L-536 LEVEE SETBACK ON THE MISSOURI RIVER: PARTNERSHIPS IN IMPLEMENTING A NATURE-BASED PROJECT

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USACE Omaha District
Environmental Resources Specialist
Engineering With Nature- River Practice Lead

Missouri Wetlands Summit
February 2, 2023

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PRESENTATION OUTLINE

- The Damage and the Solutions
- Interagency Partnerships and the Community
- Environmental Benefits
- Looking to the Future- Research Opportunities

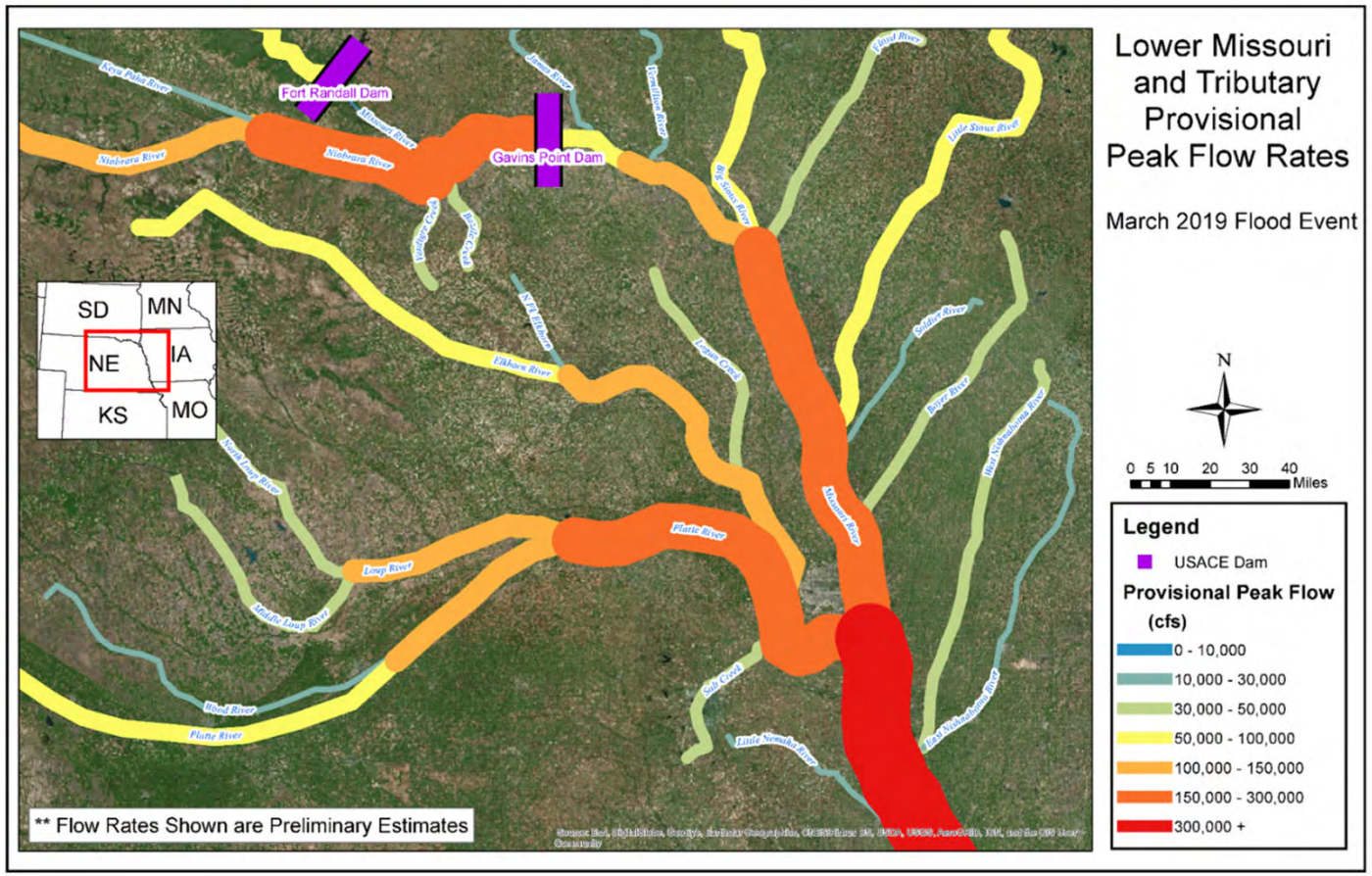

BUILDING FOR THE FUTURE
THE CONSTRUCTION OF A LEVEE SETBACK
ALONG THE MISSOURI RIVER

FULL L-536 VIDEO

WWW.NATURE.ORG/MORIVERLEVEE

HTTPS://WWW.YOUTUBE.COM/WATCH?V=A7TOJHJZUVO

OVERVIEW – THE FLOOD



Peak Flows – March 2019

<u>Missouri River</u>
Sioux City – 159,000 CFS
Platte River – 428,000 CFS
Nebraska City – 342,000 CFS

<u>Big Sioux River</u>
Hawarden, IA – 58,100 CFS

<u>Elkhorn River</u>
Waterloo, NE - 132,000 CFS

<u>Platte River</u>
Louisville, NE - 252,000 CFS

<u>Gavins Point Dam Releases</u>
Max 2011 - 160,000 CFS
Max 2019 - 100,200 CFS

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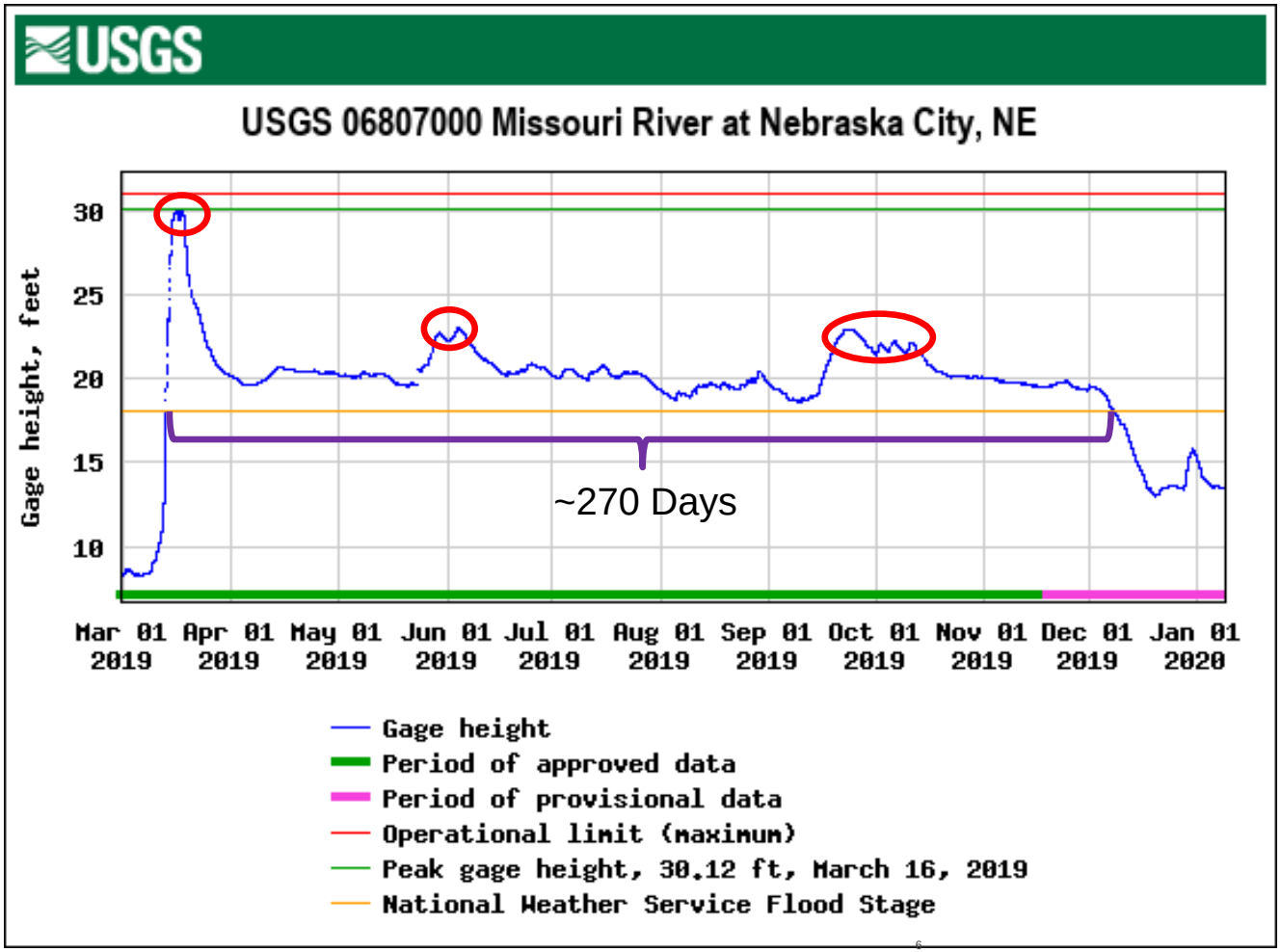
FLOOD DURATION (~270 DAYS)



- 3 Events
  - March
  - May/June
  - September
- ~9 months above flood stage
  - 163 days in 2011
  - 25 days in 2003

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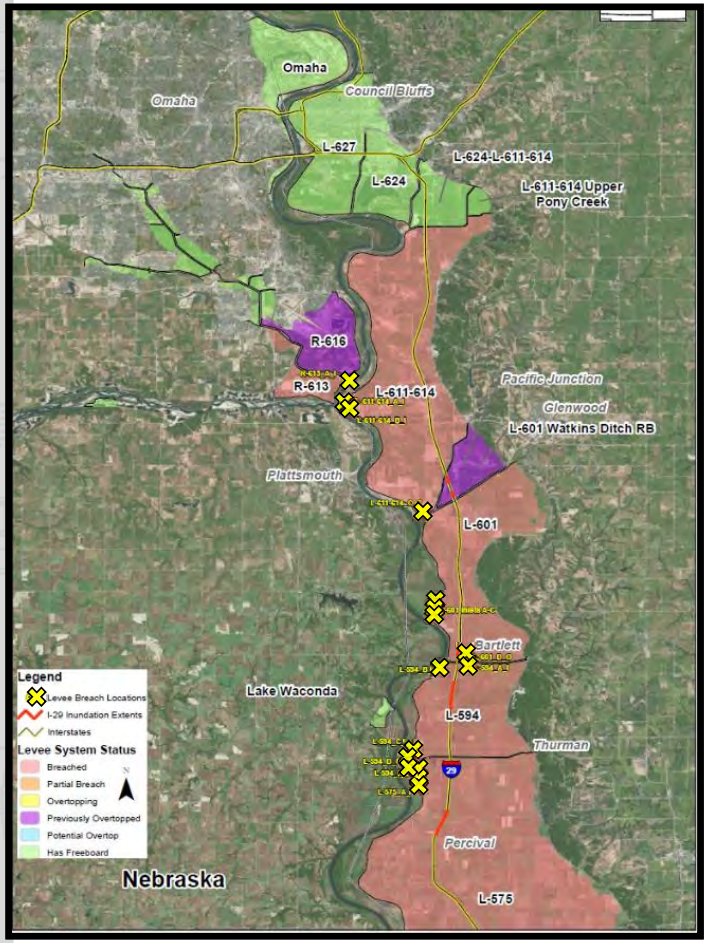
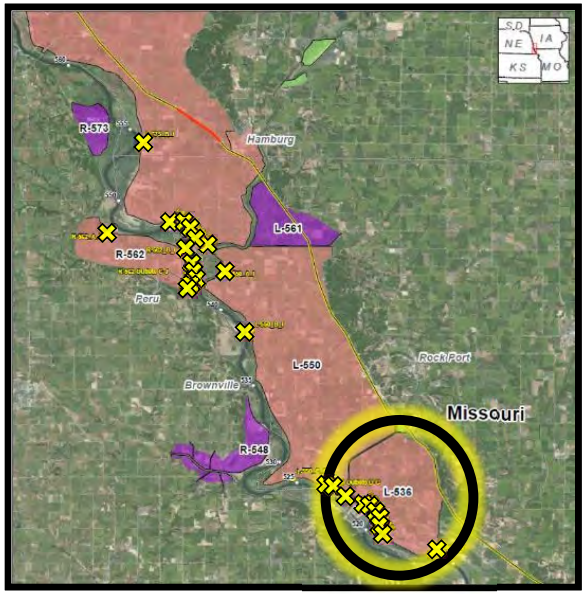
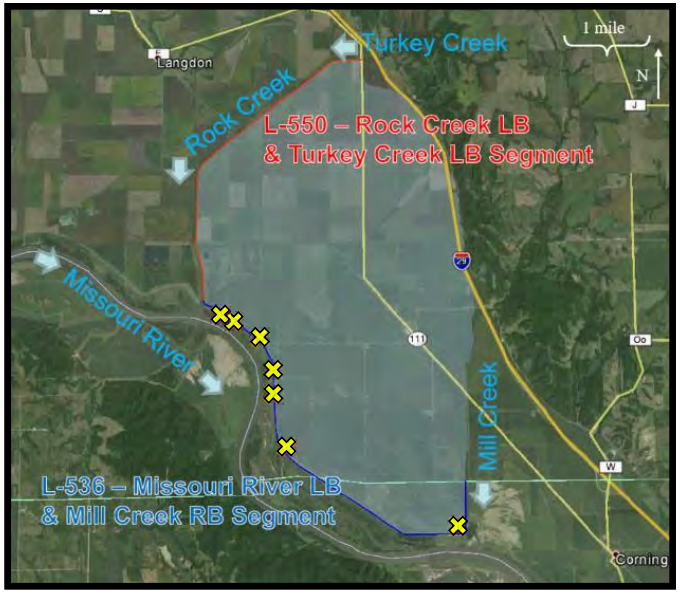
LEVEE SYSTEMS ON THE MISSOURI RIVER RM 626 – 516 (USACE OMAHA DISTRICT)





L536 LEVEE SYSTEM



2019 OVERALL DAMAGE

- 53 Breaches (over 3X total # of previous levee breached combined since 1940's)
- Failure mode primarily overtopping
  - Short duration events
  - Reloading of levees in Summer
- 352 miles of damages levees

FLOOD DAMAGES – L536

Category	Length (FT)	Length (Miles)
Breaches (5 full, 2 partial)	2,120	0.40
Damaged	56,738	10.75
Scour hole, max depth	60 FT	

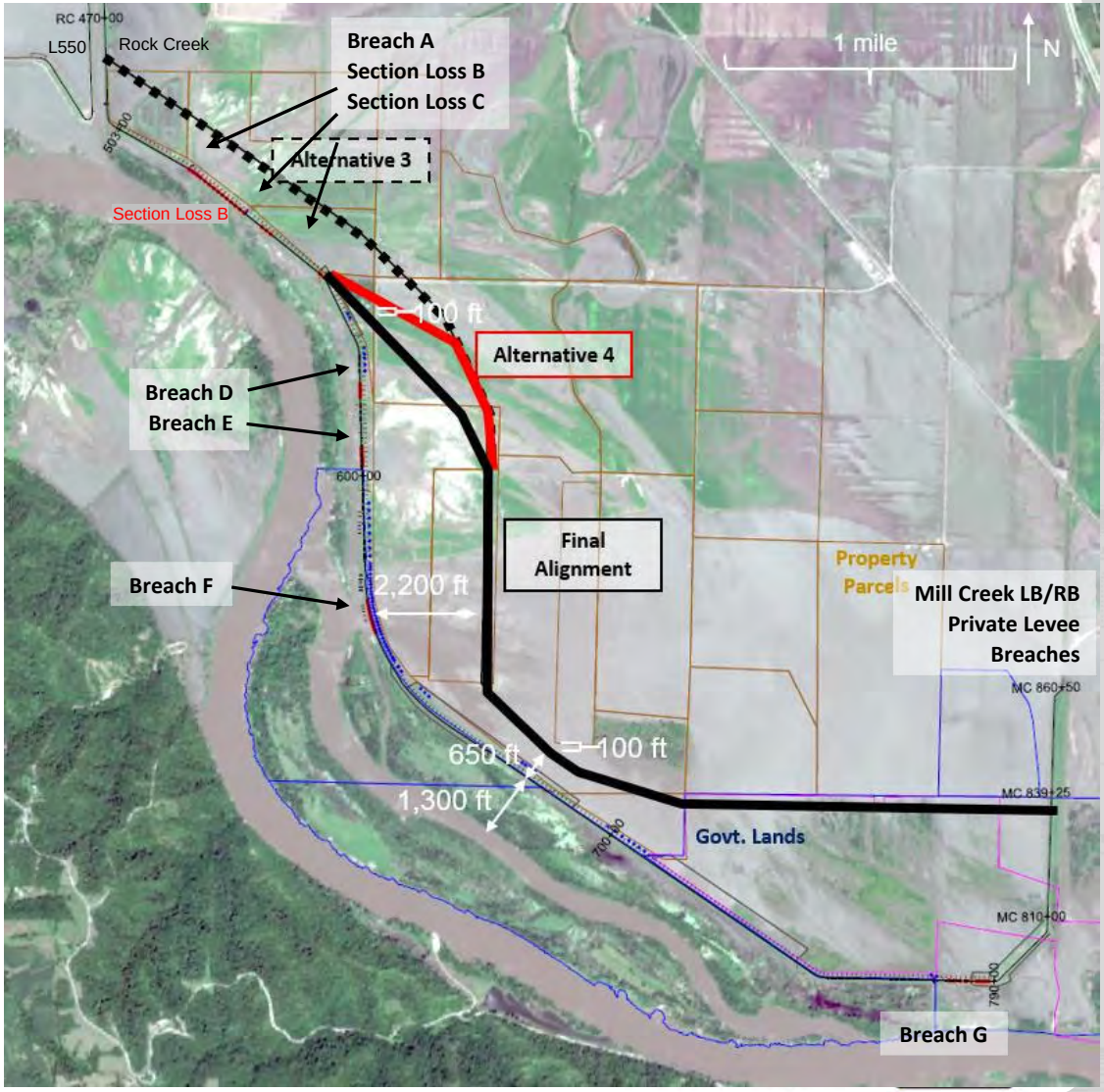
L-536 REPAIR ALTERNATIVES ANALYSIS

REPAIR CONSIDERATIONS

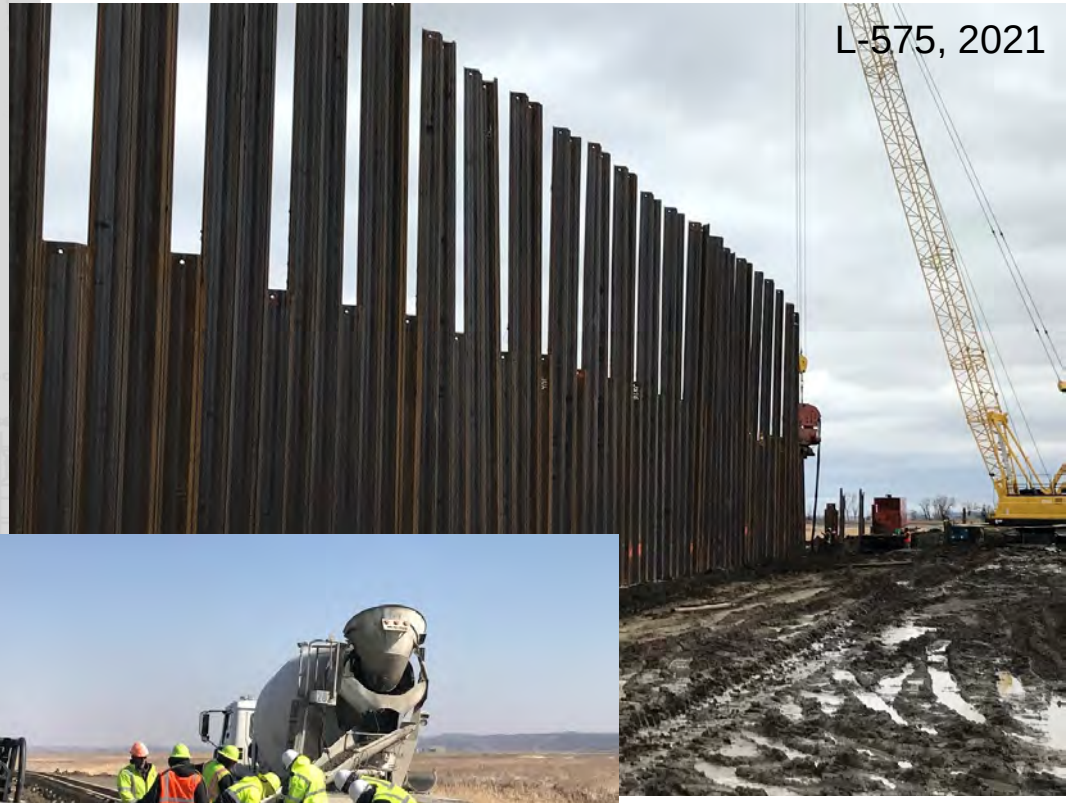
- PL 84-99 requires the **least-cost, technically feasible** solution.
- Due to extensive repairs along the entire levee system it was cheaper to realign the levee than to repair the damaged levee section.
- Sponsor is required to provide real estate, so new footprint must be viable.

REALIGNMENT RISKS

- Short timeline for Sponsor acquisition of levee realignment footprint real estate.
- No level of protection during planning and initial construction efforts
- Unknown material suitability.
- Had to make assumptions on borrow availability.

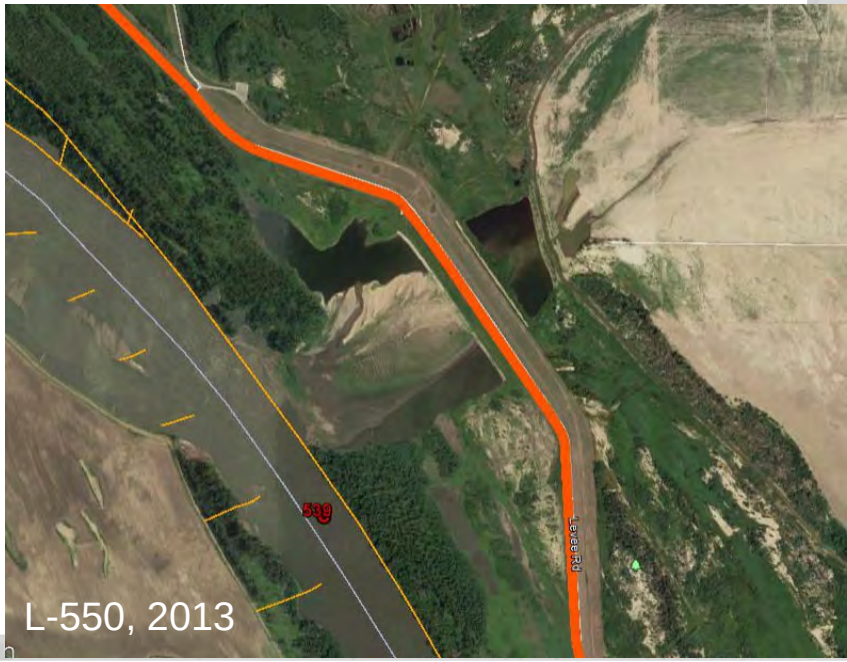


WHAT L-536 REPAIRS COULD HAVE LOOKED LIKE WITHOUT SETBACK



Drive miles of concrete capped sheet pile in-line

Rebuild levee through breach scour holes



Build 300' wide "super berm" on the landward side of levee

INNOVATIVE CONSTRUCTION METHODS

Heated tents for winter construction and material processing

Conversion of borrow pits into wetlands

Dredge-discharged sand for sand seepage berm construction

DURING CONSTRUCTION

2021-08-27, showing borrow pit wetlands on newly connected floodplain.

2021-05-26, showing reconnected floodplain to the left.

2020-12-02, grading borrow pit wetland

L536		
Material Type Placed	QTY total*	% from MRRP/ NRCS land*
Sand (cubic yards)	810,000	24%
Random (CY)	430,000	50%
Cohesive (CY)	510,000	88%
Topsoil (CY)	200,000	55%
Levee surfacing (tons)	12,000	N/A
Rip Rap (TN)	8,000	N/A
ECB (square yards)	400,000	N/A
Seeding (acres)	170	30 native seeding
Sheet pile (linear feet)	400	N/A

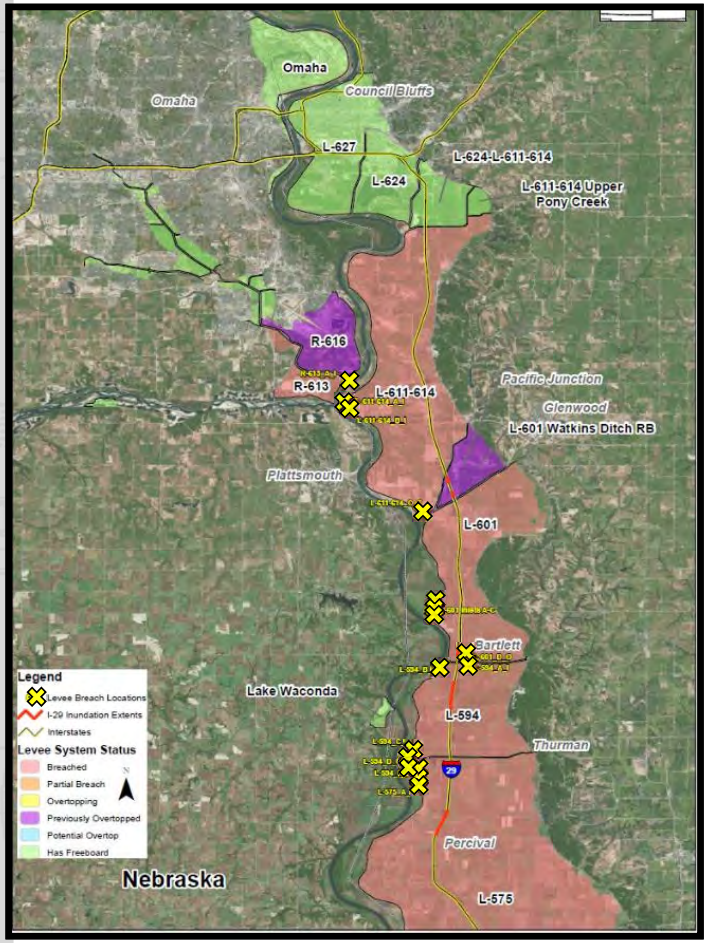
*quantities represent preliminary estimates

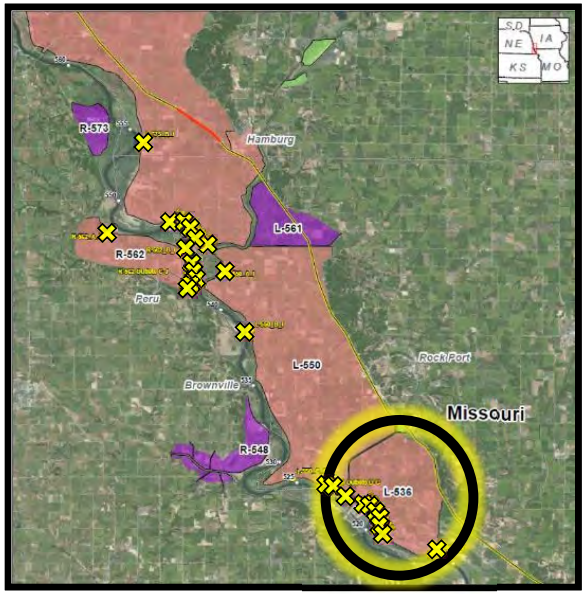
INTERAGENCY PARTNERSHIPS AND THE COMMUNITY

- Community response and USACE engagement (PL 84-99)
- Formation of multi-agency team
- Coordination and collaboration

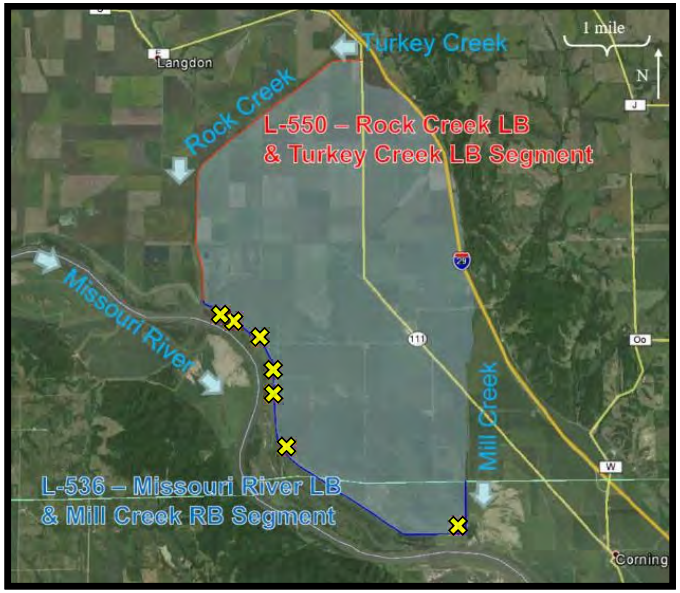

Giant ichneumon wasp, ovipositing (*Megarhyssa macrurus*)

LEVEE SYSTEMS ON THE MISSOURI RIVER RM 626 – 516 (USACE OMAHA DISTRICT)





L536 LEVEE SYSTEM



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ACLD RESPONSE TO 2019 FLOOD

- **Spring-Summer 2019:** USACE and ACLD (levee sponsor) conduct damage assessment
- **Summer 2019:** USACE estimates that setback would be “least cost” repair alternative
- **August 2019:** TNC, ACLD, and USACE host meeting to begin coordinating levee setback and establish multiagency team
- **November 2019:** ACLD held meeting with key L-536 landowners to present options and gauge interest
- **2020 – 2023:** TNC-hosted multiagency team weekly meetings to work through issues and ensure progress during planning, design, and construction

ACLD
Atchison County Levee District No1

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PARTNERSHIP TEAM+

- **USACE:** construction work and funding, PL 84-99
- **Missouri River Recovery Program (MRRP):** provided borrow & real estate, existing conservation land enabled community support
- **Atchison County Levee District #1 (ACLD):** levee sponsor, real estate for new levee footprint, community and landowner liaison
- **The Nature Conservancy (TNC):** became co-project sponsor, funded ~1FTE+ from 2019-2023, produced documentary and Levee Setback Playbook, coordinated land acquisition
- **Natural Resources Conservation Service (NRCS):** Enrolled new easements, provided borrow, enabled community support for setback concept, Regional MOU with NWD streamlined construction
- **State of Missouri (MO):** provided funding for sponsor real estate needs and staffing support throughout
  - **MO Dept of Conservation:** provided borrow, real estate access, and natural resources expertise
  - **MO Depart of Natural Resources:** provided permitting support, coordinated MO state grants for sponsor/ TNC
  - **MO State Emergency MGMT Agency:** coordinated emergency disaster funding for levee sponsor real estate acquisition
  - **Missouri Dept of Economic Development:** assisted with early disaster funding grant applications
  - **Northwest MO Regional Council of Governments:** assisted with disaster funding requests, coordinated other local efforts
- **Local landowners:** embraced setback approach; worked with ACLD, NRCS, TNC, State of MO to willingly sell land; sacrificed time and land for the sake of the community
- **Other coordinating agencies/ collaborators:** USFWS, local drainage districts, adjacent levee sponsors, Tribes, MO SHPO, other USACE Districts, etc. (too many to name)

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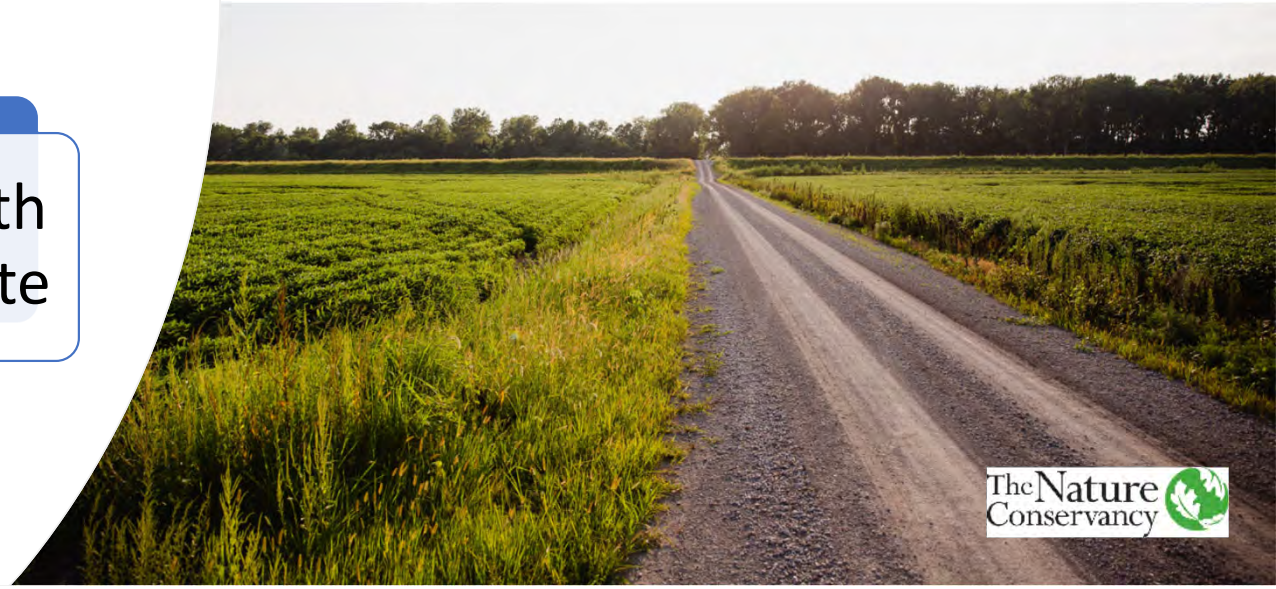
THE NATURE CONSERVANCY L-536 ROLE

CO-LEAD: BARBARA CHARRY
PROGRAM MANAGEMENT, FUNDING, MARKETING

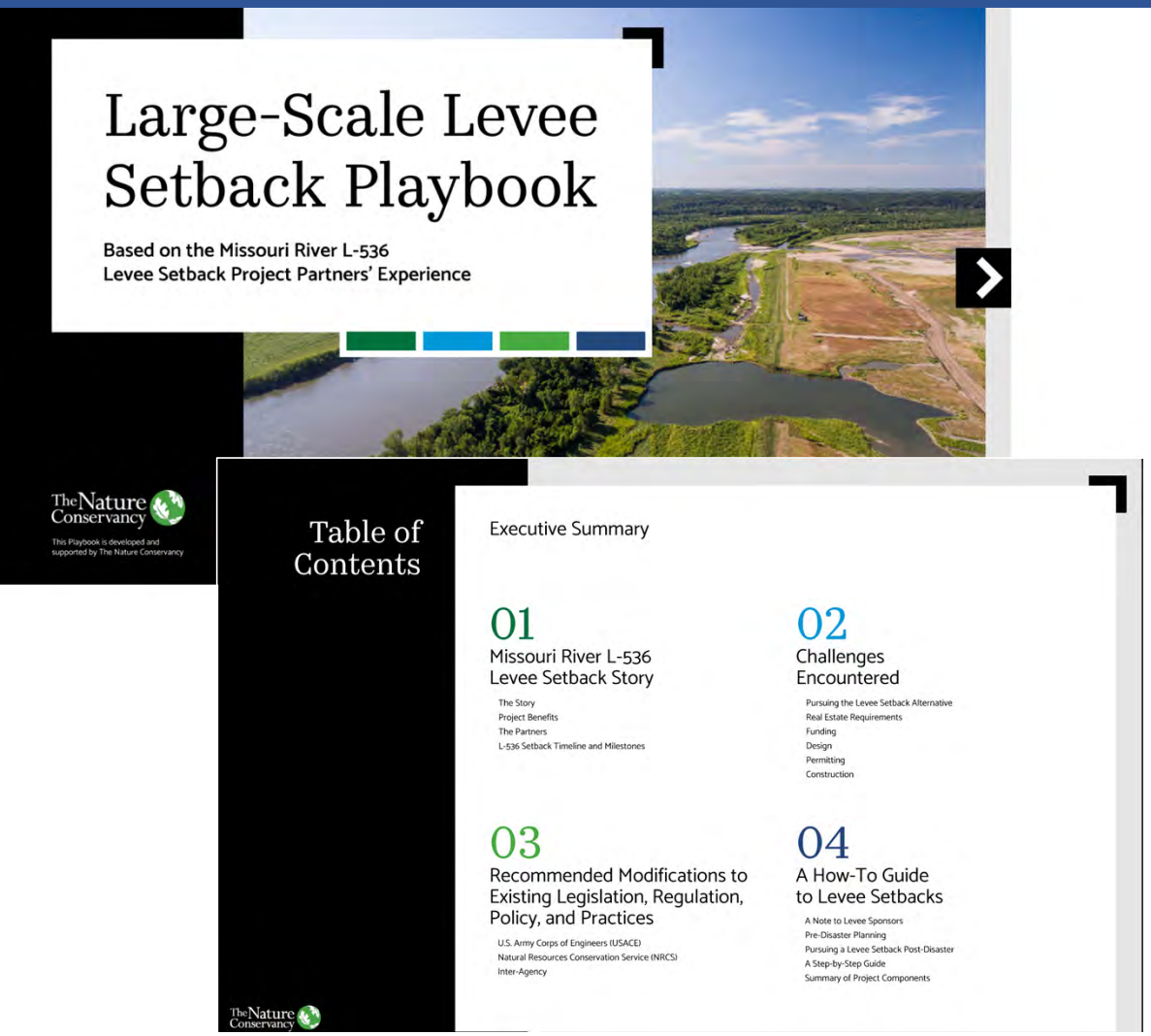
CO-LEAD: VIV BENNETT
STRATEGY, REAL ESTATE, CROSS-BOUNDARY/CROSS-PROJECT

Convene Partners

Assist with Real Estate



Large-Scale Levee Setback Playbook



https://www.nature.org/content/dam/tnc/nature/en/documents/MOLeveeSetbackPlaybook_singlepages-complete.pdf

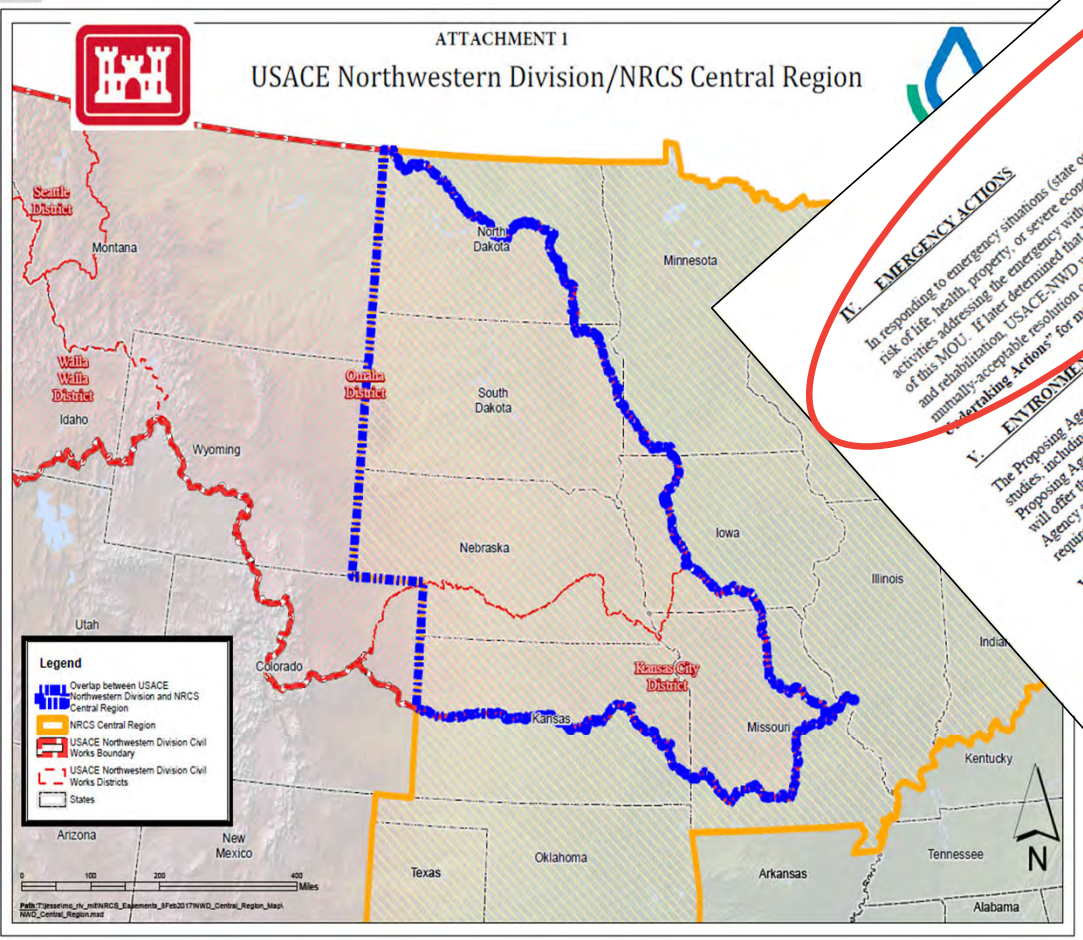
The Nature Conservancy

NRCS Collaboration Breakthroughs

- **Emergency Watershed Protection Program – Floodplain Easements (EWPP-FPE)**
  - Voluntary easement program
  - MO NRCS easement application ranking criteria considered applications' contributions to "flood resiliency"
  - All L-536 landowner' applications made the cut

- **Regional Memorandum of Understanding between NRCS Central Region and USACE Northwestern Division**
  - Worked on for 2+ years
  - Signed 1 week after flooding began
  - Immediate use of RMOU "emergency provision"

2019 REGIONAL MOU



MEMORANDUM OF UNDERSTANDING
AMONG
U.S. DEPARMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE – CENTRAL REGION
AND
U.S. DEPARTMENT OF ARMY
U.S. ARMY CORPS OF ENGINEERS – NORTHWESTERN DIVISION

This Regional Memorandum of Understanding (MOU) is between the U.S. Department of Agriculture, Natural Resources Conservation Service - Central Region (NRCS-CR) and the U.S. Department of Army, U.S. Army Corps of Engineers - Northwestern Division (USACE-NWD), collectively "the Agencies." In furtherance of the May 26, 2011 Partnership Agreement between the U.S. Department of Agriculture, Natural Resources Conservation Service and the U.S. Department of the Army, Office of the Assistant Secretary of the Army (Civil Works), the Agencies enter into this MOU to promote the long-term working relationship between the Agencies as it pertains to executing their respective missions on shared lands in the Missouri River Basin.

I. PURPOSE

The purpose of this MOU is to promote the effective coordination and communication between the Agencies within the Missouri River Basin (Basin) geographic area were their regional boundaries overlap, as depicted in **Attachment 1**. This area includes lands where both Agencies own a property interest in the name of the United States of America. For purposes of this MOU, "shared lands" is defined as locations within the Basin where both Agencies have an active programmatic or operational presence. This includes project land provided by a cost-share sponsor under the USACE-NWD Civil Works Program.

II. AUTHORITIES

Each Agency's activities within the Basin has been authorized by Congress through legislation. NRCS authorities include the Wetlands Reserve Program (WRP) (16 U.S.C. § 3837 and note, 3837a-3837f; 7 CFR Part 1467), the Agricultural Conservation Easement Program (16 U.S.C. §3865 et seq.; 7 CFR Part 1468), and the Emergency Watershed Protection Program (EWPP) (16 U.S.C. § 2203; 7 CFR § 624.10). Authorities used by USACE-NWD of particular importance are the Rivers and Harbors Act of 1935, Flood Control Act of 1944 (Section 9), Endangered Species Act (ESA) of 1973, Water Resources Development Act (WRDA) of 1986 (Section 601(a)), WRDA 1999 (Section 334), WRDA 2007 (Section 3176), Public Law 84-99, Public Law 95-625 (amended Section 707, and Section 3(a)), and 40 U.S. Code § 3111(b)(1) for Approval of Sufficiency of Title Prior to Acquisition (including DOJ 2016 Regulations of the Attorney General Governing the Review and Approval of Title for Federal Land Acquisitions). These authorities are further detailed in **Attachment 2**. Those noted here in Section II and on

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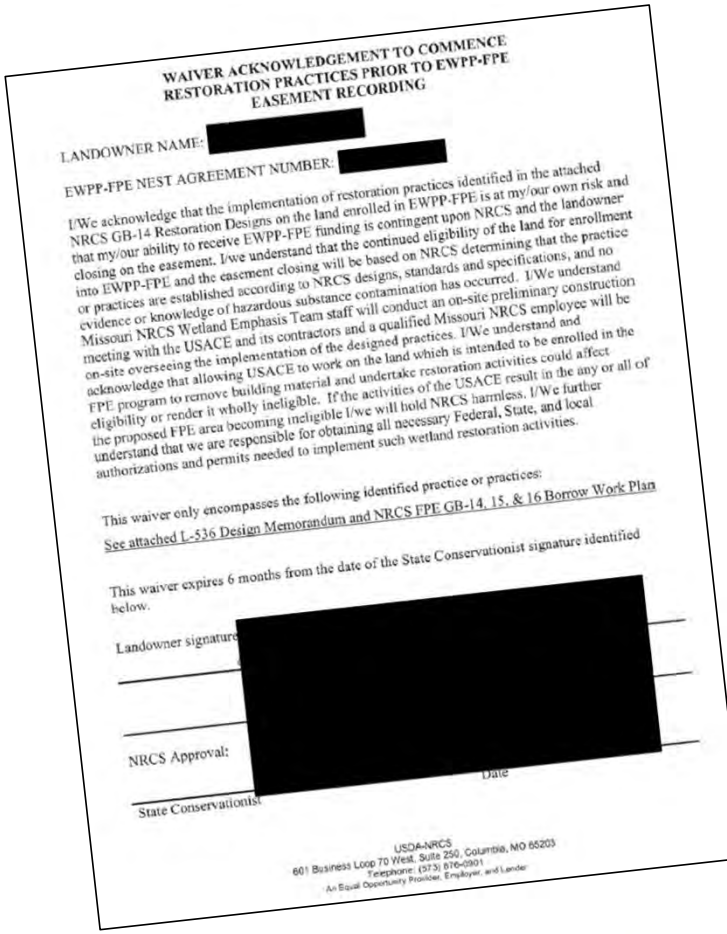
NRCS Collaboration Breakthroughs

- **Innovated 3-party agreement:** first ever “3-party” waiver for borrow excavation on pending EWPP-EWP easements (later converted to wetlands by USACE, designed by MO NRCS staff, win-win)
- **Wetland expertise:** MO NRCS and MDC provided technical expertise in borrow pit wetland location, design, and construction
- **Streamlined:** MO and HQNRCS helped streamline many “normal” NRCS processes we went through
- **USACE Omaha District and NRCS HQ looking to share collaboration lessons learned through continued coordination**



WAIVER ACKNOWLEDGEMENT TO COMMENCE RESTORATION PRACTICES PRIOR TO EWPP-FPE EASEMENT RECORDING

LANDOWNER NAME: [redacted]

EWPP-FPE NEST AGREEMENT NUMBER: [redacted]

I/We acknowledge that the implementation of restoration practices identified in the attached NRCS GB-14 Restoration Designs on the land enrolled in EWPP-FPE is at my/our own risk and that my/our ability to receive EWPP-FPE funding is contingent upon NRCS and the landowner closing on the easement. I/we understand that the continued eligibility of the land for enrollment into EWPP-FPE and the easement closing will be based on NRCS determining that the practice or practices are established according to NRCS designs, standards and specifications, and no evidence or knowledge of hazardous substance contamination has occurred. I/We understand Missouri NRCS Wetland Emphasis Team staff will conduct an on-site preliminary construction meeting with the USACE and its contractors and a qualified Missouri NRCS employee will be on-site overseeing the implementation of the designed practices. I/We understand and acknowledge that allowing USACE to work on the land which is intended to be enrolled in the FPE program to remove building material and undertake restoration activities could affect eligibility or render it wholly ineligible. If the activities of the USACE result in the any or all of the proposed FPE area becoming ineligible I/we will hold NRCS harmless. I/We further understand that we are responsible for obtaining all necessary Federal, State, and local authorizations and permits needed to implement such wetland restoration activities.

This waiver only encompasses the following identified practice or practices:

See attached L-536 Design Memorandum and NRCS FPE GB-14, 15, & 16 Borrow Work Plan

This waiver expires 6 months from the date of the State Conservationist signature identified below.

Landowner signature [redacted]

NRCS Approval: [redacted]

State Conservationist Date

USDA-NRCS
601 Business Loop 70 West, Suite 250, Columbia, MO 65203
Telephone: (573) 876-0901
An Equal Opportunity Provider, Employer, and Lender

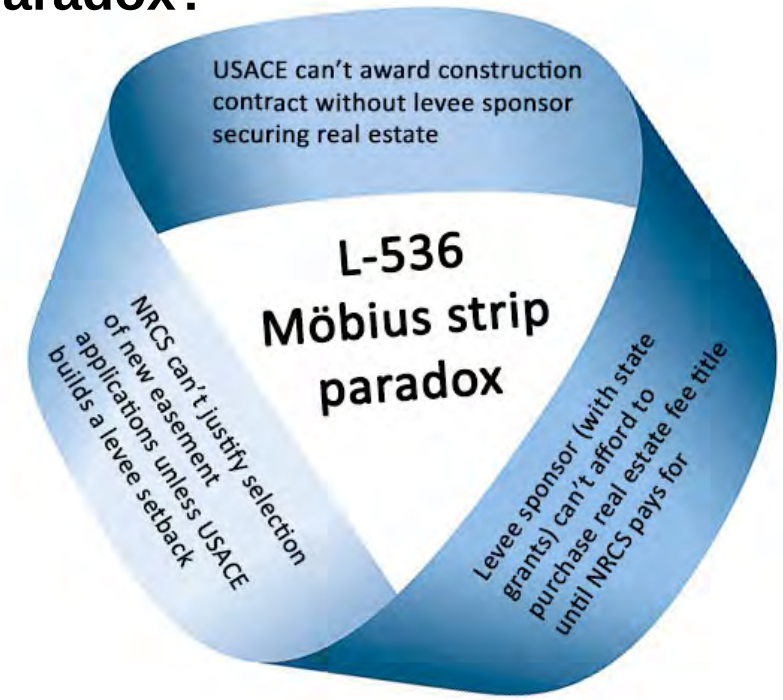
NRCS COLLABORATION BREAKTHROUGHS


Partners met in the field


Close landowner coordination


Conversion of borrow pits into wetlands

<u>Q:</u> How do you solve the L-536 paradox?



<u>A:</u> EVERYONE accepts some risks
(Agency goals aligned, team was mission-focused)

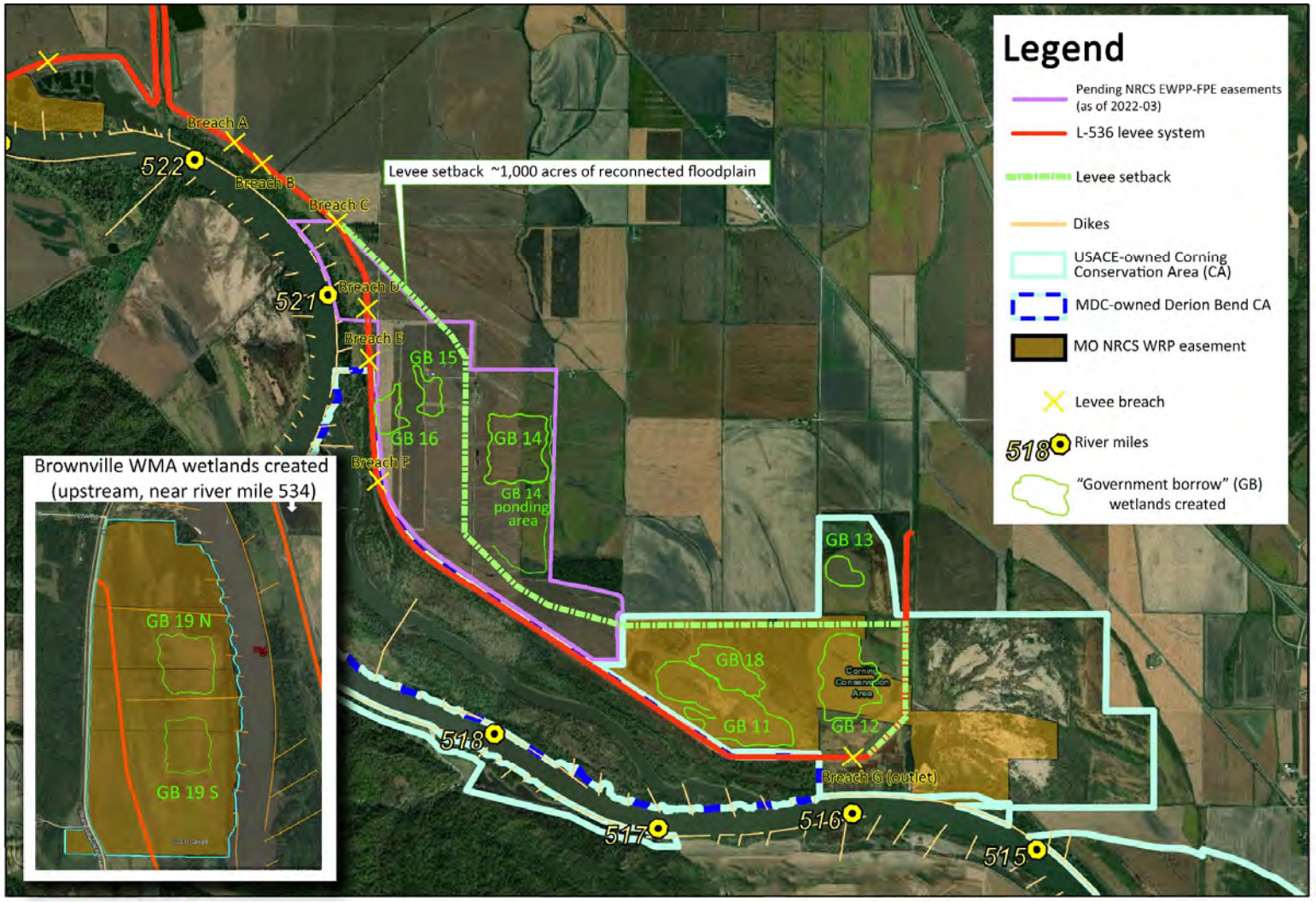
MDNR, SEMA, MDC, EDA, NWMCoG
State Agency Response & Recovery

- State funding has provided assistance to secure necessary real estate for the project
- Funding for new levee footprint, riverward land, and associated actions
- Innovative project providing an example and lessons- learned that will make future similar projects more successful

MISSOURI DEPARTMENT OF NATURAL RESOURCES

ENVIRONMENTAL BENEFITS

- Leveraging conservation land
- Collaborative habitat design
- Incidental hydraulic and environmental benefits



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Version 10
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L-536 Levee Rehab
PL 84-99 Program - 2019 Flooding
0 0.5 1 2 Miles

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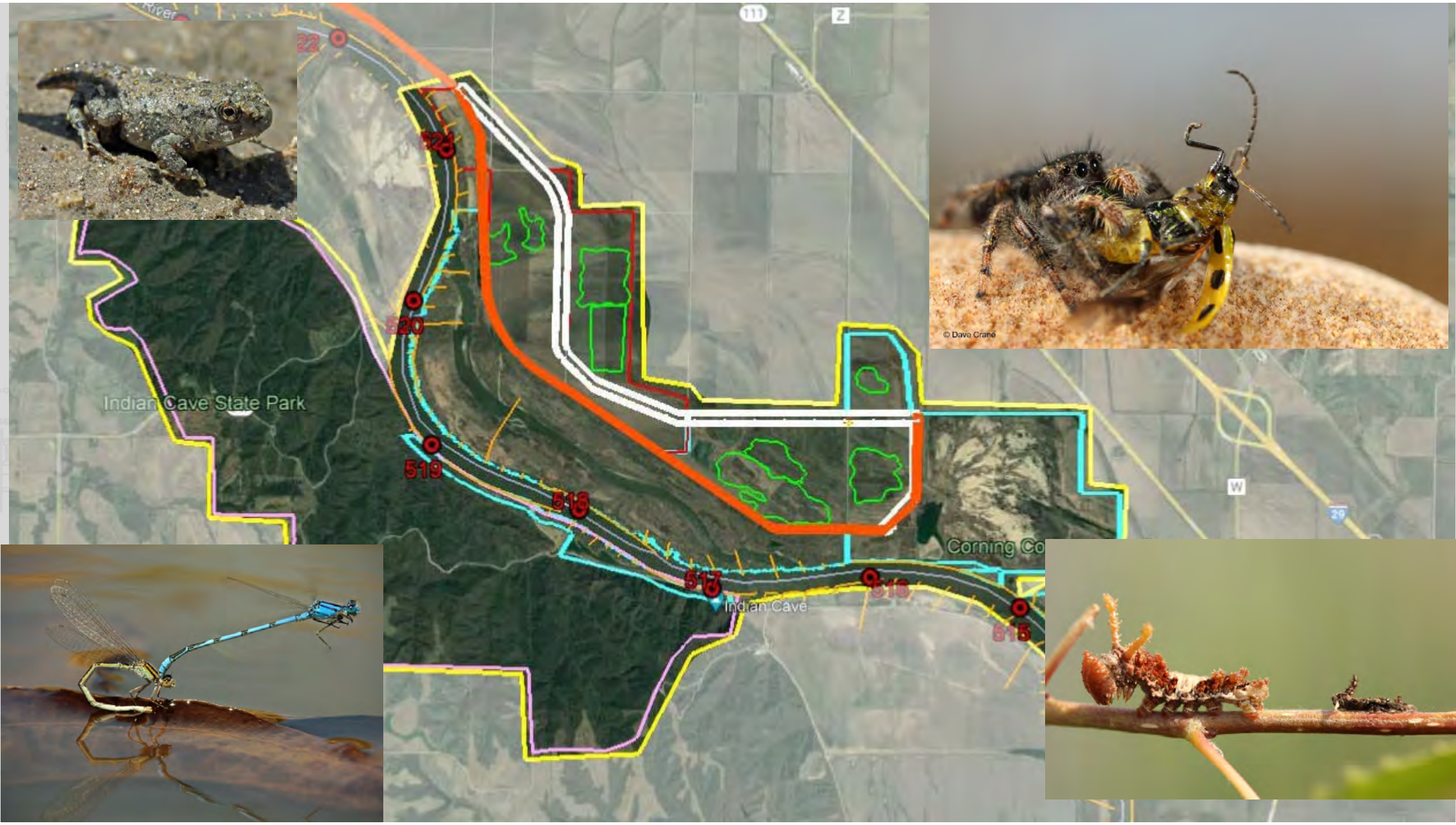
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“BORROW PIT WETLAND” DESIGN AND CONSTRUCTION

Levee sponsor:
“We need borrow, can you help?”

MRRP/ NRCS/ State Agency: “Can we get environmental benefit from borrow in that area?”

“BORROW PIT WETLAND” DESIGN AND CONSTRUCTION

(example agency collaborative input)

Missouri River Recovery Program

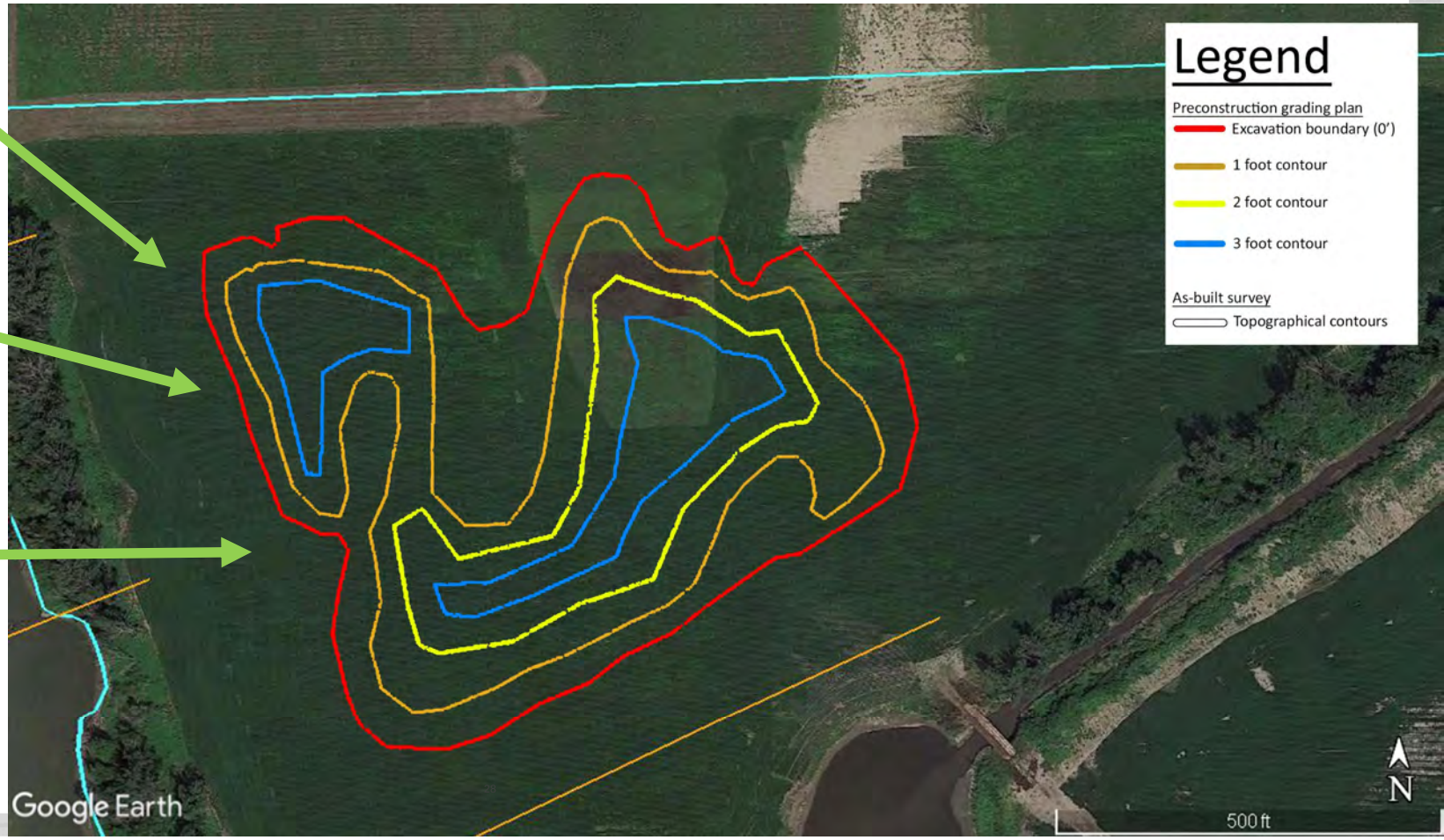
“We have this area targeted in the site MGMT plan for possible future wetland development.”

NRCS

“We don’t want the max depth to be great than 3 feet.”

Missouri Conservation Department

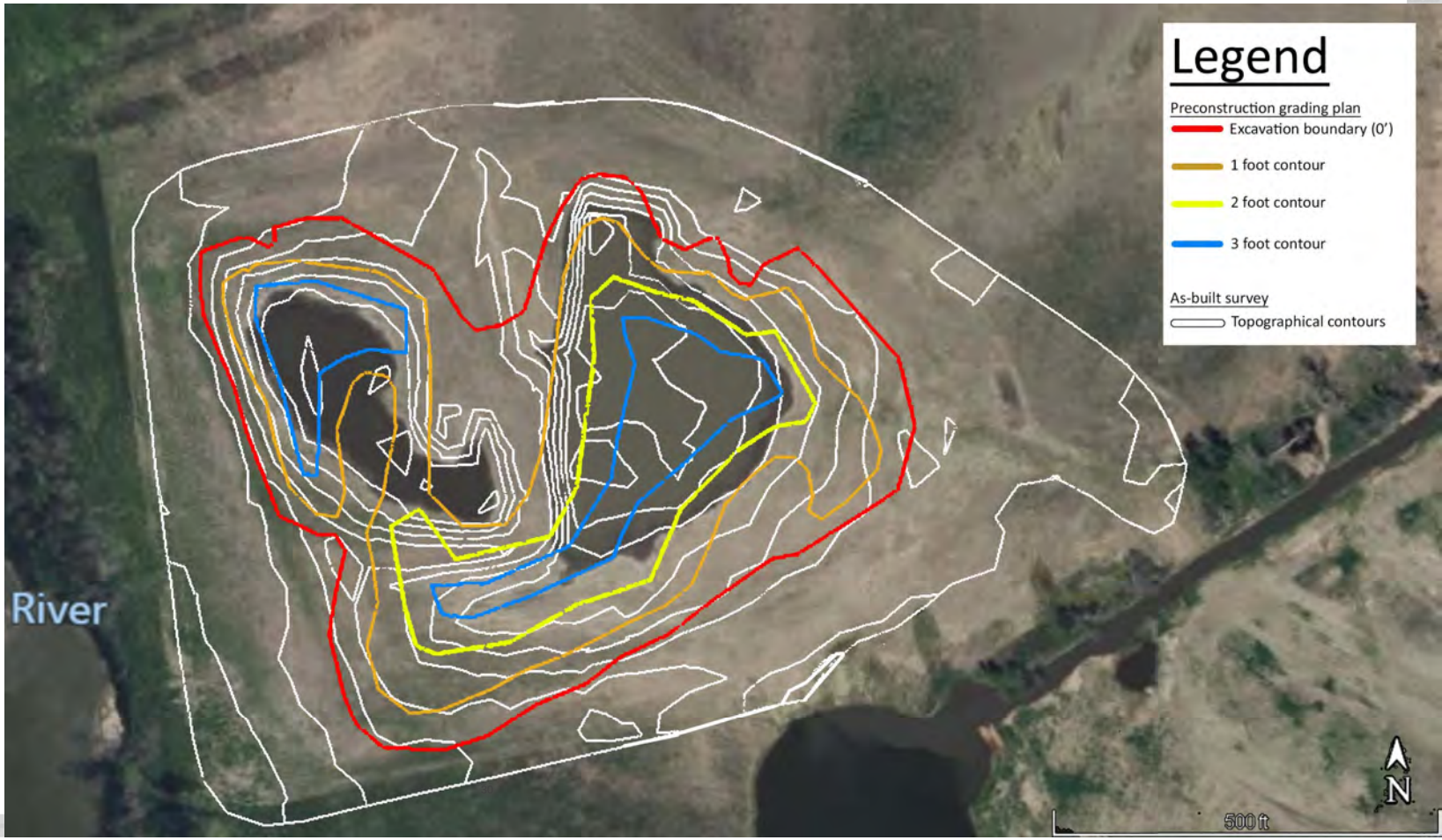
“This seed mix would help attract these kind of waterfowl.”



“BORROW PIT WETLAND” DESIGN AND CONSTRUCTION

As-built survey completed following construction

“BORROW PIT WETLAND” DESIGN AND CONSTRUCTION



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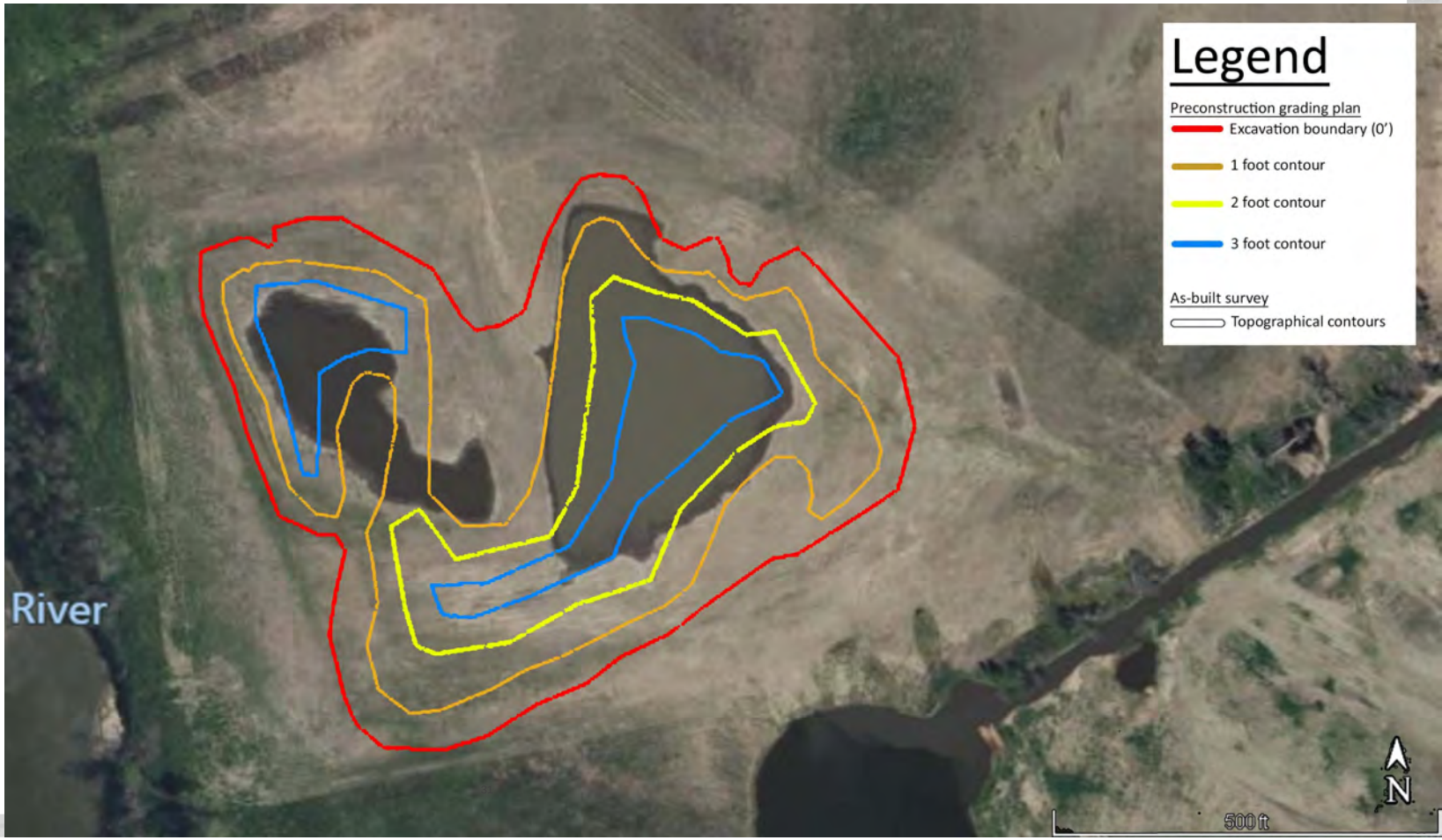


“BORROW PIT WETLAND” DESIGN AND CONSTRUCTION

PL 84-99 AND CONSERVATION PROGRAM MUTUAL BENEFITS

MISSOURI RIVER RECOVERY PROGRAM (MRRP) BORROW UTILIZATION COST SAVINGS* 2019 – 2022, Missouri River river miles 585 – 516 - DRAFT, version 1, 2022-03-11					
Levee system	**MRRP Site**	**Quantity (CY) of Clay, Sand, and Topsoil**	**Total USACE Construction Contract Cost Savings($) ****	**Total Per Unit Cubic Yards Cost Saving to Levee Sponsors ($)*****	**New Habitat Created (acres of "borrow pit wetlands")**
L-601	Noddleman Island	43,000	$1,935,000	$129,000	6.1
L-575	Civil Bend	145,000	$2,575,000	$435,000	17.4
L-575	Lower Hamburg (dredge)	800,000	-	$2,400,000	35.4
L-575	Upper Nishnabotna	750,000	$45,000,000	$2,250,000	148.0
L-575	Copeland Bend	650,000	$32,500,000	$1,950,000	169.0
L-550	Aspinwall Bend	35,000	$175,000	$105,000	15.0
L-536	Brownville	125,000	$5,625,000	$375,000	54.1
L-536	Corning	473,900	$38,518,500	$1,421,700	360.2
	TOTAL	**3,021,900 ‡**	**$126,328,500**	**$9,065,700**	**805.2**

L-536 levee setback:

- Over 1,000 acres of reconnected RW floodplain
- Connected and created a habitat complex ~8,000 acres in size in NW Missouri/ SE Nebraska
- Habitat developed on fed, state, and NGO conservation land
- Breached levee rebuilt on more competent foundation, modern design STD's, nearby borrow, high quality borrow, etc.

NOTE: without question there were mutual benefits here, this is a reasonable order of magnitude estimation of cost savings. The material quantity and acre figures are real word quantities and have a high degree of accuracy. A LOT of qualitative assumptions went into the construction savings estimate. There is great unresolvable uncertainty on those sponsor-provided borrow areas (e.g., quality of material, date and weather conditions during attempted transportation, processing requirements compared to MRRP site material, etc.), questions we'll likely never know the answer to and would likely not spend the money to conduct the highly detailed geotechnical investigation required to actually quantify this. See additional caveats/ explanations below.

*33 CFR, Part 203.82a. Allows USACE to assume responsibility for LERRD's when it is deemed advantageous to the government, like when it results in creation of habitat on USACE conversation land

**based on an average round trip of 31 miles to alternative levee sponsor ID'ed borrow source, calculated during 2019 and 2020 borrow mining operations

***based on an average of $3/CY of sand/ clay, or topsoil material, calculated during 2019 flooding based on information from levee sponsors

‡ the amount and types of material excavated were equivalent to the amount of clay that would have gone into the construction of 4 levee miles and the amount of sand that would have gone in 14 levee miles. This also would have fill over 800 Olympic-sized swimming pools.

PROJECT COSTS (EXCLUDING BORROW COSTS)

USACE: construction contract costs for setback portion of the project were approximately **$100M**

MRRP: 600 acres of fee title land leveraged for conversion to RW side of levee, worth ~**$3.5M**

TNC: funded ~1 FTE for 3 years, produced documentary, "Levee Setback Playbook," purchased parcel for future research, totaling over **$700K**, in addition to providing gap coverage easement-to-fee title land acquisition

NRCS: established 780 acres of new EWPP-FPE conservation easements worth ~**$2M**

State of Missouri: provided flood recovery grants to help the levee sponsors: buy required real estate, utility relocation, land acquisition appraisals and title work, totaling **~ $1.6M**

ACLD: facilitated community engagement and bought land for new levee alignment, totaling **~$500K**

INCIDENTAL HYDRAULIC AND ENVIRONMENTAL BENEFITS

L-536 Hydraulic Benefits:

- Increased Conveyance:
  - Reduction in water surface elevation in excess of **0.8 feet for 100-yr flood stage.**
  - Reduction in velocities within the immediate vicinity of the levee.
- Overtopping protection: State-of-the-practice design for **landward levee slope of 5V:1H** reduces overtopping velocities and erosion damage.

L-536 Environmental Benefits:

- **1,040 acres of reconnected** floodplain.
- **420 acres of wetlands** from converted borrow pits.
- Expanded floodplain can be **"hot spots" for age-0 native fish.**
- **Rare, declining, and species of conservation concern** have been observed after past levee setback construction.

Flathead chub (state listed in MO)
(MU Payne WMA setback floodplain- Hass, et al., 2020)

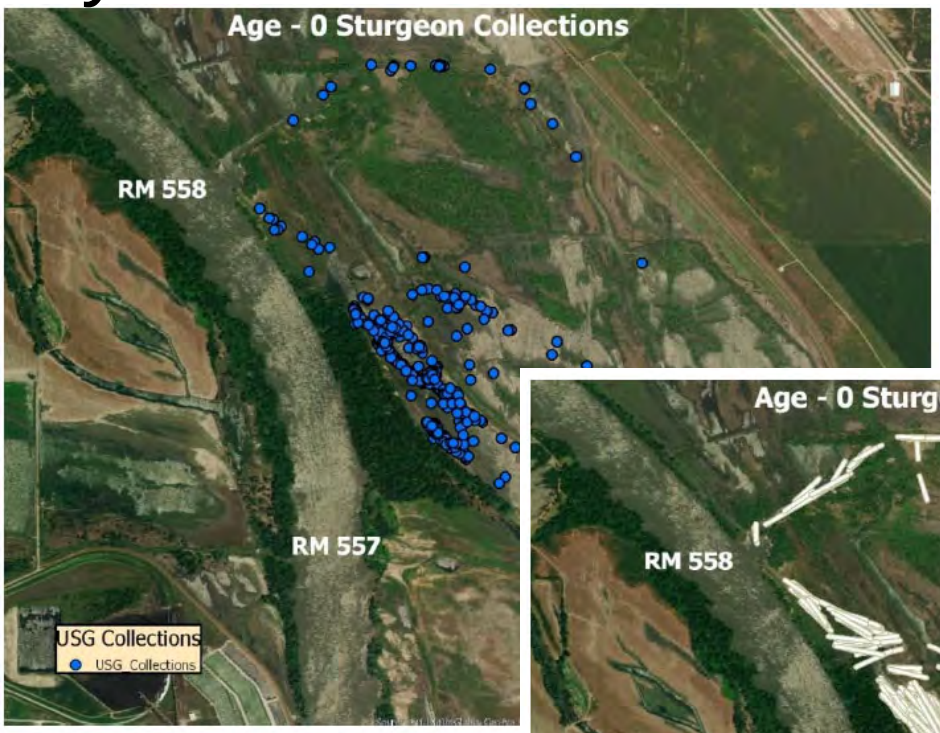
Blanchard's Cricket Frog (declining across much of range)
(Copeland Bend and MU Payne WMA setback floodplain- Murphy et al., 2014)

Wilson's Phalarope (lost prairie wetlands)
(Copeland Bend setback floodplain- Crane observation 2012, Murphy et al., 2014)

MU Payne WMA Levee Setback

Summer of 2019, Nebraska Game and Parks survey (Hass, et al., 2020):

- Single year record number of age-0 sturgeon
  - Total: 1,530 individuals
  - High number of individuals over 80mm, indicating higher rate of survival and site retention compared to previous years' main channel surveys
- One juvenile hatchery-origin Pallid Sturgeon was collected
- Relatively high number of many age-0 native species
  - Blue Sucker
  - Blue Catfish
  - Channel Catfish
  - Sturgeon Chub
  - Sicklefin Chub
  - Shoal Chub
  - Silver Chub
  - 36 MO state endangered Flathead Chubs (was one of the most common fish in the historic Missouri River, now rarely sampled in the modified river)



Flathead chub

ArcGIS Maps of push trawl deployments (white lines) and age-0 sturgeon captures (blue dots) on the floodplain at Frazer Bend WMA in 2019.

LOOKING TO THE FUTURE

- Engineering With Nature® – Lower Missouri River Levee Setback Research Tasks (benefits quantification and guidance development)

- Lower Missouri River Flood Risk and Resiliency General Investigation Study – opportunity for implementing results from applied research

Engineering With Nature

US Army Corps of Engineers ®

U.S.ARMY

LOOKING TO THE FUTURE

Lower Missouri River Levee Setback Research Program

Research Summary

- Funded through USACE's R&D Engineering With Nature Program
- Collaborative, interdisciplinary team

Goals:

1. Quantify benefits at a specific, but generalizable, levee system
2. Advancing the practice of EWN® by translating learnings into the civil works planning process

Applied research

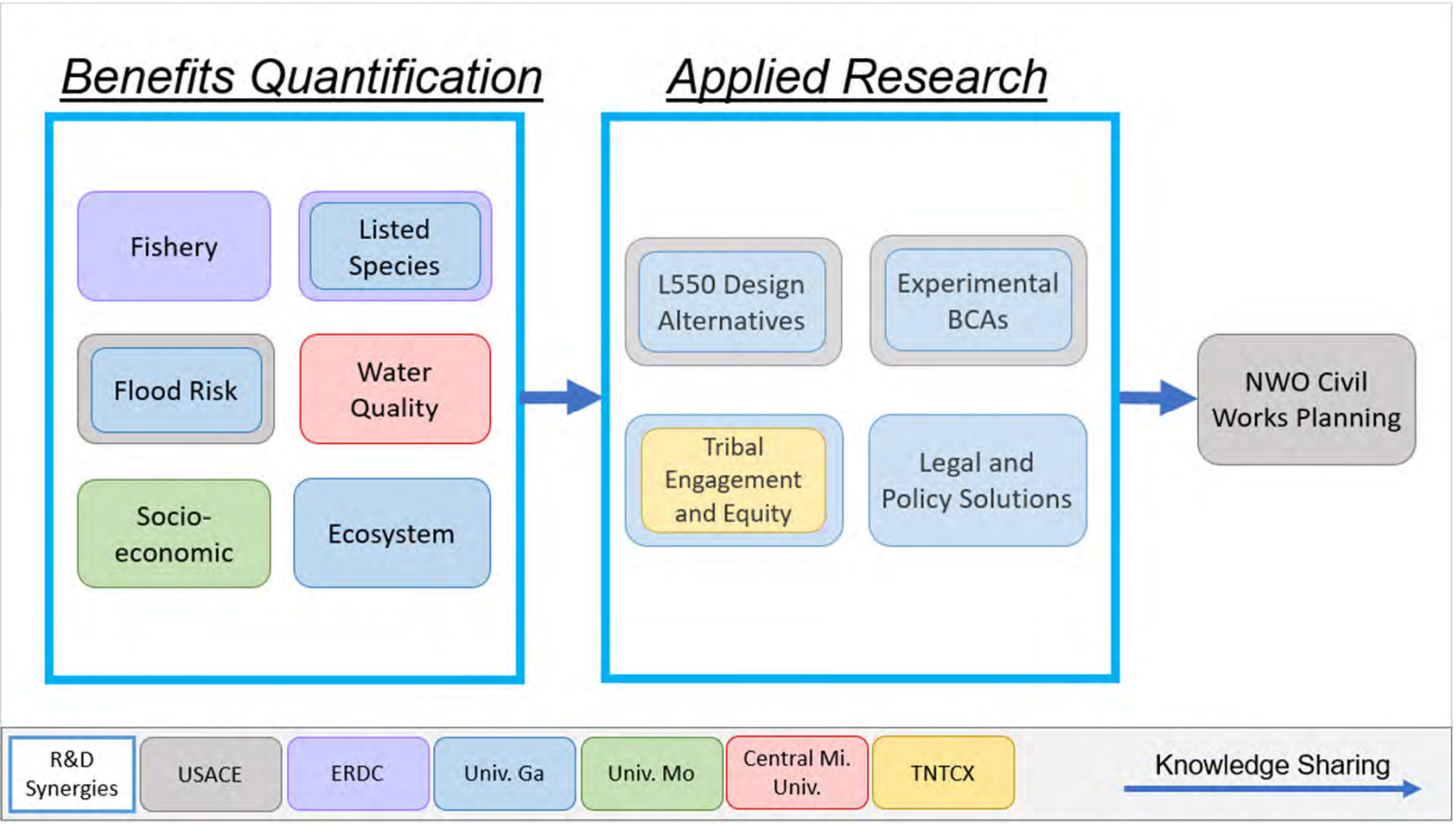
- Planning info > R&D teams
- R&D products > Planning teams
- = translate R&D products into practice
- = Academic publications tied to real-world water resources development projects

"Borrow pit wetlands" were constructed along agricultural drainage ditches on conservation land (L-575, 2012)

Waterfowl are abundant near Missouri River levee setbacks (L-575, 2013)

LOOKING TO THE FUTURE

Lower Missouri River Levee Setback Research Program



Collaborative research teams:

- Flood risk benefits
- Benefit-cost analysis
- Fisheries benefits/ access
- Ground/ surface water quality improvements
- Community acceptance

- RESULTS IN improved future designs

LOOKING TO THE FUTURE

Lower Missouri River Flood Risk and Resiliency System Plan

- Spurred by 2019 flooding
- Authorized in WRDA 2022, Section 120
- Sponsored by Nebraska, Iowa, Kansas, and Missouri
- Results in a comprehensive “system plan” for flood risk and resiliency along lower MoR
- Allows for “spin off” projects to be initiated during or after system plan is complete

USACE Districts
Kansas City District
Omaha District

Non-Federal Sponsors
Missouri DNR,
Kansas Water Office,
Iowa DNR,
Nebraska DNR

U.S. ARMY

US Army Corps of Engineers

IOWA DEPARTMENT OF NATURAL RESOURCES

MISSOURI DEPARTMENT OF NATURAL RESOURCES

Kansas Water Office

NEBRASKA Good Life. Great Water. DEPT. OF NATURAL RESOURCES

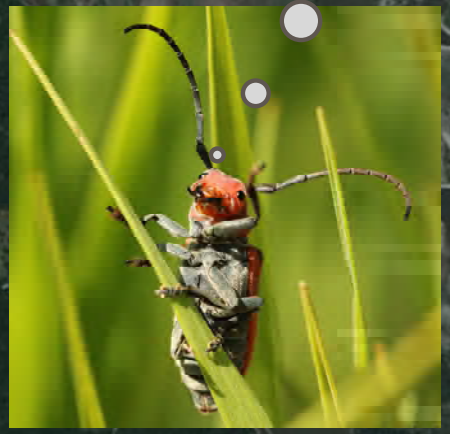
LOOKING TO THE FUTURE

Lower Missouri River Flood Risk and Resiliency System Plan

https://www.nwk.usace.army.mil/Missions/Civil-Works/Civil-Works-Programs-And-Projects/LoMo/

THANK YOU!

Questions?



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Citations;

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Summer 2022