



# CE 3354 ENGINEERING HYDROLOGY

LECTURE 3: HYDROLOGIC DATA, WATERSHED DELINEATION



# OUTLINE

- Hydrologic Data
- Watershed Delineation

# HYDROLOGIC DATA

➤ Data sources for rainfall:

➤ National Weather Service

➤ Surface Weather Observation Stations

The screenshot shows the National Weather Service website's "NWS Observations" page. The page is titled "National Weather Service Office of Climate, Water, and Weather Services" and includes a navigation bar with "Home", "News", "Organization", and "Search". The main content area is divided into three columns: "Automated Surface Stations (ASOS)", "Cooperative Surface Stations", and "Upper Air Stations (Weather Balloons)".

Automated Surface Stations (ASOS)	Cooperative Surface Stations	Upper Air Stations (Weather Balloons)
<p>Select a state <input type="text"/></p> <p>OR</p> <p>Enter Station ID (Lookup) <input type="text"/> <input type="submit" value="Submit"/></p> <p>Learn about ASOS</p> <p>Other ways to get these observations (METAR)</p>	<p>Clickable Map</p> <p>Learn about Coop stations</p> <p>Become a Cooperative Observer</p> <p>Surface Observations</p> <p>Forms, Directives and other Surface Observation links</p>	<p>Charts</p> <p>Learn about Upper Air observations</p>
<p>International Weather Observations</p>		

The footer of the page includes the NOAA logo, contact information for the Office of Climate, Water, and Weather Services (1325 East West Highway, Silver Spring, MD 20910), and links for "Disclaimer", "Help/Viewers", "Glossary", "Privacy Policy", "About Us", and "Career Opportunities".

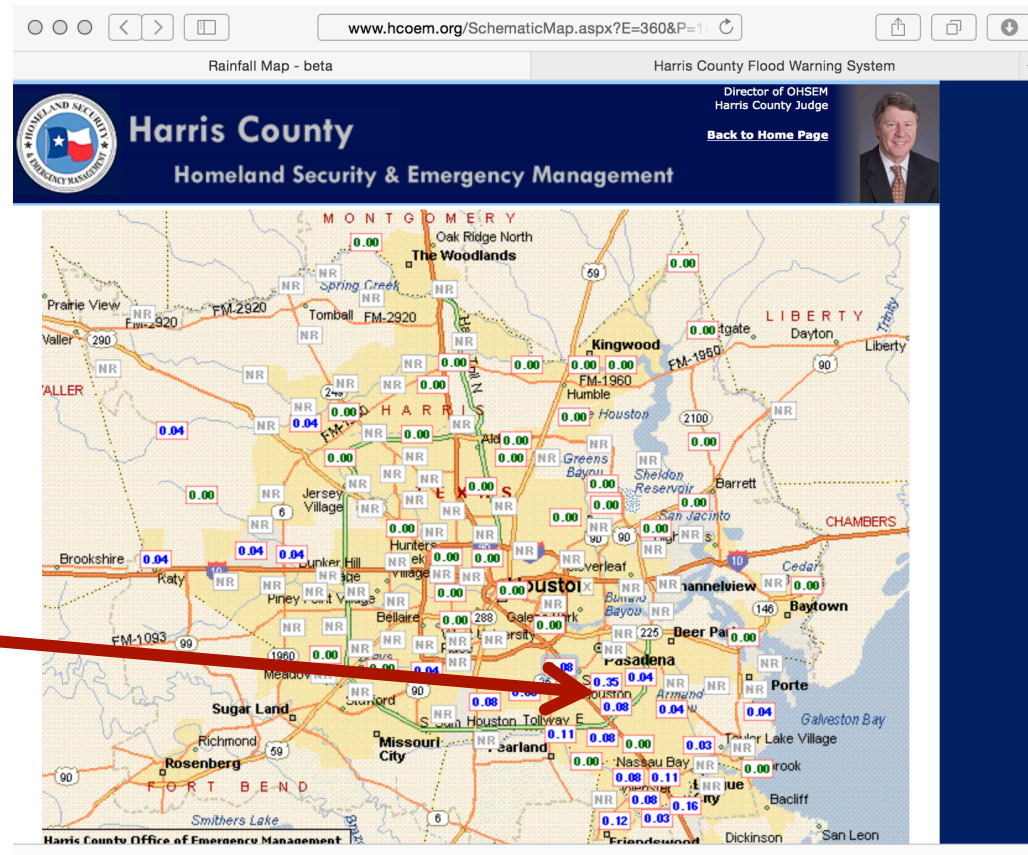
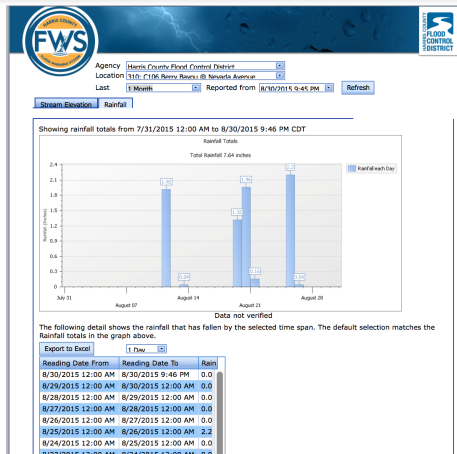
# HYDROLOGIC DATA

- Data sources for rainfall:
  - National Weather Service
  - Surface Weather Observation Stations



# HYDROLOGIC DATA

- Data sources for rainfall:
- Local Gage Networks



# HYDROLOGIC DATA

- Data sources for streamflow include:
  - USGS NWIS (Website)
  - IBWC
  - Older “paper-based” records
  - Local gage networks

# USGS WEBSITE

The screenshot shows a web browser window with the URL <http://waterdata.usgs.gov/tx/nwis/sw>. The page features the USGS logo and the tagline "science for a changing world". Below the logo is a navigation bar with "USGS Home", "Contact USGS", and "Search USGS" links. The main content area is titled "National Water Information System: Web Interface" and includes a "Data Category:" dropdown menu set to "Surface Water" and a "Geographic Area:" dropdown menu set to "Texas". A "GO" button is located to the right of the "Geographic Area:" dropdown. Below the navigation bar, there is a "News" section with the text "News - updated September 2012". The main heading is "USGS Surface-Water Data for Texas".

**Current Conditions (503 sites)**  
Current conditions at selected sites based on the most recent data from on-site automated recording equipment. Measurements are commonly recorded at a fixed interval of 15- to 60-minutes and transmitted to the USGS every hour. Values may include "Approved" (quality-assured data that may be published) and/or more recent "Provisional" data (of unverified accuracy and subject to revision). Most current data are provisional.

**Historical Observations (647 sites)**  
The same data accessed by the Current Conditions link above but including both active and discontinued sites with data for any part of the period October 1, 2007, through the present. Values may include "Approved" (quality-assured data that may be published) and/or more recent "Provisional" data (of unverified accuracy and subject to revision).

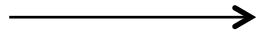
**Daily Data (926 sites)**  
Summary of all data for each day for the period of

**Introduction**  
The U.S. Geological Survey's (USGS) National Water Information System (NWIS) is a comprehensive and distributed application that supports the acquisition, processing, and long-term storage of water data. Water Data for the Nation serves as the publicly available portal to a geographically seamless set of much of the water data maintained within NWIS ([additional background](#)).

Nationally, USGS surface-water data includes more than 850,000 station years of time-series data that describe stream levels, streamflow (discharge), reservoir and lake levels, surface-water quality, and rainfall. The data are collected by automatic recorders and manual [field measurements](#) at installations across the Nation.

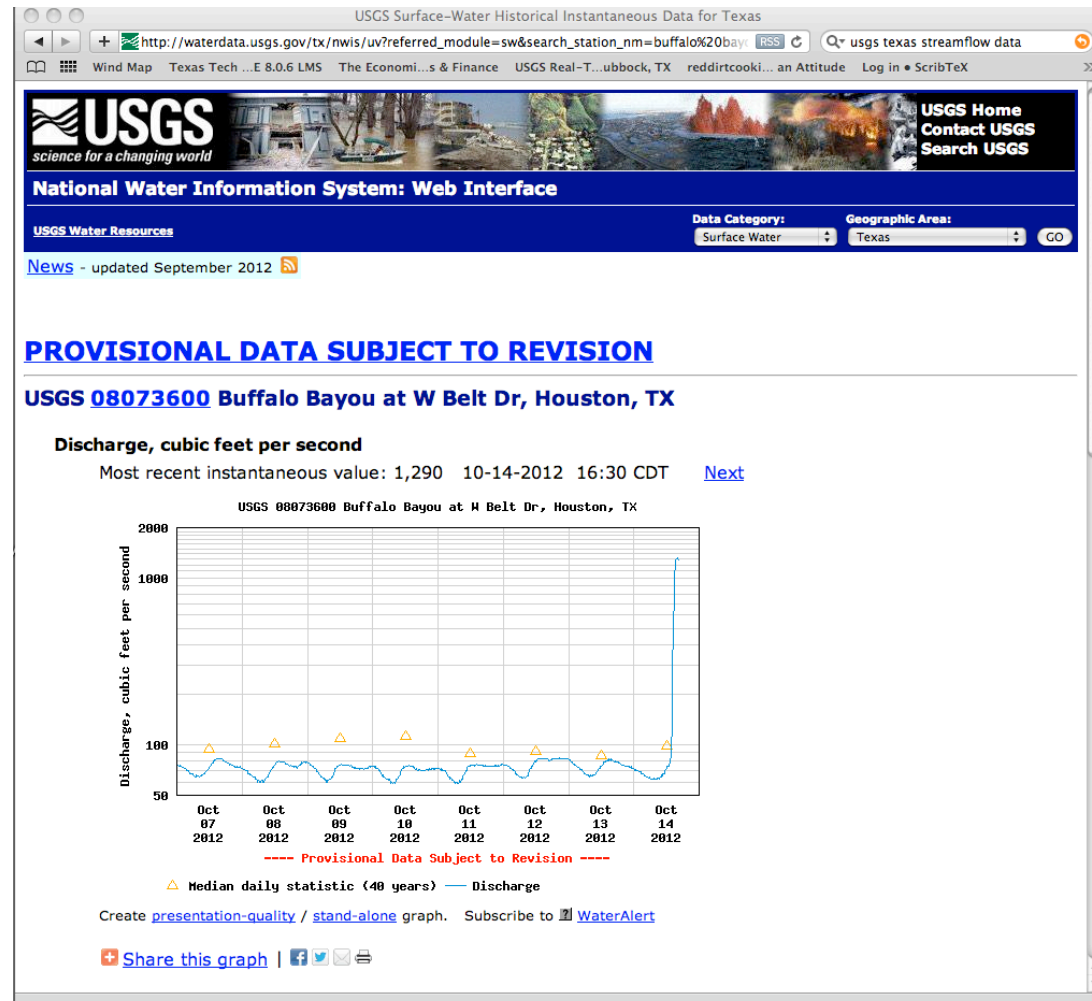
Data are collected by field personnel or relayed through telephones or satellites to offices where it is stored and processed. The data relayed through the Geostationary Operational Environmental Satellite (GOES) system are processed automatically in near real time, and in many cases, [current data](#) are

Start here and build a QUERY



# USGS WEBSITE

➔ Search Result for  
“Harris County +  
Buffalo Bayou”





# USGS WEBSITE



Select the Station ID can find Peak Discharges

USGS \*\* USGS 08073600 Buffalo Bayou at W Belt Dr, Houston, TX

http://waterdata.usgs.gov/nwis/nwisman/?site\_no=08073600&agency\_cd=USGS

## USGS 08073600 Buffalo Bayou at W Belt Dr, Houston, TX

Available data for this site [SUMMARY OF ALL AVAILABLE DATA](#) GO

### Stream Site

**DESCRIPTION:**  
Latitude 29°45'43", Longitude 95°33'27" NAD27  
Harris County, Texas, Hydrologic Unit 12040104  
Drainage area: 290 square miles  
Contributing drainage area: 290 square miles  
Datum of gage: 0.00 feet above NAVD88.

**AVAILABLE DATA:**

Data Type	Begin Date	End Date	Count
<a href="#">Current / Historical Observations</a> (availability statement)	2007-10-01	2012-10-14	
<a href="#">Daily Data</a>			
Discharge, cubic feet per second	1971-09-01	2012-10-13	15019
Gage height, feet	1996-10-01	2012-10-13	5785
<a href="#">Daily Statistics</a>			
Discharge, cubic feet per second	1971-09-01	2011-11-30	14701
Gage height, feet	1996-10-01	2011-11-30	5467
<a href="#">Monthly Statistics</a>			
Discharge, cubic feet per second	1971-09	2011-11	
Gage height, feet	1996-10	2011-11	
<a href="#">Annual Statistics</a>			
Discharge, cubic feet per second	1971	2012	
Gage height, feet	1997	2012	
<a href="#">Peak streamflow</a>	1972-03-20	2010-12-29	40
<a href="#">Field measurements</a>	1971-07-28	2012-09-10	326
<a href="#">Field/Lab water-quality samples</a>	1978-06-05	2001-03-26	140
<b>Additional Data Sources</b>	<b>Begin Date</b>	<b>End Date</b>	<b>Count</b>

40-yr. record, adequate for  
1% AEP analysis as per Bulletin 17B



# USGS WEBSITE

```
# Gage height qualification codes(gage_ht_cd,ag_gage_ht_cd):
# 1 ... Gage height affected by backwater
# 2 ... Gage height not the maximum for the year
# 3 ... Gage height at different site and(or) datum
# 4 ... Gage height below minimum recordable elevation
# 5 ... Gage height is an estimate
# 6 ... Gage datum changed during this year
#
#
#
agency_cd      site_no peak_dt peak_tm peak_va peak_cd gage_ht gage_ht_cd
year_last_pk  ag_dt   ag_tm   ag_gage_ht ag_gage_ht_cd
5s            15s    10d     6s        8s        27s     8s       13s      4s       10d
6s            8s     11s
USGS 08073600      1972-03-20      3770 6,C      62.15
USGS 08073600      1973-06-13      3750 6,C      61.47
USGS 08073600      1974-01-19      2000 6,C      54.33
USGS 08073600      1975-06-03      2430 6,C      55.52
USGS 08073600      1976-06-01      2330 6,C      54.89
USGS 08073600      1976-12-06      1610 6,C      52.23
USGS 08073600      1978-06-07      3520 6,C      60.34
USGS 08073600      1979-09-19      3710 6,C      61.28
USGS 08073600      1980-06-22      1810 6,C      53.72
USGS 08073600      1981-08-31      5350 6,C      64.58
USGS 08073600      1982-05-13      1580 6,C      51.69
USGS 08073600      1983-09-19      3810 6,C      61.48
USGS 08073600      1984-07-18      1940 6,C      53.12
USGS 08073600      1984-10-25      3340 6,C      58.98
USGS 08073600      1985-11-11      2930 6,C      57.44
USGS 08073600      1986-11-23      2590 6,C      54.99
USGS 08073600      1988-03-17      2090 6,C      53.25
USGS 08073600      1989-05-18      4850 6,C      63.32
USGS 08073600      1990-04-27      2320 6,C      54.09
USGS 08073600      1991-01-15      2530 6,C      54.27
USGS 08073600      1992-03-04      7290 6,C      68.30
USGS 08073600      1993-06-20      3680 6,C      60.09
USGS 08073600      1994-05-16      2150 6,C      53.58
USGS 08073600      1994-10-18      3780 6,C      59.74
USGS 08073600      1995-12-10      3300 6,C      53.30
```

➔ Typical annual peak file from USGS

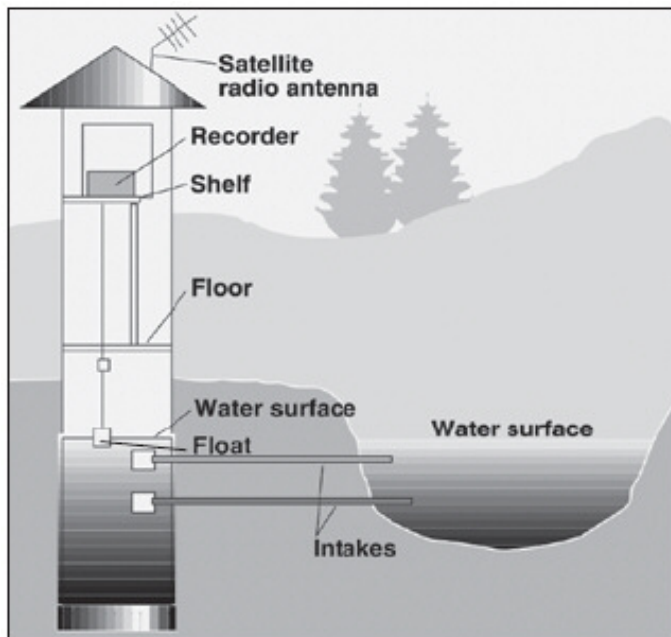
Annual peaks are by “water year”  
Like a fiscal year, multiple water years span calendar years

# STREAMFLOW GAUGES

- Different kinds of gages
  - Continuous record (usually stage, then rated to produce discharge)
    - Located at control section if possible
  - Crest-Stage (captures peak stage)
    - Uses slope-area to estimate discharge
    - Post-event site visit recommended to survey debris-line as independent check of estimate

# CONTINUOUS GAGE (DCP)

- Continuous gage use some kind of stilling well, and transducers to measure stage and send to satellite. During visits, a nearby staff gage is read to independently validate the transducer readings



# CREST-STAGE GAGE

- Vertical pipe has holes in bottom – becomes a stilling well.
- Inside a staff gage and small amount of cork “flour” records water surface elevation.
- Analyst visits site routinely (or after event) and records cork elevation and re-sets gage.
- The elevations are marked on a staff inside the pipe with pencil (and dated)
- Slope area between several nearby pipes is used to estimate discharge



# SLOPE-AREA

- Application of Manning's equation, using the slope of the water surface as the friction slope, and the stage-geometry at measured cross sections.

$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$$

- \* See pp 33-39 CMM for a derivation of Manning's equation
- \* See 7-31 TxDOT HDM for a description of slope-area (slope-conveyance) method

# WHAT IS A WATERSHED?

- Topographic area that collects and discharges surface streamflow through one outlet or mouth (pour point)
- The area on the surface of the Earth that drains to a specific location
- In groundwater a similar concept is called a groundwater basin – only the boundaries can move depending on relative rates of recharge and discharge

# WATERSHED DELINEATION

- Identifies the boundaries of our hydrologic unit / area of study.
  - Need to interpret topographic maps (or DEM/DTM) to construct the boundary
  - Read “How to ...” on server (check the reading list!)



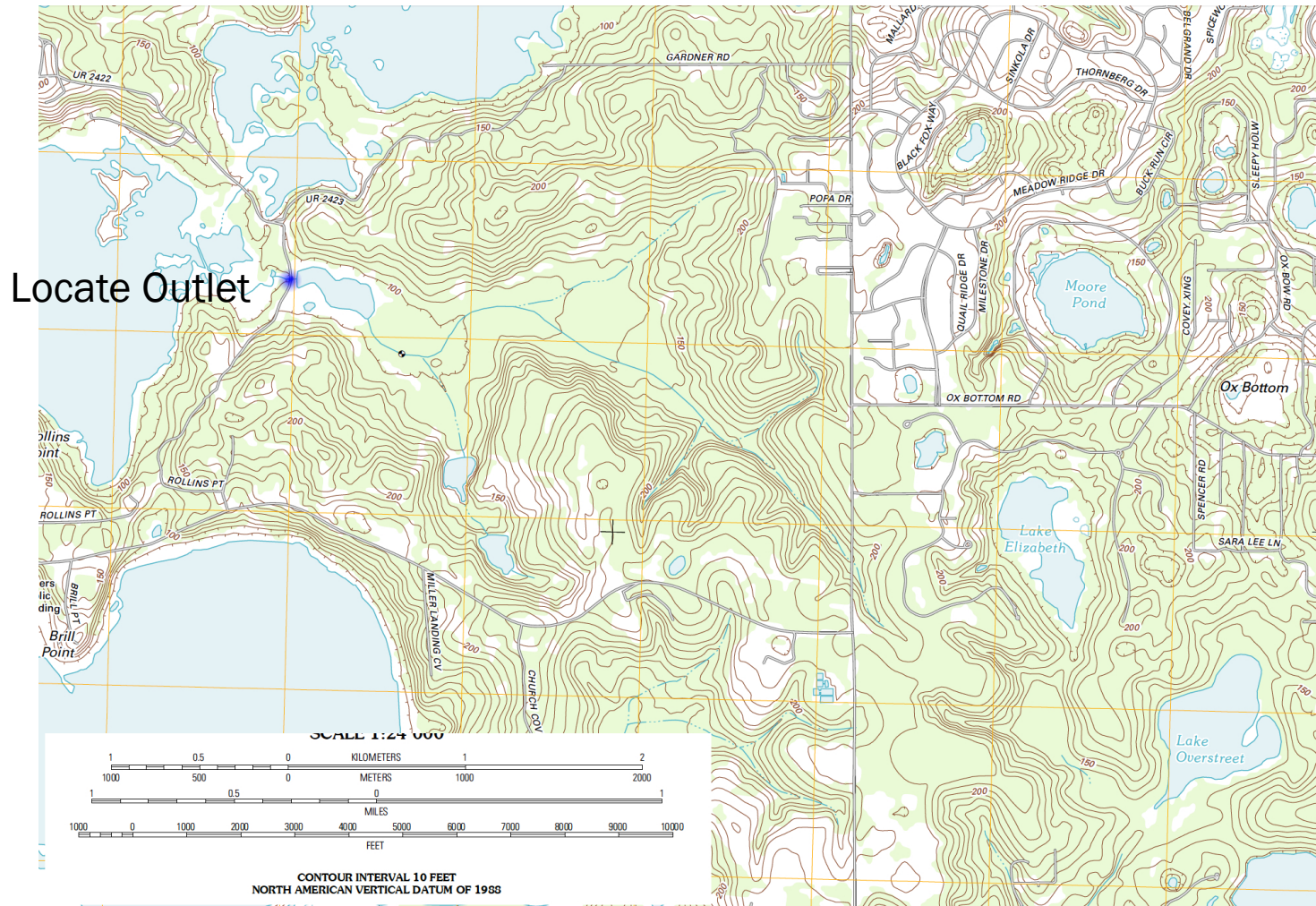
# IDENTIFYING WATERSHED BOUNDARIES

- Steps to delineation
  - Superimpose a grid
    - used to assign average elevations for demarking the boundary
  - Trace/outline the main stem of the stream that you want to examine
  - Trace all perennial or influential tributaries
  - Locate the lowest point/outlet of the main stem and work uphill

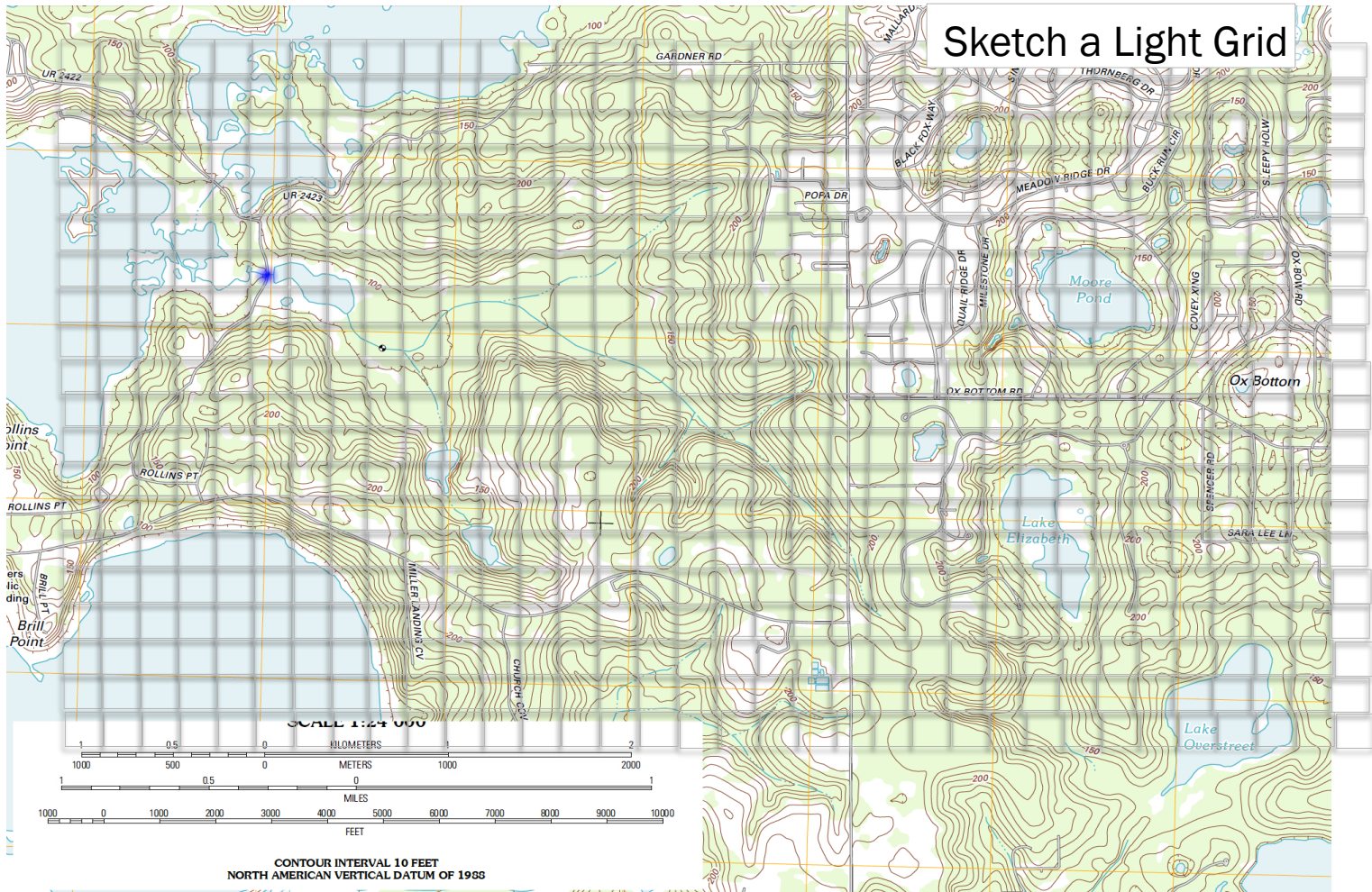
# IDENTIFYING BOUNDARIES

- Working uphill, Identify the ridges and hill tops that divide the water from flowing into separate watersheds
- When in doubt, consider,
  - Where will the rain drops go

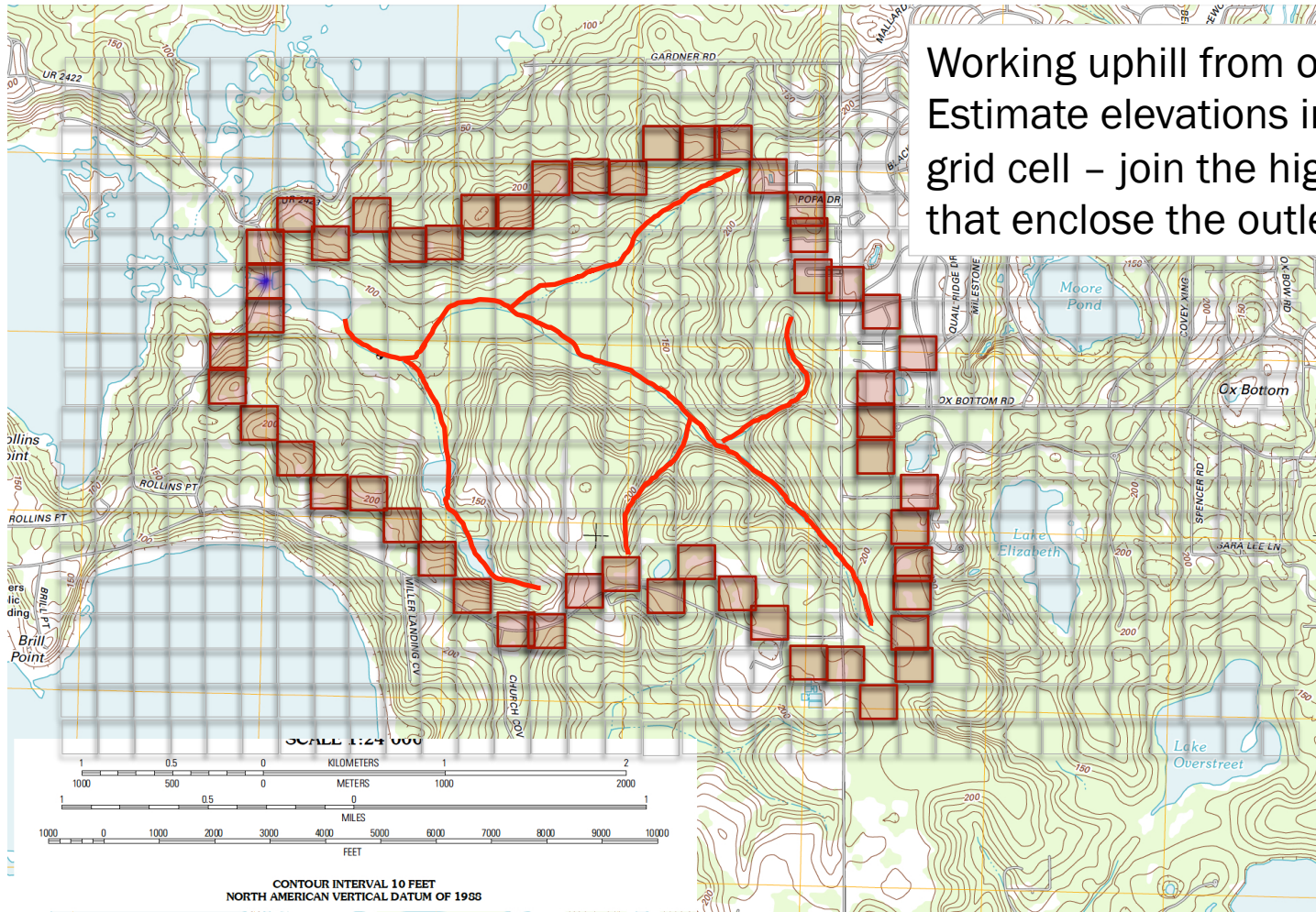
# WATERSHED DELINEATION



# WATERSHED DELINEATION

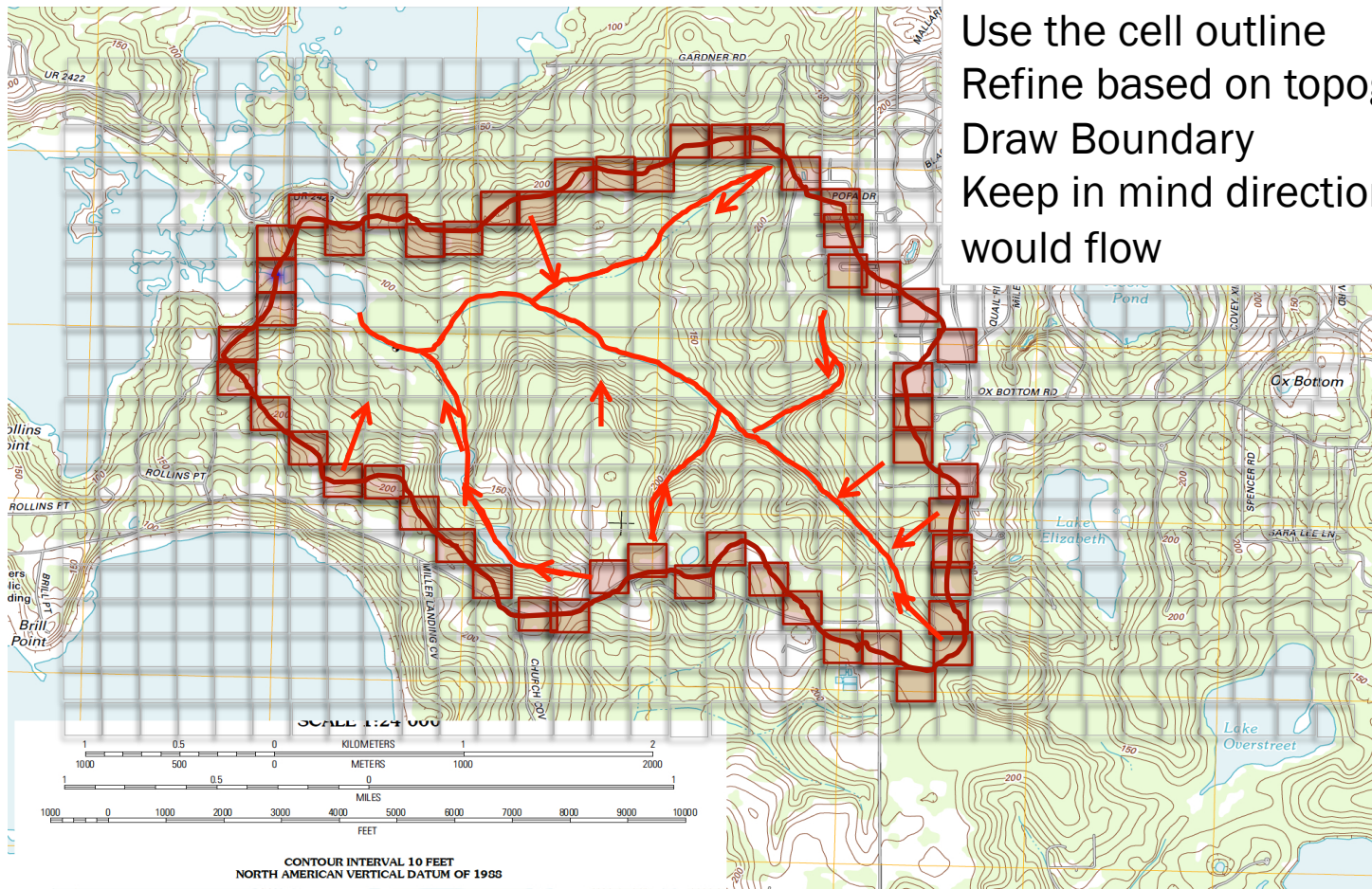


# WATERSHED DELINEATION



Working uphill from outlet  
Estimate elevations in each  
grid cell – join the high cells  
that enclose the outlet

# WATERSHED DELINEATION



Use the cell outline  
Refine based on topography  
Draw Boundary  
Keep in mind direction water  
would flow

# WATERSHED DELINEATION

- Repeat the example in-class as team exercise
  - Work on 11X17 supplied maps
- Hardin Branch watershed as team exercise
  - Hardin Branch is part of the semester project, so be sure you delineate the watershed with some commitment to accuracy
  - Work on 11x17 supplied maps

# Next Time

- Watershed Delineation (continued)
- Watershed Metrics