WET SOIL STUDIES
IN THE TEXAS GULF COAST PRAIRIE
1989 – 2004

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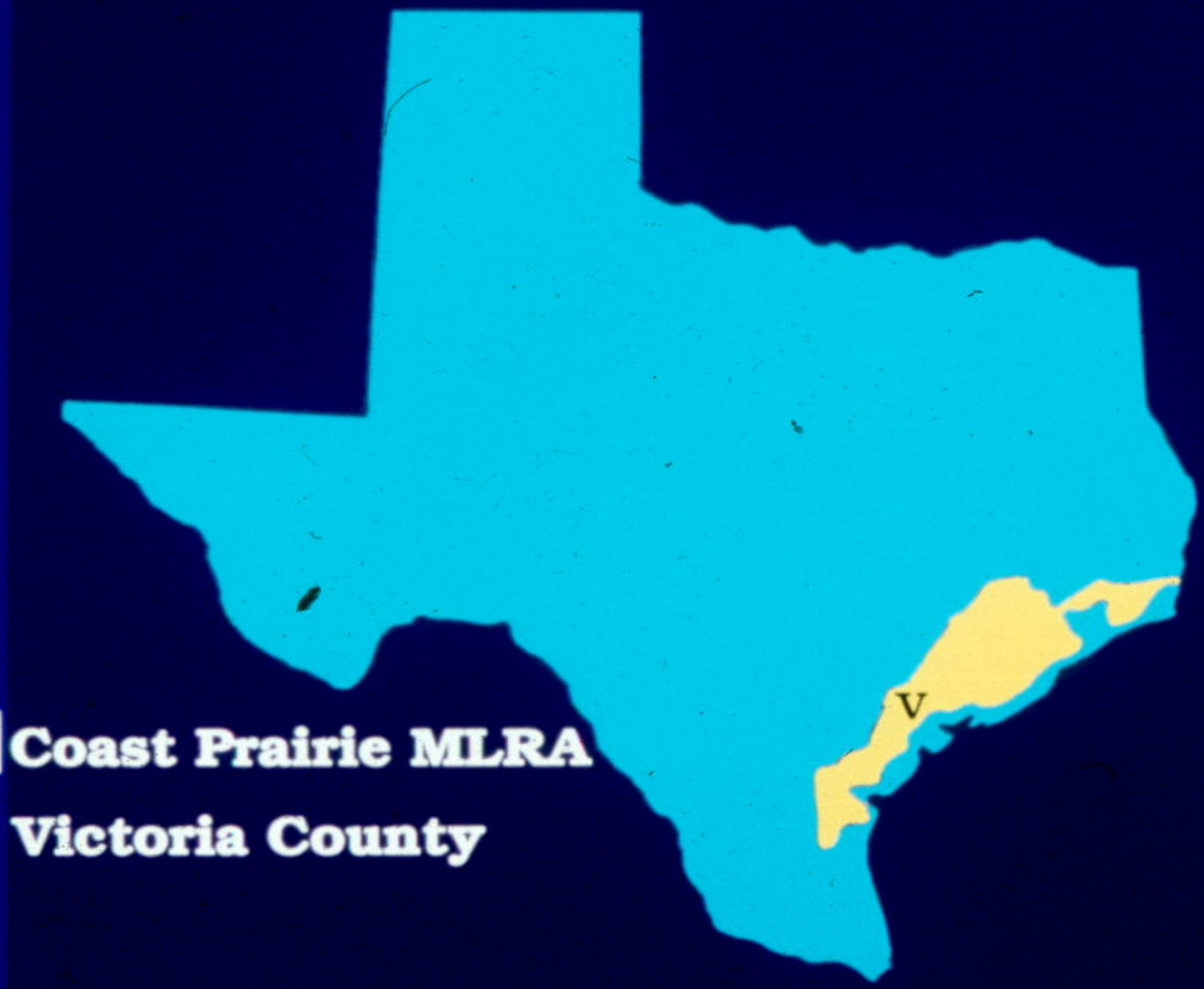
Victoria, Texas

COOPERATING AGENCIES & UNIVERSITIES

- **USDA NATURAL RESOURCE CONSERVATION SERVICE**
- **TEXAS A&M UNIVERSITY**
- **LOUISIANNA STATE UNIVERSITY**
- **BAYLOR UNIVERSITY**
- **U.S. ENVIRONMENTAL PROTECTION AGENCY**
- **U.S. ARMY CORPS OF ENGINEERS,**
  Galveston District, TX
- **U.S. ARMY CORPS OF ENGINEERS,**
  ERDC, Vicksburg, MS
- **U.S. FISH AND WILDLIFE SERVICE, TX**
- **TEXAS PARKS AND WILDLIFE DEPARTMENT**

Map of the Texas Coast Prairie Major Land Resource Area



TEXAS GULF COAST PRAIRIE WET SOIL STUDIES

1989 - 2004

- **Climate**
  Precipitation and Temperature
  USDA National and State level. 1980 to 2004

- **Eighth International Soil Correlation Meeting, 1990**
  International Committee on Aquic Soils (ICOMAQ)
  Victoria County, Texas. 1989 to 1996

- **Interagency Bottomland Hardwood Vertisol Study**
  Brazoria County, Texas. 1996 to 2002

- **Other Field Observations**
  Galveston Island Study, Baylor University.
  1994 to1998. Storm High Tide, October, 1996
  Victoria, Texas City Park
  Guadalupe River Flood, July, 2002

TEXAS GULF COAST PRAIRIE WET SOIL STUDIES CLIMATE

- **Normal precipitation ~100 to 133 cm/year**
- **Normal years average 4 to 5 normal precipitation months each year**
- **Normal years average 3 to 4 above normal precipitation months each year**
- **Episaturation and ponding during normal years occur in months of October to May**

TEXAS GULF COAST PRAIRIE WET SOIL STUDIES
CLIMATE
USDA Texas Hyperthermic – Thermic Temperature Studies

- **Victoria and Jackson Counties, 1980-1987**
- **Mollisols and Alfisols in native prairies**
- **Average coldest temperature in January was 11 to 12 Degrees C.**

TEXAS GULF COAST PRAIRIE WET SOIL STUDIES

CLIMATE

USDA National Hyperthermic – Thermic Temperature Studies

- **Brazoria County, 2002 - 2004**
- **Ponded and Nonponded Vertisols in Bottomland Hardwoods**
- **Average coldest temperature in January was 14 Degrees C.**

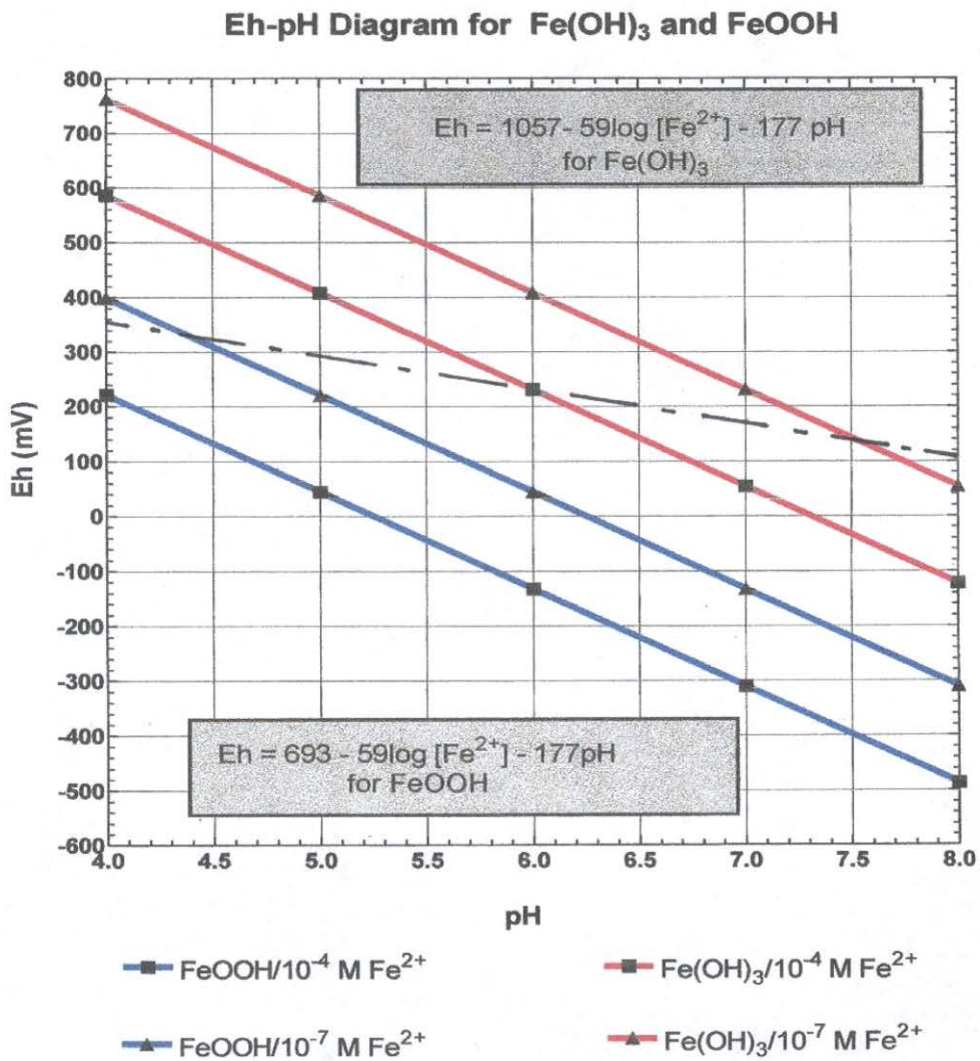
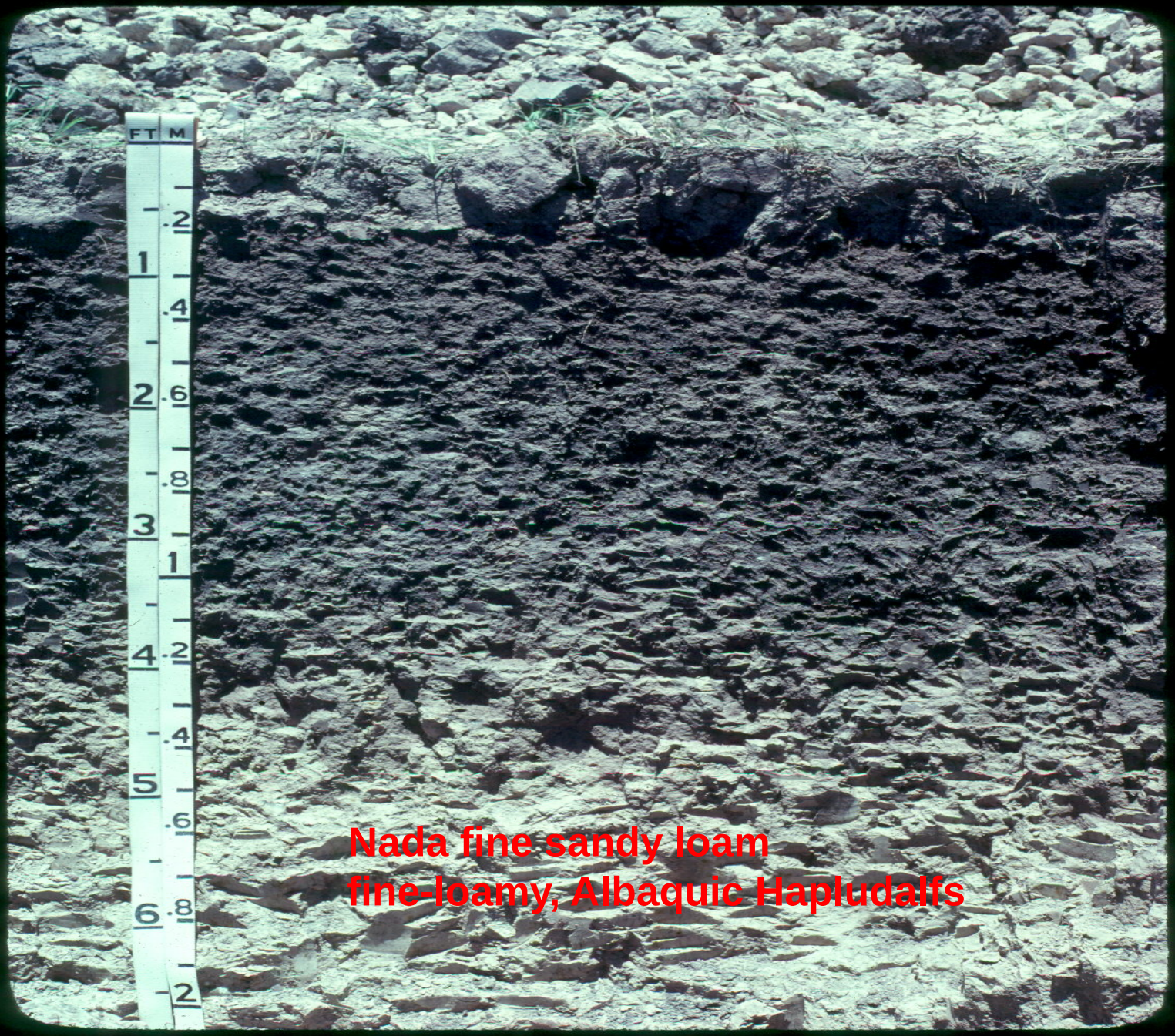
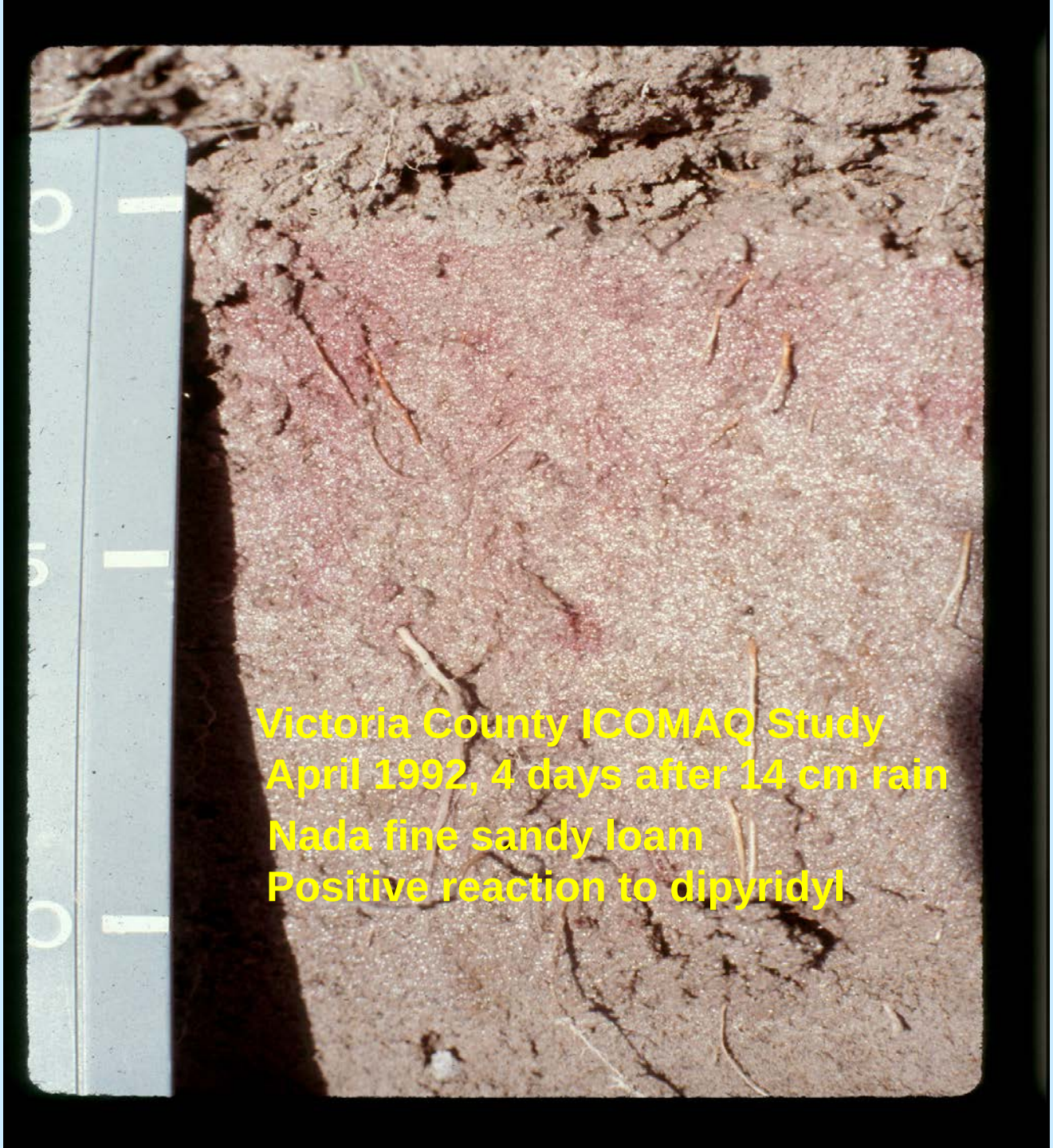


Fig. 12. Eh-pH diagram showing the threshold value (oxidized-reduced) and stability of different forms and concentrations of iron hydroxides (Dr. Bruce James, Professor of Soil Chemistry, University of Maryland. Presented at National Wet Soil Monitoring and Standards Conference, Baton Rouge, LA. 1998).
Dashed line represesnts current NRCS-NTCHS aerobic-anaerobic condition boundary (Eh = [595 – (60 x pH)]).

Victoria County, Texas, ICOMAQ Study Site,
January, 1992 – 14 cm rain in 2 days
Ponded Depression – Cieno soils - pH 5.0; 0.6% OC
Nonponded Flat – Nada soils – pH 5.0; 0.5% OC


FT
M
Nada fine sandy loam
fine-loamy, Albaquic Hapludalfs


Victoria County ICOMAQ Study
April 1992, 4 days after 14 cm rain
Nada fine sandy loam
Positive reaction to dipyridyl

Victoria County ICOMAQ Study
April 1992
Nada fine sandy loam
4 continuous weeks reduced conditions
Oxidized rhizospheres with sharp and clear boundaries
2
Scale 1 cm

April 1992
Nada fine sandy loam
4 to 6 weeks reduced conditions
Positive dipyridyl reaction in reduced matrix (10YR 4/1)

SOIL CHARACTERIZATION AND HYDROLOGICAL MONITORING PROJECT, BRAZORIA COUNTY BOTTOMLAND HARDWOOD VERTISOLS

Federal, University, and Texas State Interagency Study

Develop procedures to identify and develop reliable soil field indicators for delineating wetlands in forested bottomlands in the lower Brazos and San Bernard River basins in Brazoria, Fort Bend, Wharton, and Matagorda counties.

BOTTOMAND HARDWOOD VERTISOL SITES

NONPONDED SITES - SITES 1, 2, & 5

- **Vertisols with distinct gilgai.**
- **Microlows that pond make up about 10% surface.**
- **Elevation difference between microhighs and microlows, 13 cm (range 6 to 20 cm)**
- **Microlows 2 to 3 meters long by 0.5 to 1 meter wide.**
- **Less than 1% easily identifiable redox features in microlows.**

Site 1 Nonponded,
Pledger clay
Very-fine Typic Hapludert

Site 1 Nonponded,
Pledger clay with distinct gilgai
Very-fine Typic Hapludert
August, 1998

BOTTOMAND HARDWOOD VERTISOL SITES

PONDED SITES - Site 3 Ponded Middle & 3 Ponded Edge.

- **Abandoned channel about 30 cm deep, 75 m wide and 380 m long.**
- **Vertisols without distinct gilgai**
- **Easily identifiable redox features in middle and outer edge of ponding.**

Ponded Sites - Site 3 Ponded Middle & 3 Ponded Edge
Churnabog clay
Very-fine Typic Epiaquert

Ponded Sites - Sites 3 Ponded Middle & 3 Ponded Edge
Churnabog clay
Very-fine Typic Epiaquert

Site 3 Ponded
March, 2002

8 to 22 cm depth
Ponded 7 months

Site 3, Edge of Ponding
September, 2002
50 cm precip. in 4 days
Observations on 5th day
Dipyridyl Reaction

September, 2002
Site 3 Ponded Edge
50 cm precip. in 4 days
Observations on 5th day

- 0.5 cm deep ponded water
  Dipyridyl dye positive reaction in water mixed with upper 1 to 3 cm submerged clay.
-

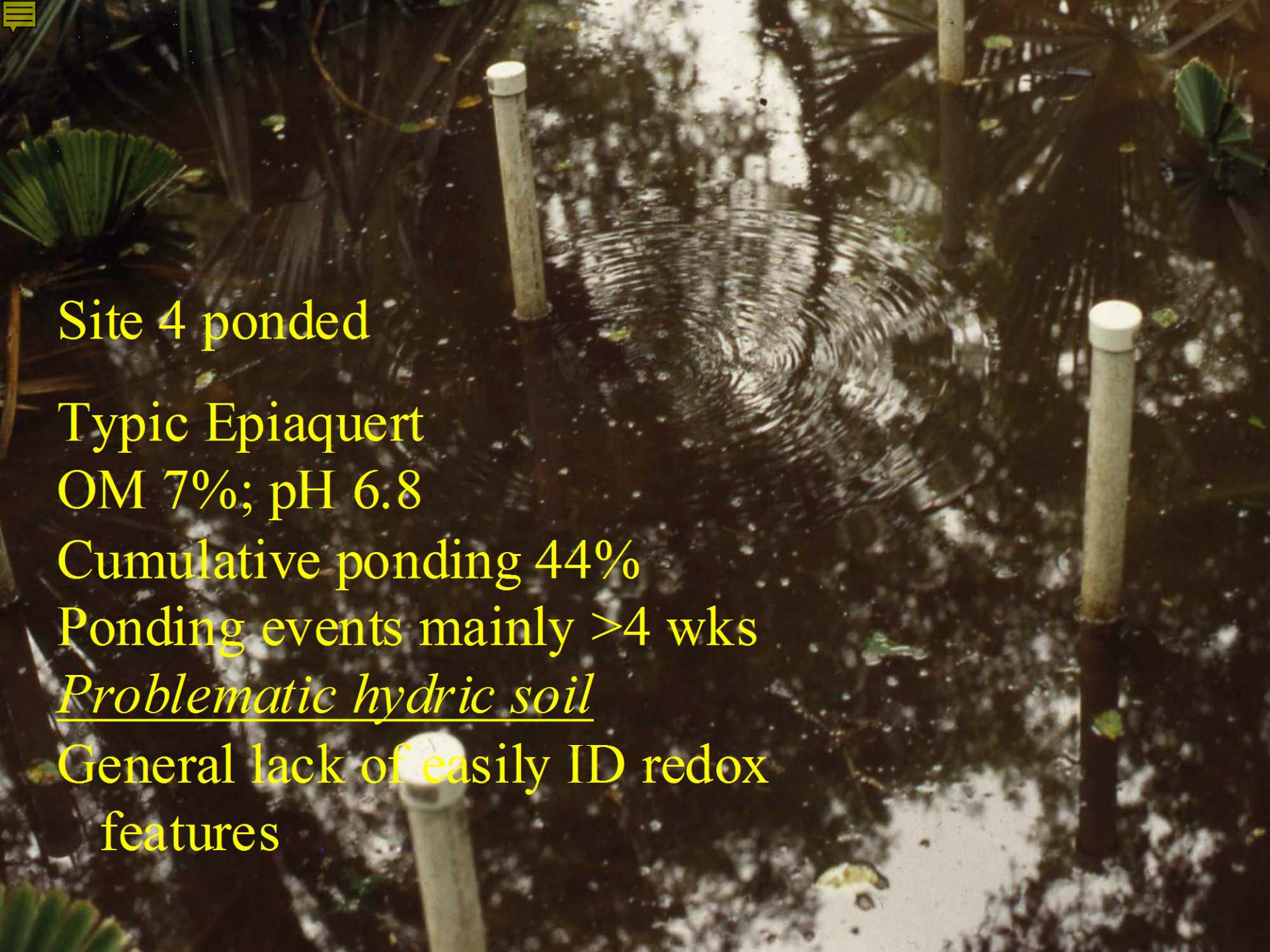
BOTTOMAND HARDWOOD VERTISOL SITES

PONDED SITES - Site 4

- **Large shallow depression**
  about 15 cm deep, 150 m wide and 240 m long.

- **Vertisols without distinct gilgai.**

- **Very few to no easily identifiable redox features.**

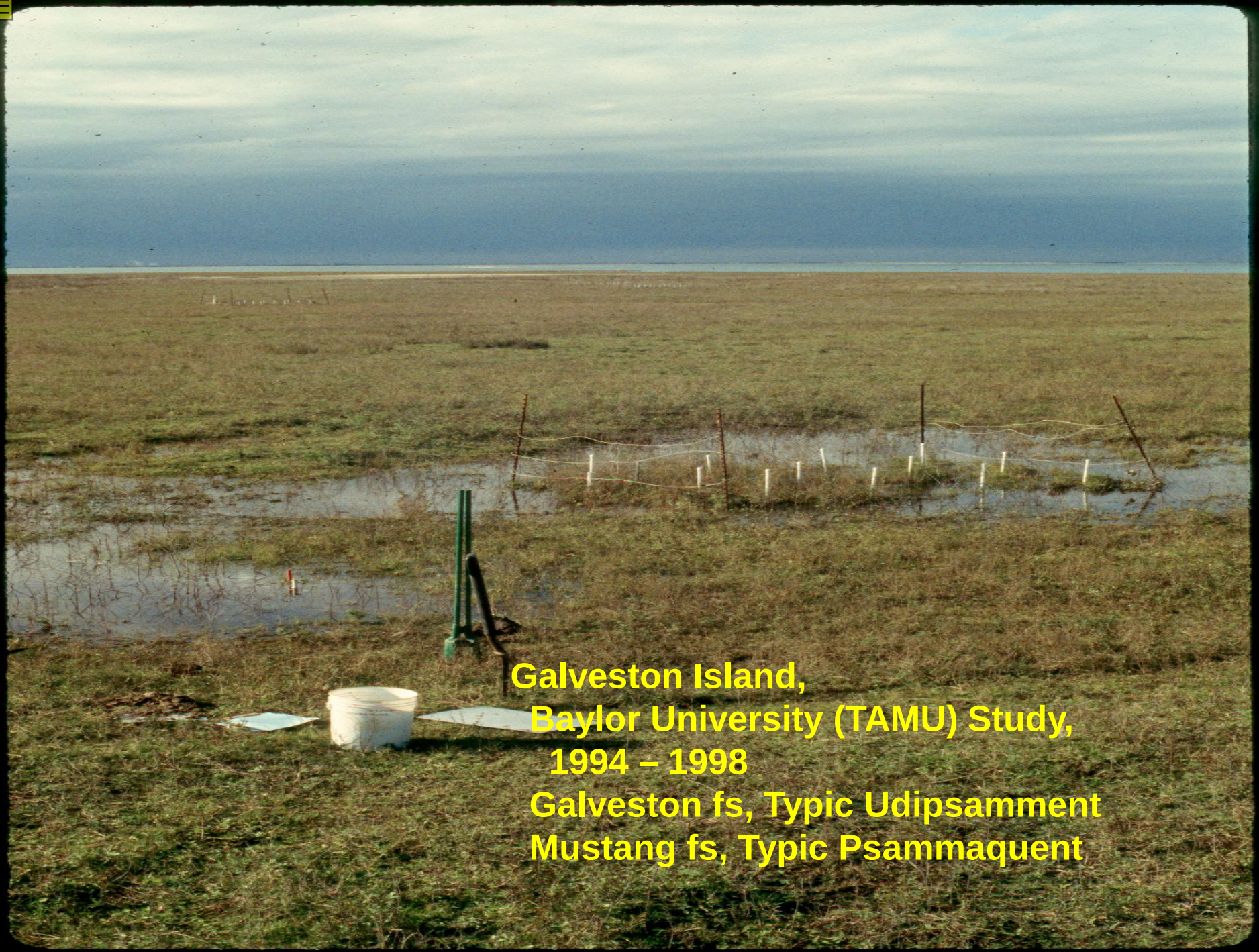


Site 4 ponded

Typic Epiaquert
OM 7%; pH 6.8
Cumulative ponding 44%
Ponding events mainly >4 wks
Problematic hydric soil
General lack of easily ID redox features

Site 4 Ponded, Pit discussion

Bottomland Hardwoods
Churnabog clay
Typic Epiaquert
Site 1 Ponded, Soil Laboratory Jar Sample,
Saturated - Reduced 4 continuous months
Field site has very few easily ID redox features
OM 6%; pH 6.9
Cumulative ponding 15%, mainly less than 2 weeks duration, a few 4 weeks duration


Galveston Island,
Baylor University (TAMU) Study,
1994 – 1998
Galveston fs, Typic Udipsamment
Mustang fs, Typic Psammaquent

Galveston Island,
October, 1996
Mustang fine sand, Typic Psammaquent
4 days after 1.5 meter storm tide surge

10
15
CM
Galveston Island,
Mustang fine sand
Typic Psammaquent
Dipyridyl dye reaction 4 days after storm tide surge

July, 2002 ,
Victoria, Texas City Park
Guadalupe River Flood
Fine-silty, Cumulic Hapludolls
3 days flooding, soil reduced (Eh) to 25 cm
Dipyridyl dye 1% faint in upper 5 cm

July, 2002
Guadalupe River Flood, Victoria, Texas City Park
Fine-silty, Cumulic Hapludolls
7 days flooding near river bank (water flowing very fast, 50 cm deep)
Dipyridyl dye 100% very positive 0 to 15 cm

RESULTS & DISCUSSION

REDUCING CONDITIONS (Eh, Dipyridyl Dye), PONDING EVENTS

- **Vertisols, earliest recorded 4 to 5 days after start of precipitation event (Eh at 10 cm, dipyridyl dye upper 5 CM)**
- **14 days Eh readings reduced to 50 cm**
- **12 days Dipyridyl dye 100 % positive in upper 10 to 15 cm.**
- **Dipyridyl dye positive reaction always at soil surface – flowing or ponded water boundary (also in Victoria Co.)**
- **Measured after four different storm events from dry conditions**

ICOMAQ STUDY RESULTS

- **Gray matrix in many soils with or without redoximorphic features (redox) reflect past climatic conditions and are not always associated with contemporary wet soil conditions.**

- **Root pore linings and ped coats in surface horizons and eluvial zones along root pores and ped faces in subsurface horizons are considered contemporary redoximorphic features.**

- **Reducing conditions developed within 1 to 2 days, redox features within 4 to 6 weeks.**

CONCLUSIONS FOR BRAZORIA COUNTY BOTTOMLAND HARDWOOD STUDY

1. **Growing season as currently defined is year round in central Texas Gulf Coast Prairie.**

2. **Landscape position is key to understanding hydrology.**

3. **Most seasonal episaturated conditions due to ponding from runoff, not stream flooding.**

4. **Ponding, episaturation, and reducing condition events closely related.**

CONCLUSIONS FOR BOTTOMLAND HARDWOOD STUDY

5. **Dipyridyl dye is reliable field indicator for measuring reducing conditions (neutral and alkaline soils may be problematic).**

6. **Soil reducing conditions develop quickly at soil surface-water boundary (either ponded or flowing water).**

7. **Documented Vertisols that pond, saturate and reduce for significant periods, but do not have easily identifiable redox features.**

CONCLUSIONS FOR BOTTOMLAND HARDWOOD STUDY

8. **A new soil series (Churnabog) was established to identify ponded soils and wetlands in areas previously mapped as Pledger soils.**

9. **May have to use vegetation (new indicator species list) and landscape position to identify wetland Vertisols that lack redox features in bottomland hardwoods.**

10. **Initial results of this study and Sharkey Soil Study in Mississippi River Floodplain used to develop NRCS National Technical Standard for Hydric Vertisols.**

CONCLUSIONS FOR BOTTOMLAND HARDWOOD STUDY

11. **Proposed interagency development of addendum to 87 COE Delineation Manual for delineating wetlands in Texas Gulf Coast Prairie MLRA Bottomland Hardwood Vertisols.**

12. **Field observations at this study site, also Victoria County ICOMAQ Study, Galveston Island Study, and Victoria City Park Guadalupe River flood all indicate that during flooding, ponding, runoff or episaturated conditions, oxygenated water preventing development of soil reducing conditions was never observed over the 15 year wet soil studies duration.**

SUMMARY OF WET SOIL STUDIES IN TEXAS

- **Recent formal studies in Texas Gulf Coast Prairie MLRA have contributed to our knowledge and better understanding of wet soils and their genesis, classification, and interpretation at both the state and national level (COE, NRCS Field Indicators).**

- **Studies were a cooperative effort of many individuals, institutions, and government agencies.**

- **The task before us now is to make the information available to everyone involved in wet soil classification or interpretation.**

- **Continue the process of updating interpretation and regulation guidelines concerning the use and management of wet soils in Texas and, where applicable, the nation.**

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