Shoreline Stabilization

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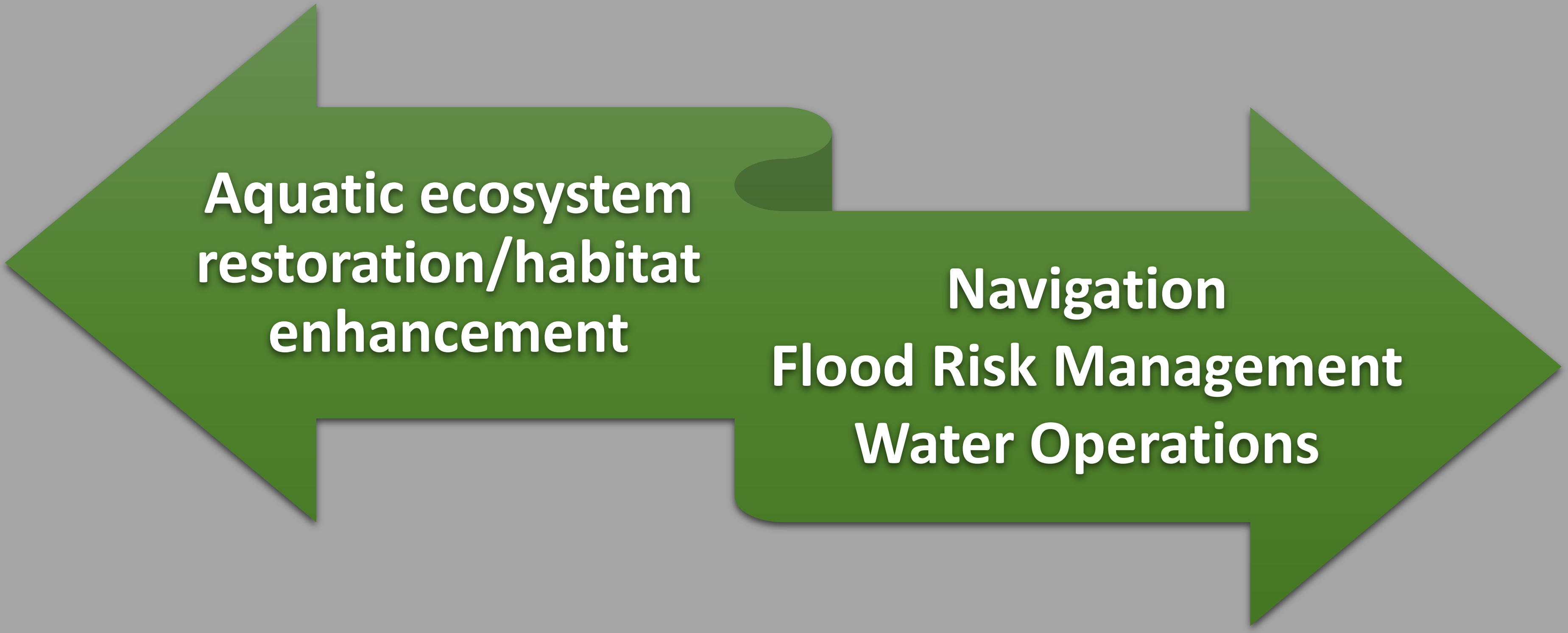
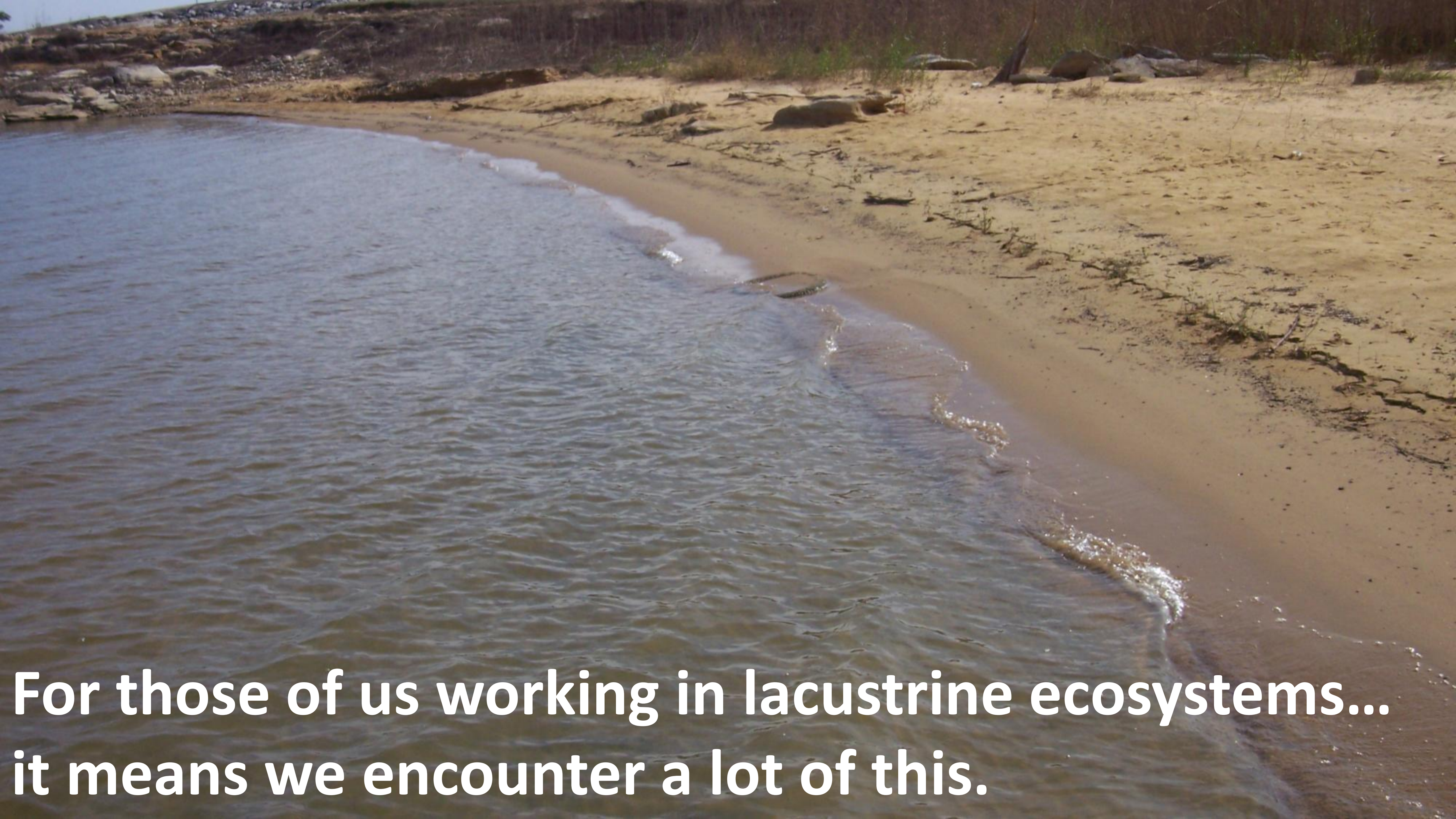
Hydrology – makes life a little challenging….



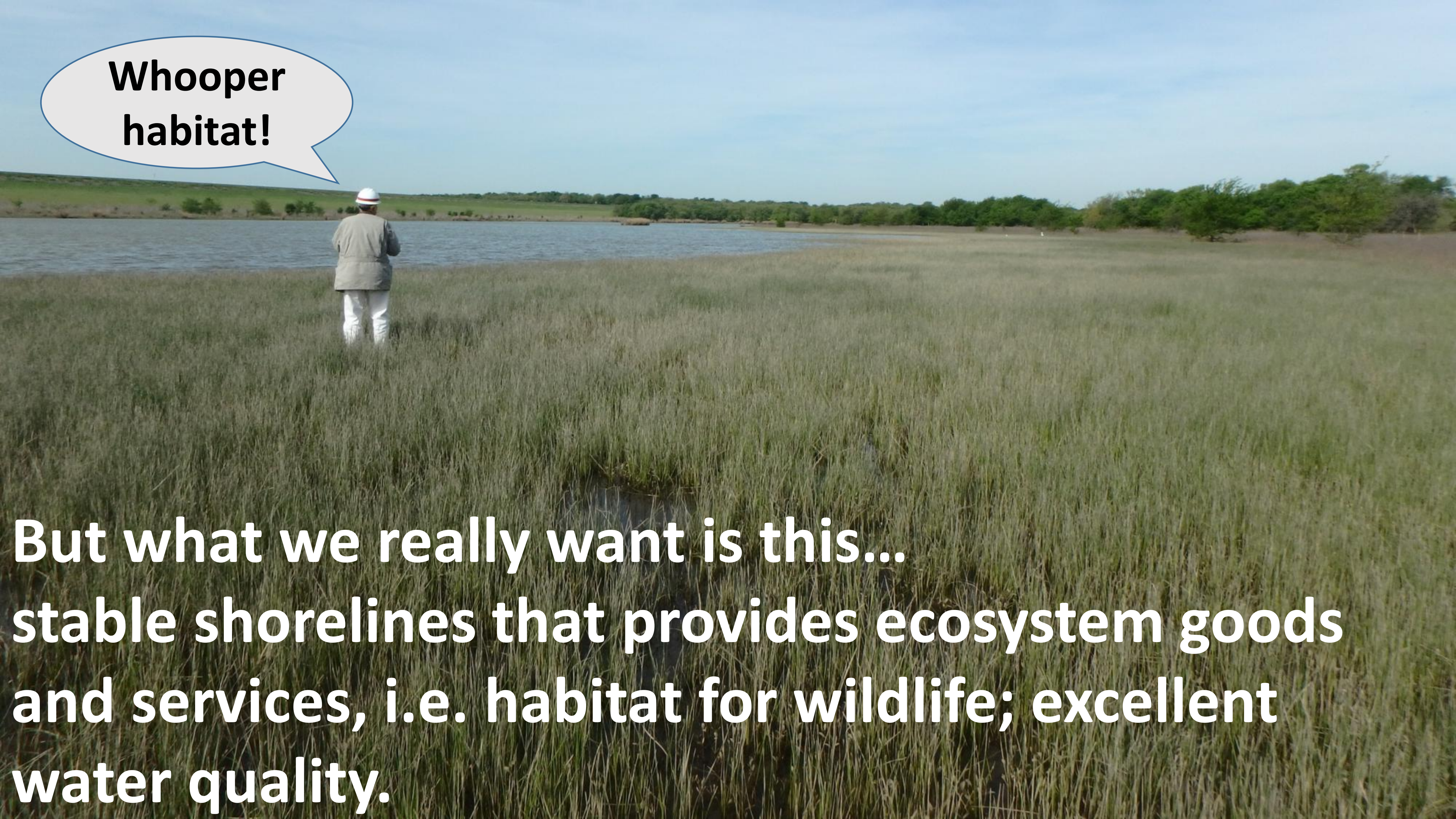
What is it about hydrology that is so troublesome for water resource managers?

- Water - you either have it or you don’t
  - Regional variability (east coast to west coast)
  - Seasonality (spring, summer, fall, winter)
  - Flow regime
  - Water rights (surface water/ground water)

- When you do get it - not sure what you’re gonna get along with those H_2O molecules – i.e. excess nutrients, toxic contaminants, debris (not the good kind that helps to stabilize shorelines, but mostly trash)


For those of us working in lacustrine ecosystems…
it means we encounter a lot of this.


I need a diet coke.
We're totally screwed!

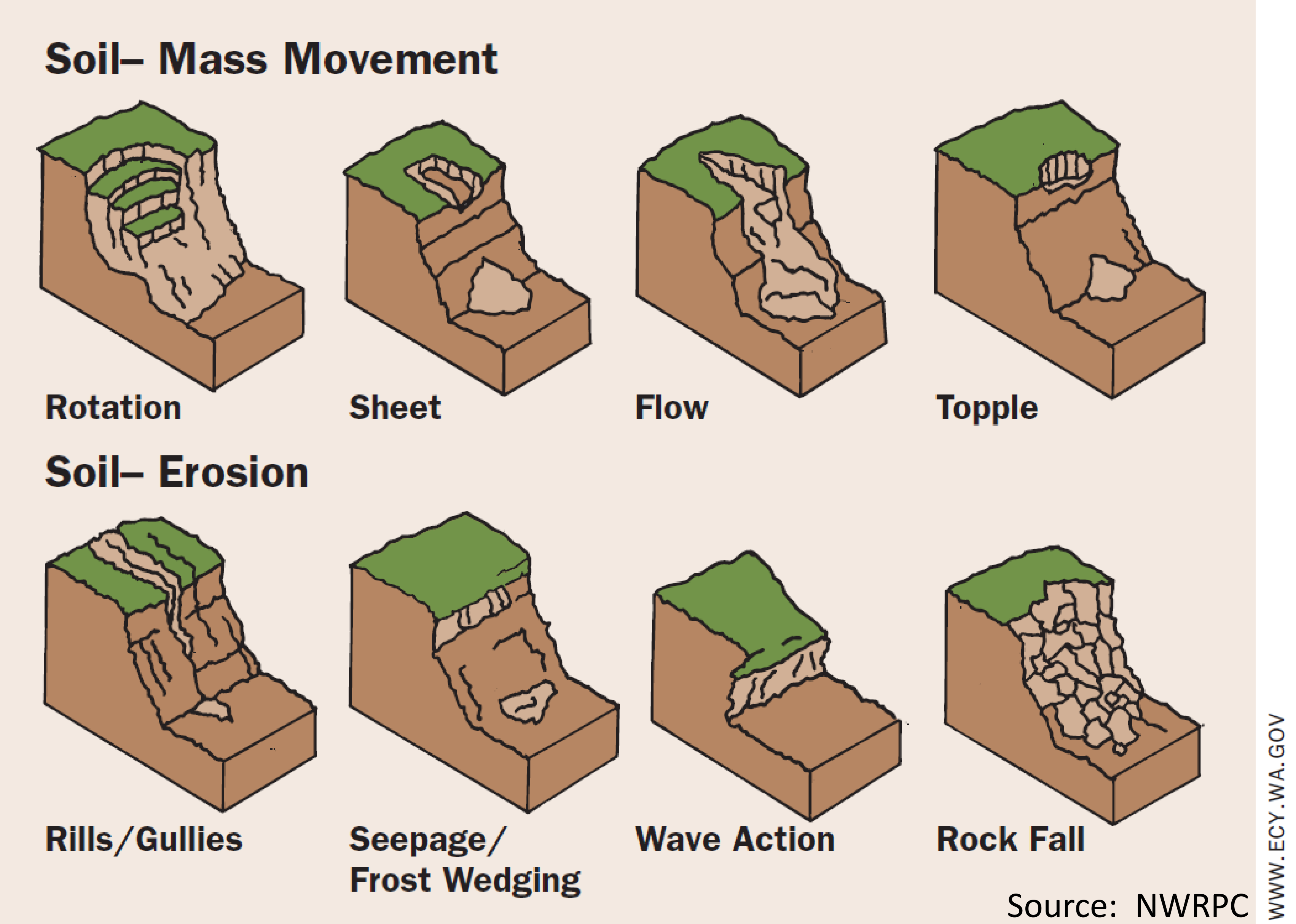


But what we really want is this…
stable shorelines that provides ecosystem goods and services, i.e. habitat for wildlife; excellent water quality.

Switchgrass along the shoreline of
Lake Aquilla, TX

What are common issues that cause shoreline erosion (an otherwise natural process) or more importantly, shoreline instability?

- Sediment transport (erosion vs. accretion)
  - Geology generally drives this – unconsolidated material (sand, gravel, clay, silt); consolidated material like bedrock
    - Storms
      - Surface water runoff; long term inundation causing die-off of riparian/terrestrial vegetation; ice/wind; gully formation
    - Wave energy
      - Splash, overwash, sediment drift; can be intensified with hard structures i.e. bulkheads.


Soil– Mass Movement
Rotation
Sheet
Flow
Topple
Soil– Erosion
Rills/Gullies
Seepage/
Frost Wedging
Wave Action
Rock Fall
WWW.ECY.WA.GOV
Source: NWRPC

- Anthropogenic influences
  - Development that increases impervious surfaces
  - Control structures/bulkheads/revetments (↑wave energy)
  - Removal of riparian/aquatic vegetation along shoreline
    - Includes native or invasive vegetation
  - Water operations
    - Navigation
    - Flood risk management (WATER LEVEL FLUCUATIONS)
    - Recreation (↑ wave activity)


Lady Bird Lake, Austin, TX


Lake Austin, Austin, TX

Lake Austin, Austin, TX

Lake Austin, Austin, TX

Lake Austin, Austin, TX

What is a LIVING SHORELINE?

"A shoreline management practice that provides erosion control benefits; protects, restores, or enhances natural shoreline habitat; and maintains ~~coastal~~ processes through the strategic placement of plants, stone, sand fill, and other structural organic materials (e.g. biologs, oyster reefs, etc)." (NOAA)


Living shoreline


Navarro Mill Lake, Purdon, TX

What are some techniques to stabilize sediments to achieve a LIVING SHORELINE?

Other than minimizing disturbance and avoiding hard armoring…

- Soft armoring in low energy areas – degradable materials (coir), vegetation
- Mix of both hard infrastructure and vegetation in moderate to high energy areas - i.e. riprap planted with high stability rated vegetation; high density outplantings of suitable woody/emergent/submersed vegetation

Common Plants of Riparian Areas - Central – Southwest Texas
With Wetland Indicator (WI) and Proposed Stability Rating (SR)

Sedges / Grasses	WI	SR
Spikerushes (most)	OBL	6
Emory sedge	OBL	9
Sawgrass	OBL	9
Rice cutgrass	OBL	6
Water bentgrass	OBL	5
Cattail	OBL	9
Bulrushes (most)	OBL	9
Porcupine sedge	OBL	5
Black sedge	OBL	6
Teal lovegrass	OBL	4
Knotgrass	FACW	6
Hairyseed paspalum	FACW	6
Bushy bluestem	FACW	5/6
Flatsedges (most)	FACW	5/6
Common reed	FACW	9
Gulf cordgrass	FACW	9
White top sedge	FACW	5/6
Rushes (most)	OBL or FACW	6
Aparejograss	FACW	6
Spike bentgrass	FACW	5
Barnyardgrass	FACW	4
Junglerice *	FACW	4
Rabbitsfoot grass *	FACW	3
Carolina canarygrass *	FACW	3
Wetland sprangletops	FACW	4
Switchgrass	FAC	9
Eastern gammagrass	FAC	9
Big sacaton	FAC	9
Alkali sacaton	FAC	7
Lindheimer muhly	FAC	7
Wildrye	FAC	5/6
White tridens	FAC	5
Vine-mesquite	FAC	6
Seep muhly	FAC	6
Nimble-will	FAC	5
Broadleaf Uniola	FAC	5
Dallisgrass *	FAC	7
Vaseygrass *	FAC	5/6
Rustyseed paspalum	FAC	5
Giant reed (Arundo)*	FAC	7
St Augustine grass *	FAC	6
Buffalograss	FACU	3
Indiangrass	FACU	7
Johnsongrass *	FACU	6
Bermudagrass *	FACU	6
Big sandbur	FACU	7
Dichanthelium (most)	FACU	4
Southwestern bristle	UPL	5
King Ranch bluestem *	UPL	5
Creeping muly	UPL	6

*Indicates Introduced Species

Forbs	WI	SR
Water willow	OBL	7
Ludwigia	OBL	3
Watercress *	OBL	3
Scouring rush	OBL	6
Marsh aster	OBL	3
Marsh fleabane	OBL	5
Smooth bidens	OBL	5
Water hyssop	OBL	3
Burhead	OBL	3
Pennywort	OBL	3
Monkeyflower	OBL	3
Swamp rosemallow	OBL	5
California loostrife	OBL	[illegible]
Cardinalflower	FACW	5
Tall aster	FACW	5
Spiny aster	FACW	8
Large buttercup	FACW	6
Smartweed (most)	FACW	3
Bog nettle	FACW	5
Dock (most)	FACW	3/4
Mint *	FACW	3
Smallhead sneezeweed	FACW	3
Sesbania	FACW	3
Frogfruit	FAC	4
Late boneset	FAC	5
Ironweed	FAC	[illegible]
Shield fern	FAC	6
Giant ragweed	FAC	3
Annual sumpweed	FAC	[illegible]
Brazilian verbena *	FAC	4
Cocklebur	FAC	3
Tall goldenrod	FACU	6
Common ragweed	FACU	2
Frostweed	FACU	6
Maximilian sunflower	FACU	6
Heath aster	FACU	5
Illinois bundleflower	FACU	4
Clammyweed	FACU	3
Castor bean *	FACU	3
Western ragweed	UPL	5
Field ragweed	UPL	5
Mexican sagewort	UPL	5
Turk's cap	UPL	5
Toothed goldeneye	UPL	5

Woody	WI	SR
Buttonbush	OBL	8
Bald Cypress	OBL	9
Indigobush amorpha	OBL	7
Seepwillow baccharis (B. salicifolia)	FACW	6
Black willow	FACW	7
Arroyo willow	FACW	7
Sandbar willow	FACW	7
Spiny aster	FACW	8
Box elder maple	FACW	6
Retama	FACW	6
Possum haw	FACW	6
Sycamore	FAC	6
Eastern cottonwood	FAC	7
Pecan	FAC	6
Little walnut	FAC	7
Roosevelt baccharis (B. neglecta)	FAC	6
American elder	FAC	6
Roughleaf dogwood	FAC	6
Sugar hackberry	FAC	5
American elm	FAC	6
Cedar elm	FAC	6
Mexican ash	FAC	6
Bur oak	FAC	6
Chinquapin oak	FAC	6
Lindheimer indigo	FAC	5
Wafer ash (Ptelea)	FAC	6
Dewberry	FAC	4
Greenbriar	FAC	5
Poison ivy	FAC	5
Grape vine (most)	FAC	5
Japanese honeysuckle *	FAC	6
Live oak	FACU	6
Netleaf hackberry	FACU	5
Red mulberry	FACU	6
Mesquite	FACU	5
Huisache	FACU	5
Western soapberry	FACU	6
Bumelia	FACU	6
Black walnut	FACU	6
Desert willow	FACU	6
Carolina snailseed	FACU	4
Chinese tallow *	FACU	6
Gravelbar bricklebush	UPL	5
Slender bricklebush	UPL	5
Burrobush	UPL	6
Whitebrush	UPL	6
Juniper	UPL	5
Mexican persimmon	UPL	5
Spiny hackberry	UPL	5
Bois d'arc	UPL	6
Vitex *	UPL	6
Ligustrum *	UPL	6
Chinaberry *	UPL	6

SR - Stability Ratings (Draft) on a scale of 1 – 10. Based on USFS GTR-47, by Al Winward. Bare ground has a SR of 1. Anchored rock or logs have a SR of 10. A SR of 7 (or 6) is considered the minimum for acceptable bank stability. Woody plants, when associated with stabilizing grasses and sedges provide a higher stability rating that shown

WI - Wetland Indicator Categories (Region 6 USFWS)

OBL *Obligate Wetland* Almost always occur in wet areas.
FACW *Facultative Wetland* Occur in wet areas 67-99% probability.
FAC *Facultative* About equally likely to occur in wet and non wet areas.
FACU *Facultative Upland* Occur in wet areas 1-33% probability; otherwise, in uplands
UPL *Obligate Upland* Almost always occur in non wet areas

Revised May, 2009

For comments, additions or corrections contact: steve.nelle@tx.usda.gov

Spikerushes – SR 9

Waterwillow – SR 7

Buttonbush – SR 8

Black willow – SR 7

Bulrushes – SR 9

Switchgrass – SR 9

Eastern gamma – SR 9

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Winward, Alma H. 2000. **Monitoring the vegetation resources in riparian areas. Gen. Tech. Rep. RMRSGTR-**47. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 49 p. https://www.fs.fed.us/rm/pubs/rmrs_gtr047.pdf


Lady Bird Lake, Austin, TX - 2014
Outfall - 2012

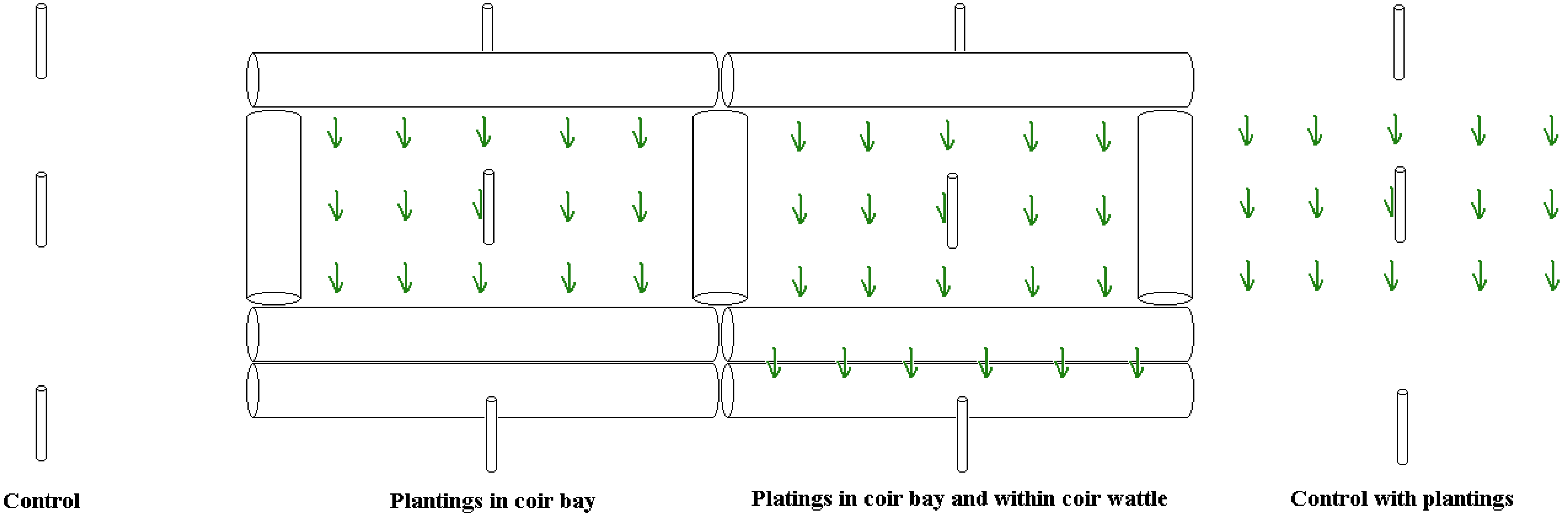

2012


2013

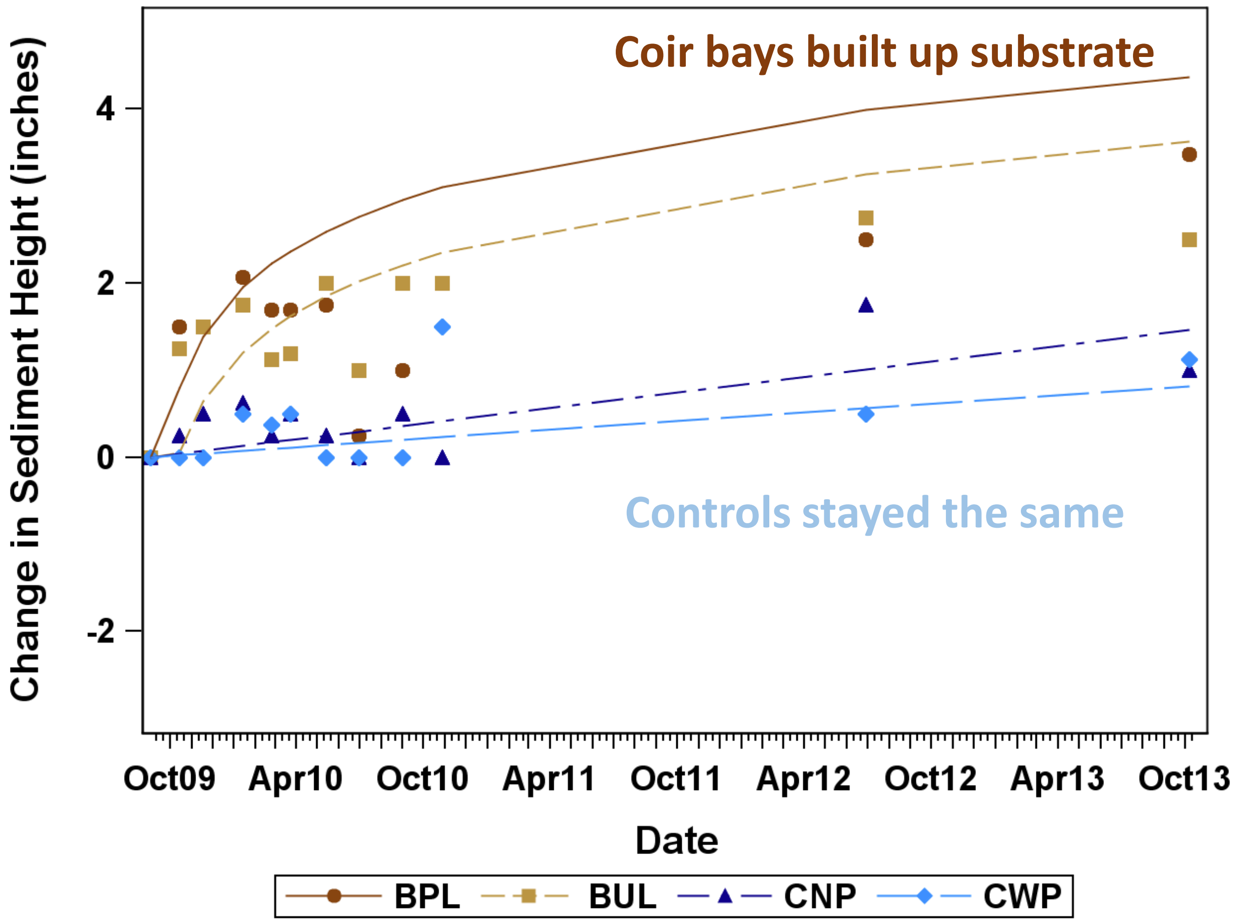

2014

Bioengineering Pilot Project with City of Austin and LAERF - 2009

Objective: Test living shoreline approach to stabilize shoreline and restore habitat function – biodegradable material (coir logs) and wetland vegetation (Clamann – COA)


Control
Plantings in coir bay
Platings in coir bay and within coir wattle
Control with plantings

Bioengineering Pilot Project with City of Austin and LAERF - 2009



Results of plantings in control and in coir bays:

Pickerelweed - none remaining after 4 years

American bulrush - none remaining after 4 years

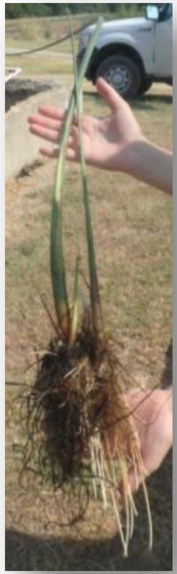
American water-willow -
in control = avg 50 stems/bay
in coir bays = avg 247 stems/bay

Bioengineering Pilot Project with City of Austin and LAERF - 2009

Large Scale Implementation with City of Austin and LAERF - 2014

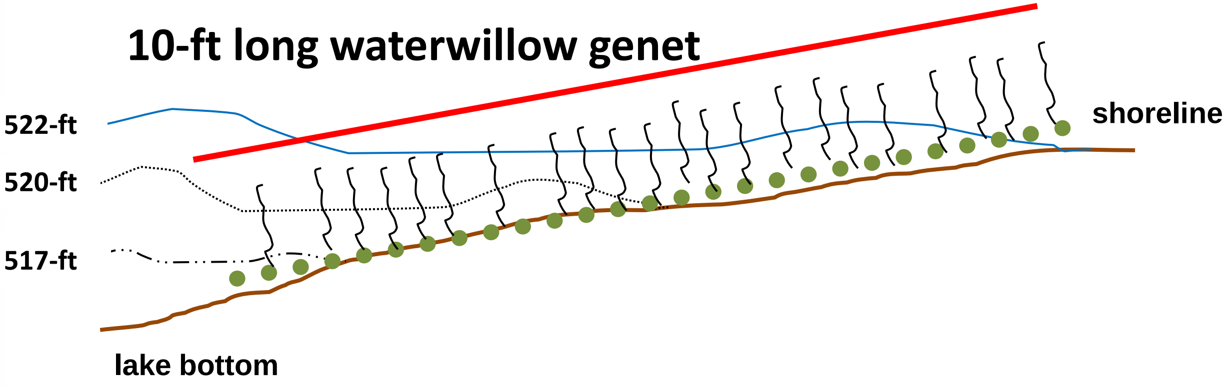
Experimental strategies for outplanting in reservoirs with fluctuating water levels…

Acropetal – growth or development upward from base or point of attachment – outward toward shoot and root apex…



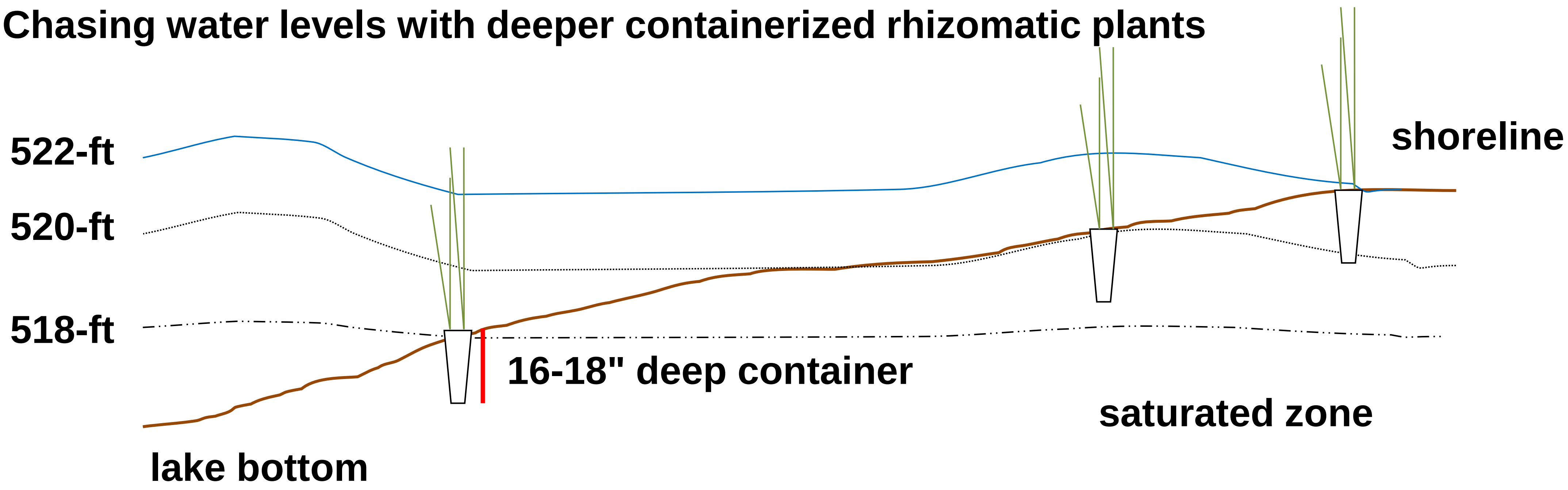
bulrush

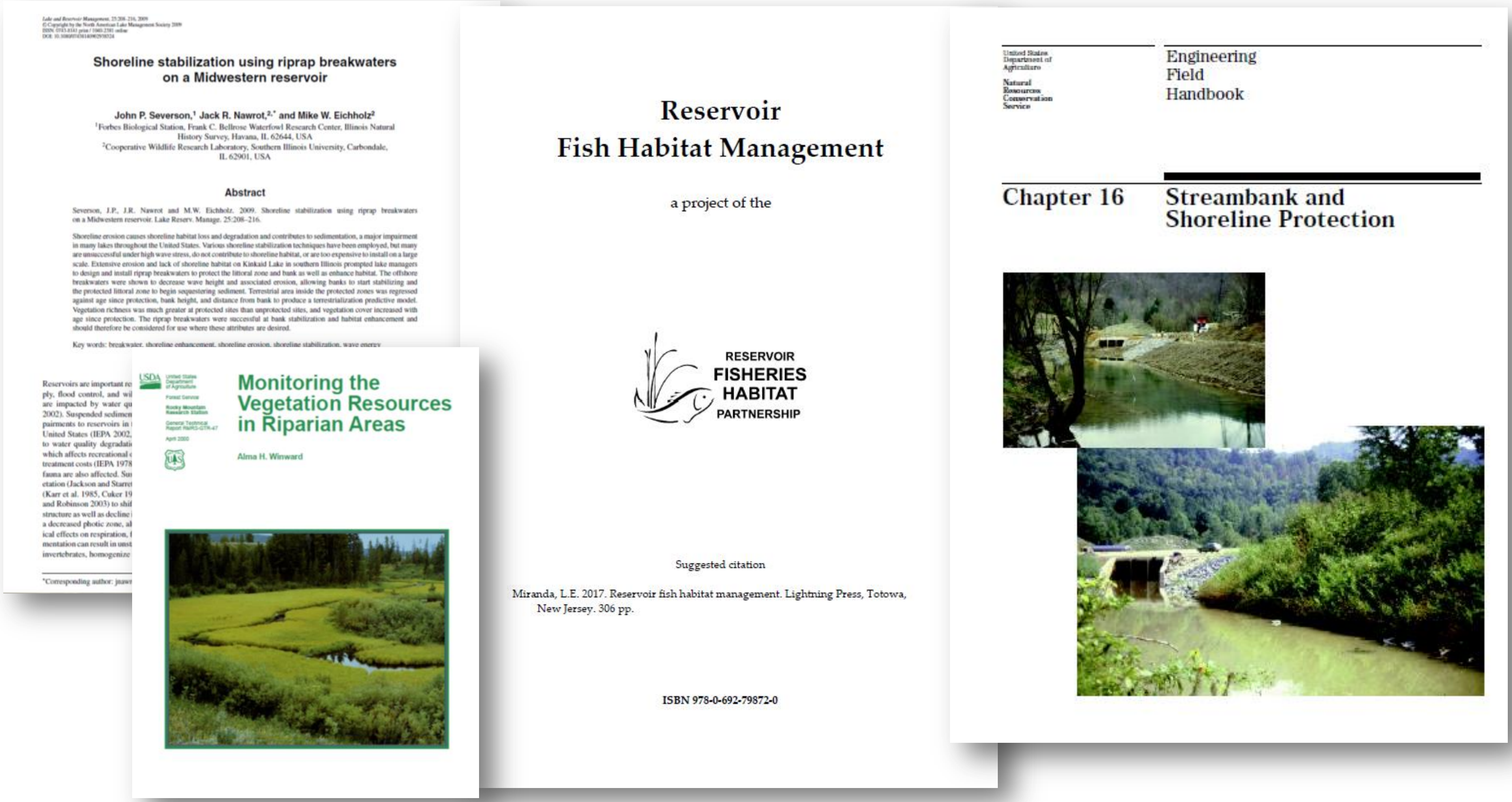
waterwillow



Touchette, B. W., J. W. G. Moody, C. M. Byrne, and S. E. Marcus. 2013. Water integration in the clonal emergent hydrophyte, Justicia americana: benefits of acropetal water transfer from mother to daughter ramets. Hydrobiologia 702:83-94.

Experimental strategies for outplanting in reservoirs with fluctuating water levels…





Lake and Reservoir Management, 25:208–216, 2009
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Shoreline stabilization using riprap breakwaters on a Midwestern reservoir

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Abstract

Severson, J.P., J.R. Nawrot and M.W. Eichholz. 2009. Shoreline stabilization using riprap breakwaters on a Midwestern reservoir. Lake Reserv. Manage. 25:208–216.

Shoreline erosion causes shoreline habitat loss and degradation and contributes to sedimentation, a major impairment in many lakes throughout the United States. Various shoreline stabilization techniques have been employed, but many are unsuccessful under high wave stress, do not contribute to shoreline habitat, or are too expensive to install on a large scale. Extensive erosion and lack of shoreline habitat on Kinkaid Lake in southern Illinois prompted lake managers to design and install riprap breakwaters to protect the littoral zone and bank as well as enhance habitat. The offshore breakwaters were shown to decrease wave height and associated erosion, allowing banks to start stabilizing and the protected littoral zone to begin sequestering sediment. Terrestrial area inside the protected zones was regressed against age since protection, bank height, and distance from bank to produce a terrestrialization predictive model. Vegetation richness was much greater at protected sites than unprotected sites, and vegetation cover increased with age since protection. The riprap breakwaters were successful at bank stabilization and habitat enhancement and should therefore be considered for use where these attributes are desired.

Key words: breakwater, shoreline enhancement, shoreline erosion, shoreline stabilization, wave energy

USDA United States Department of Agriculture

Monitoring the Vegetation Resources in Riparian Areas

Alma H. Winward

Reservoir Fish Habitat Management

a project of the

RESERVOIR FISHERIES HABITAT PARTNERSHIP

Suggested citation

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United States Department of Agriculture
Natural Resources Conservation Service

Engineering Field Handbook

Chapter 16 Streambank and Shoreline Protection

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