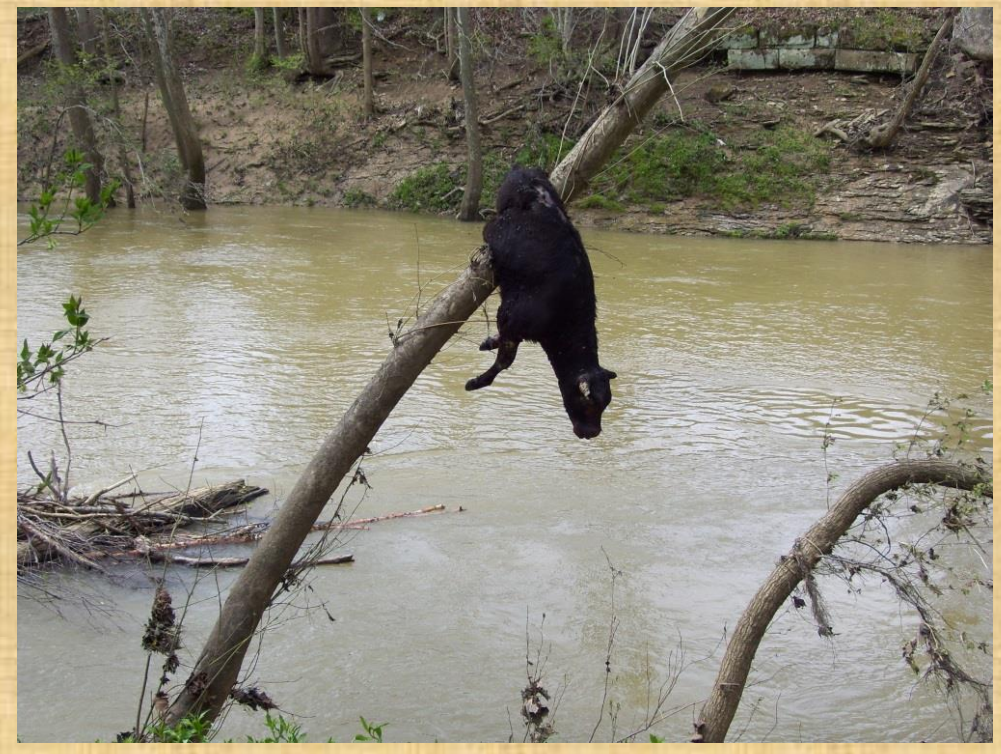
High Water Mark Training
An Initiative to Record Flood Elevations on a Local Level



June 10, 2014

USGS
science for a changing world

Thank You For Your Time

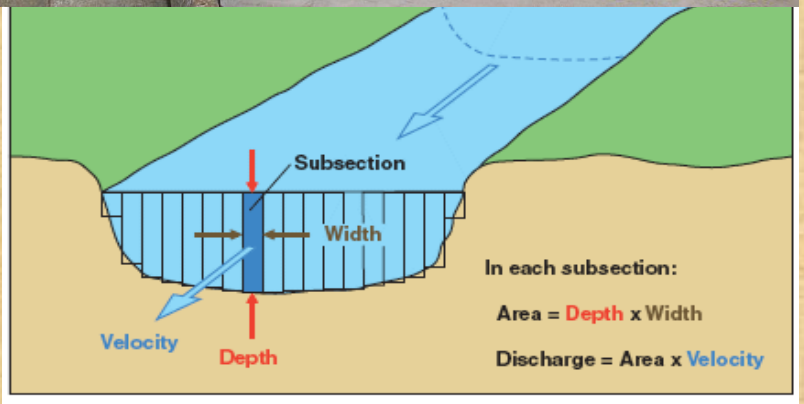
Any Questions?

High-Water Mark Training

- Benefits of high-water marks
- Setting and documenting marks
- High-water mark field kits
- Future of HWM collection in Kentucky

Direct Discharge Measurements

- Direct measurements of discharge are made by USGS routinely at stream gages
- During floods, crews make measurements using sophisticated current meters



Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.

Discharge (volumetric stream flow) is needed for:

- Flood forecasting
- Hydraulic modeling
- Bridge design
- Classifying magnitude of flood (e.g. 100-year or 1% annual exceedance probability)
- Calibration of stream gage stage-discharge ratings

It Isn’t Always Possible to Get to Every Site

- Techniques of Indirect Measurement are needed

What is an Indirect Measurement?

- Makes use of the energy equation for computing stream flow.
- Three Factors:
  - Physical characteristics of the channel
  - Water-surface elevations at time of peak stage (HWMK)
  - Hydraulic factors
    - Roughness coefficients
    - Discharge coefficients

Types of Indirect Measurements:

1. Contracted Opening – at a bridge
2. Culvert – at a culvert
3. Slope-area – along the channel, no structure
4. Step-backwater – along the channel, no structure

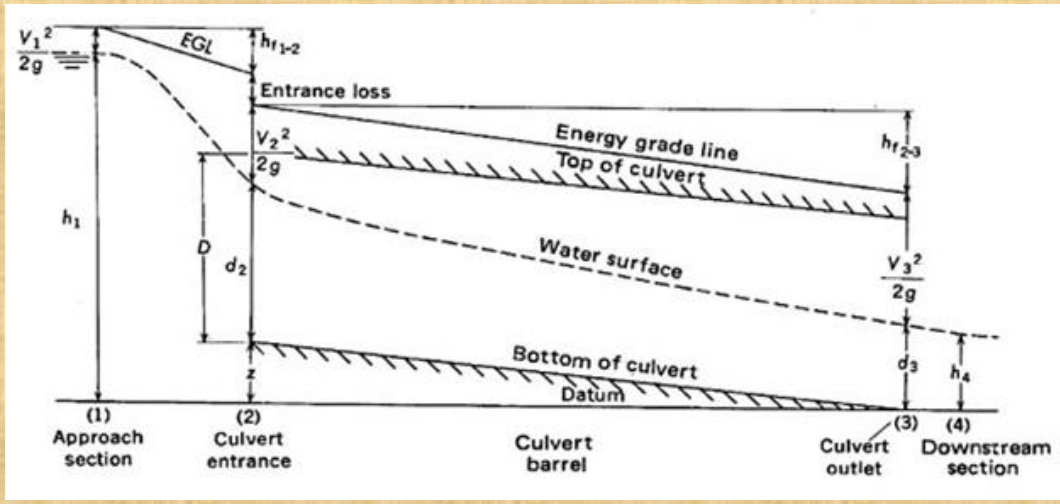
- For each of these, hydraulic modeling is used to compute the discharge.
- HWMKs are the key to indirect measurement techniques - the models all need water levels for input.
- The marks are set per standard guidelines for each kind of measurement.

Example Guidelines, Contracted Opening:

- Set HWMKs along the upstream and downstream face of the bridge on both sides of the channel.
- Set HWMKs one-bridge opening width upstream of the upstream face of the bridge.

Example Guidelines, Culvert:

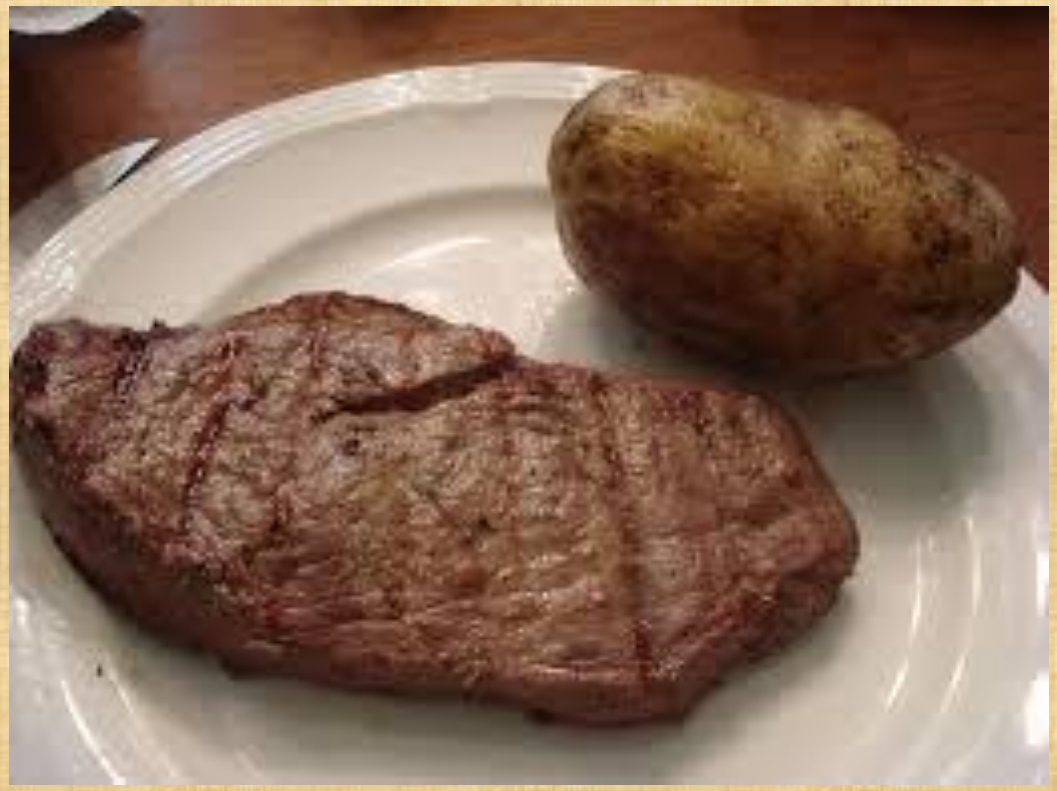
- Set marks on both sides of the channel at the culvert entrance and exit.
- Set marks at least two culvert diameters upstream of the culvert entrance.



Slope Area

- At least one-half foot of fall in study area
- General rule is 2000 feet US and DS
- HWMKs on both sides of channel

Now for the



Portion of the Presentation

Setting High-Water Marks

1. Locate marks
2. Flag the marks with durable markers
3. Document the flagged marks
4. An elevation will need to be determined for the marks later for them to be useful.

Locating Marks

- The need for speed – marks can be highly perishable
- Rain can quickly degrade/destroy marks
- Important to locate and flag ASAP after a flood

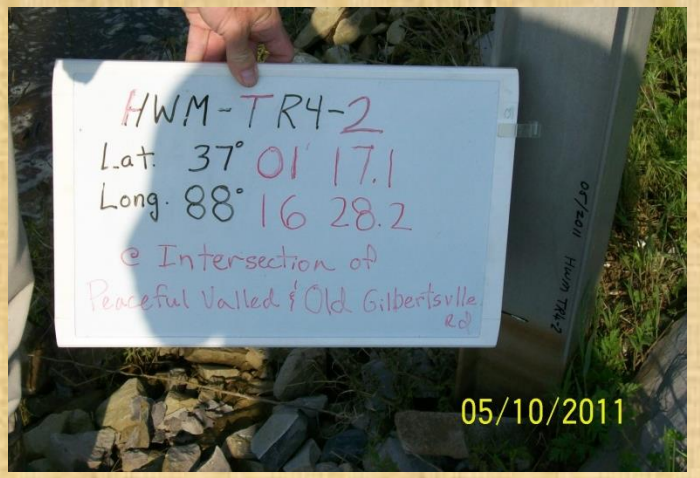
Types of Marks

- Mud lines
- Seed Lines
- Debris lines on the ground
- Debris snags in branches

Examples

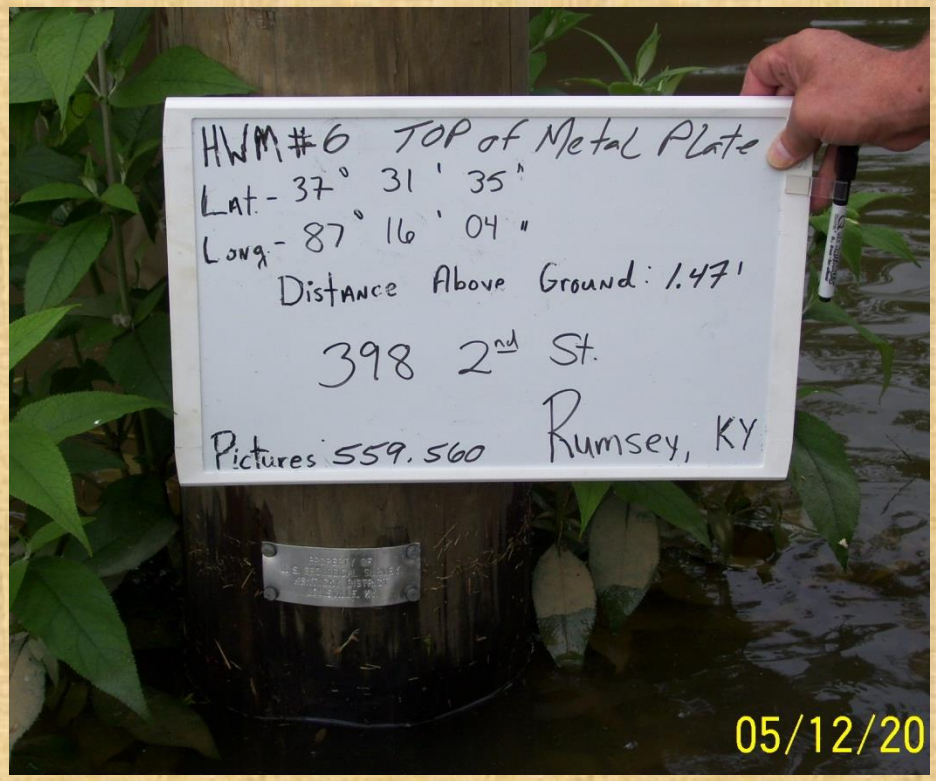
Mud Lines


USGS

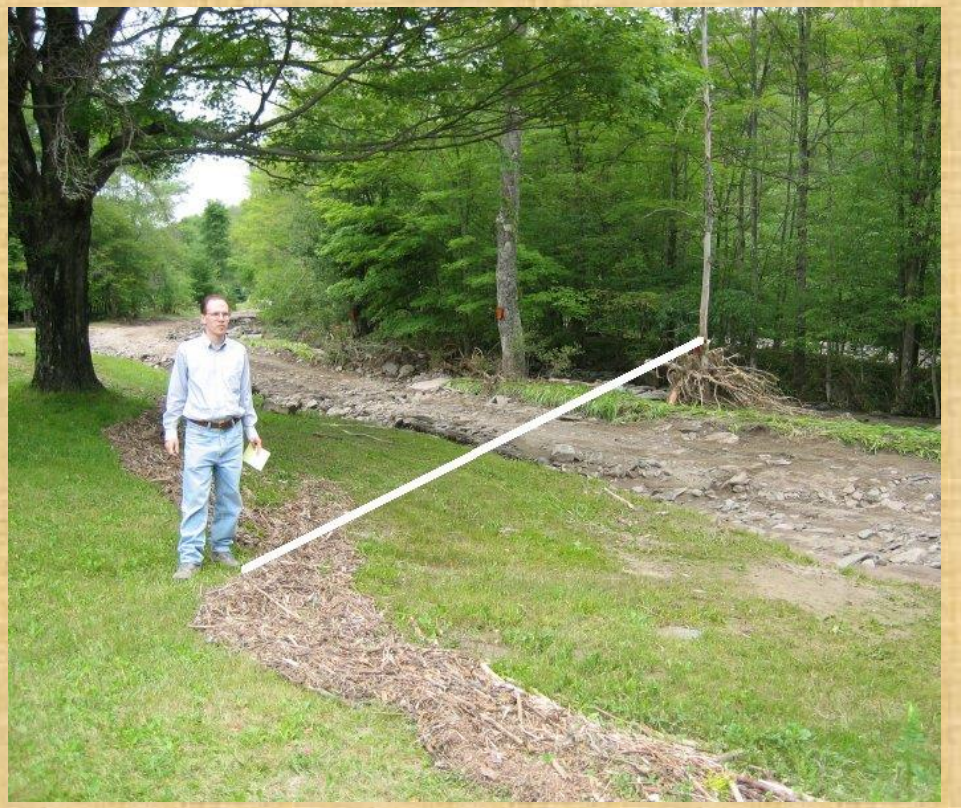

HWM-TR4-2
Lat. 37° 01' 17.1
Long. 88° 16 28.2
@ Intersection of
Peaceful Valley & Old Gilbertsville
Rd
05/10/2011

Seed Lines


USGS


HWM #6 TOP of Metal Plate
Lat - 37° 31' 35"
Long - 87° 16' 04"
Distance Above Ground: 1.47'
398 2nd St.
Pictures 559. 560
Rumsey, KY
05/12/20

Debris lines on the ground



Debris snags in branches

You Found the HWMKs

Now What?

Flagging HWMKs

- Use a durable marker to note water surface
  - Nail/cap
  - Surveyor's tape
  - Paint mark
  - Wooden stake
  - Chiseled square or line in concrete/rock
- IMPORTANT – make sure you get permission of property owners before flagging marks!

Basic HWM Field Kit

- Nails
- HWM disks, washers, bottle caps
- Wooden stakes
- Paint crayon – spray paint
- Surveying flagging tape – high vis.
- Hammer
- Chisel
- Container – canvas bag, toolbox, bucket with tool pouch
- Easily put together for <$50






Kit additions

- Hand level
- 100 ft. tape
- Range Finder
- Hand-held GPS
- Digital Camera
- Safety/comfort items – e.g. insect repellant, ivy wipes, sunscreen, safety glasses

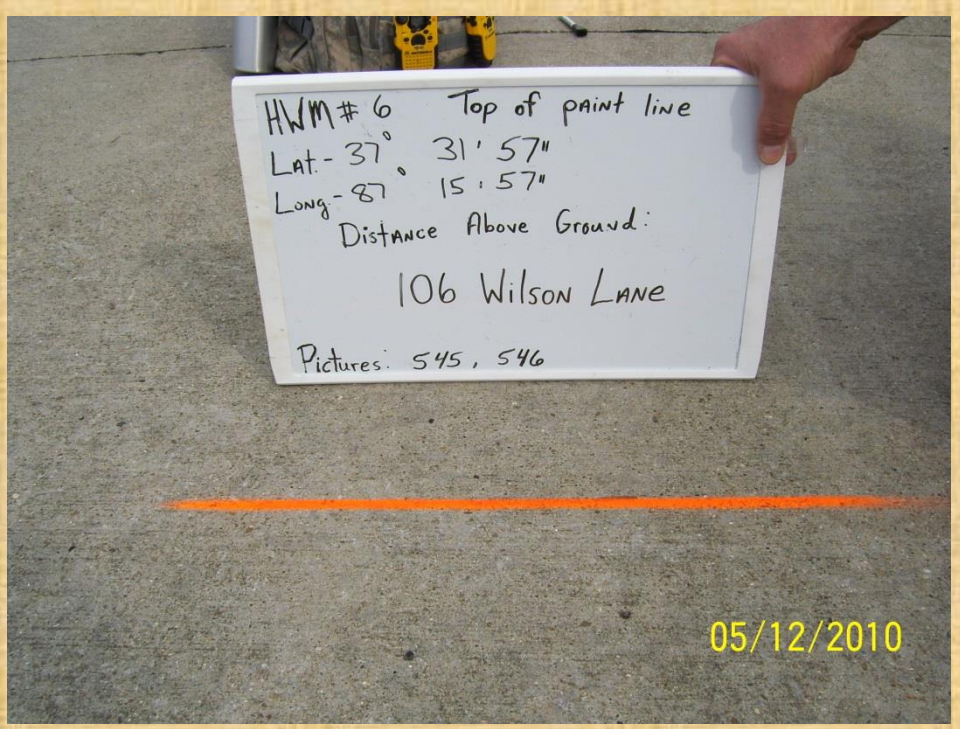
Marking Examples


04/22/2013 16:09

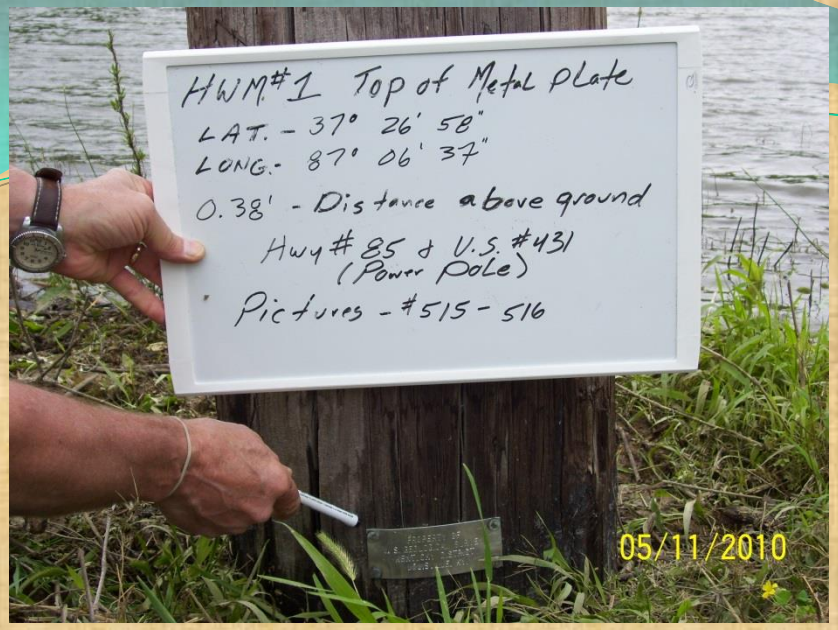

05/06/2010

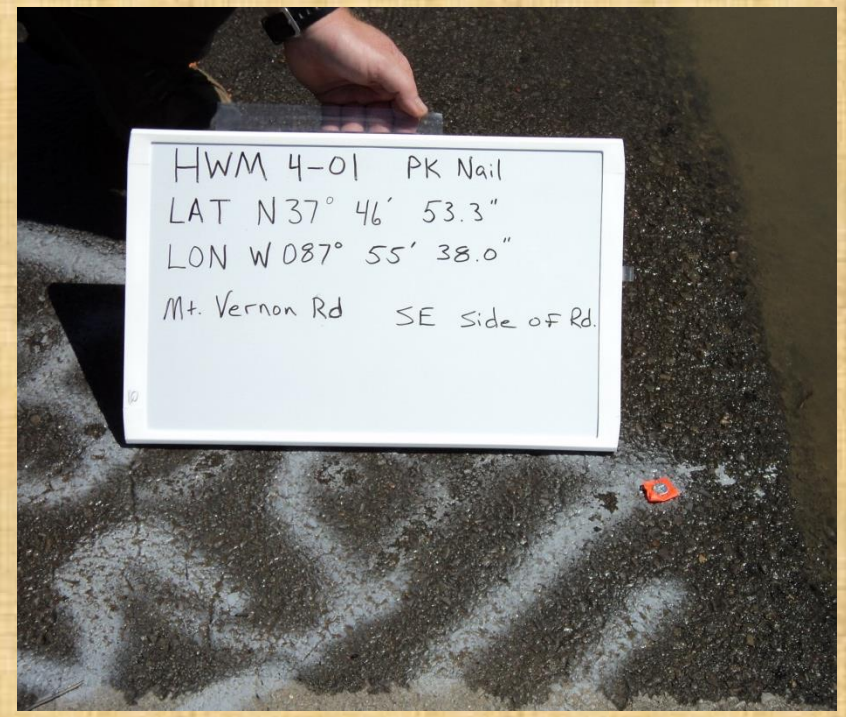

05/06/2010

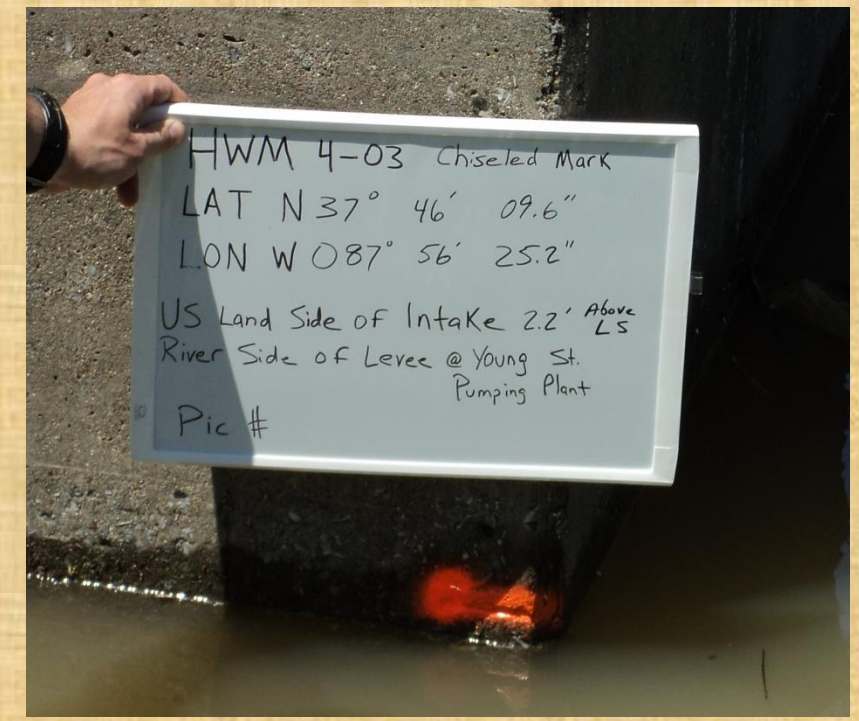
Chiseled square on sidewalk



Painted Line on Boat Ramp

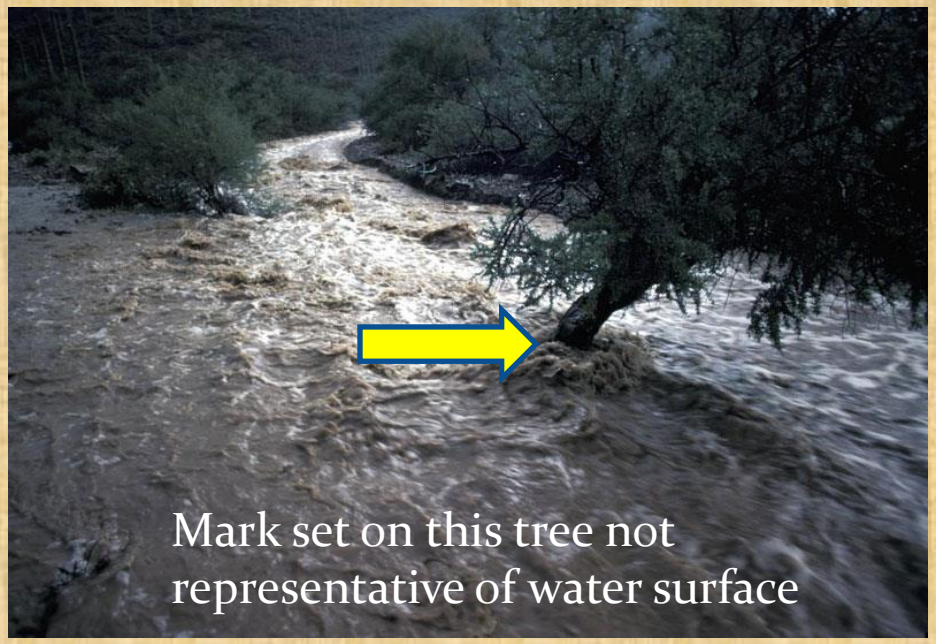

HWM #1 Top of Metal Plate
LAT. - 37° 26' 58"
LONG. - 87° 06' 37"
0.38' - Distance above ground
Hwy #85 & U.S. #431
(Power Pole)
Pictures - #515 - 516
05/11/2010


HWM 4-01 PK Nail
LAT N37° 46' 53.3"
LON W087° 55' 38.0"
Mt. Vernon Rd SE Side of Rd.


HWM 4-03 Chiseled Mark
LAT N37° 46' 09.6"
LON W087° 56' 25.2"
US Land Side of Intake 2.2' Above LS
River Side of Levee @ Young St. Pumping Plant
Pic #

Some Tips

- Always look a little higher – make sure you are not marking a lower, secondary peak which is common
- Setting multiple marks can be advantageous, also try to get them on both sides of the channel
- A HWM should represent the water surface in relatively still water



Look for areas off the main channel, where water would likely be pooled and not piling up due to swift current.

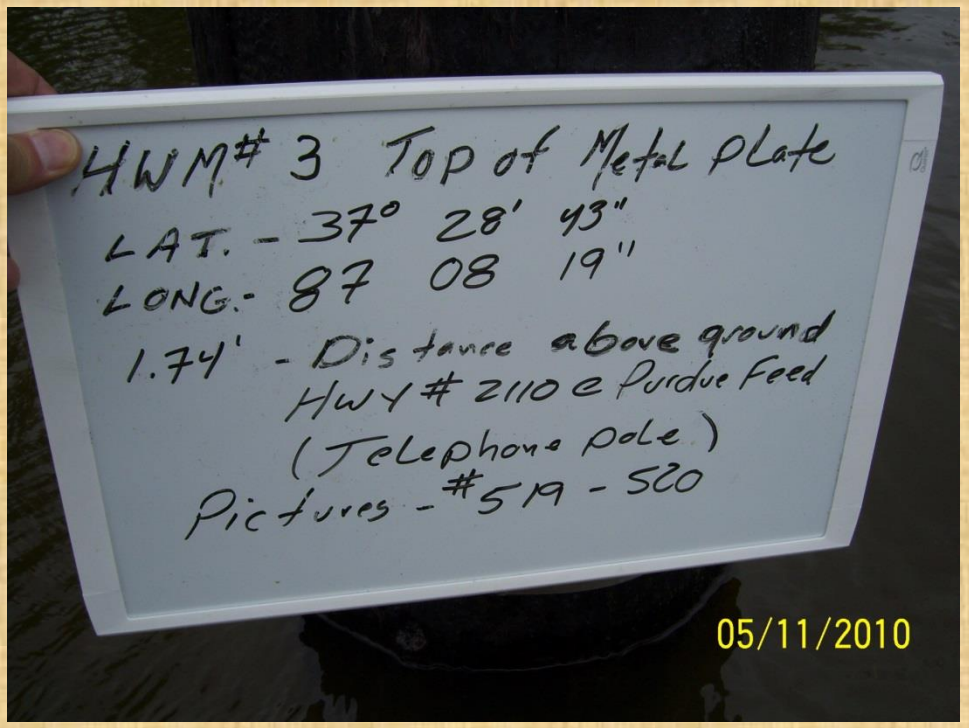
Photo courtesy of Arizona Geologic Hazards Center

Examples of Calmer Water

If some time has elapsed between flood and a HWM search, look for them in sheltered areas. Note for a mark in a structure, transfer the mark height outside with a leveling device – that way if the owner cleans the structure the mark height is preserved.

Get at least 2 pictures of each HWMK

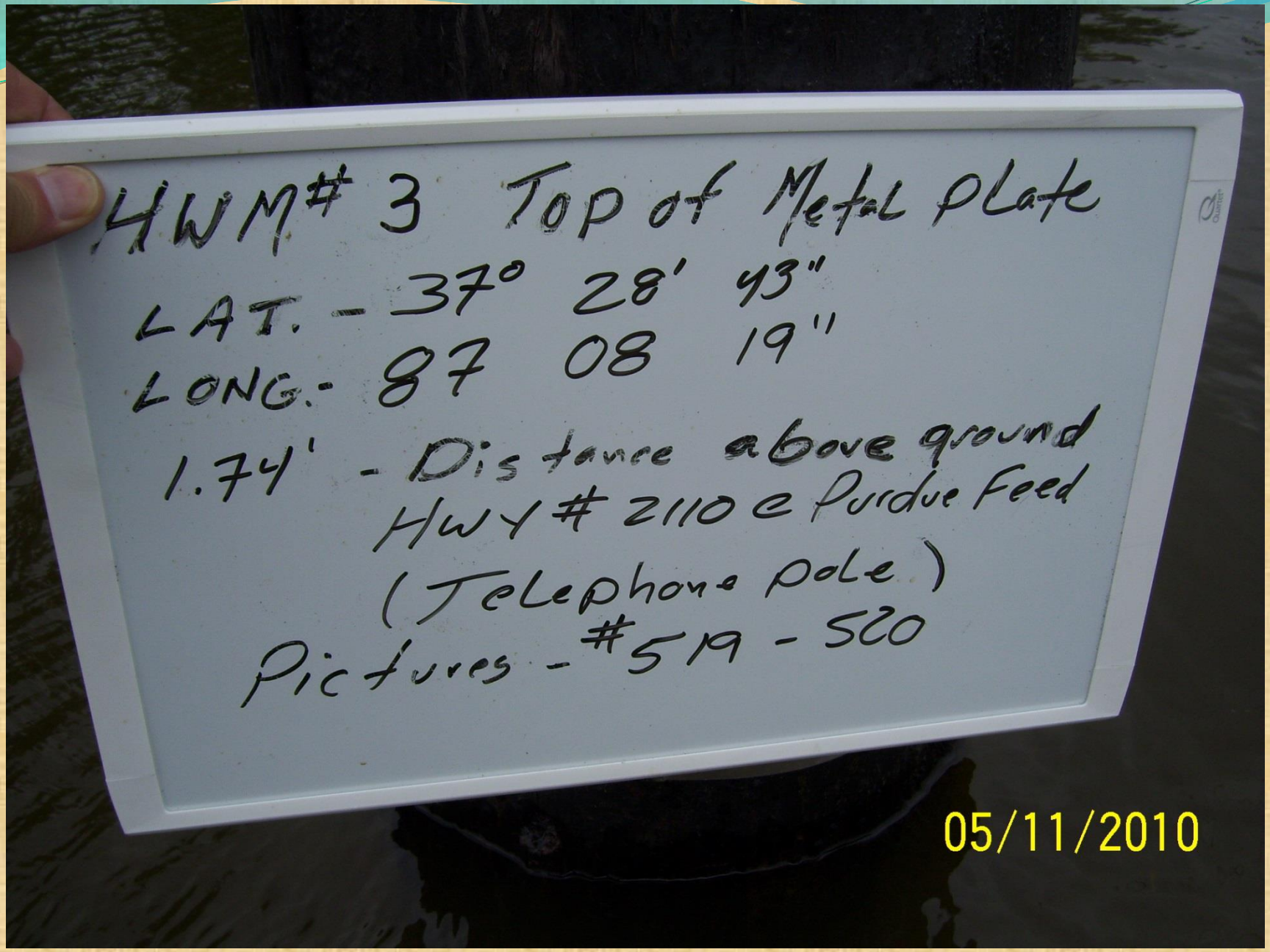
- One up close with description visible
- One with background in frame



Be Careful at Boat Ramps

HWM Documentation

- Type of mark – e.g. mud line, seed line
- Location of mark – lat/long, distance from a well defined point
- Type of flagging used e.g. nail through bottle cap
- Quality of the mark
- Miscellaneous important notes
  - Landowner contact info
  - Logistics/safety information
- Noting mark location on a map/site sketch is helpful
- Date stamped digital photo of marks is helpful


HWM# 3 Top of Metal plate
LAT. - 37° 28' 43"
LONG. - 87 08 19"
1.74' - Distance above ground
Hwy # 2110 @ Purdue Feed
(Telephone pole)
Pictures - #519 - 520
05/11/2010

"An accuracy rating of the floodmarks was assigned in the field according to the type of mark and the field conditions in the immediate area. For example, excellent or good marks are generally mud lines or seed lines on trees or structures in protected areas, fair marks are usually debris lines or fairly well defined mud lines on the streambank, and poor marks are piles of debris, eroded banks, or poorly defined washlines."

High-water Mark Rating	Accuracy (ft.)
Excellent	+/- 0.02
Good	+/- 0.05
Fair	+/- 0.10
Poor	> +/- 0.10

FLOODING OF DECEMBER 29, 1984 THROUGH JANUARY 2, 1985, IN NORTHERN NEW YORK STATE, WITH FLOOD PROFILES OF THE BLACK AND SALMON RIVERS
By Richard Lumia, Patricia M. Burke, and William H. Johnston
U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 86-4191

Field forms

USGS science for a changing world

41°06'43"
74°35'21"

BM No.3 GPS READING 41°06'43.0" 74°35'19.7"
MET BIG JIM

River/stream: WALLKILL RIVER
Road name: AT FRANKIN POND OUTLET
Site number: W9 01367700 at Franklin Ave
County:
Municipality:
Party: TJ. REED / R.W. EDWARDS
Date: THU 09-14-2000
Horizontal datum used: circle: 1927 NAD / (1983) NAD
Vertical datum used: circle: 1929 NGVD / 1988 NAVD

SKETCH W9.5 TREE FLOW W9.4 WOODEN HUB SET IN SLOPE OF BANK NEAR TOP OF BANK (W9.6)
FRANKLIN AVENUE BRIDGE
BM No.3 W9.3 ROBBIE IN BANK FLOW W9.4
WHITE BRICK BUILDING DAM
25 FEET HWM W9.2 PK IN 2.5' DIAM TREE
WALKWAY
≈200 FEET
FRANKLIN POND
HWM W9.1 PK NAIL on 14" DIAMETER TREE

HWM# W9.1 → ELEVATION = 531.05+3.6 = 534.65'
circle: excellent / (good) / fair / poor
location: 200 feet (u.s.) / d.s. / r.b. / (l.b.) of bridge / dam
HWM is: (seed line) / mud line / debris line / other (describe)_____
HWM marked with: paint / hub / rebar / nail / (PK nail) / chiseled mark / other (describe) _____
Distance of HWM above ground (in feet): 2.5 FEET ABOVE LAND SURFACE AND 3.6' ABOVE CURRENT LAKE LEVEL
GPS reading: lat 41 06' 39.8" long 74 35' 19.7" (good/poor)
Photo# 44 W9-1.JPG

HWM# W9.2 → ELEVATION: 531.05+3.9 = 534.95
circle: excellent / (good) / fair / poor
location: 25 feet (u.s.) / d.s. / (r.b.) / l.b. of bridge / (dam) AND APPROXIMATELY 70' TO RIGHT OF DAM
HWM is: seed line / (mud line) / debris line / other (describe)_____
HWM marked with: paint / hub / rebar / nail / (PK nail) / chiseled mark / other (describe) _____
Distance of HWM above ground (in feet): 1.6 ABOVE LAND SURFACE BELOW PK AND 3.9 FEET ABOVE CURRENT LAKE LEVEL
GPS reading: lat 41 06' 42.9" long 74 35' 17.5" (good/poor)
Photo# 45 W9-2.JPG
AT BASE
2.5 FOOT DIAMETER MAPLE TREE

HWM# W9.3
circle: excellent / good / (fair) / poor
location: ____ feet u.s. / d.s. / r.b. / (l.b.) of bridge / dam HALFWAY BETWEEN DAM AND UPSTREAM SIDE OF BRIDGE
HWM is: seed line / mud line / (debris line) / other (describe)_____
HWM marked with: paint / hub / rebar / nail / PK nail / chiseled mark / other (describe) _____
Distance of HWM above ground (in feet):
GPS reading: lat 41 06' 43.5" long 74 35' 20.0" (good/poor)
Photo# 47 and 48 W9-4.JPG W9-5.JPG
SLOPE OF LEFT BANK

HWM# W9.4
circle: excellent / good / (fair) / poor
location: ____ feet u.s. / d.s. / (r.b.) / l.b. of bridge / dam BETWEEN DAM AND UPSTREAM SIDE OF BRIDGE
HWM is: seed line / mud line / (debris line) / other (describe)_____
HWM marked with: paint / hub / (rebar) / nail / PK nail / chiseled mark / other (describe) _____
Distance of HWM above ground (in feet): AT GROUND SURFACE
GPS reading: lat 41 06' 43.7" long 74 35' 19.1" (good/poor)
Photo# 49 W9-6.JPG
BANK

HWM# W9.5
circle: excellent / good / fair / (poor)
location: 15 feet u.s. / (d.s.) / r.b. / (l.b.) of bridge / dam DOWNSTREAM OF FRANKLIN AVENUE BRIDGE
HWM is: (seed line) / mud line / debris line / other (describe)_____
HWM marked with: paint / hub / rebar / nail / (PK nail) / chiseled mark / other (describe) _____
Distance of HWM above ground (in feet): 6.5
GPS reading: lat 41 06' 44.1" long 74 35' 20.0" (good/poor)
Photo# 46 W9-3.JPG
12" DIAMETER TREE

HWM# W9.6
circle: excellent / good / (fair) / poor
location: 30 feet u.s. / (d.s.) / r.b. / l.b. of bridge / dam
HWM is: seed line / mud line / debris line / other (describe)_____
HWM marked with: paint / (hub) / rebar / nail / PK nail / chiseled mark / other (describe) _____
Distance of HWM above ground (in feet): AT GROUND SURFACE
GPS reading: lat 41 06' 44.6" long 74 35' 19.8" (good/poor)
Photo# 50 W9-7.JPG
EARTHEN BANK

STATE OF INDIANA
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WATER
402 W. WASHINGTON ST. ROOM W264
INDIANAPOLIS, INDIANA 46204

PD# _____ Sheet _____
Stream _____
Flood of _____
Date _____
Marks set by _____

HIGH WATER MARKS & STREAM FEATURES

Reach of Stream _____ Quad _____
RP Description: On the ☐ U/S; ☐ D/S; side of the bridge.
_____ ft. _____ of the centerline of the bridge.
_____ ft. _____ of the ☐left; ☐right; end of the bridge. ☐ set, ☐ found

☐ A chiseled "V", ☐ Two filed notches, Other _____
RP Elev _____ Levels by _____ Date / /
Low structure _____ Elev. _____
Crown of Arch _____ Elev. _____
Thalweg _____ Elev. _____
Other _____ Elev. _____
Sec. _____, Twp. _____, Rge. _____, _____PM UTM N _____
River Mile _____ E _____

Field # _____, River Mile _____, Crest Date _____ Mark # _____
Source of info. ☐ P.O., or Other _____ Elev. _____
Quality of mark ☐ very good, ☐ good, ☐ fair, ☐ poor
Reliability ☐ very good, ☐ good, ☐ fair, ☐ poor
Type of Mark ☐ Mud, ☐Seed, ☐ Drift, Other _____
Description: On the ☐ Left Bank; ☐ Right Bank; _____ ft., ☐ U/S; ☐ D/S; of the ☐ bridge; Other _____
_____ft. ☐ Landward; ☐ Streamward of _____

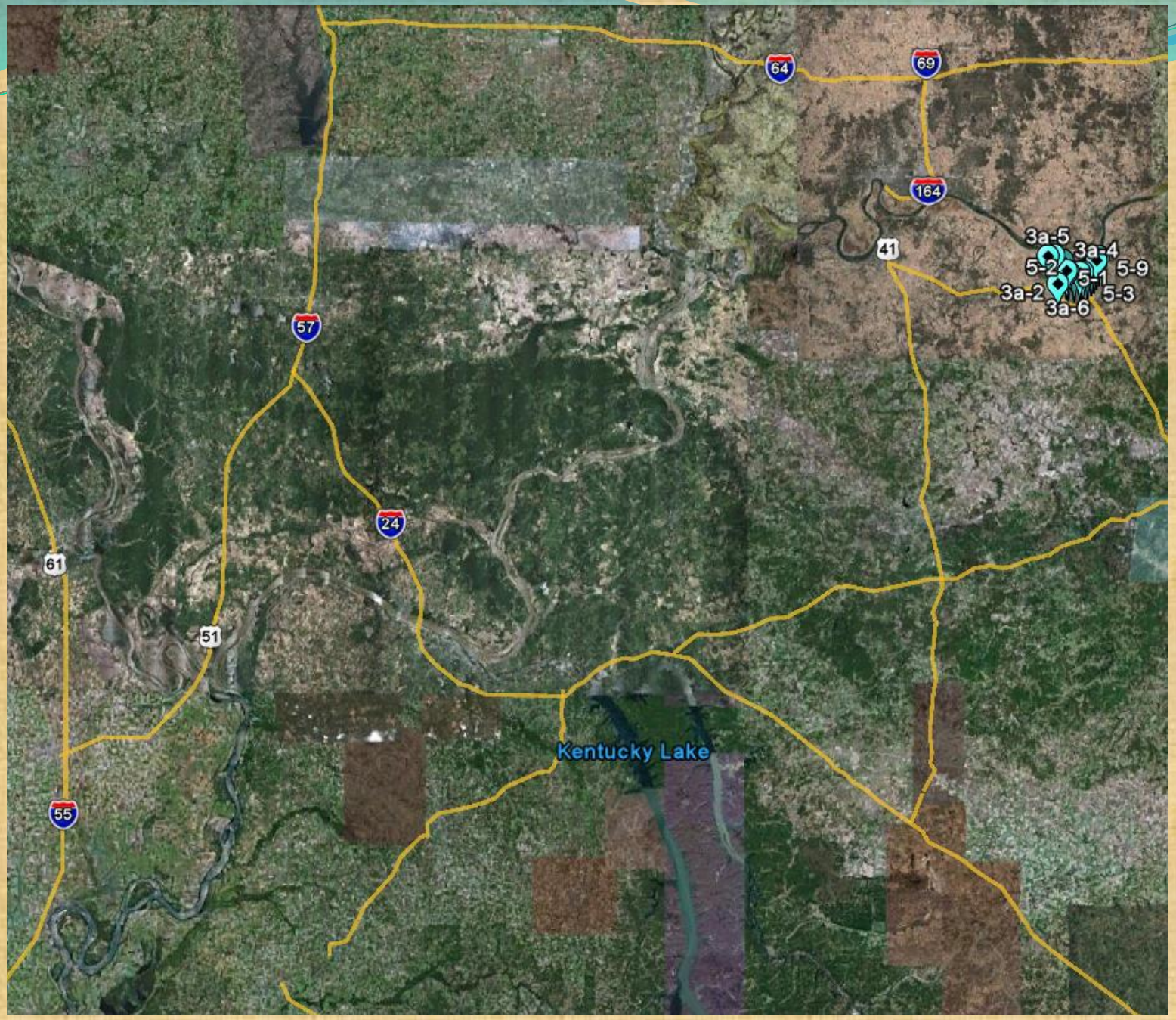
A ☐ 20d; or _____d nail and ☐ B.C.; ☐ Shiner; ☐ Al. Tag; Other _____
On the ☐ U/S; ☐ D/S; ☐ LWD; ☐ SWD side of a _____" dia. _____tree
☐ Power Pole; or Other _____; _____ft. above ground
A ☐ Chiseled; ☐ Painted crowsfoot _____

Field # _____, River Mile _____, Crest Date _____ Mark # _____
Source of info. ☐ P.O., or Other _____ Elev. _____
Quality of mark ☐ very good, ☐ good, ☐ fair, ☐ poor
Reliability ☐ very good, ☐ good, ☐ fair, ☐ poor
Type of Mark ☐ Mud, ☐Seed, ☐ Drift, Other _____
Description: On the ☐ Left Bank; ☐ Right Bank; _____ ft., ☐ U/S; ☐ D/S; of the ☐ bridge; Other _____
_____ft. ☐ Landward; ☐ Streamward of _____

A ☐ 20d; or _____d nail and ☐ B.C.; ☐ Shiner; ☐ Al. Tag; Other _____
On the ☐ U/S; ☐ D/S; ☐ LWD; ☐ SWD side of a _____" dia. _____tree
☐ Power Pole; or Other _____; _____ft. above ground
A ☐ Chiseled; ☐ Painted crowsfoot _____

Future of HWMK Collection in KY

?????


64
69
164
41
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Kentucky Lake
3a-5
3a-4
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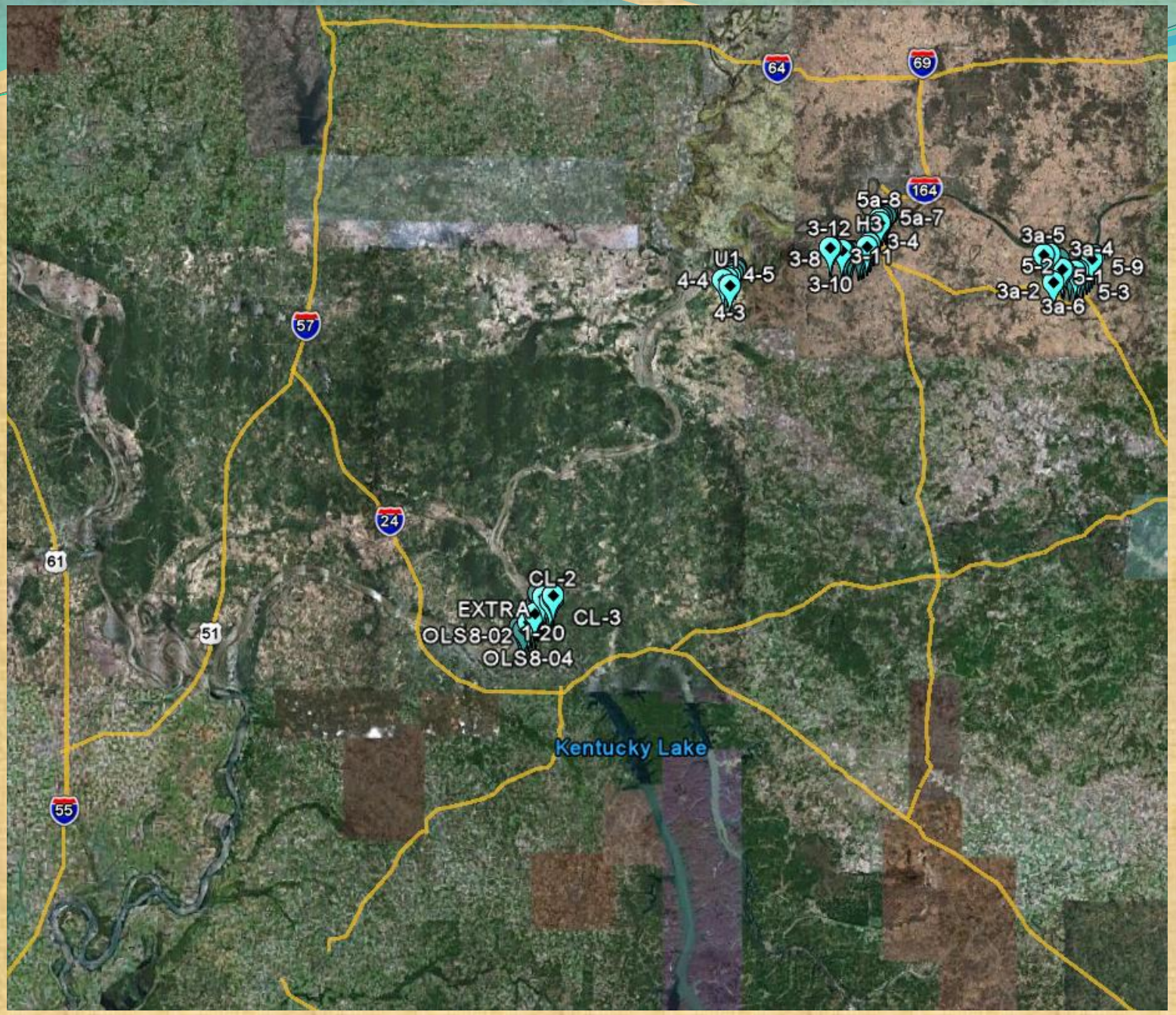
3a-2
5-3
3a-6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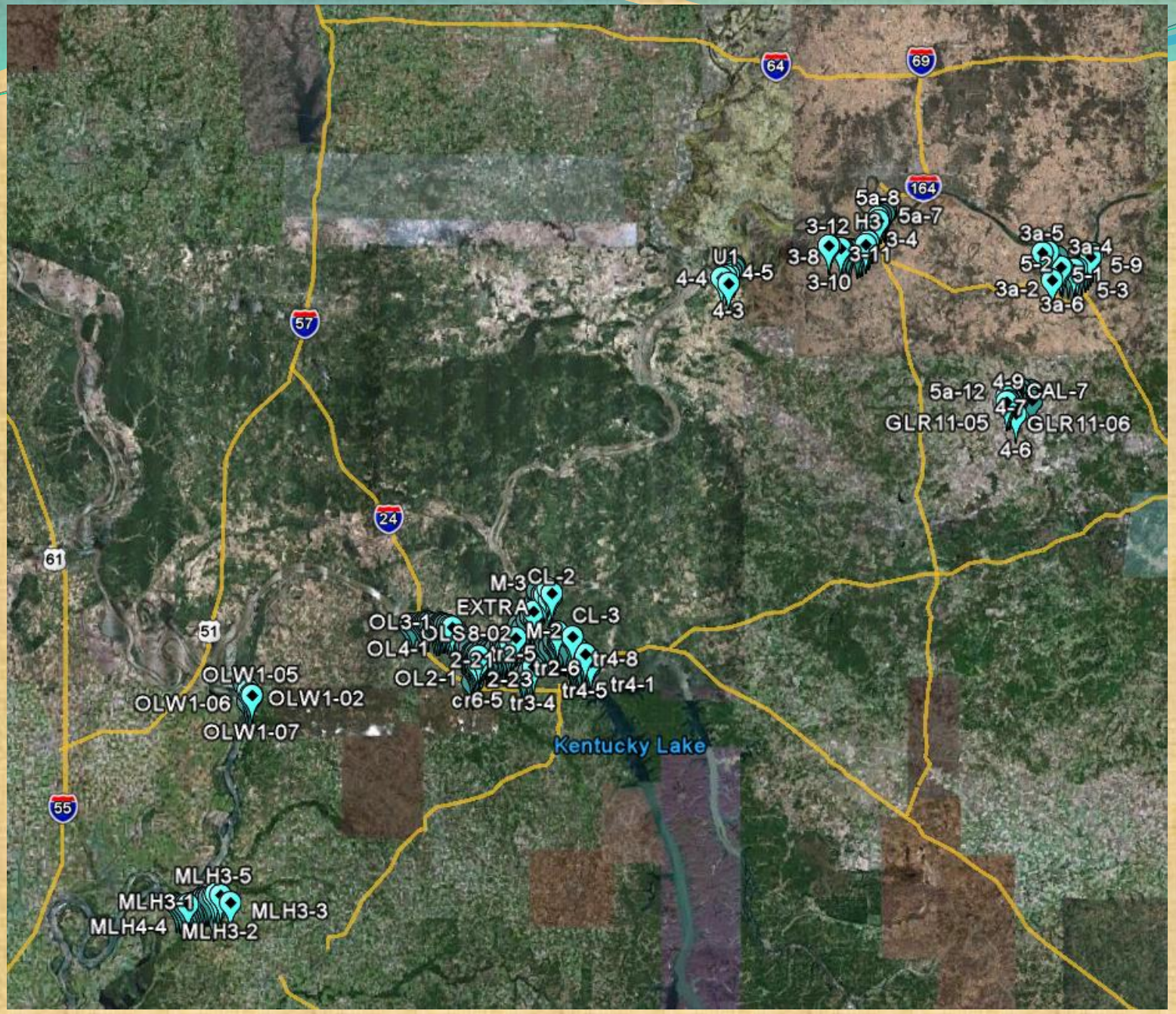
OLS8-04
Kentucky Lake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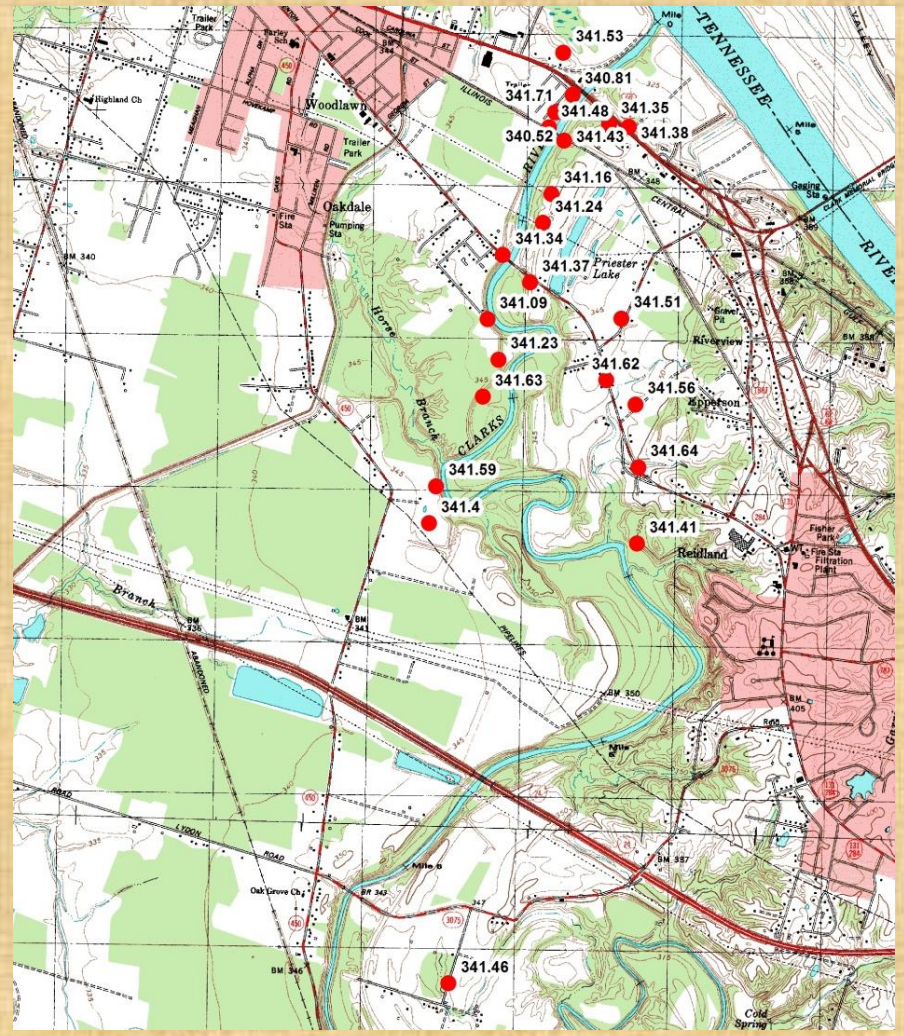
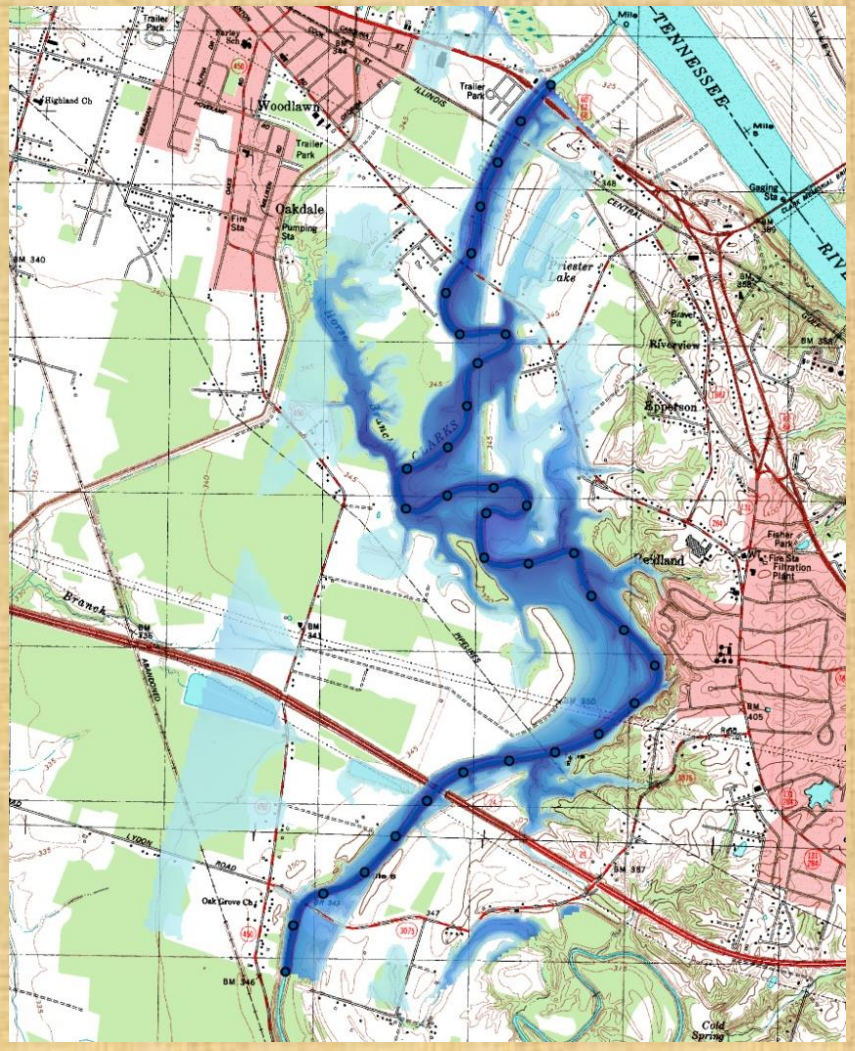
U1
4-4
4-5
4-3
3a-5
3a-4
5-2
5-1
5-9
3a-2
3a-6
5-3
5a-12
4-9
CAL-7
4-7
GLR11-05
GLR11-06
4-6
M-3
CL-2
EXTRA
CL-3
OL3-1
OLS8-02
M-2
OL4-1
2-2-1
tr2-5
tr2-6
tr4-8
OL2-1
2-23
tr4-5
tr4-1
cr6-5
tr3-4
OLW1-05
OLW1-06
OLW1-02
OLW1-07
Kentucky Lake
MLH3-5
MLH3-1
MLH3-3
MLH4-4
MLH3-2

Flood Inundation Maps





QUESTIONS?