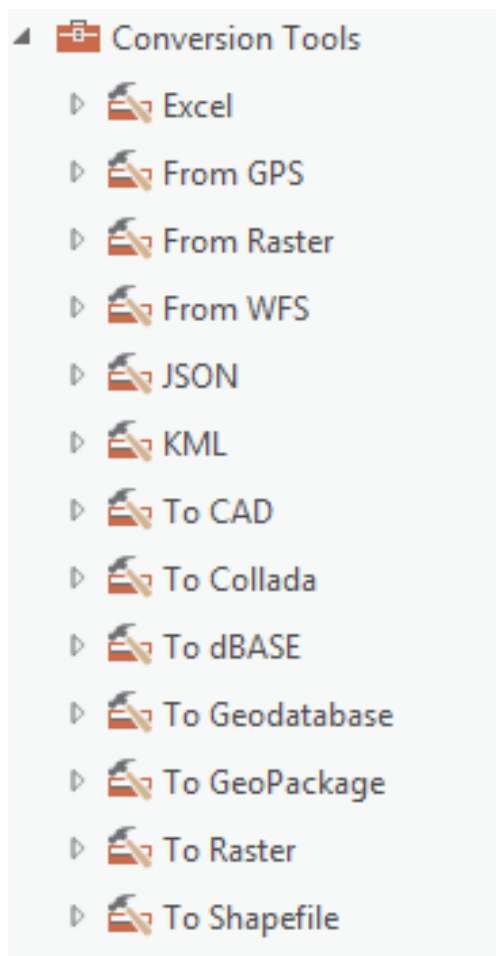


Geodatabase feature class

- Esri, proprietary



Data formats



Coordinate systems

Geographic (3D)

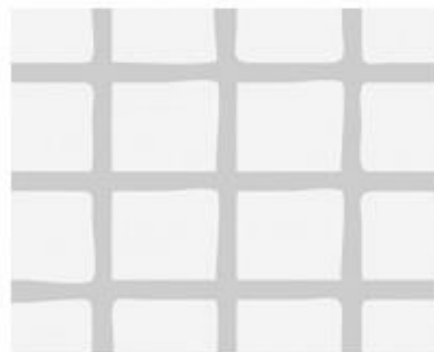
- A method of representing points in a space of given dimensions using spherical measures of lat/long
- Measured in degrees



Geographic (3D)

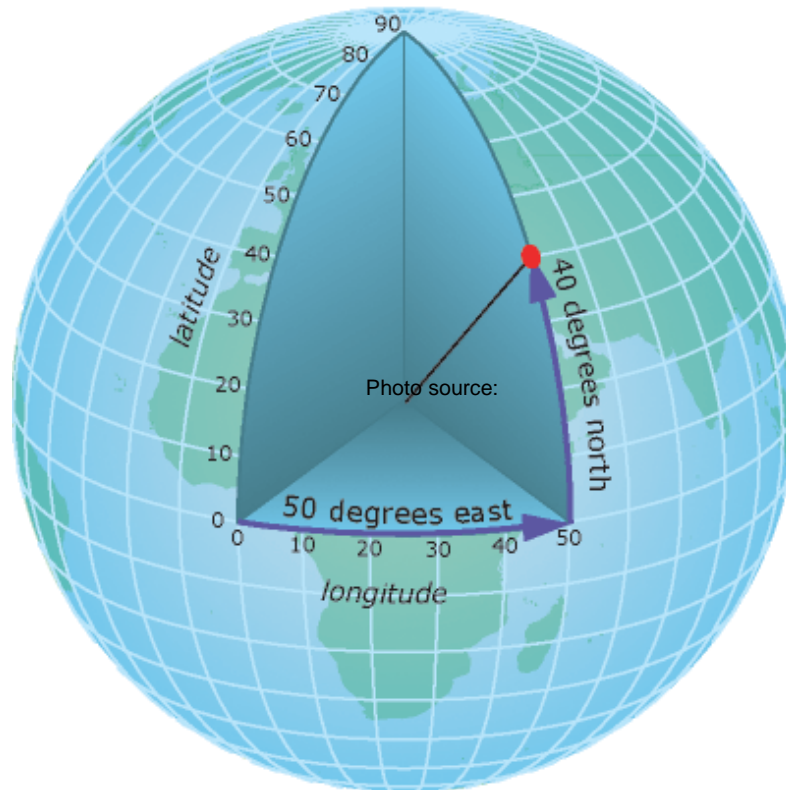
Projected (2D)

- A method of representing the earth's 3D surface as a 2D surface
- Measured in feet/meters

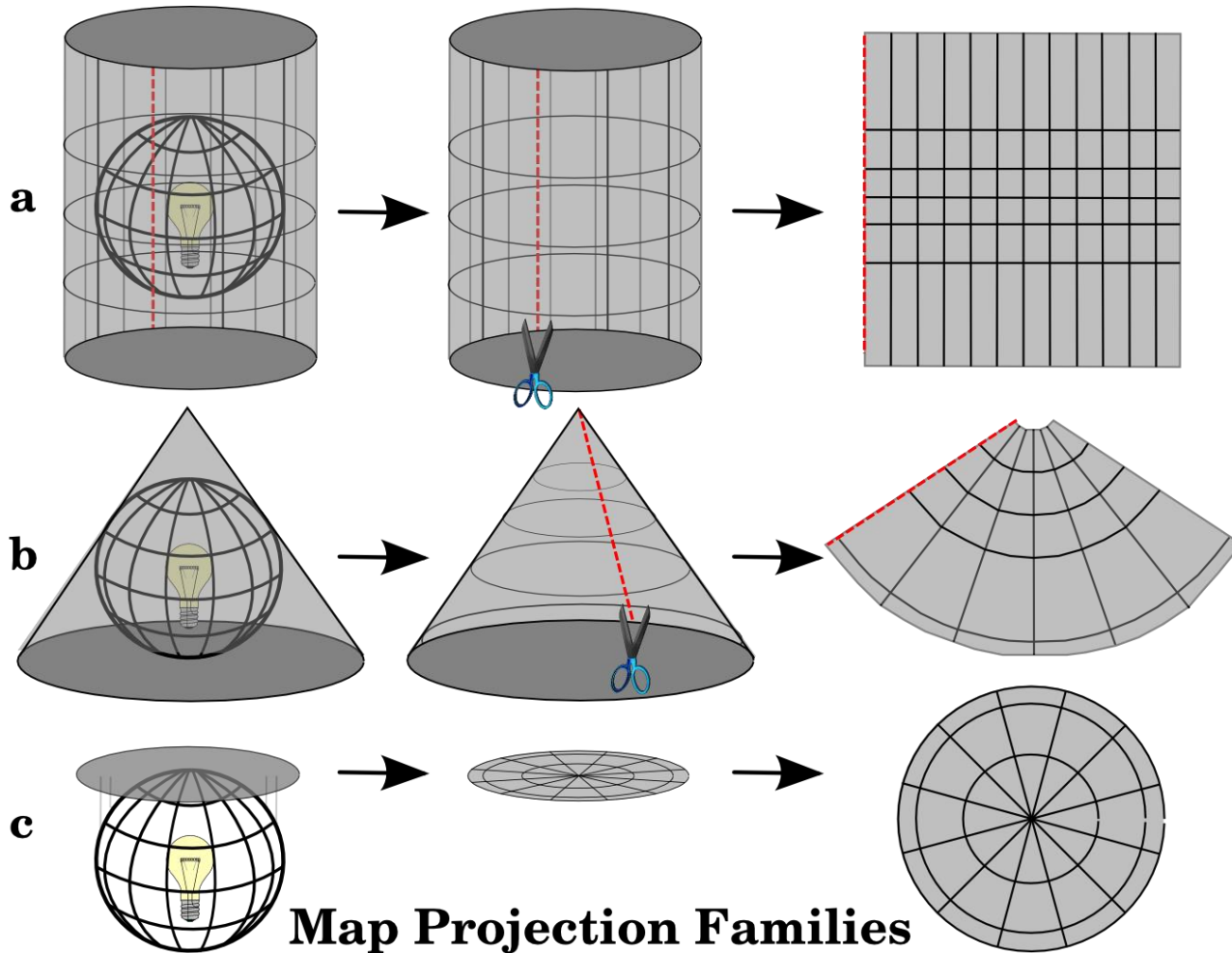


Projected (2D)

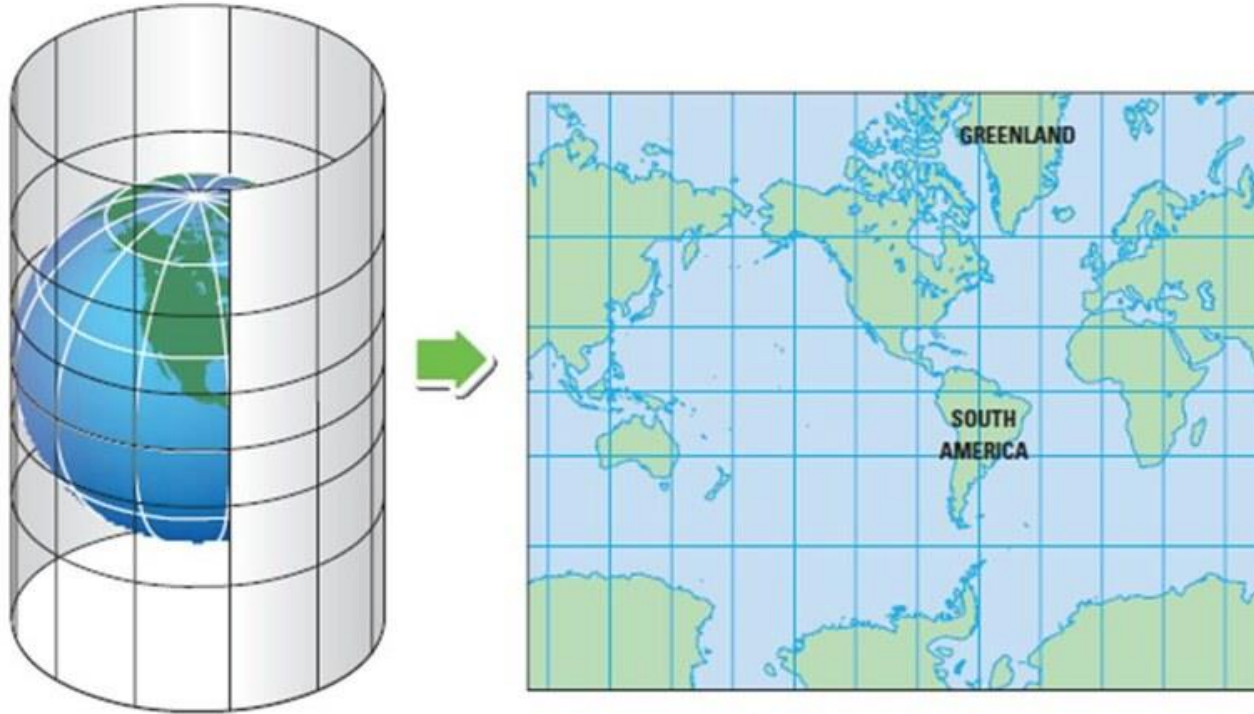
Geographic coordinate systems



Projected coordinate systems



Projected coordinate systems



Esri ArcGIS software

ArcGIS products

Desktop GIS

- ArcGIS Pro, ArcMap, ArcCatalog

Web-based GIS

- ArcGIS Online (AGOL): web maps, web apps

Mobile GIS

- Collector for ArcGIS
- Survey123 for ArcGIS



ArcGIS software @ Rice

On campus access

- GIS/Data Center
- Fondren Library 1st Floor Rice Computers
- Mudd Lab
- Various Department Labs (ARCH, CEVE, ESCI)

Personal use

- Request a 1-year student trial by e-mailing gisdata@rice.edu
- Windows only

GIS in practice

Nature and Conservation

Sea Level Rise and Storm Surge Effects on Energy Assets



- Introduction
- Baltimore MSA
- Boston MSA
- Houston MSA**
- Los Angeles MSA
- Miami MSA
- Mobile MSA
- New Orleans MSA
- New York MSA
- Norfolk MSA
- Philadelphia MSA
- Bibliography

Sea Level Rise and Storm Surge Effects on Energy Assets: Houston

Sea Level Rise and Storm Surge Inundation

OE generated several inundation surfaces to account for the range of possibilities of both future SLR and storm surge. Using the NCA Intermediate-High scenario in conjunction with NOAA data, the Houston area is projected to experience 2 feet of SLR by around 2050, and 5 feet of SLR by around 2100.

The following layers were created to show projected inundations. Click to view.

No Storm Surge

2 Foot of Sea Level Rise

5 Feet of Sea Level Rise

Category 1 Storm Surge

2 Foot of Sea Level Rise

5 Feet of Sea Level Rise

Category 5 Storm Surge

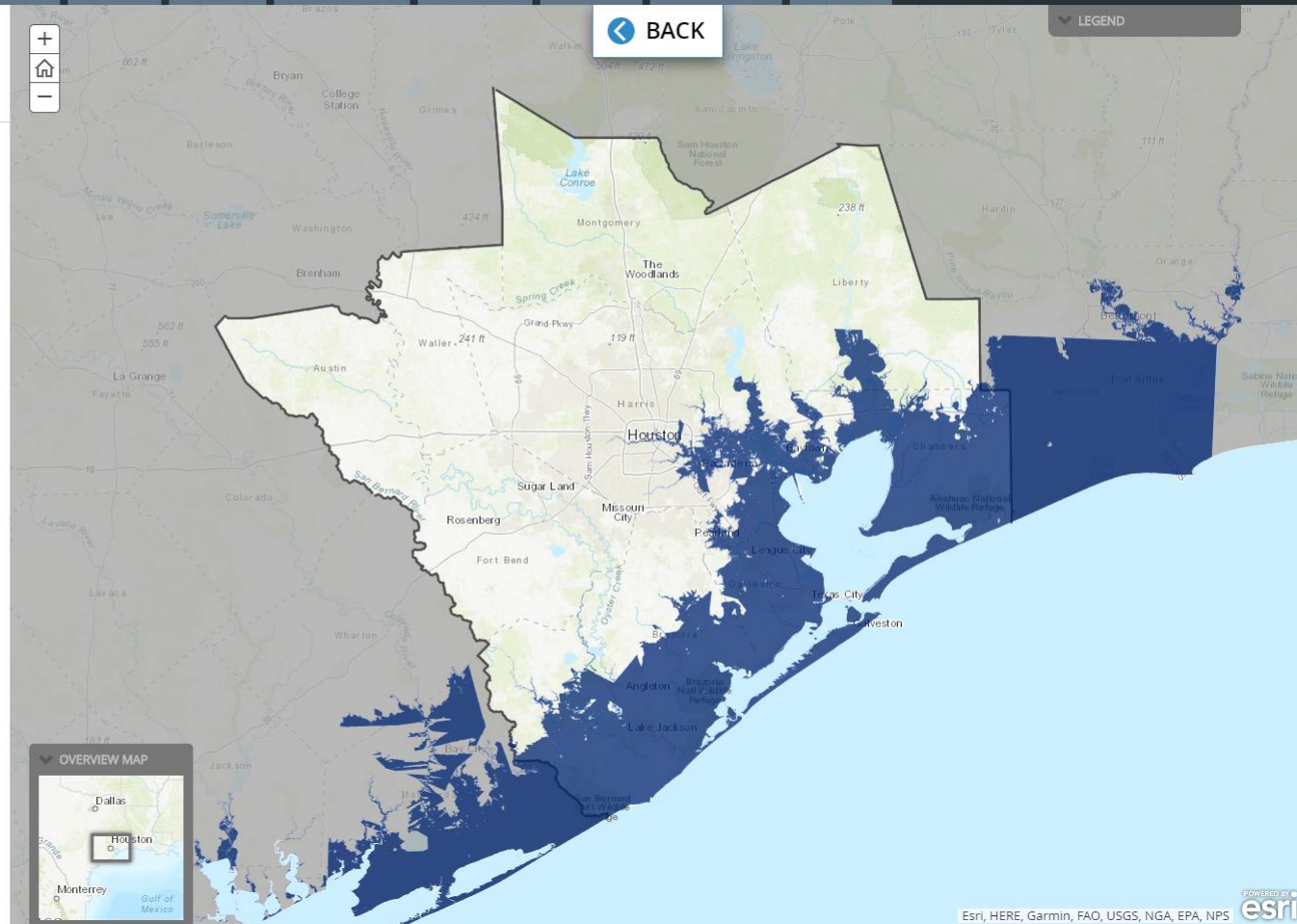
2 Foot of Sea Level Rise

5 Feet of Sea Level Rise

Assets

The Houston MSA includes more than 1,455 energy assets, which consists of electricity, petroleum and natural gas assets. For the purposes of this analysis, additional focus is placed on larger, more important assets.

Assets that were examined included:



POWERED BY Esri, HERE, Garmin, FAO, USGS, NGA, EPA, NPS

<https://icfgeospatial.maps.arcgis.com/apps/MapSeries/index.html?appid=58f90c5a5b5f4f94aaff93211c45e4ec>

Environmental Impacts

Summarizing Hurricane Harvey's Environmental Impacts

- Intro
- Water
- Air**
- Health and Safety
- Built Environment and People
- Electricity and Energy
- About

Air

- Ozone**
- Toxics

Daily Maximum 8-hour Ozone Concentrations

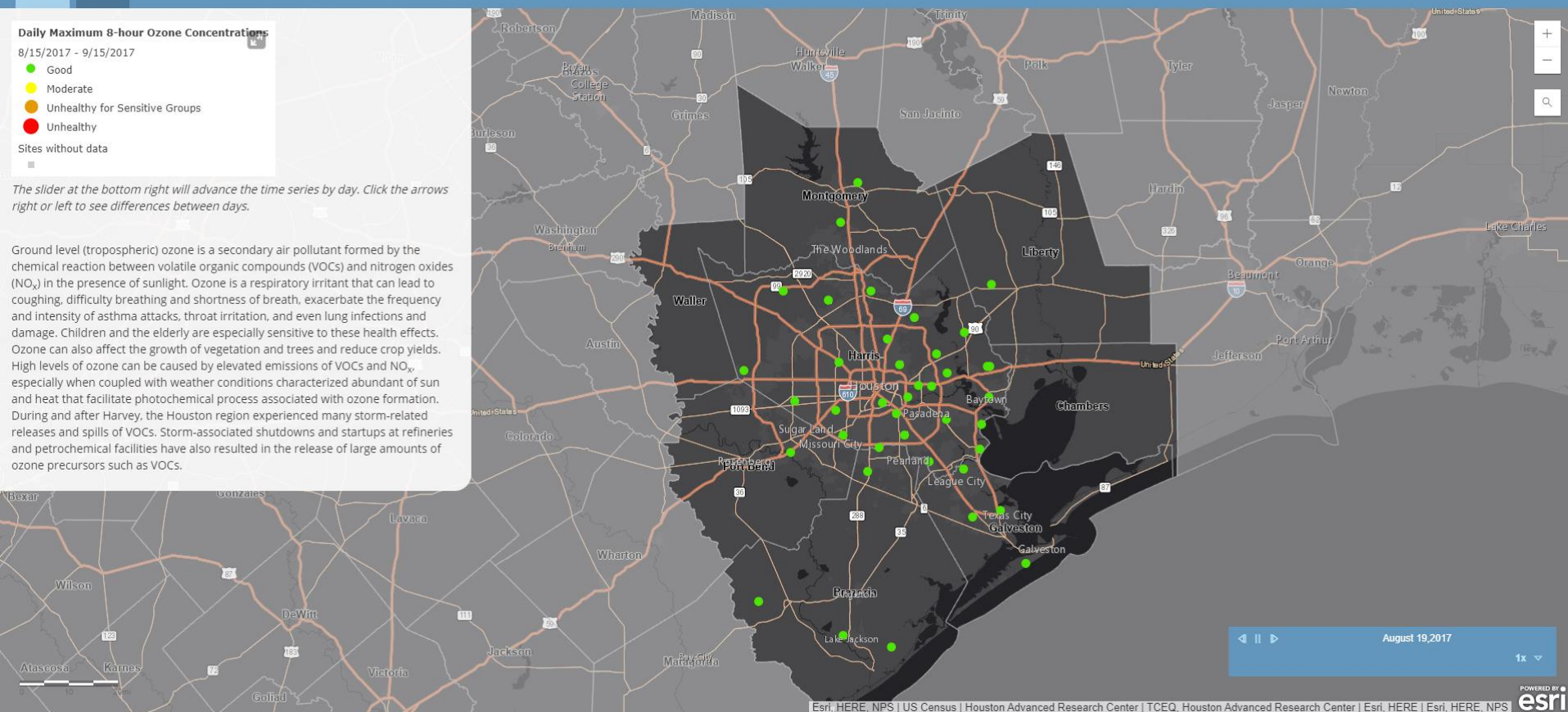
8/15/2017 - 9/15/2017

- Good
- Moderate
- Unhealthy for Sensitive Groups
- Unhealthy

Sites without data

The slider at the bottom right will advance the time series by day. Click the arrows right or left to see differences between days.

Ground level (tropospheric) ozone is a secondary air pollutant formed by the chemical reaction between volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight. Ozone is a respiratory irritant that can lead to coughing, difficulty breathing and shortness of breath, exacerbate the frequency and intensity of asthma attacks, throat irritation, and even lung infections and damage. Children and the elderly are especially sensitive to these health effects. Ozone can also affect the growth of vegetation and trees and reduce crop yields. High levels of ozone can be caused by elevated emissions of VOCs and NO_x, especially when coupled with weather conditions characterized abundant of sun and heat that facilitate photochemical process associated with ozone formation. During and after Harvey, the Houston region experienced many storm-related releases and spills of VOCs. Storm-associated shutdowns and startups at refineries and petrochemical facilities have also resulted in the release of large amounts of ozone precursors such as VOCs.

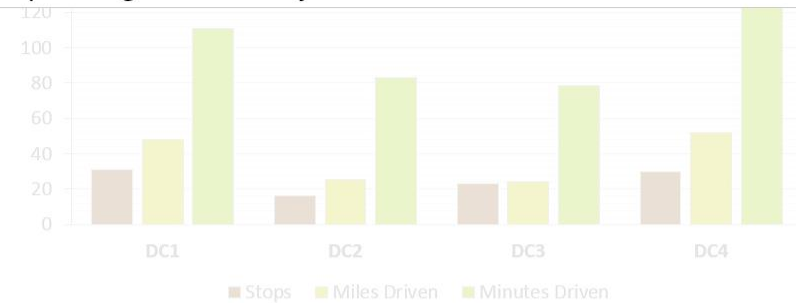


Business and Economics

A story map



Optimizing Home Delivery with Location Services



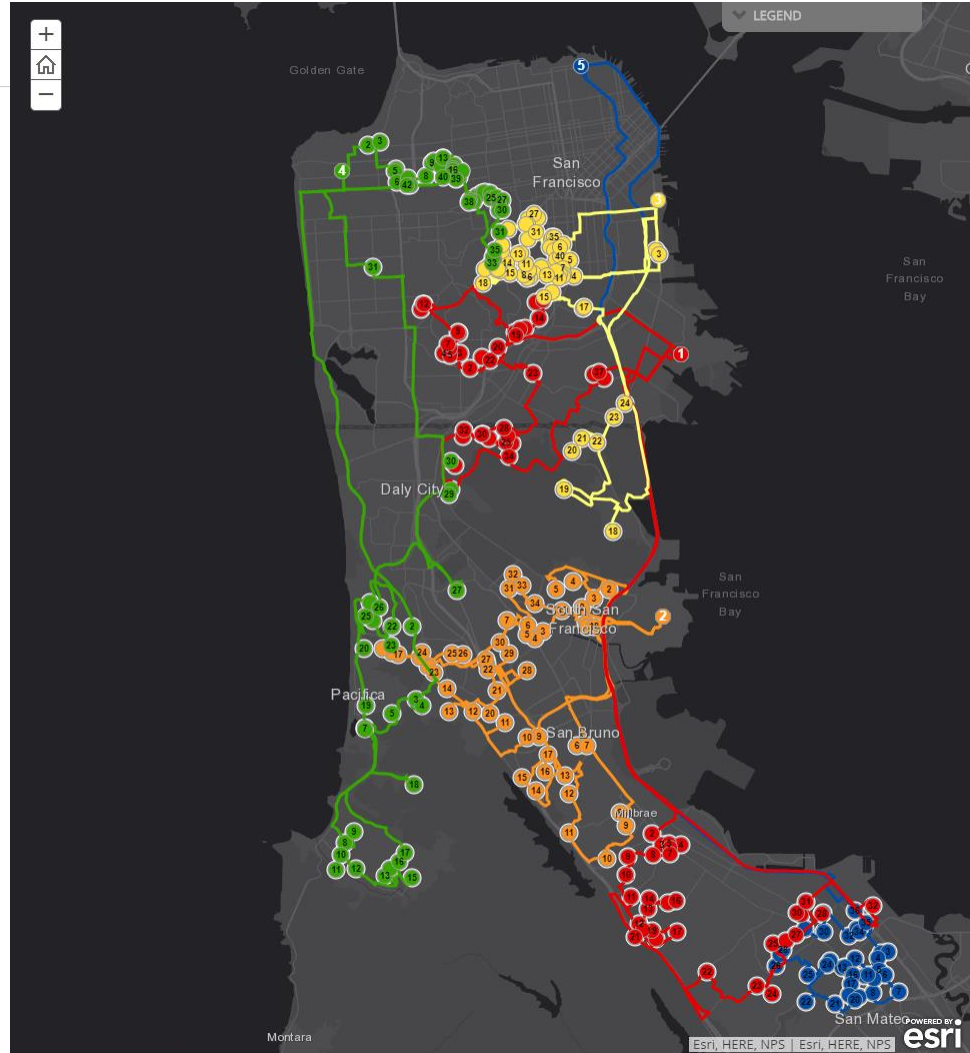
Blending Deliveries for All Customers

If the service strategies were simply combined by giving all the unassigned deliveries to a second vehicle at any of the DCs, there would be 63 hours of work but only approximately 8 hours allocated to DC5.

A strategy to minimize vehicles but ensure all DCs are used is not optimal because the second vehicle is often driving long distances to start deliveries. DC5 could serve some of those customers while more vehicles at some DCs might reduce time and distance.

DC	Stops	Work Hours	Minutes Driving	Miles Driven	Start Time	End Time
DC1	67	14:56	225.97	77.84	9:00 AM	4:55 PM
DC2	53	11:56	186.22	57.11	9:00 AM	4:53 PM
DC3	63	13:05	154.59	41.13	9:00 AM	4:56 PM
DC4	71	15:30	220.91	65.98	9:00 AM	4:53 PM
DC5	35	7:51	121.32	54.77	9:00 AM	4:51 PM
Totals	289	63:18	909.01	296.82		

Servicing All Customer Deliveries from Existing DCs (Blend)



<https://esribizteam.maps.arcgis.com/apps/MapJournal/index.html?appid=c81dfbf908d84eb89ec52351415c4dea>

Hands-on workshop

Wiki tutorial print-outs in the back of room!

Summary

1. Familiar with GIS terms and concepts
2. Navigate ArcGIS Pro software
3. Know where to go for further help