Enhancing Biological Assessments: GIS Basics

SARAH WHITLEY

TCEQ SWQM

What is GIS? (Geographic Information System)

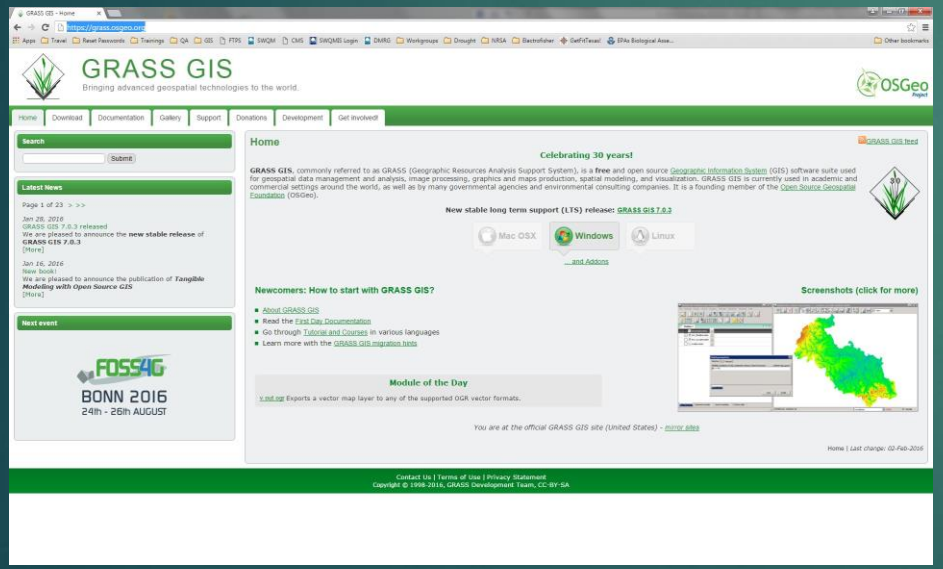
- Use it to capture, store, manipulate, analyze, manage, and present all types of spatial or geographical data
- Combines layers of information about a place to give a better understanding of that place
- Very powerful decision-making tool that has a wide range of applications:
  - Resource management
  - Logistics, planning, transportation
  - Surveying
  - Demographic studies
  - Environmental studies

Why would I use GIS?

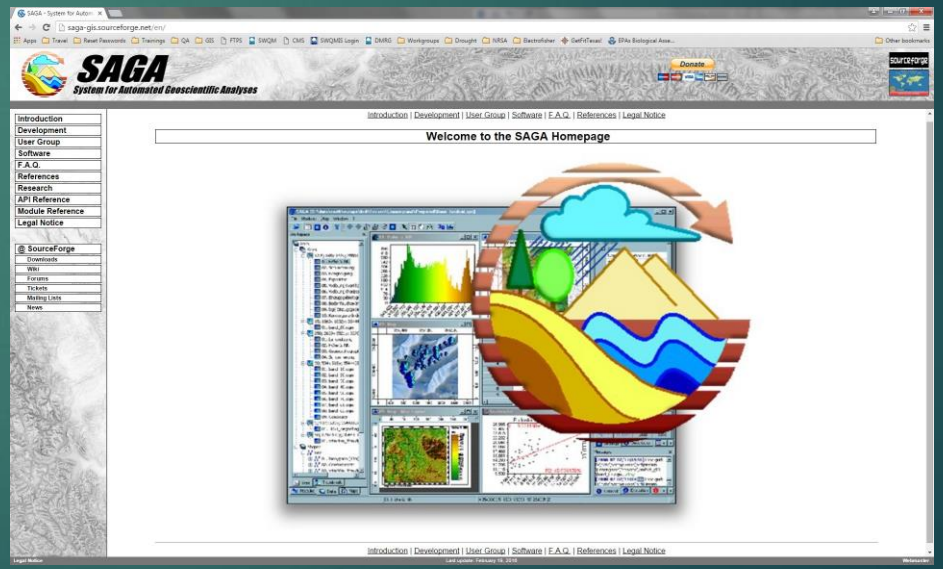
- Simple map-making
- Change detection (increase/decrease in vegetation, waterways, urban areas)
- Transportation route planning
- Habitat mapping
- Flood risk mapping
- Agriculture planning
- Site selection (water sampling, wells, neighborhood development, suitable locations to start a new business)
- Weed and pest management
- Watershed analysis

What programs can be used for GIS? Free and Open-source desktop

GRASS (Geographic Resources Analysis Support System)

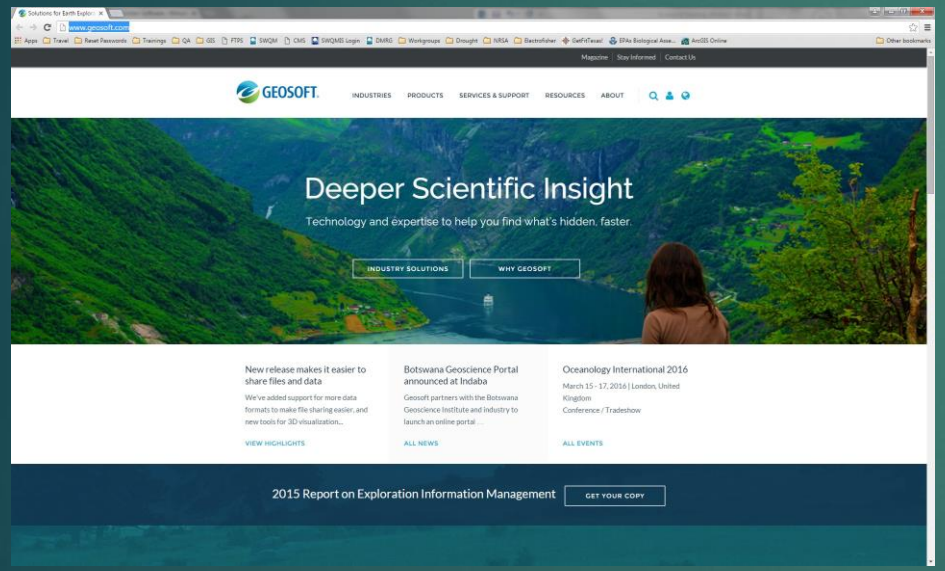


SAGA (System for Automated Geoscientific Analyses)



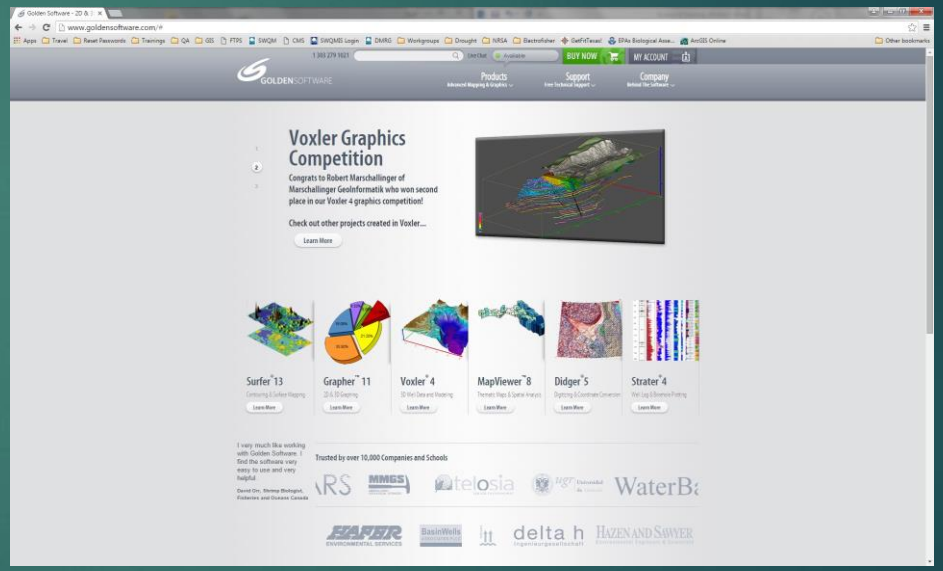
What programs can be used for GIS? Companies with minor market share

GEOSOFT



Software for Geochemistry for ArcGIS (geochemical analysis) and Target for ArcGIS (geological software)

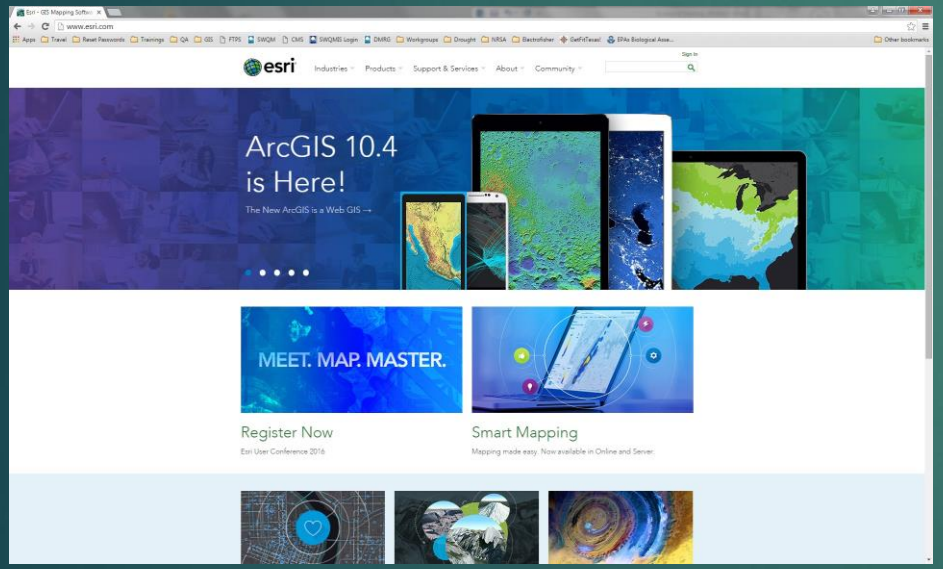
Golden Software



Contains various programs for different needs (MapViewer 8 is used for spatial analysis)

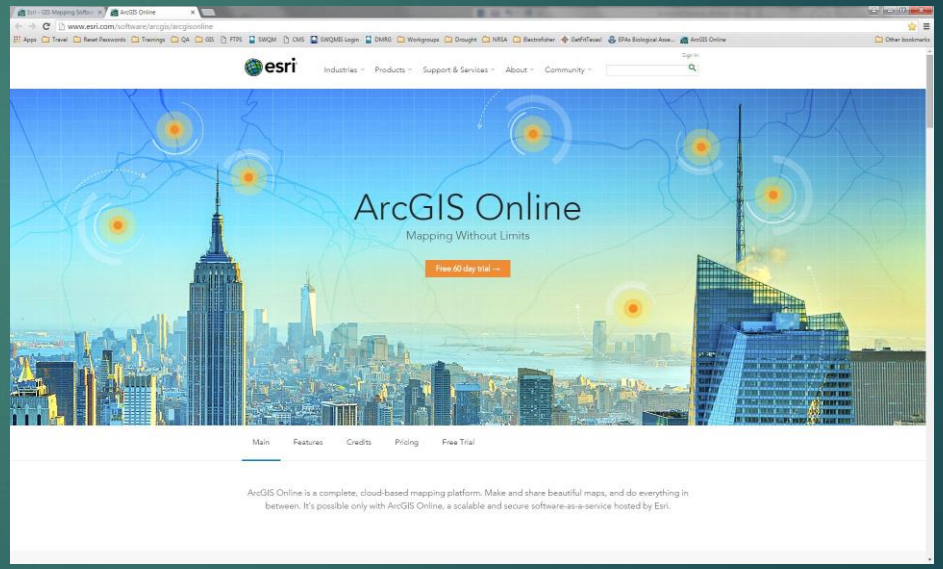
What programs can be used for GIS? Companies with high market share

ESRI



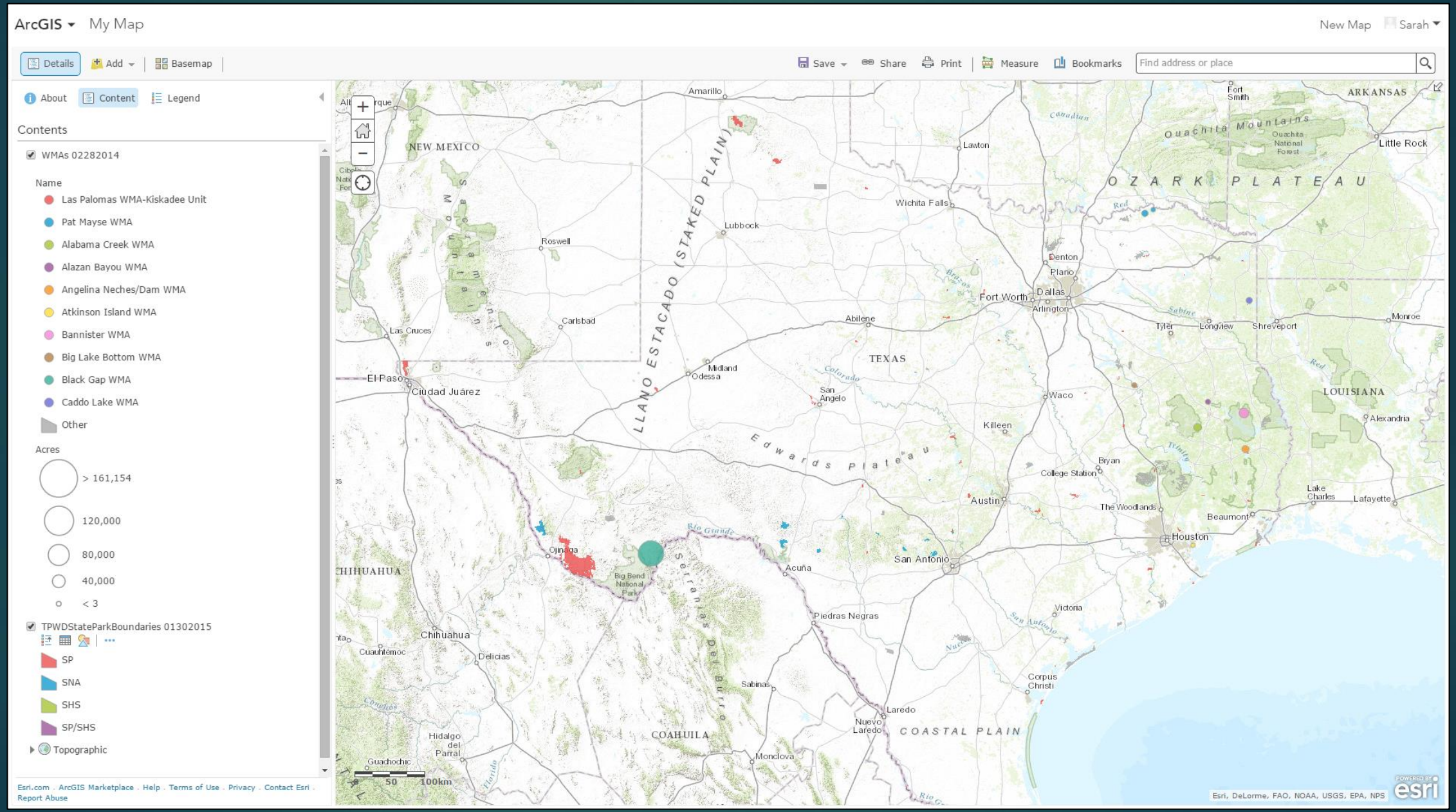
ESRI is the developer of ArcGIS products
One of the most popular GIS programs

ArcGIS

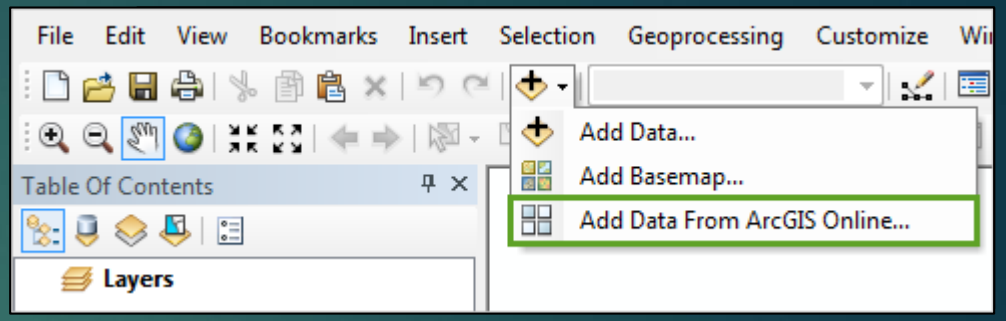


Create a free account to view maps and import downloaded data

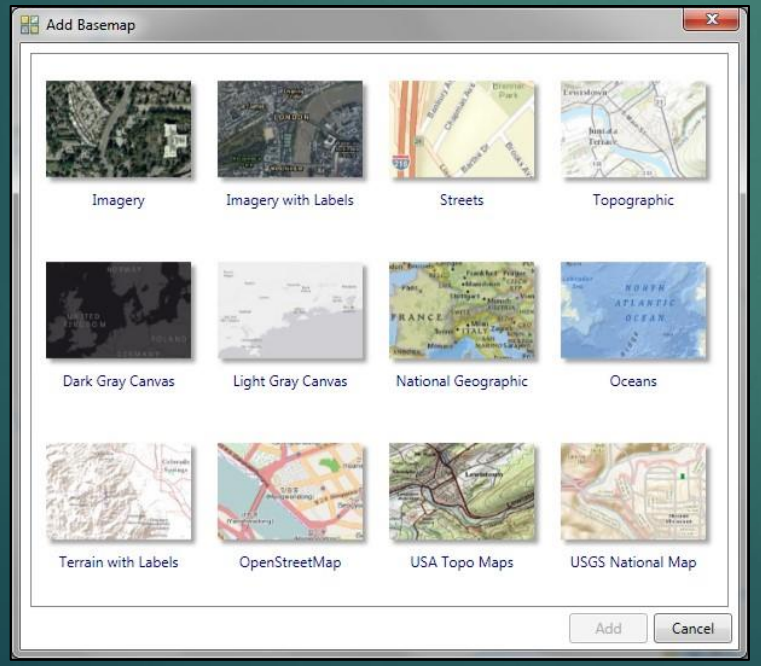
ArcGIS Online – view downloaded data



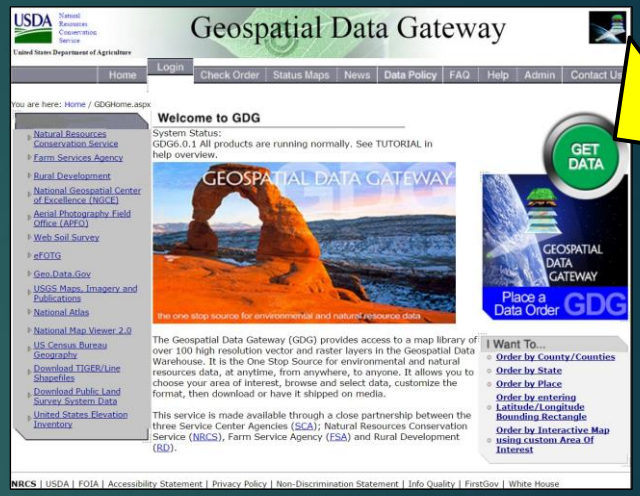
Where can I get GIS data? Many sources!!!



- Add Data from ArcMAP
  - Add Basemaps (satellite imagery, streets, topographic, oceans, etc.)
  - Add data from ArcGIS Online (search the online database)

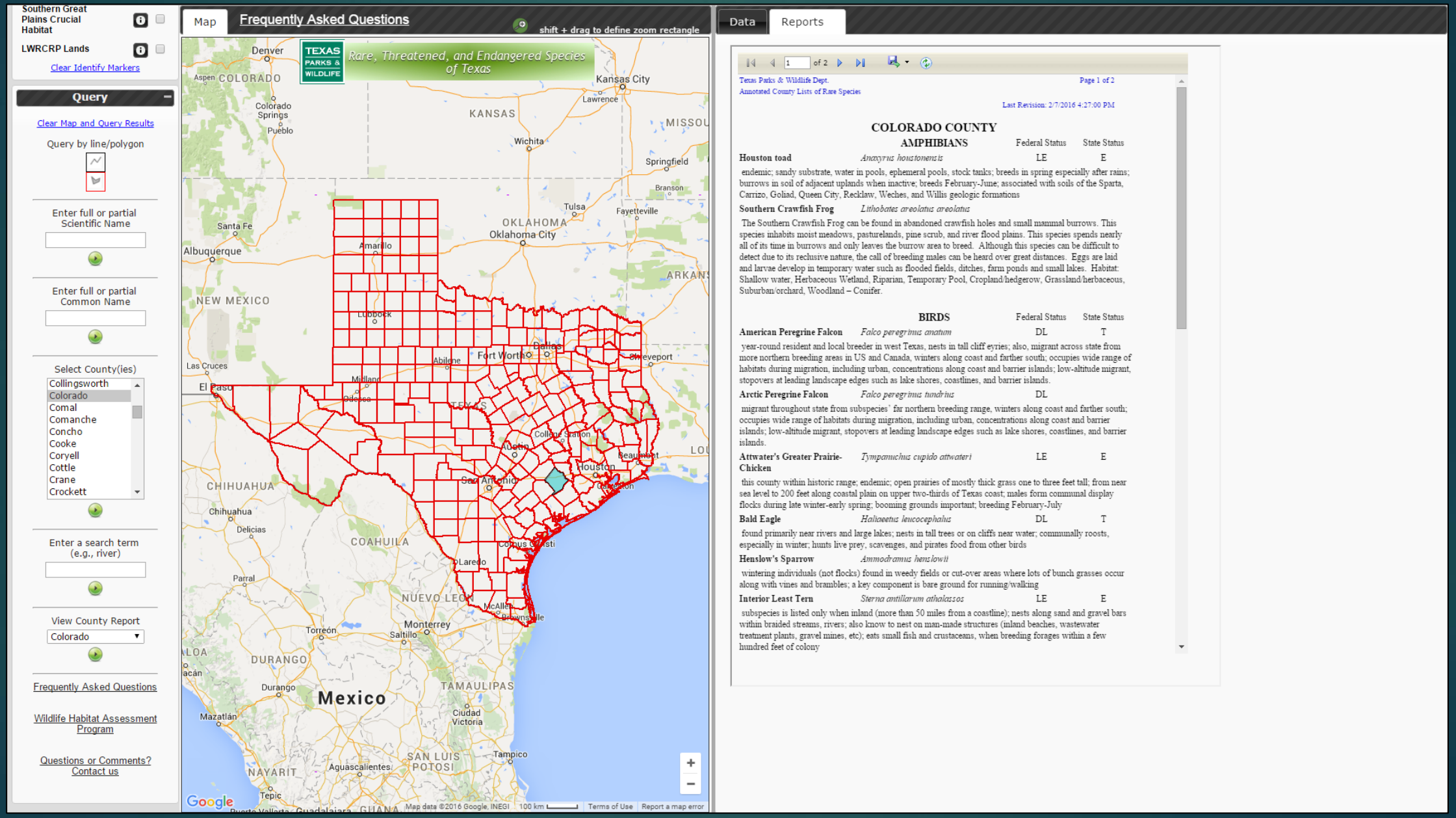


Where can I get GIS data? Many sources!!!



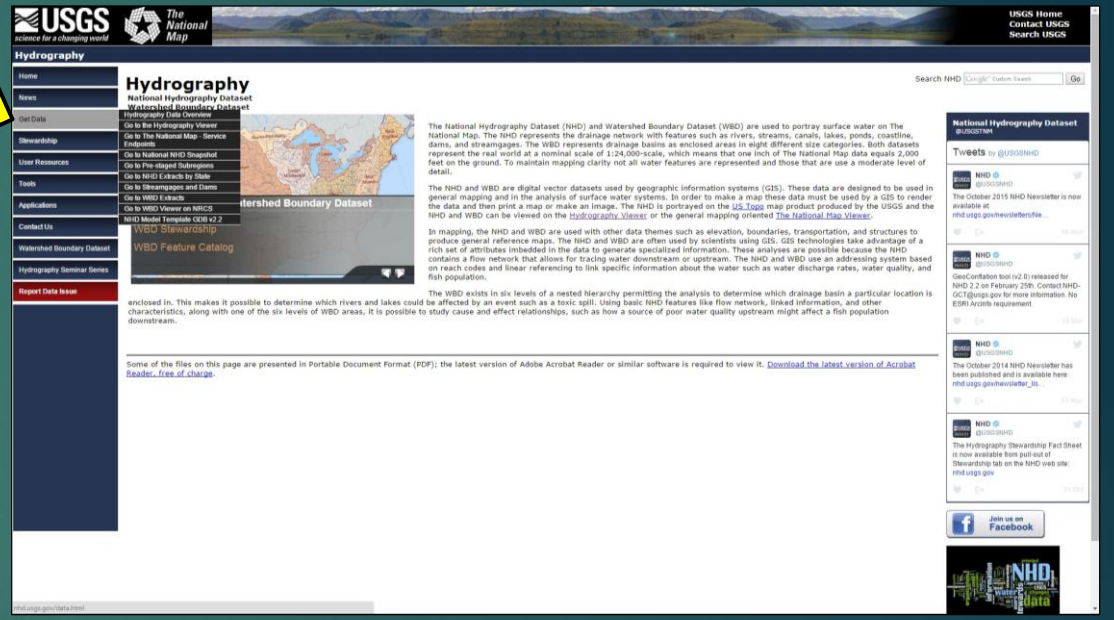
- USDA Geospatial Data Gateway
  - Contains a wide variety of data that can be downloaded
  - Census, climate, easements, government units, elevation, etc.
- Texas Natural Resource Information System (TNRIS- part of TWDB)
  - Bathymetry, census boundaries, elevation, hydrology, land cover, soils, transportation
- TCEQ
  - SWQM segs/AUs/stations, regional boundaries, wells, waste water outfalls, landfills, superfund sites, Edwards Aquifer boundaries and land cover, air monitoring sites
- TPWD
  - Wildlife management areas, ecological mapping systems, geology, state parks
  - Texas watershed viewer, seagrass viewer, Golden-cheeked warbler habitat change

TPWD – Rare, Threatened, Endanger Species Map Viewer

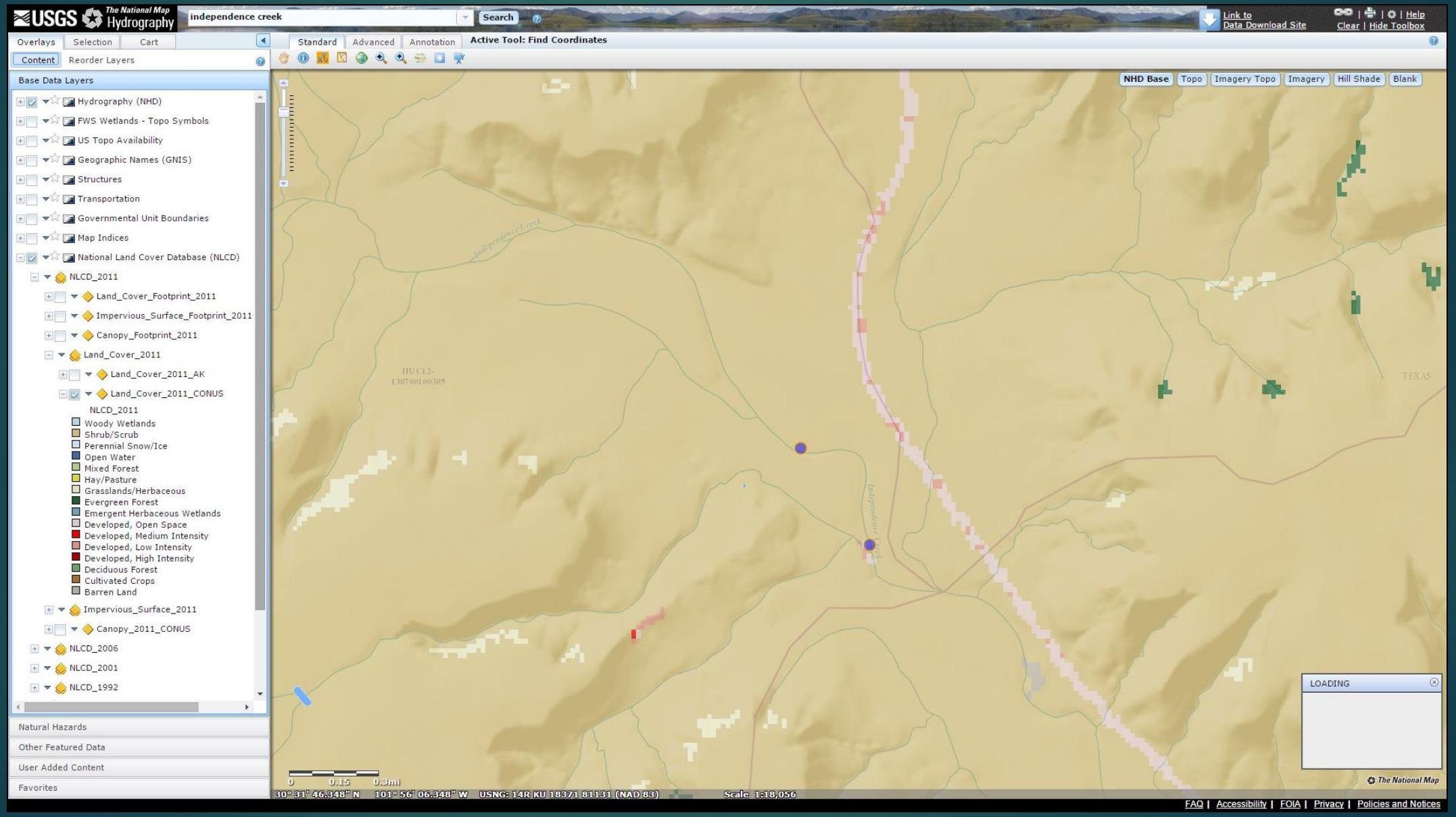


Where can I get GIS data? Many sources!!!

- USGS
  - Water spatial data, groundwater, surface water, water quality (chemical, biological, physical characteristics), watershed theme maps
  - Streamflow gauging stations
  - Hydrography (National Hydrography Dataset and Watershed Boundary Dataset)
  - Hydrography Viewer – quick reference NHD, topographic imagery, transportation, land cover, elevation, natural hazards, streamflow gauges
    - Add data content, find coordinates, spot elevation, measure distances and areas, build queries, set buffers, annotate map

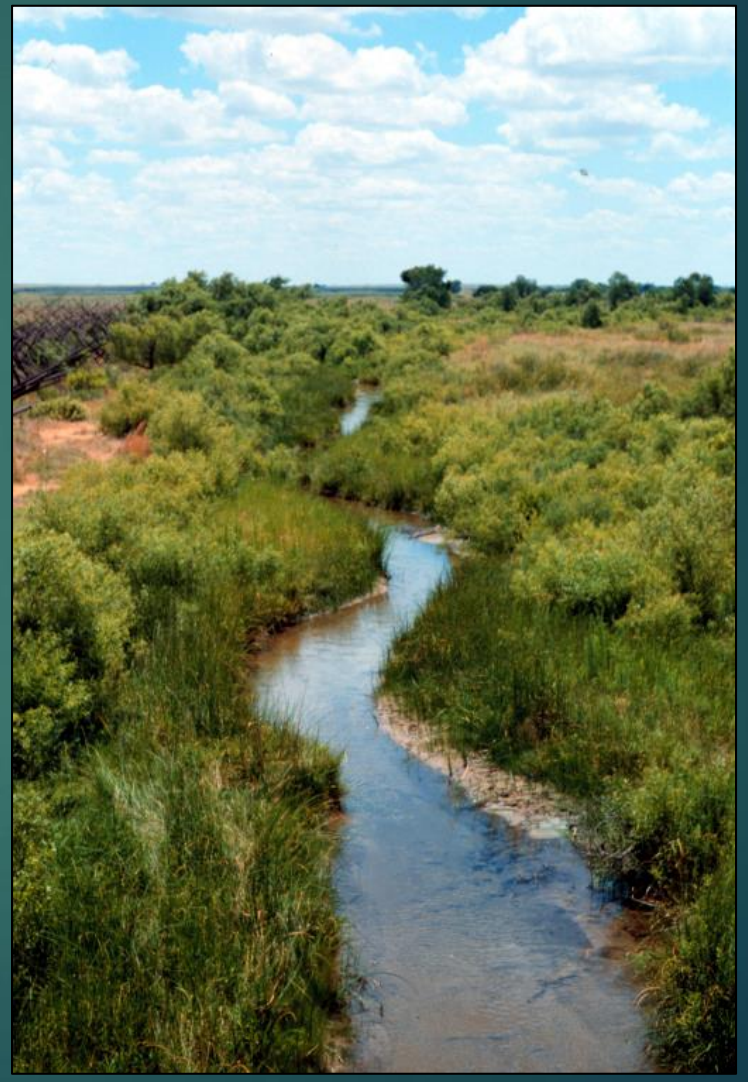


USGS – Hydrography Viewer



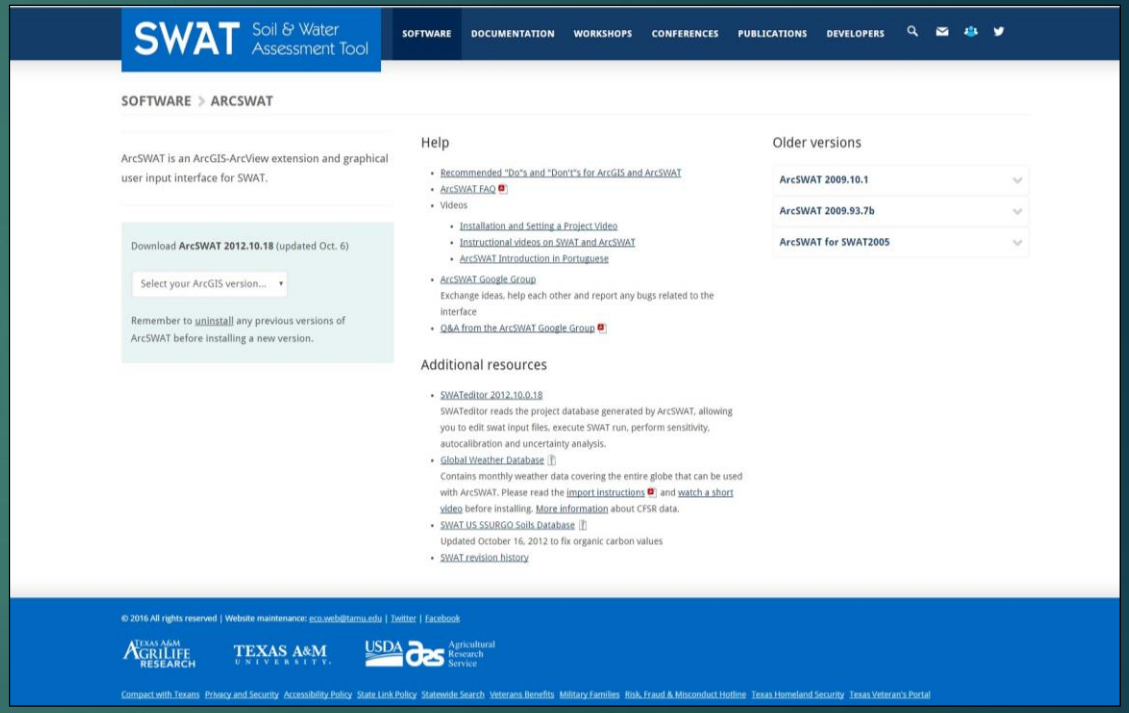
Enhancing PHAB Assessments

- Watershed characterization
- Identify land uses within riparian buffer and surrounding area
- Sinuosity of stream segment (beyond the reach)
- Measure distance of disturbances surrounding reach
- Identify instream obstructions, riffles, pools
- Site history

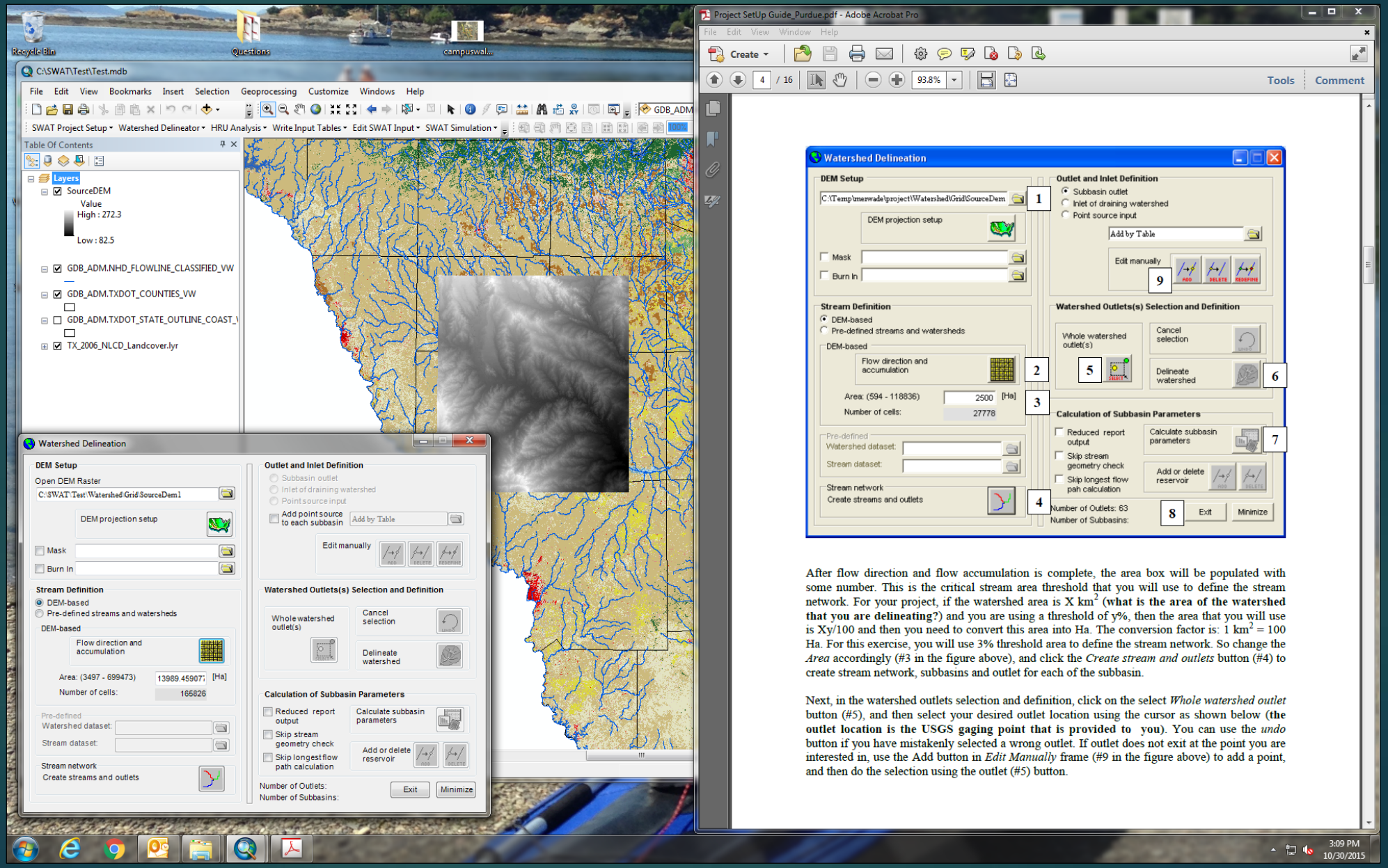


Watershed Characterization

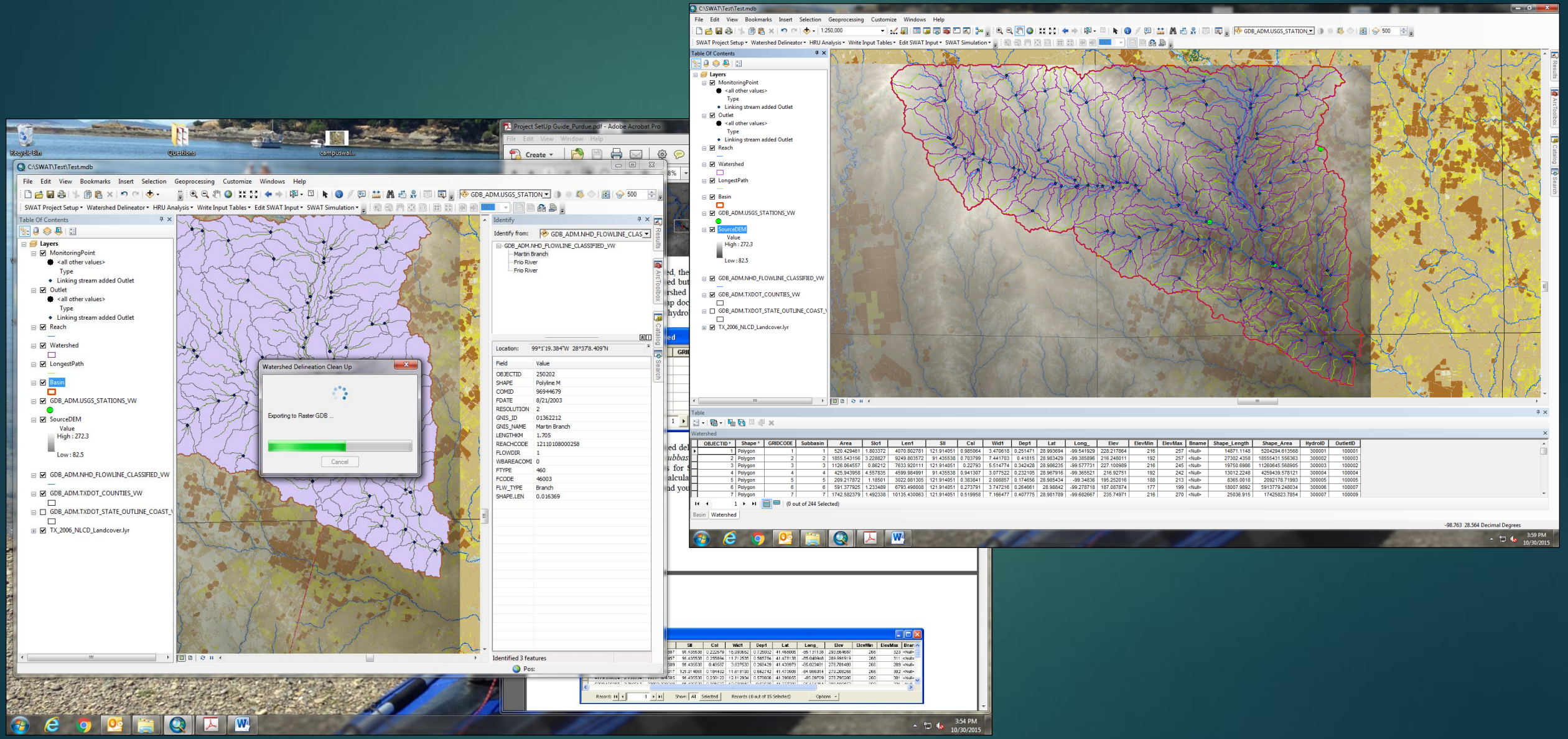
- Watershed delineation tutorials available – TCEQ SWQM & WQS have written tutorial; YouTube has some good video tutorials
- ArcMap (optional free ArcSWAT tool - separate download)
- Need to have Spatial Analyst license and extension turned on
- Data needed
  (all data needs to be in the same projection)
  - National Elevation Dataset 2013
    (10 meter DEM from TNRIS)
  - National Land Cover Dataset 2011
    (land use from TNRIS)
  - State Soil Geographic Dataset
    (STATSGO from Geospatial Data Gateway)



SWAT – Watershed Delineation for Hondo Creek

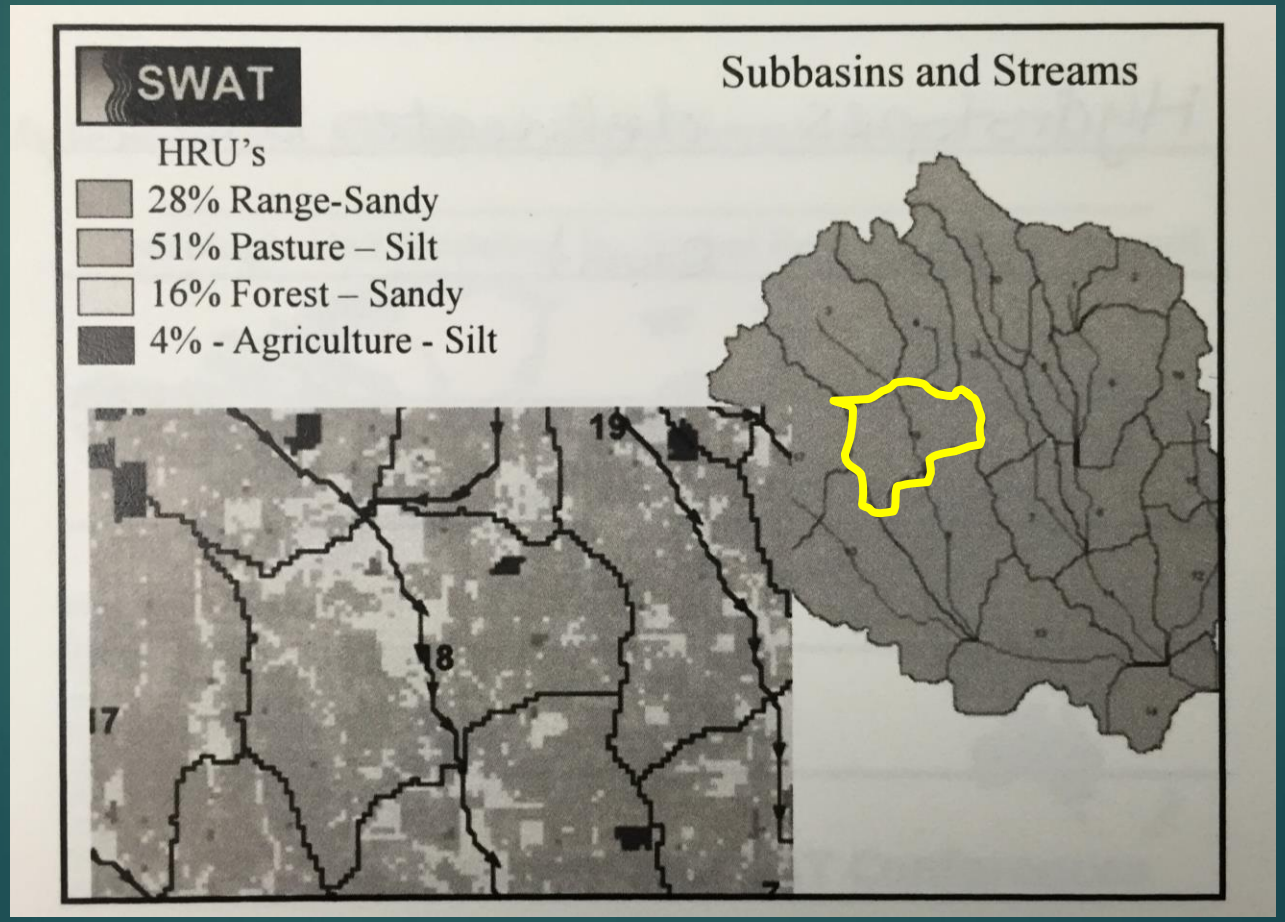


SWAT – Watershed Delineation

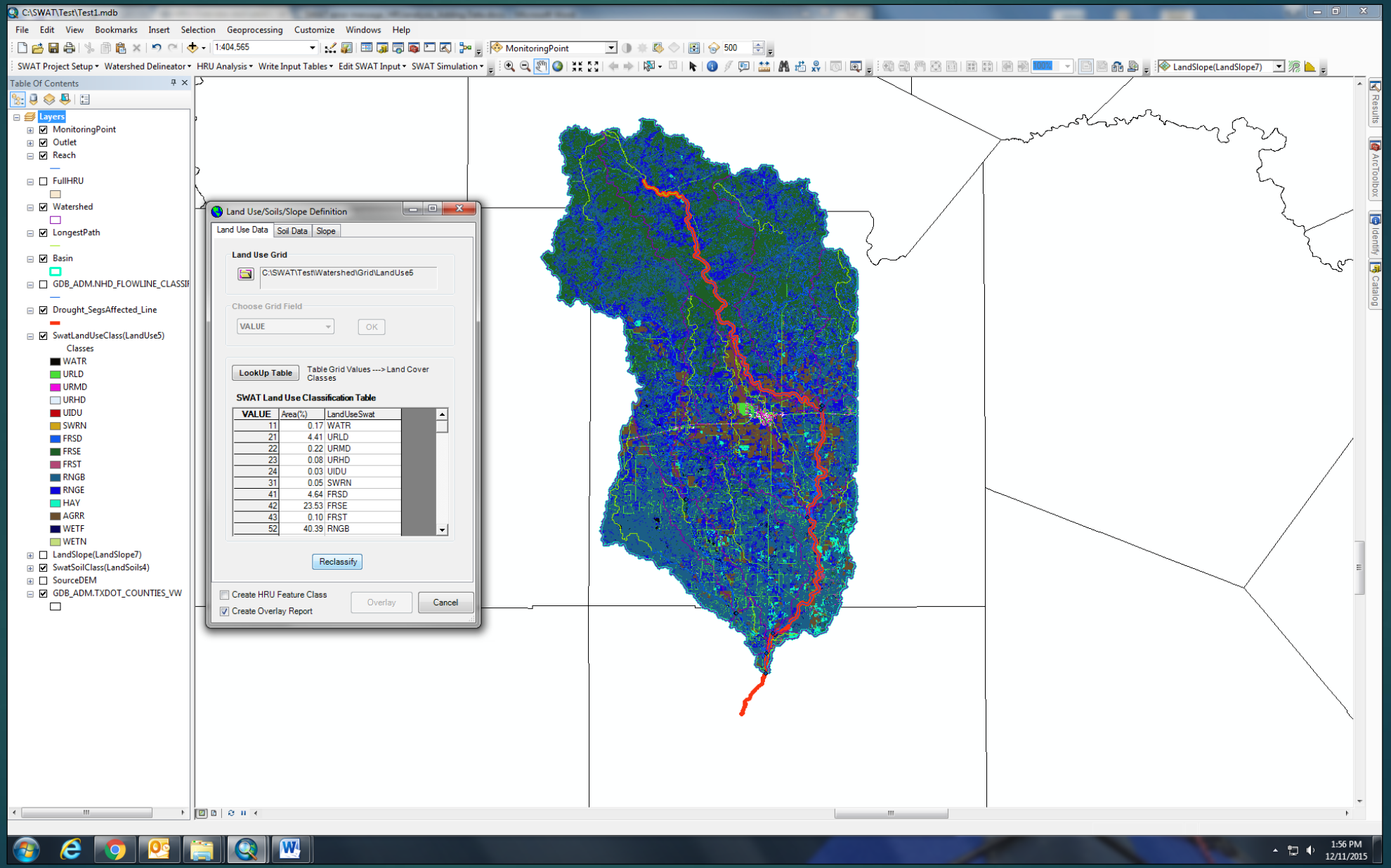


SWAT – HRU Analysis

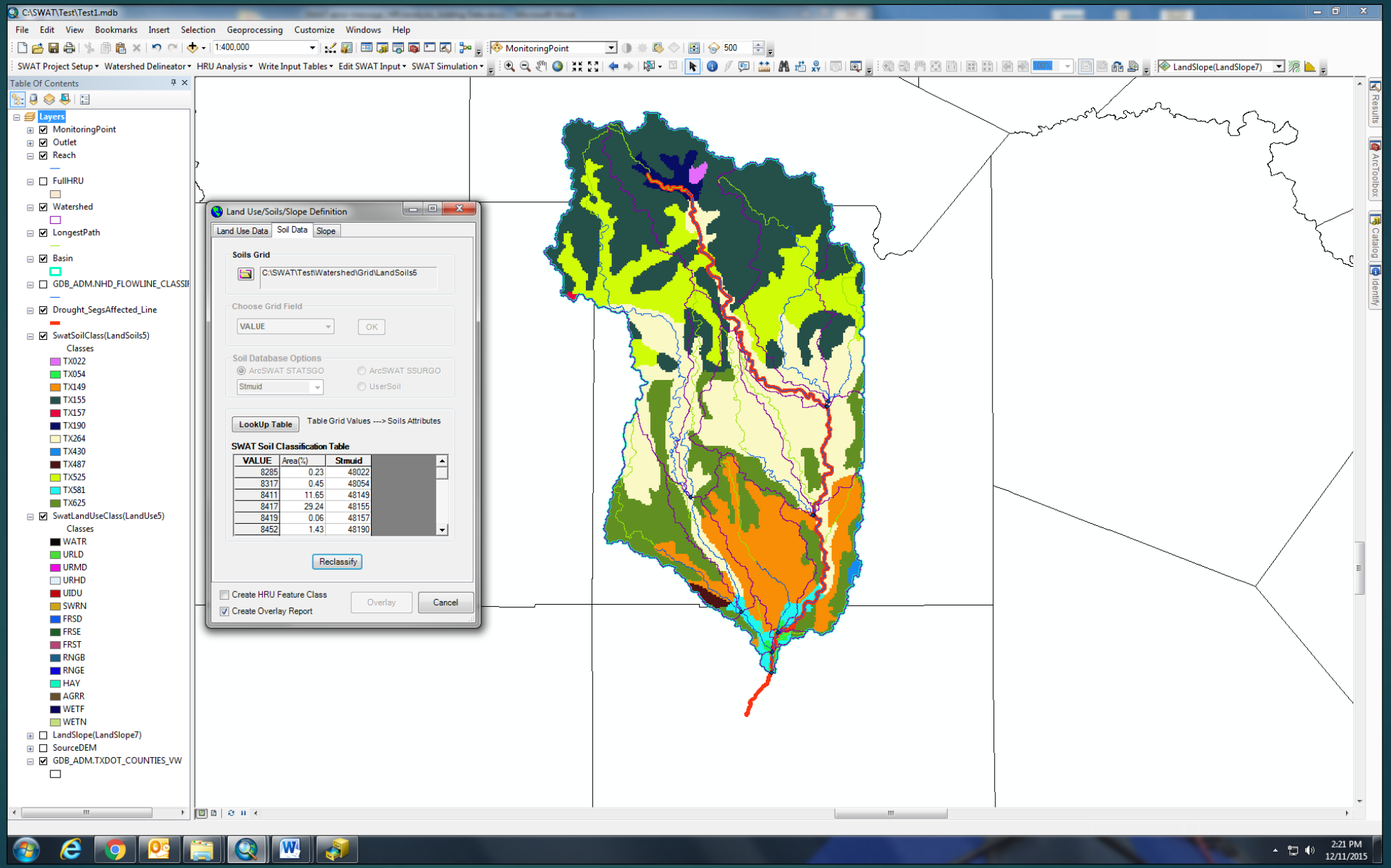
- Hydrologic Response Unit – smallest spatial unit containing similar land uses, soils, and slopes within a subbasin.



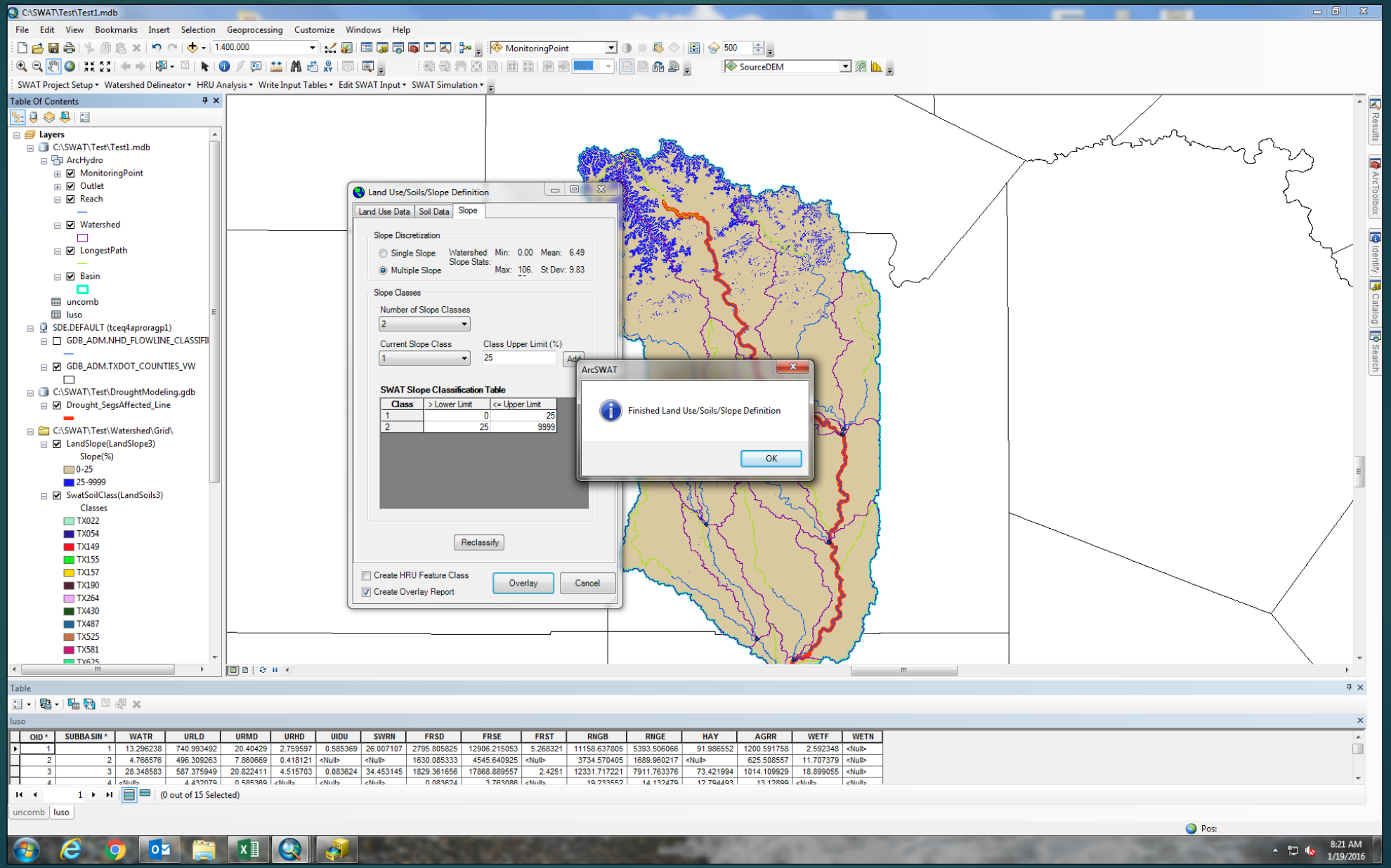
SWAT – HRU Analysis: Land Use



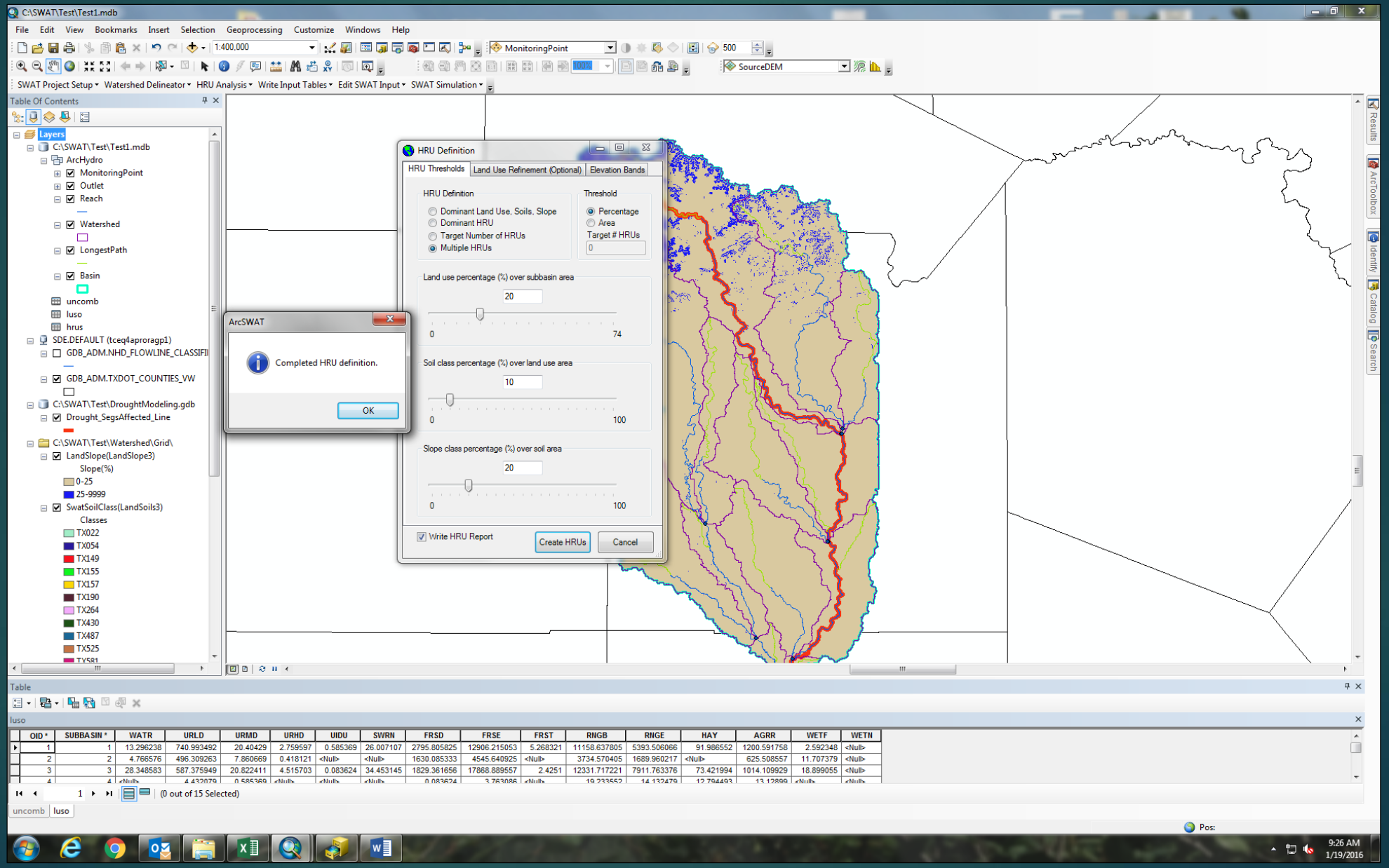
SWAT – HRU Analysis: STATSGO Soil



SWAT – HRU Analysis: Slope and Overlay



SWAT – HRU Definition (20/10/20)



HRU Report: Hondo Creek

HondoCreek_HRULandUseSoilsReport.txt - Notepad

File Edit Format View Help

```
SWAT   model  simulation   Date: 1/19/2016 12:00:00 AM   Time: 00:00:00
MULTIPLE HRUs  LandUse/Soil/Slope OPTION            THRESHOLDS : 20 / 10 / 20 [%]
Number of HRUs: 64
Number of Subbasins: 15
```

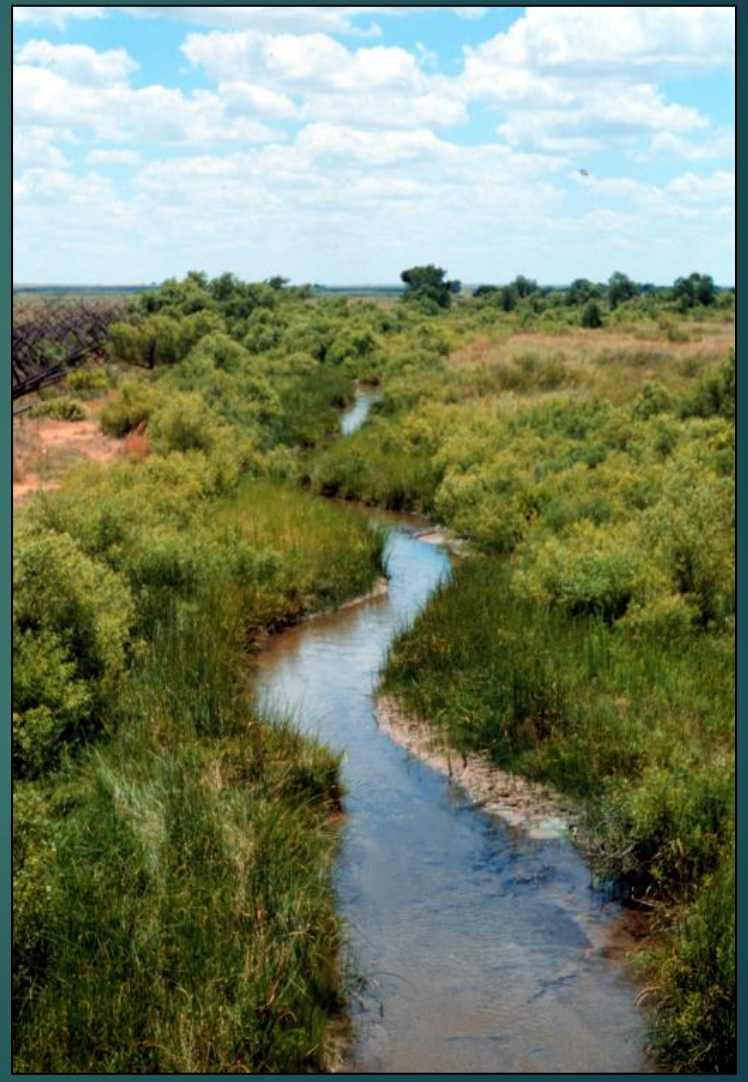
	Area [ha]	Area[acres]	
Watershed	254203.2488	628148.9380	

	Area [ha]	Area[acres]	%Wat.Area
LANDUSE:			
Forest-Evergreen --> FRSE	78926.4801	195031.2787	31.05
Range-Brush --> RNGB	146845.8380	362863.4081	57.77
Range-Grasses --> RNGE	22119.1709	54657.5771	8.70
Agricultural Land-Row Crops --> AGRR	6311.7598	15596.6741	2.48
SOILS:			
TX155	91909.1515	227112.1089	36.16
TX525	38365.9993	94804.3026	15.09
TX264	48819.1620	120634.5903	19.20
TX190	2352.6244	5813.4526	0.93
TX625	39598.9157	97850.9006	15.58
TX149	30935.9830	76444.3609	12.17
TX581	1559.7297	3854.1701	0.61
TX054	661.6831	1635.0521	0.26
SLOPE:			
0-25	239818.5887	592603.7236	94.34
25-9999	14384.6601	35545.2144	5.66

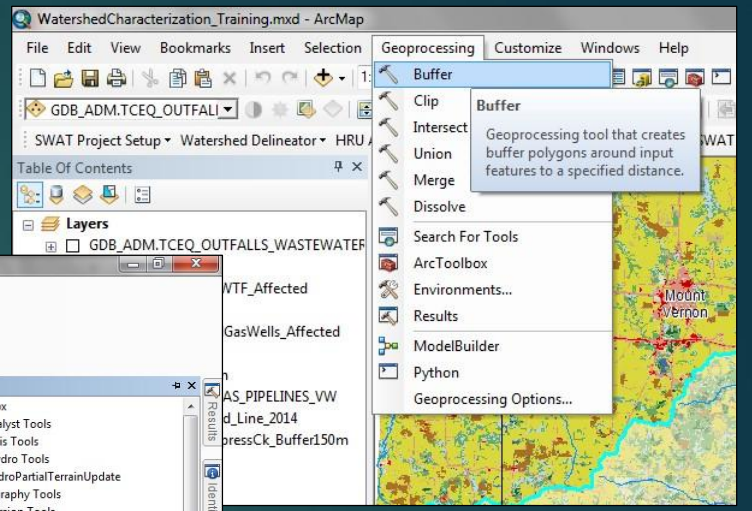
	Area [ha]	Area[acres]	%Wat.Area	%Sub.Area
SUBBASIN # 1	34344.3351	84866.5693	13.51	
LANDUSE:				
Forest-Evergreen --> FRSE	18419.2015	45514.7680	7.25	53.63
Range-Brush --> RNGB	15925.1336	39351.8013	6.26	46.37
SOILS:				
TX155	21328.3537	52703.4284	8.39	62.10
TX525	11388.7149	28142.0839	4.48	33.16
TX264	1627.2666	4021.0571	0.64	4.74

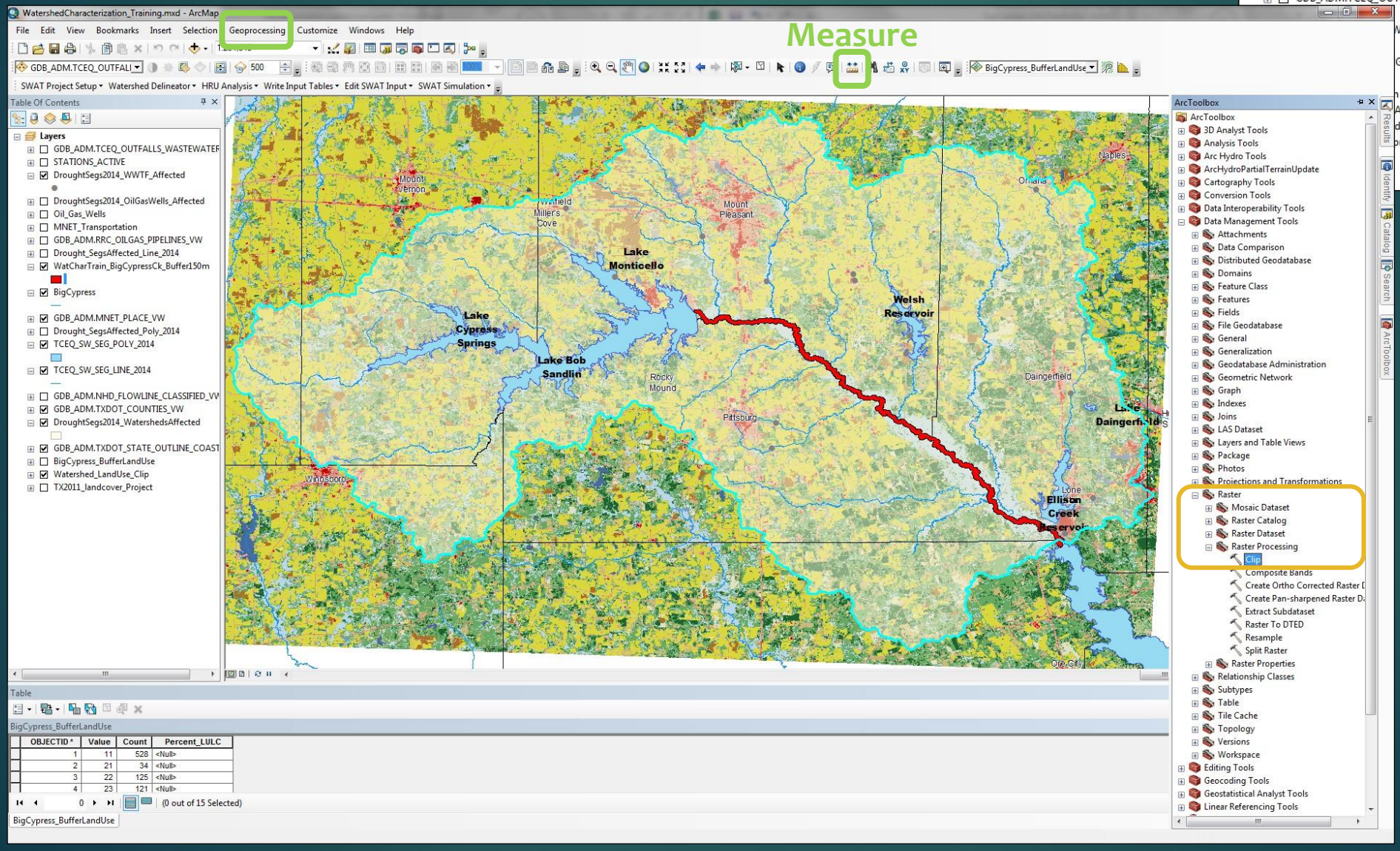
Enhancing PHAB Assessments

- Watershed characterization
- Identify land uses within riparian buffer and surrounding area
- Sinuosity of stream segment (beyond the reach)
- Measure distance of disturbances surrounding reach
- Identify instream obstructions, riffles, pools
- Site history



Land uses within riparian buffer

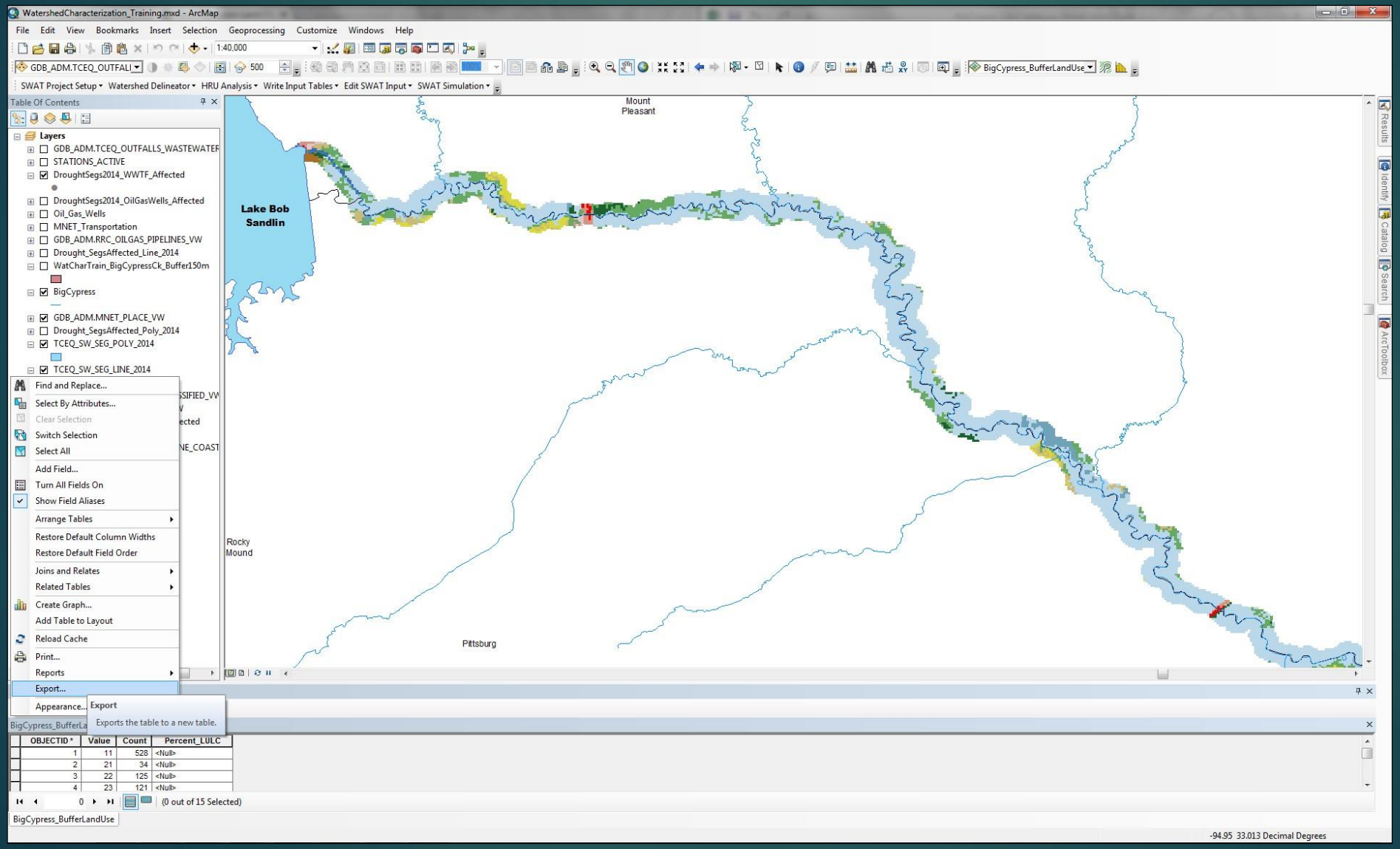




Useful tools:

- Measure
- Buffer
- Clip (Raster Processing)

Land uses within riparian buffer



- Export attribute table to Excel and calculate percent land use within the riparian buffer.

Land uses within riparian buffer

BigCypress_LULCtable.xlsx - Excel

FILE HOME INSERT PAGE LAY FORMULA DATA REVIEW VIEW Sarah Whi...

J1

	A	B	C	D	E
1	OBJECTID	Value	Count	Percent_LULC	LULC_Class
2	1	11	528	3.11	Open Water
3	2	21	34	0.20	Developed, Open Space
4	3	22	125	0.74	Developed, Low Intensity
5	4	23	121	0.71	Developed, Medium Intensity
6	5	24	15	0.09	Developed, High Intensity
7	6	31	35	0.21	Barren Land
8	7	41	1189	6.99	Deciduous Forest
9	8	42	214	1.26	Evergreen Forest
10	9	43	17	0.10	Mixed Forest
11	10	52	167	0.98	Shrub/Scrub
12	11	71	4	0.02	Grassland/Herbaceous
13	12	81	205	1.21	Pasture/Hay
14	13	82	28	0.16	Cultivated Crops
15	14	90	14106	82.97	Woody Wetlands
16	15	95	213	1.25	Emergent Herbaceous Wetlands
17			17001		

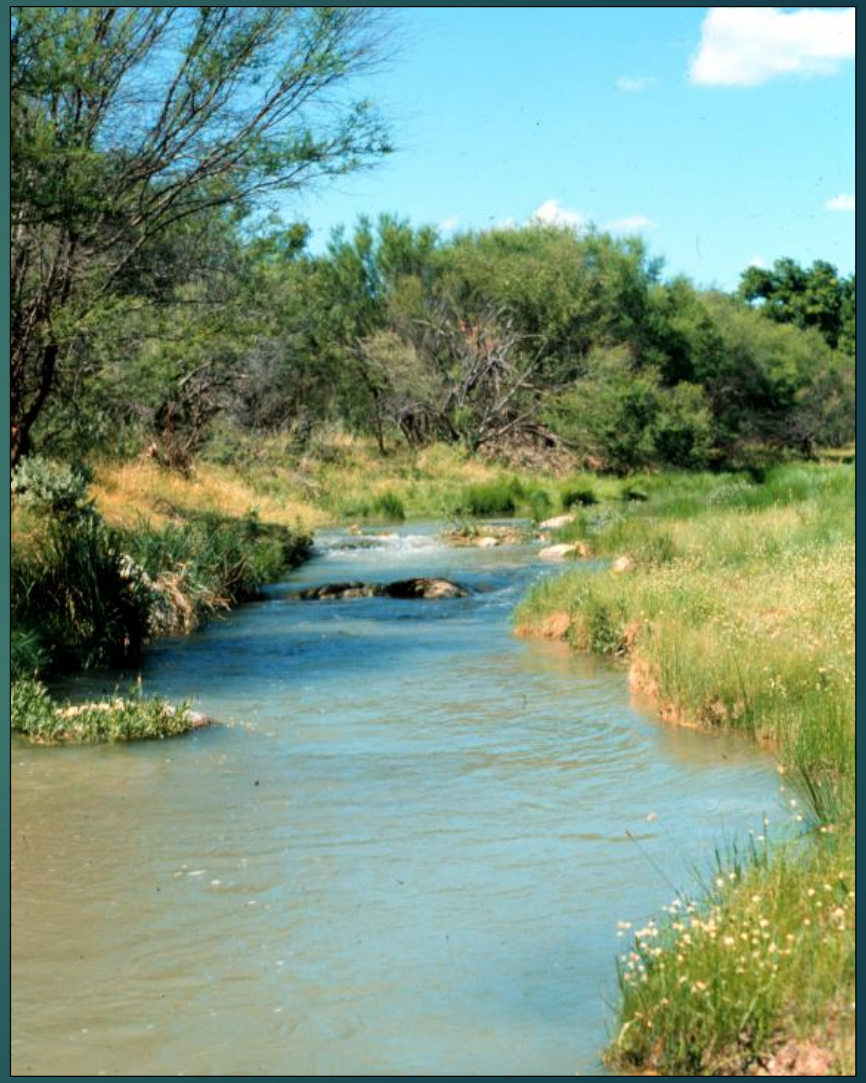
Sheet1

READY 100%

- Export attribute table to Excel and calculate percent land use within the riparian buffer.

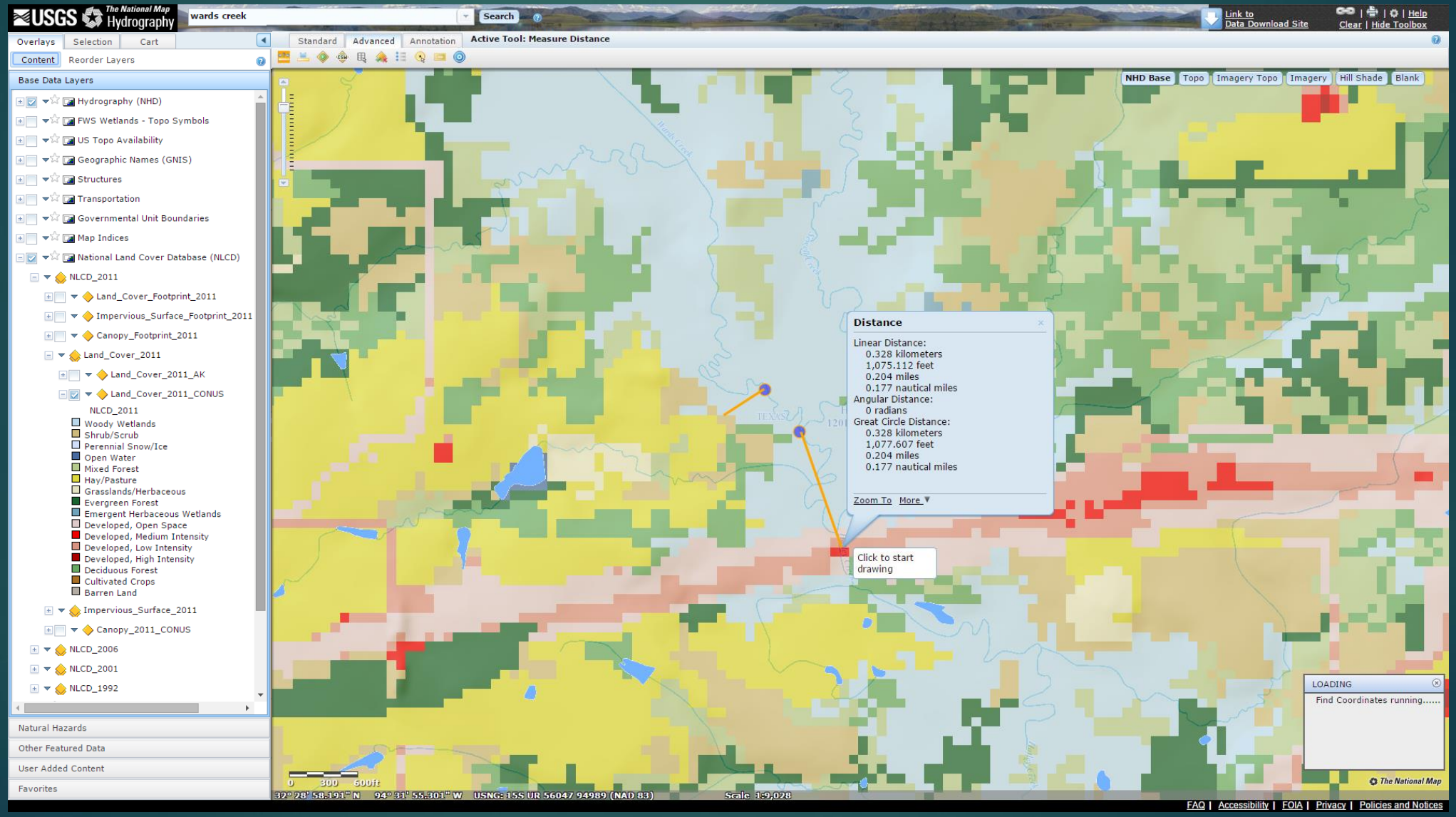
Enhancing PHAB Assessments

- Watershed characterization
- Identify land uses within riparian buffer and surrounding area
- Sinuosity of stream segment (beyond the reach)
- Measure distance of disturbances surrounding reach
- Identify instream obstructions, riffles, pools
- Site history



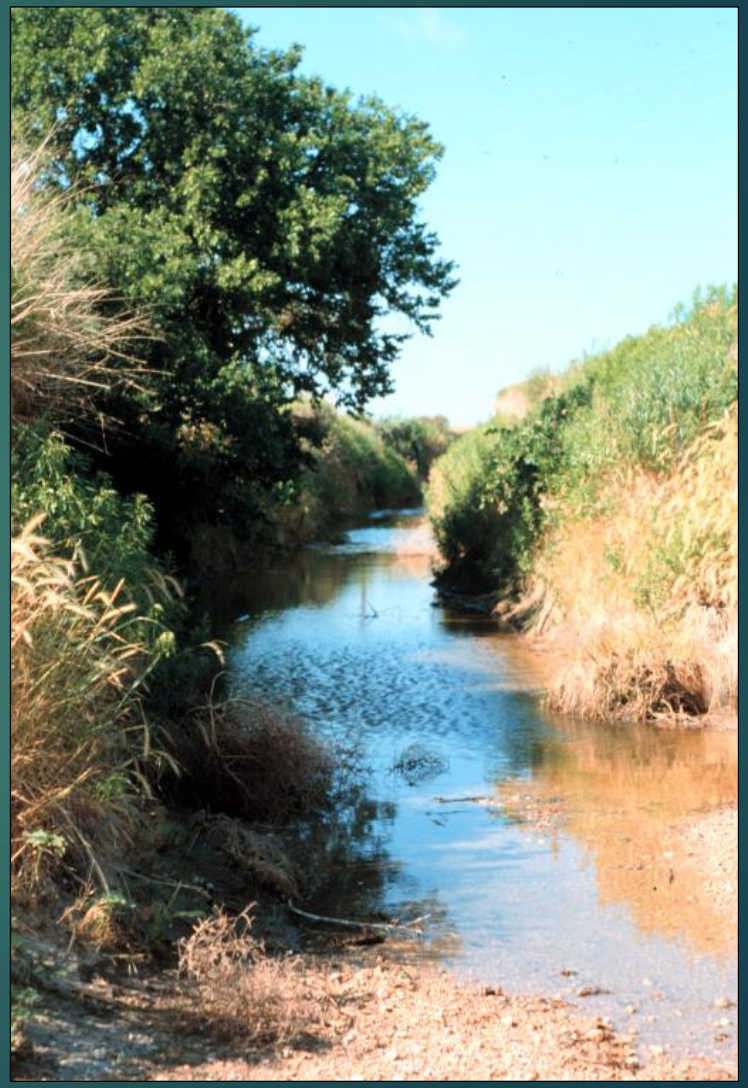
Sinuosity and measuring distance from disturbance

Hydrography Viewer



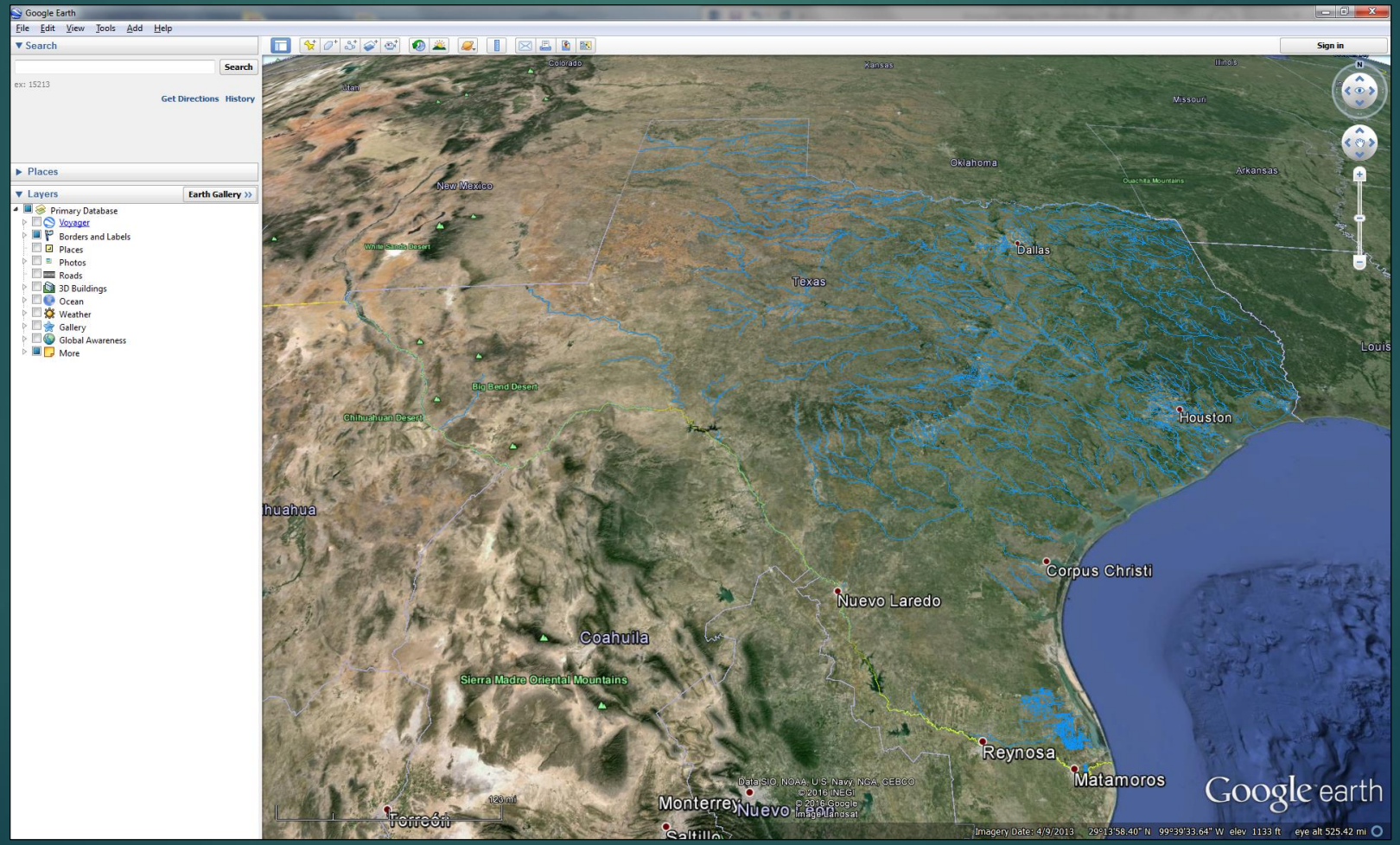
Enhancing PHAB Assessments

- Watershed characterization
- Identify land uses within riparian buffer and surrounding area
- Sinuosity of stream segment (beyond the reach)
- Measure distance of disturbances surrounding reach
- Identify instream obstructions, riffles, pools
- Site history



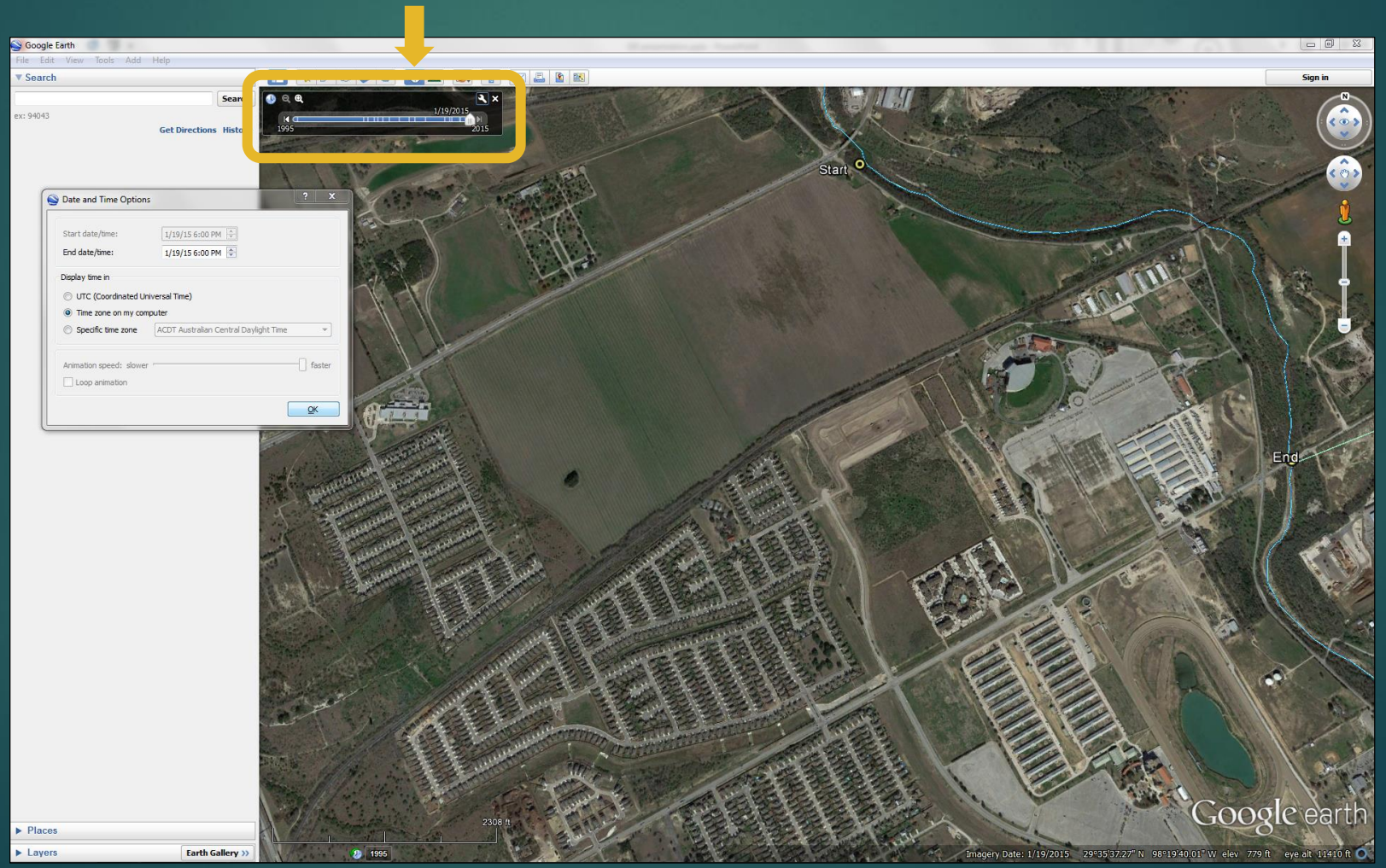
Google Earth

- Convert any GIS layer to KML layer, and vice versa, using conversion tool in ArcMap
- TCEQ SWQM Seg Layer (downloaded KML file from TCEQ GIS website)



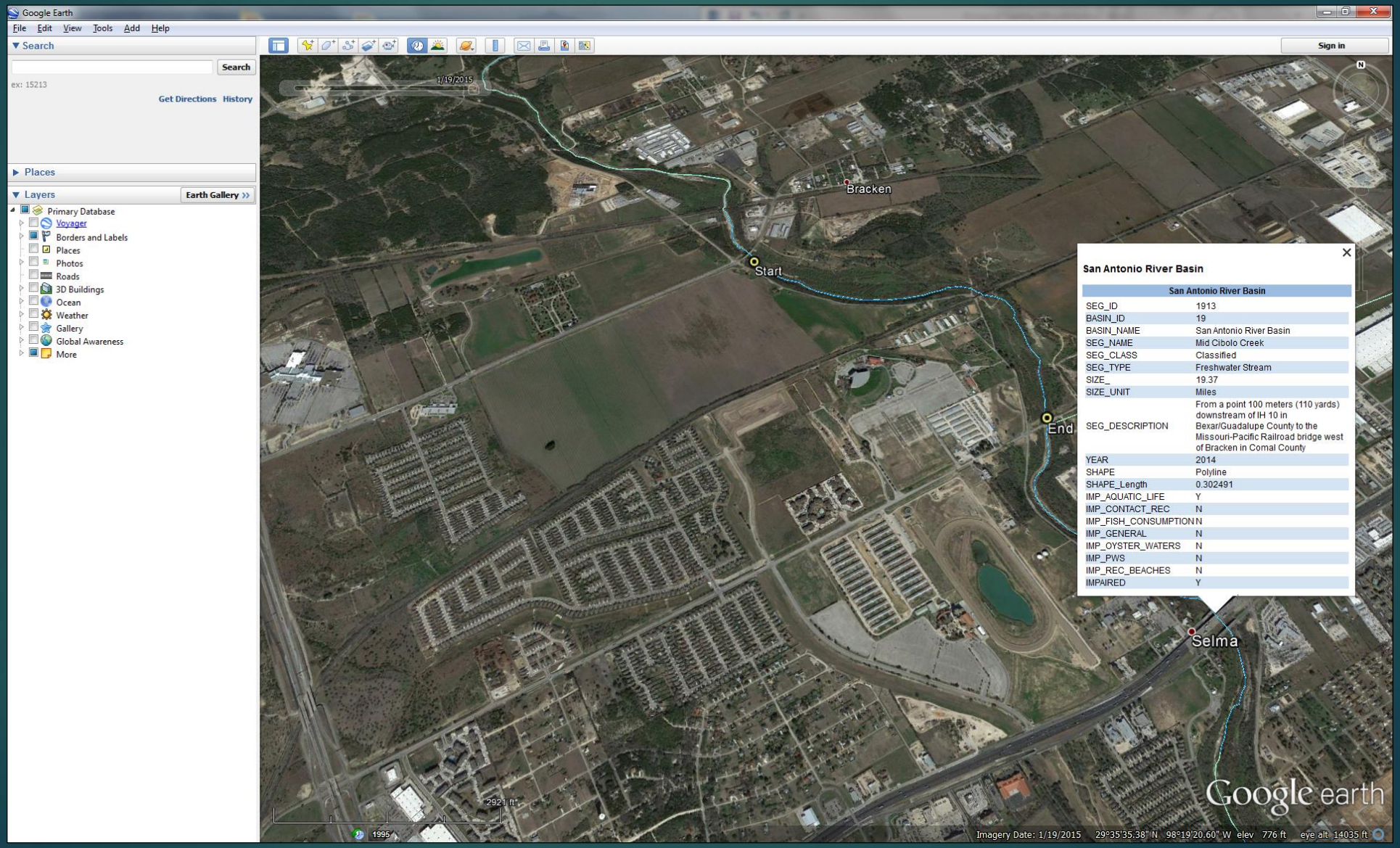
Site History using Google Earth

- Use the historical imagery time slider to view changes in land use, reach bends or width, after major floods events, etc.



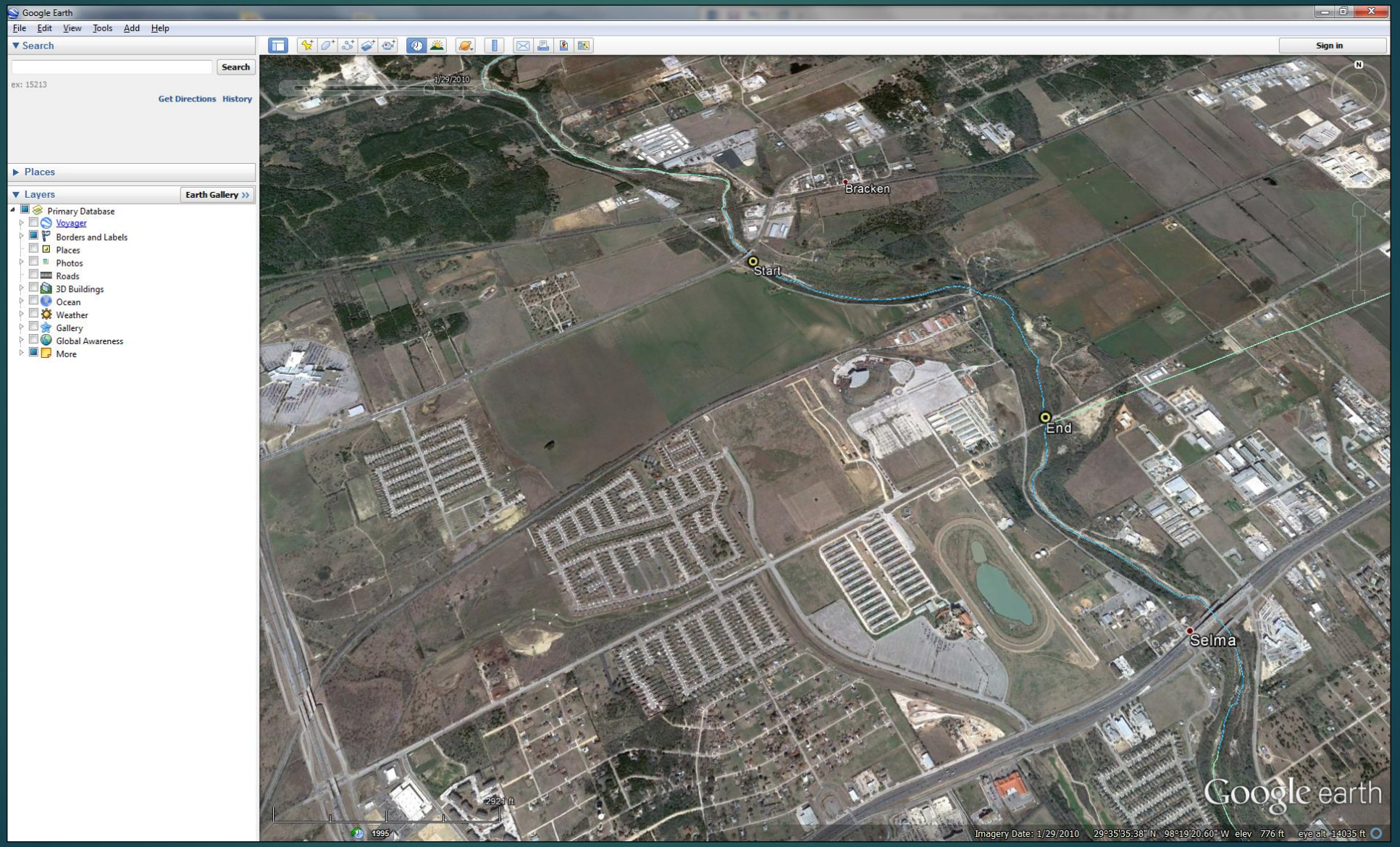
Site History: Mid Cibolo Creek

January 2015



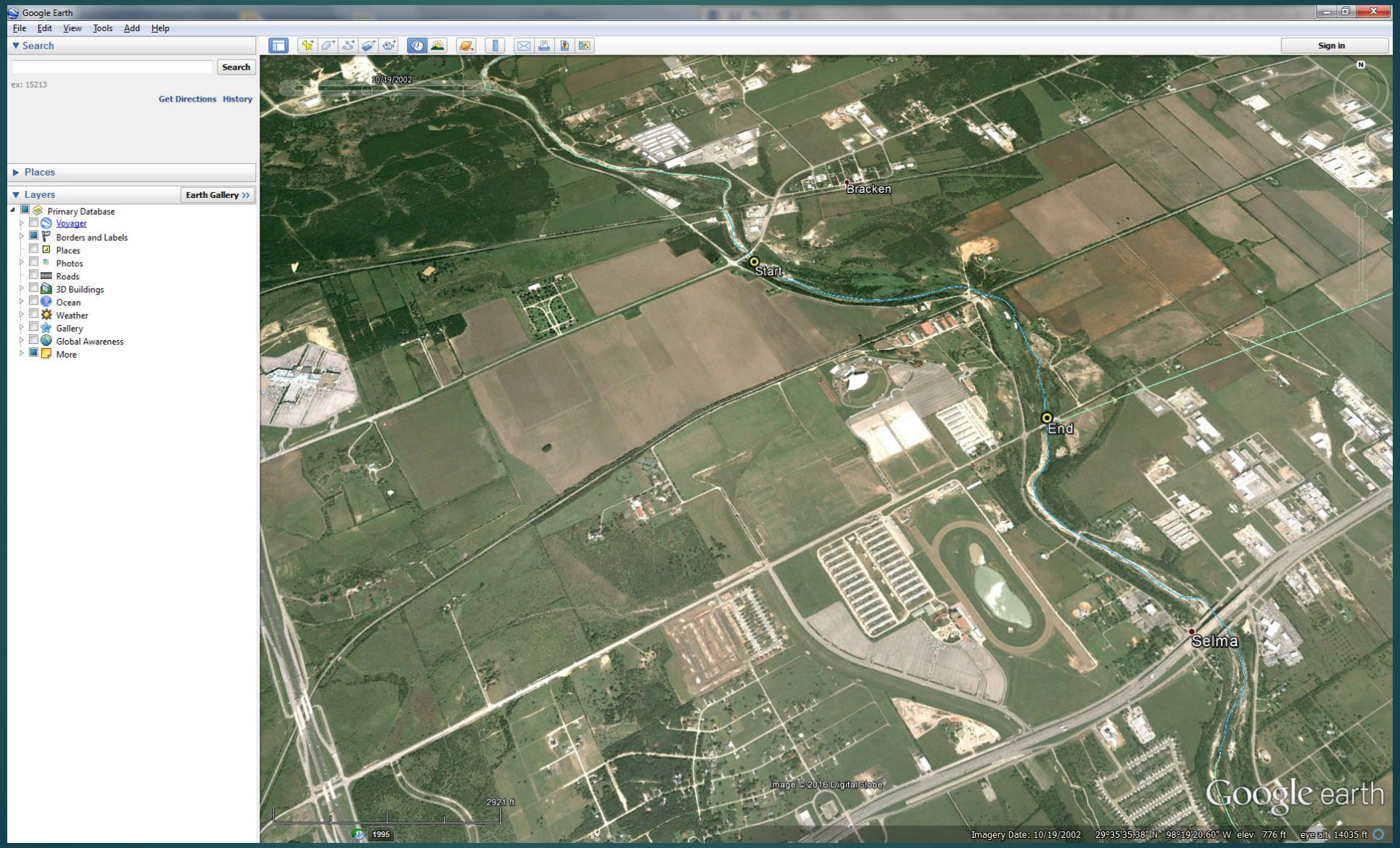
Site History: Mid Cibolo Creek

January 2010



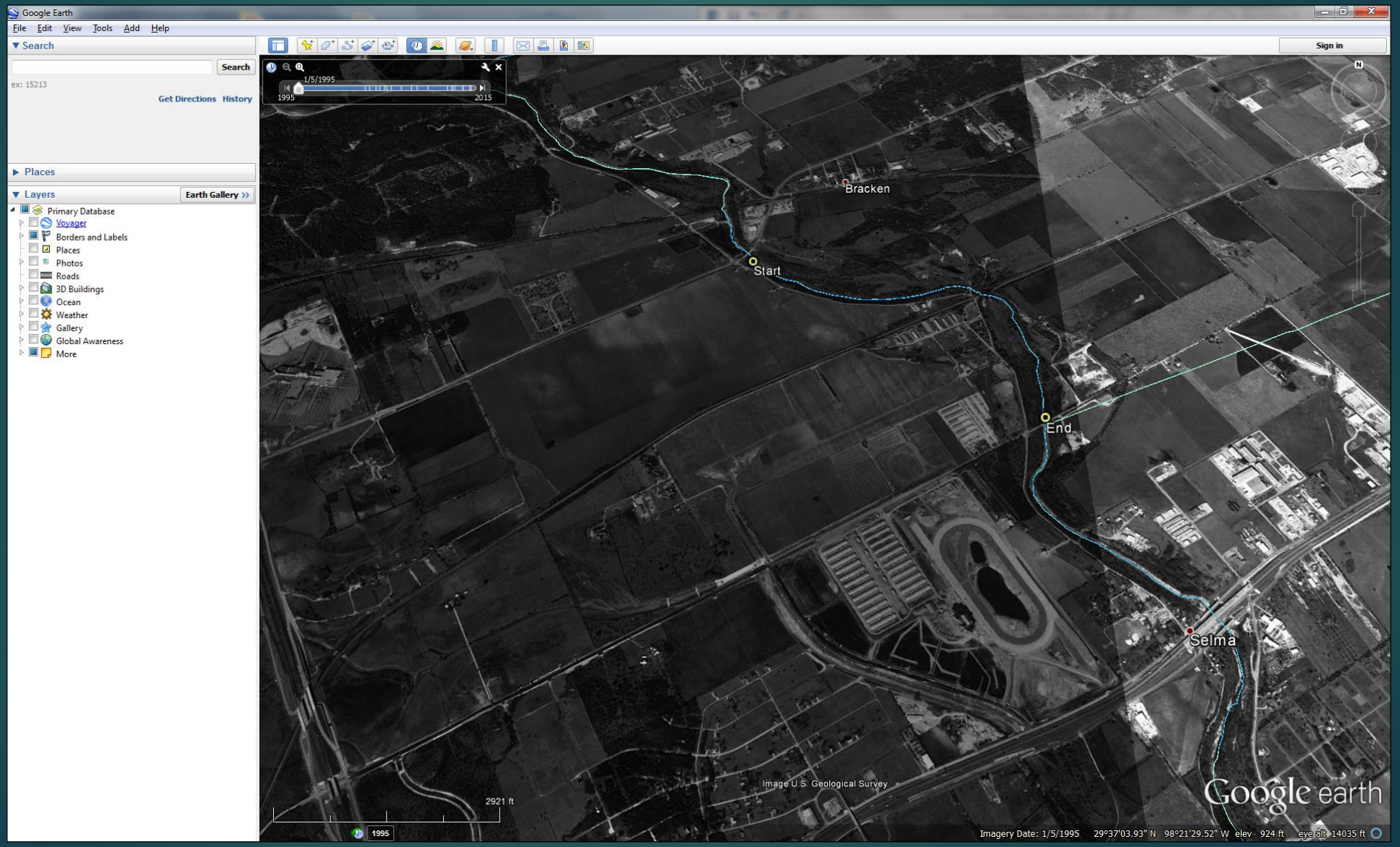
Site History: Mid Cibolo Creek

October 2002



Site History: Mid Cibolo Creek

January 1995



Enhancing Biological Assessments: Next Steps

- How have you evaluated land use characteristics and changes?
- What has been your experiences with GIS?
- How would you like to expand/extend your use of GIS?

Happy Field Work Season!

- Please let us know if you have any ideas or suggestions for enhancing biological assessments, particularly incorporating GIS to enhance physical habitat evaluations.
  - Sarah Whitley
    sarah.whitley@tceq.texas.gov
  - Anne Rogers
    anne.rogers@tpwd.texas.gov
  - Lauren Pulliam
    lauren.pulliam@tceq.texas.gov
  - Bill Harrison
    bill.harrison@tceq.texas.gov