

PRESENTATION TO THE NRCS CONSERVATION PORTAL

# WATERSHED-WIDE INFILTRATION AND FLOOD BENEFITS FROM THE FIELDS

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Lead Silver Jackets Coordinator, KS  
USACE – Kansas City District

14-Jun-2022



US Army Corps  
of Engineers ®



Authority and Scope: Section 206 of the Flood Control Act of 1960, as amended, provides authority for the Corps of Engineers to provide a full range of flood risk information, technical services and planning guidance to support and promote effective flood risk and floodplain management.

Average Budgets: May range from \$20,000 - \$150,000. Subject to availability of funds from Congressional appropriations.

The Flood Plain Management Services (FPMS) program is to **advise**, **recommend**, **educate**, **inform** and **provide technical support** to others, both external and internal, so that informed decisions with respect to floodplain management can be made.

Under FPMS, the Corps of Engineers can provide:

- Technical services
- Planning assistance and guides and pamphlets for floodplain management



*The FPMS program services are provided free to communities and to tribal governments.*





**US Army Corps  
of Engineers®**



# PARTNERS

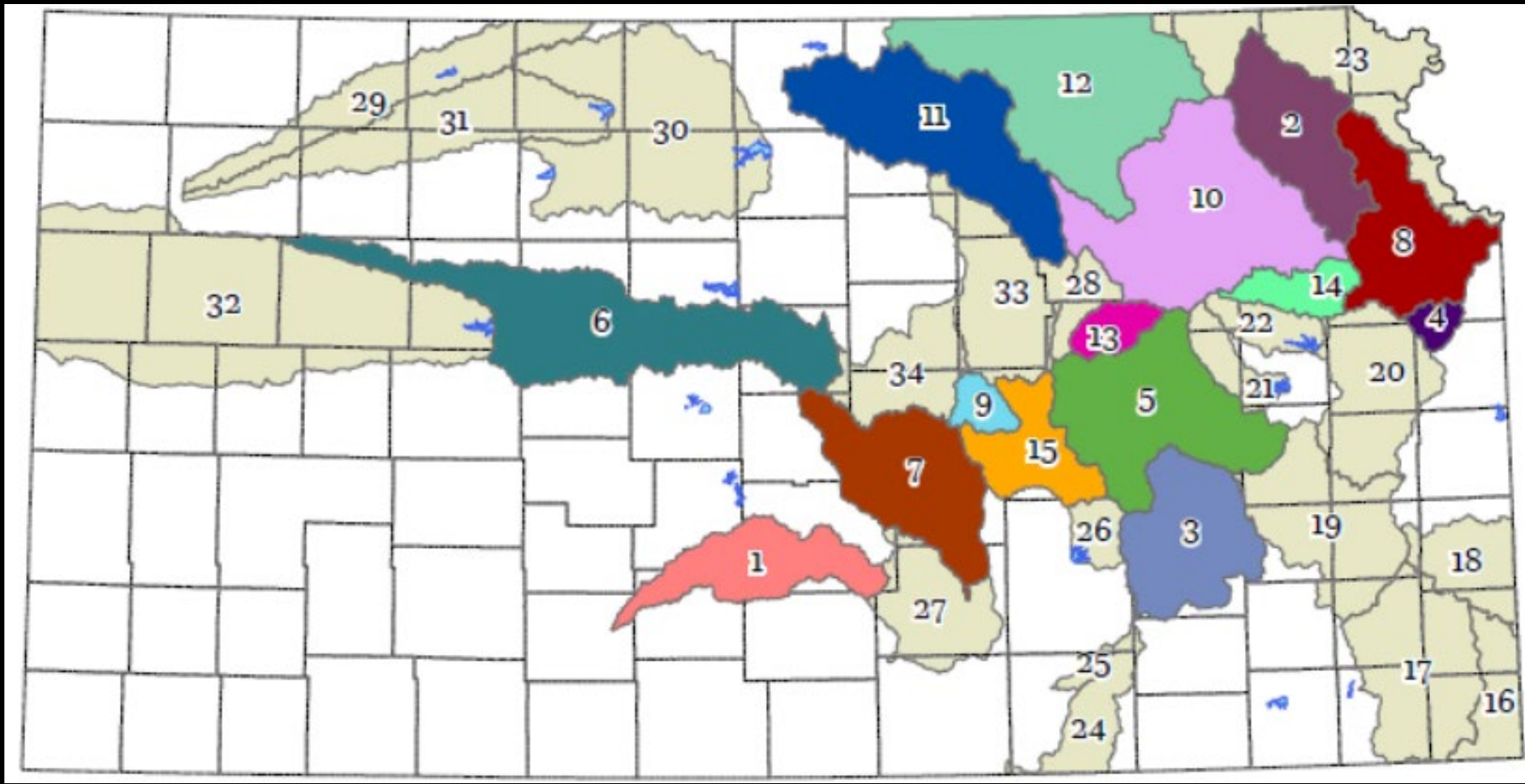


**FEMA**



STATE ASSOCIATION  
OF KANSAS WATERSHEDS





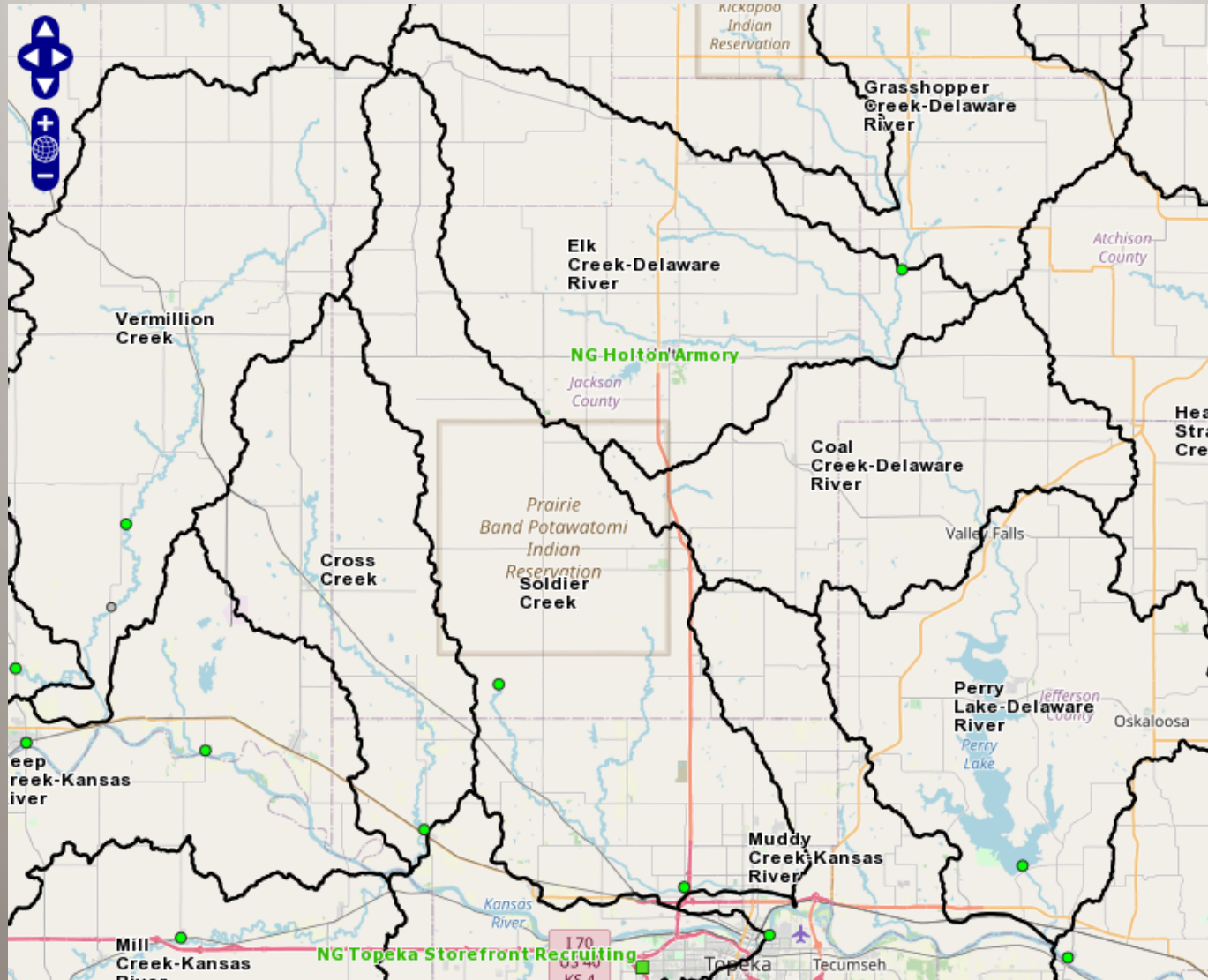




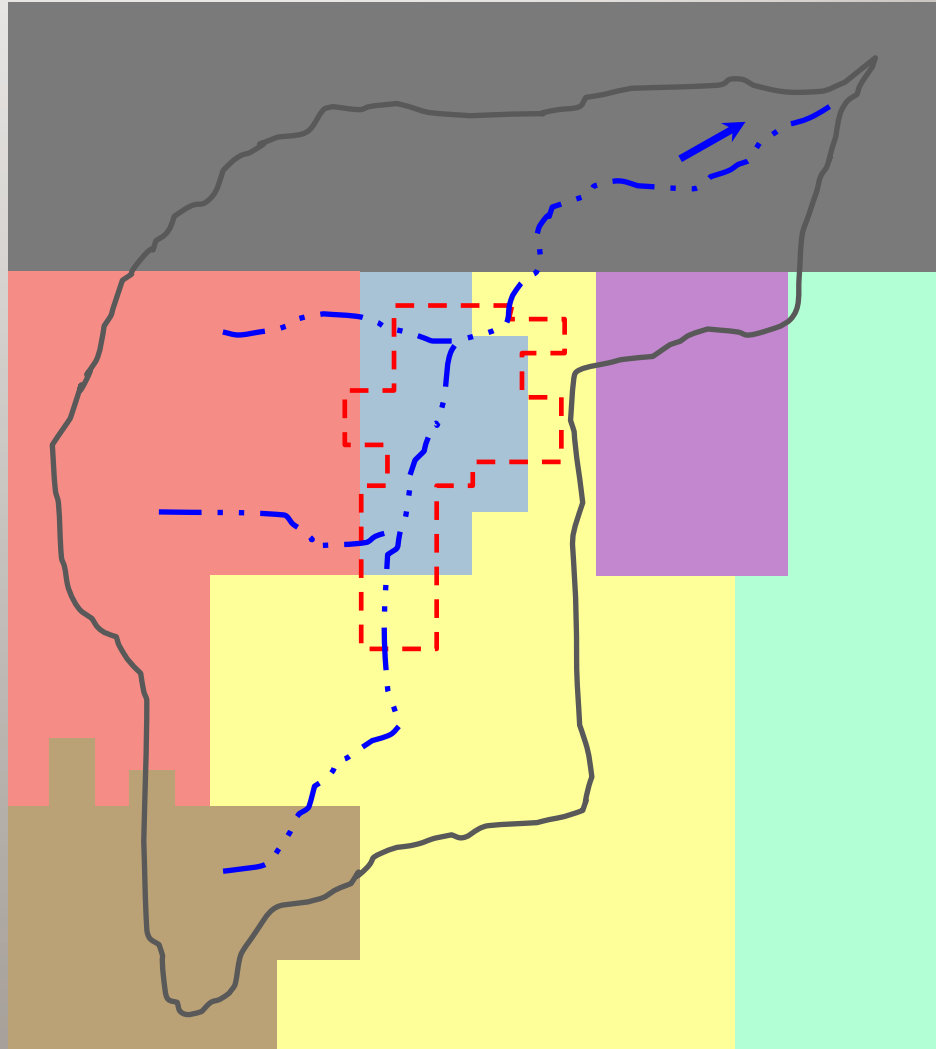
Manhattan, Sept 2018



# CHALLENGE – WATERSHED THINKING



-  Watershed
-  Mill Levy
-  Stream



# CHALLENGE – EROSION OFF FIELDS AND IN STREAMS

NEON.D06.KING.DP1.20002 - NetCam SC1R - Sun May 16 2021 14:00:06 UTC  
Camera Temperature: 39.5  
Exposure: 1319

**Stream  
bank  
erosion**



# MANY MEASURES



Treat Rain Where It Falls



Beneficial Uses



Community Awareness



Regulations & Mapping



Flood Insurance



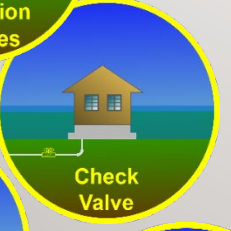
Building Inspection & Codes



Flood Warning



Land Use Policies



Check Valve



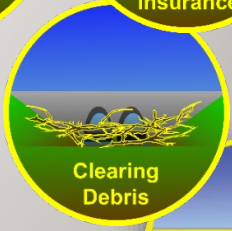
Evacuation Planning



Emergency Management Planning



Temporary Barriers



Clearing Debris



Flood Openings



Buyout



Road Closings



Storm Sewers



Bridges



Fill Basement with Main Floor Addition



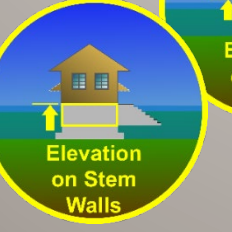
Relocation



Elevation on Piles



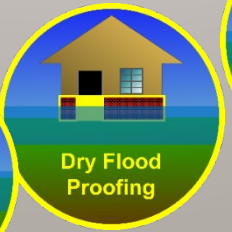
Elevation on Fill



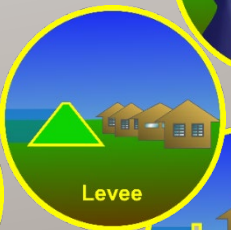
Elevation on Stem Walls



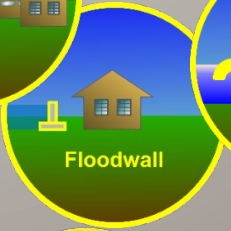
Wet Flood Proofing



Dry Flood Proofing



Levee



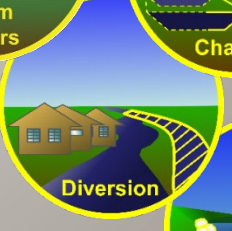
Floodwall



Pumping



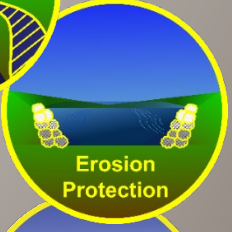
Dam / Reservoir



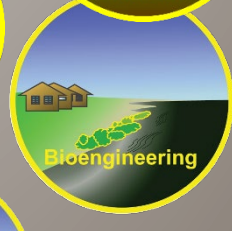
Diversion



Channel



Erosion Protection



Bioengineering



Beach Berms



Dunes



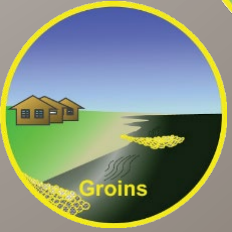
Seawalls



Revetments

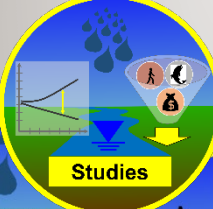


Breakwaters



Groins

# NON-STRUCTURAL MEASURES



Studies



Beneficial Uses



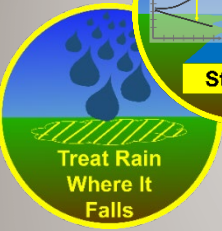
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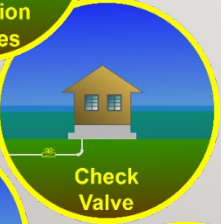
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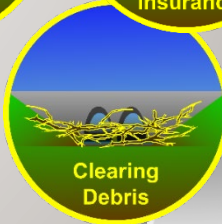
Evacuation Planning



Emergency Management Planning



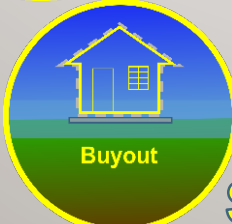
Temporary Barriers



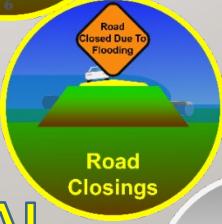
Clearing Debris



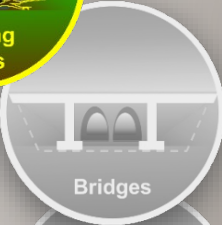
Flood Openings



Buyout



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Fill Basement with Main Floor Addition



Relocation



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Elevation on Fill



Elevation on Stem Walls



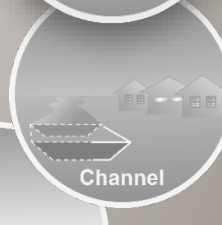
Wet Flood Proofing



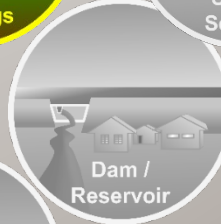
Dry Flood Proofing



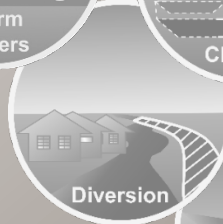
Storm Sewers



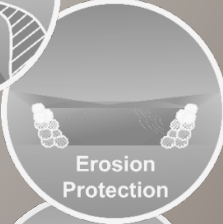
Channel



Dam / Reservoir



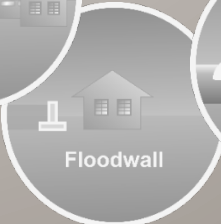
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NRCS/USACE **Partnership Agreement** signed July 7, 2005 and recently renewed memorandum of understanding.

Promote working relationship to improve the management of water and related natural resources under the missions and authorities of NRCS and USACE.

The agencies have pledged to work together in the following areas:

- 1) watershed planning;
- 2) wetlands creation, restoration/enhancement
- 3) natural disaster recovery

Included activities related to Wetlands Conservation and Regulatory Compliance (The "Swampbuster" Provision of the Farm Bill and Section 404 of the Clean Water Act).



- USACE may lead or follow
- USACE Flood Plain Management Services and the Planning Assistance to States programs can support
- Emphasis on **systems approach**
- Focus shifts **away from limiting project focus** political boundaries
- **Cumulative** effects are emphasized
- Common problems shared in **basins**
- Solutions are more interdependent, **long-term**, and **holistic** solutions rather than piecemeal approaches
- Blueprint for continued involvement in the watershed, regardless of the entities
- Leveraged resources and shared actions over time
- Integrated Water Resources Management

	DEPARTMENT OF THE ARMY U.S. Army Corps of Engineers 441 G Street, NW Washington, DC 20314-1000	ER 1105-2-102
CECW-P		
Regulation No. 1105-2-102		01 April 2022
	Water Resource Policies and Authorities WATERSHED STUDIES	
	<b>1. Purpose.</b>	
	a. This Regulation establishes an accountable strategy for conducting watershed studies with U.S. Army Corps of Engineers (USACE) participation. This Regulation includes policy and process guidance. The policy portion of this guidance applies to: watershed studies led by USACE under Section 729 of the Water Resources Development Act (WRDA) 1986, as amended (33 United States Code [U.S.C.] §2267(a)); other specifically authorized watershed studies; watershed assessments completed under the Tribal Partnership Program (TPP) authority, Section 203 of WRDA 2000, as amended (33 U.S.C. §2269); and to certain comprehensive studies, depending on the study authority.	
	b. The process portion of this guidance provides the procedures for the preparation and coordination of watershed plans for studies led by USACE under Section 729 of WRDA 1986, other specifically authorized watershed planning authorities, and certain comprehensive studies. Additional guidance on the procedures leading to a watershed study under the TPP authority will be provided separately. Finally, this Regulation provides the procedures for communication and reporting if USACE is a participating agency in a watershed study.	
	<b>2. Applicability.</b> This Regulation applies to all USACE Headquarters (HQUSACE) elements, major subordinate commands, districts, laboratories, centers of expertise, and field operating activities that have civil works planning, engineering, design, construction, and operations and maintenance responsibilities.	
	<b>3. Distribution Statement.</b> Approved for public release; distribution is unlimited.	
	FOR THE COMMANDER:	
		<i>John P. Lloyd</i> JOHN P. LLOYD COL, EV Chief of Staff
3 Appendixes		
		ER 1105-2-102 • 01 April 2022
		i



# HOW DOES THE RAINFALL RUNOFF IN WATERSHEDS REACT TO GOOD LAND PRACTICES?



## Principles that sustain soil health:

- Least amount of mechanical disturbance
- Diversity
- Armor on the soil, living root at all times
- Animal integration

## Regenerative Agriculture:

1. No till
2. Cover crops
3. Perennials & trees
4. Compost / mob grazing

## *Co-Benefits, Effects*

*Increased soil moisture | groundwater*

*Decreased flooding downstream*

*Resilience to drought*

*Retained soil / less erosion*

*Increased soil organic matter*

*Preparedness for more intense rainfall*



## Benefits

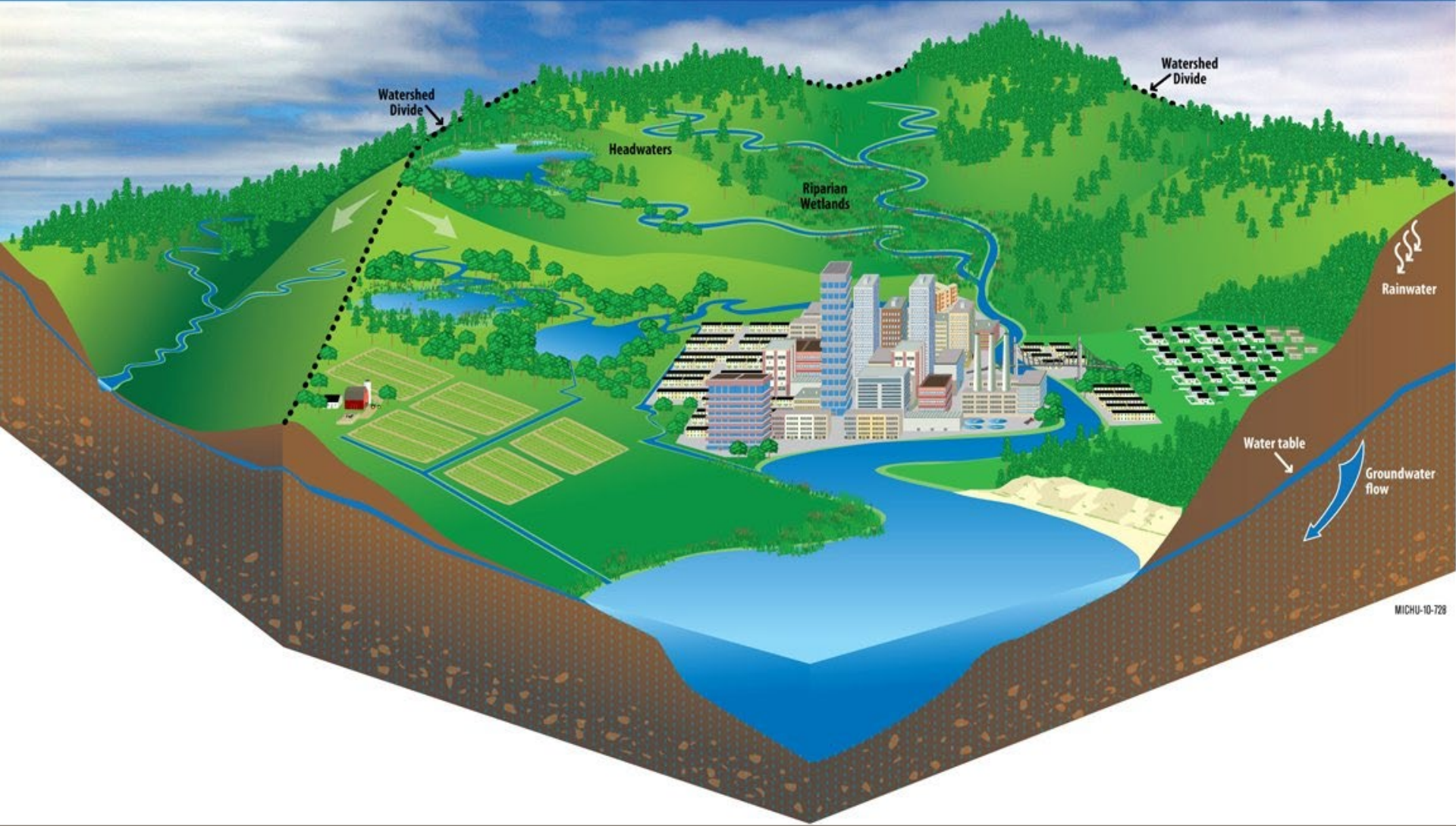
*More days in the field possible*

*Diversified crops*

*Less dependency on subsidies*

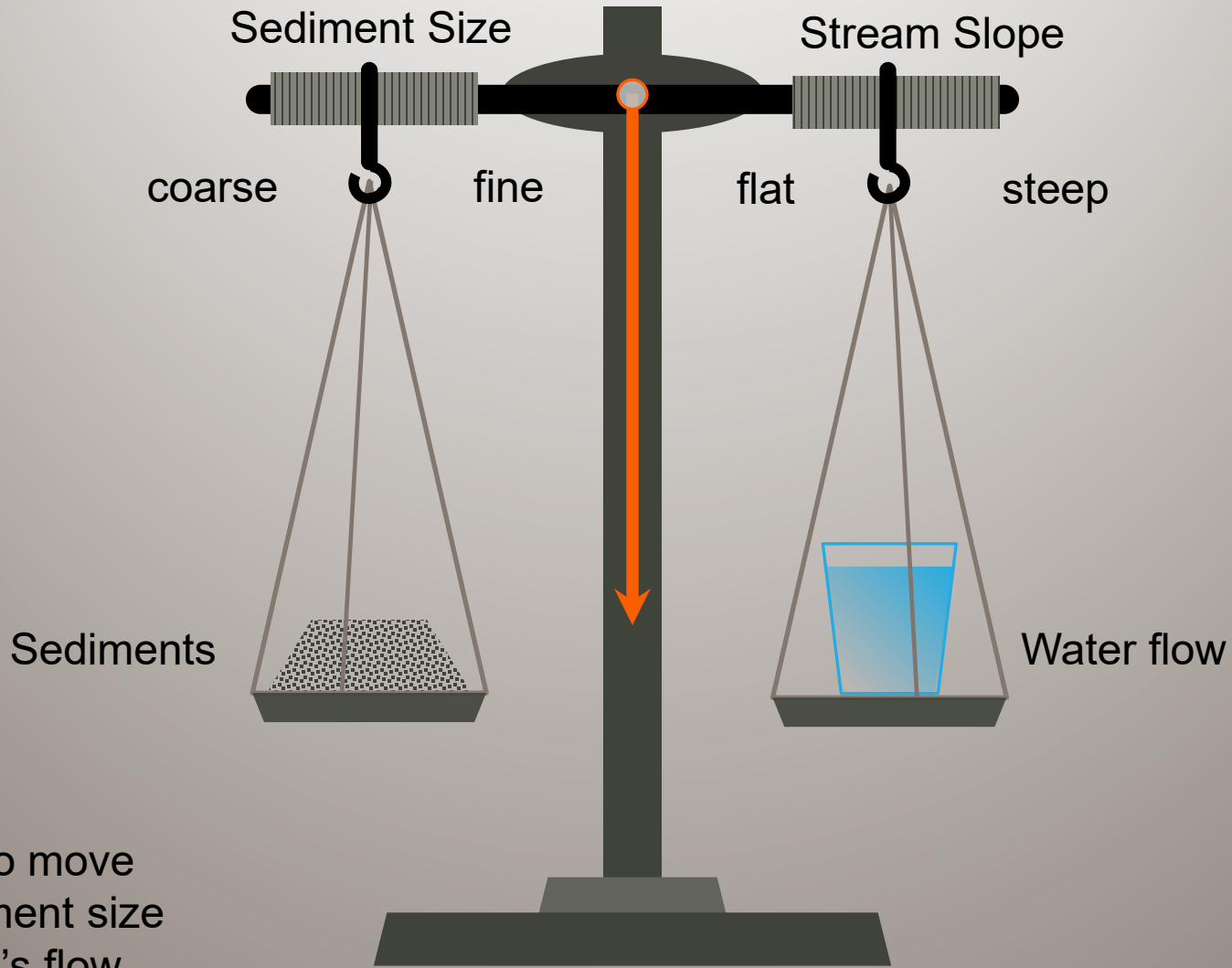
## HOW WATERSHEDS WORK

“CATCHMENTS” Stop shedding!

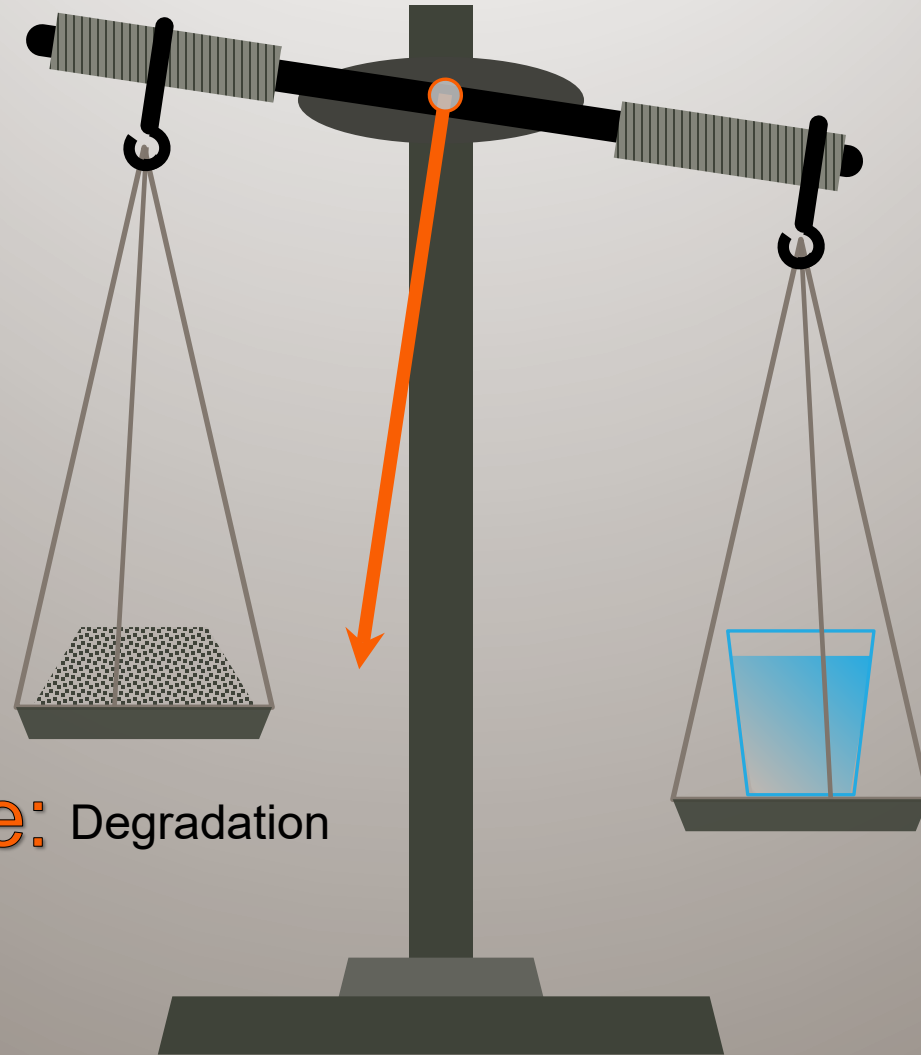


# LANE'S RELATIONSHIP ABOUT STABLE STREAMS

$Q_s D_{50}$  and  $Q S$  are proportional



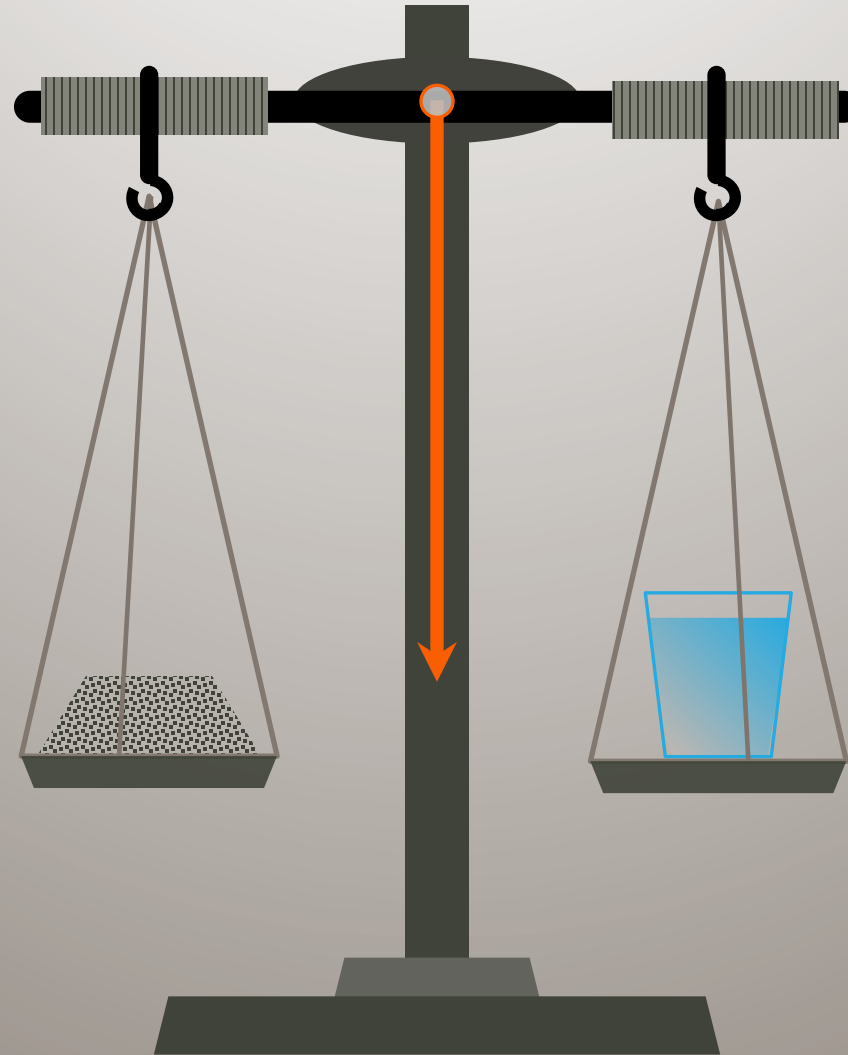
$Q_s$  = Flow to move  
 $D_{50}$  = Sediment size  
 $Q$  = Stream's flow  
 $S$  = slope

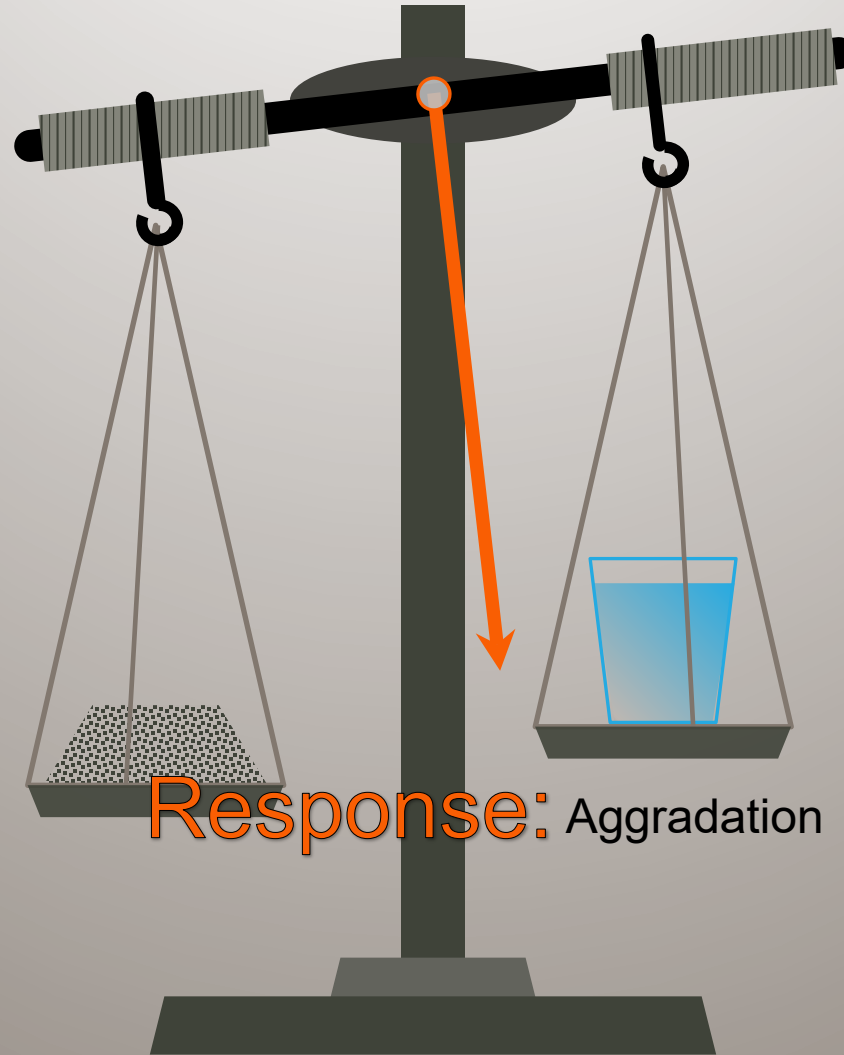


Removed meanders, shortened stream: Results in a steepened slope

**Response:** Degradation

$Q_s$  = Flow to move  
 $D_{50}$  = Sediment size  
 $Q$  = Stream's flow  
 $S$  = slope

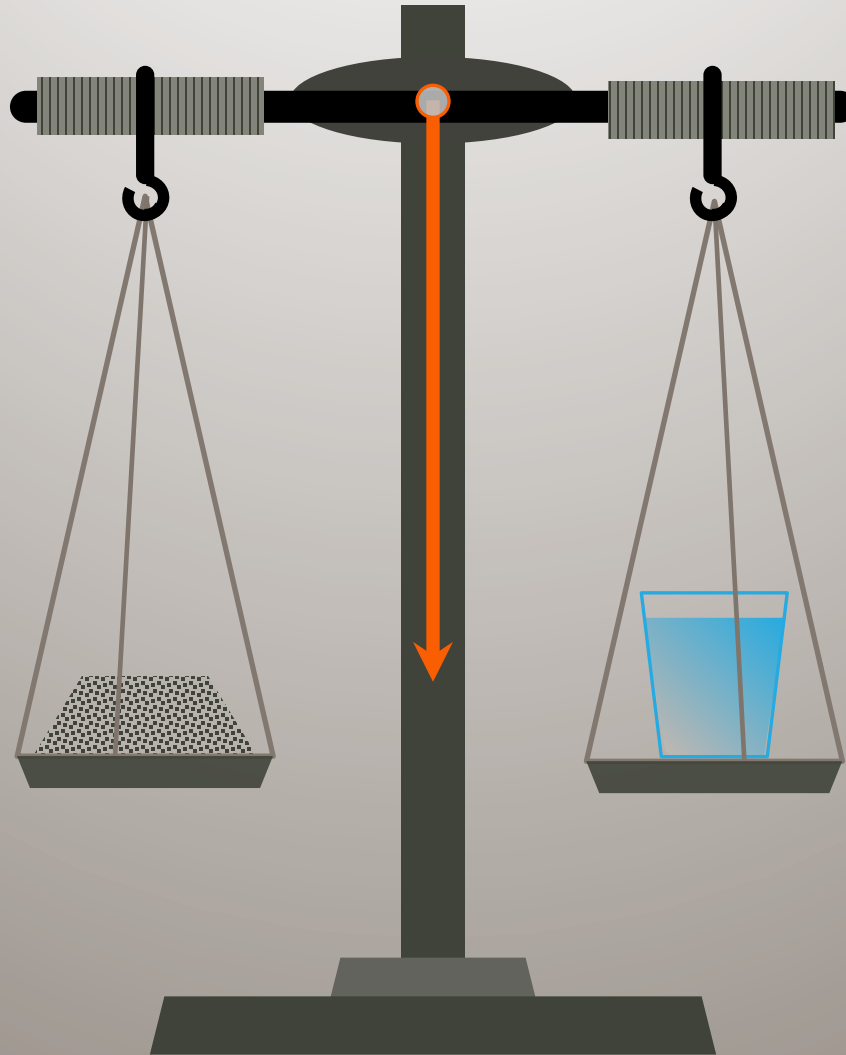


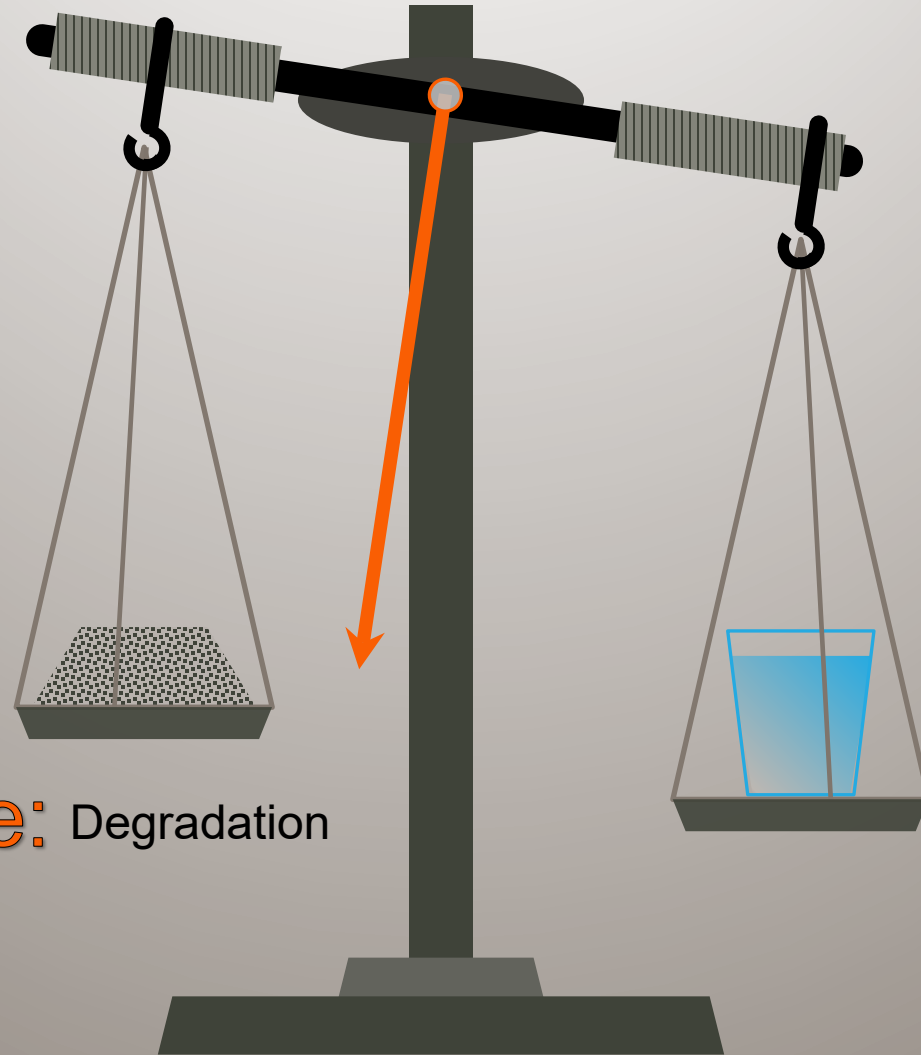


At downstream  
end of the  
watershed slopes  
get flatter  
approaching  
larger rivers

**Response:** Aggradation

$Q_s$  = Flow to move  
 $D_{50}$  = Sediment size  
 $Q$  = Stream's flow  
 $S$  = slope

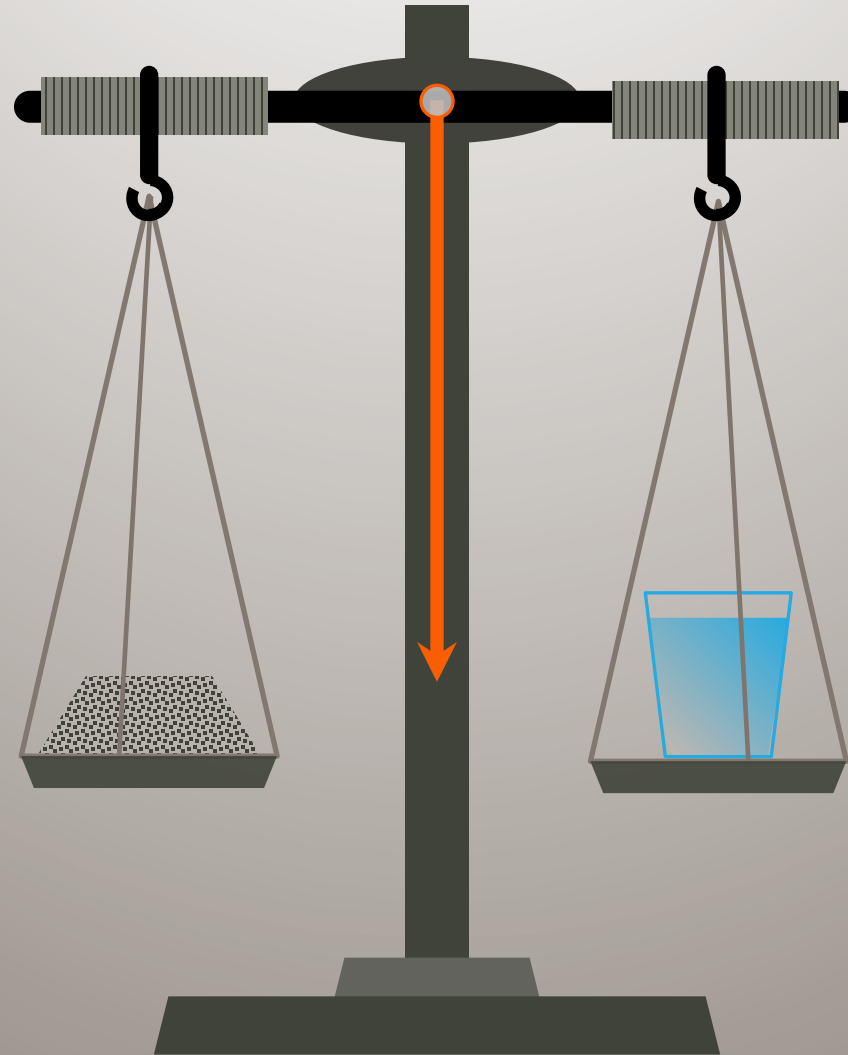




Watershed changes land use to a more impervious type (roof tops, parking lots, tile-drained agriculture)

**Response:** Degradation

- $Q_s$  = Flow to move
- $D_{50}$  = Sediment size
- $Q$  = Stream's flow
- $S$  = slope

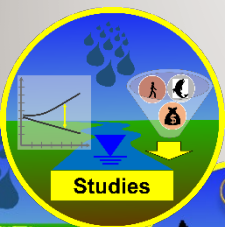


# KANSAS HEALTHY WATERSHEDS

A project done using the USACE Flood Plain Management Services Program



# MANY MEASURES



Studies



Beneficial Uses



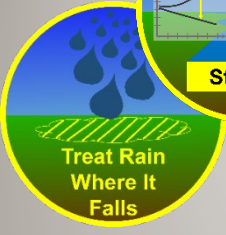
Community Awareness



Regulations & Mapping



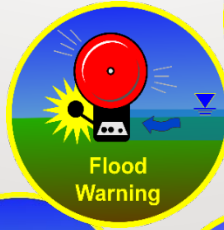
Flood Insurance



Treat Rain Where It Falls



Building Inspection & Codes



Flood Warning



Evacuation Planning



Emergency Management Planning



Temporary Barriers



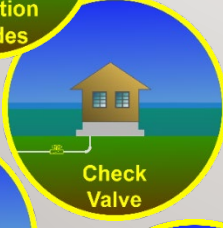
Clearing Debris



Land Use Policies



Flood Openings



Check Valve



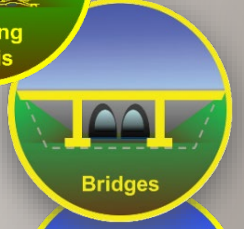
Buyout



Road Closings



Storm Sewers



Bridges



Fill Basement with Main Floor Addition



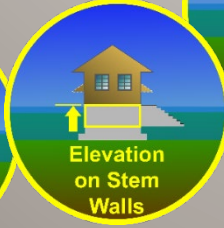
Relocation



Elevation on Piles



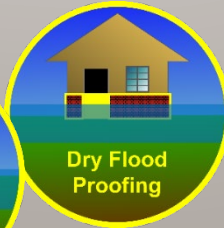
Elevation on Fill



Elevation on Stem Walls



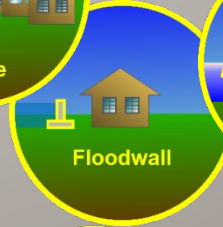
Wet Flood Proofing



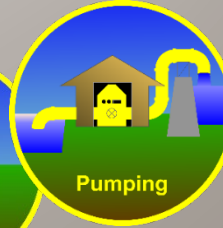
Dry Flood Proofing



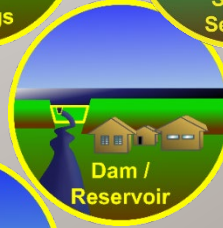
Levee



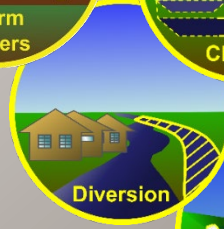
Floodwall



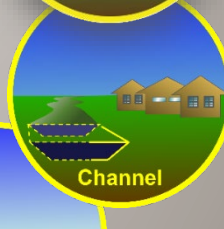
Pumping



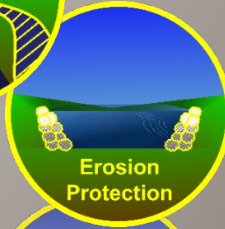
Dam / Reservoir



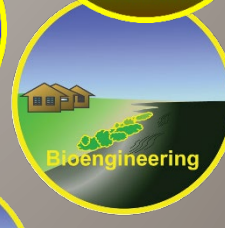
Diversion



Channel



Erosion Protection



Bioengineering



Beach Berms



Dunes



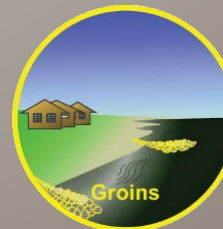
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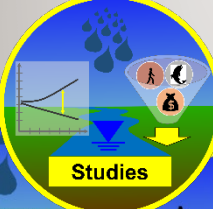


Breakwaters



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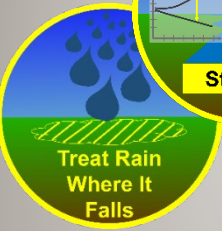
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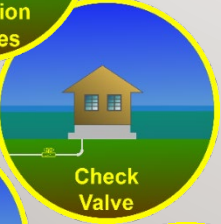
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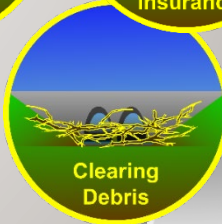
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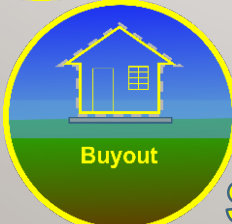
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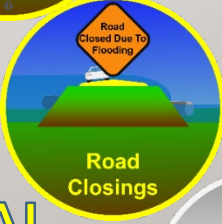
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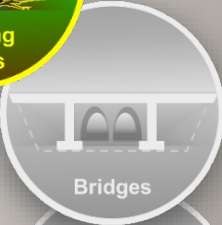
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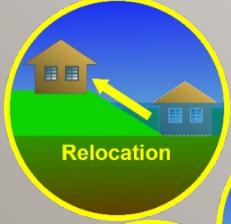
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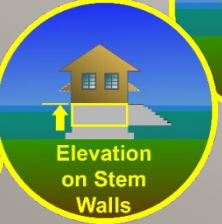
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Elevation on Fill



Elevation on Stem Walls



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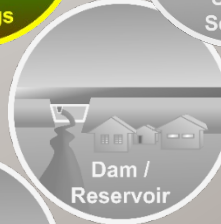
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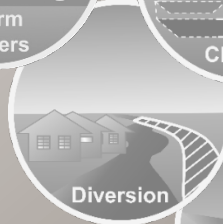
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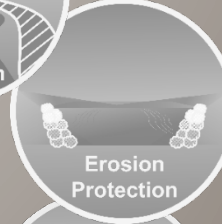
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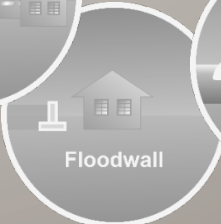
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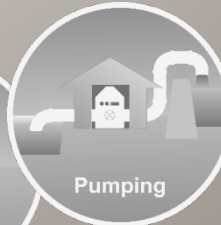
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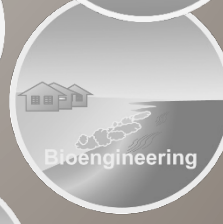
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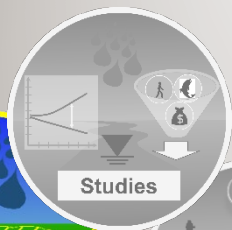
Groins



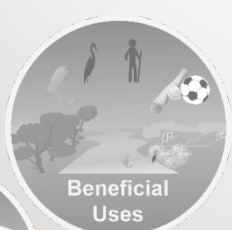
Treat Rain Where It Falls



Land Use Policies



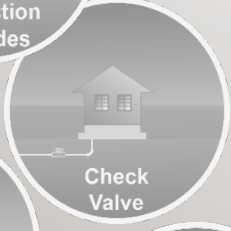
Studies



Beneficial Uses



Building Inspection & Codes



Check Valve



Flood Warning



Community Awareness



Regulations & Mapping



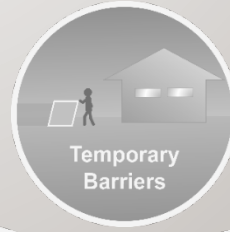
Flood Insurance



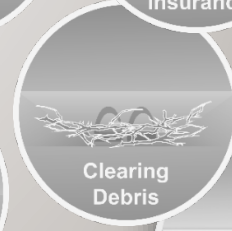
Evacuation Planning



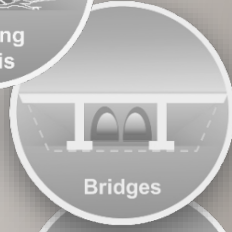
Emergency Management Planning



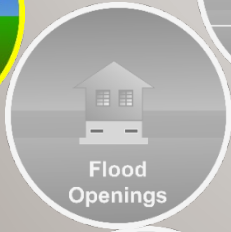
Temporary Barriers



Clearing Debris



Bridges



Flood Openings



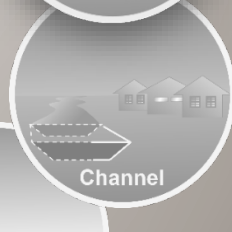
Buyout



Road Closings



Storm Sewers



Channel



Fill Basement with Main Floor Addition



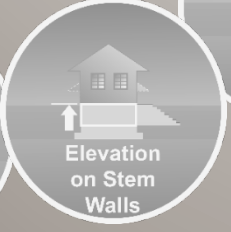
Relocation



Elevation on Piles



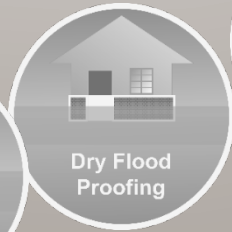
Elevation on Fill



Elevation on Stem Walls



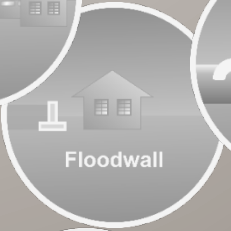
Wet Flood Proofing



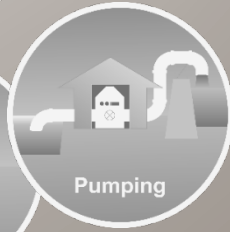
Dry Flood Proofing



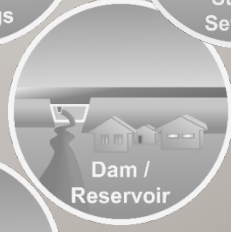
Levee



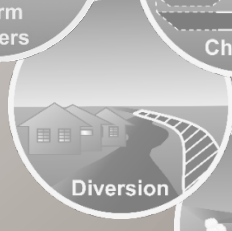
Floodwall



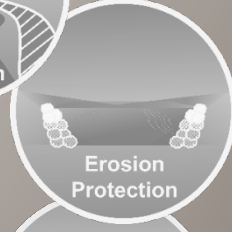
Pumping



Dam / Reservoir



Diversion



Erosion Protection



Bioengineering



Beach Berms



Dunes



Seawalls



Revetments



Breakwaters



Groins

# LAND USE INCENTIVES

- Partnerships are necessary to address increased flooding, yet few agencies offer the means for staff flexibility for those roles
- Many are unaware of the full menu of flood risk management measures
- Few understand how to implement a watershed approach
- Many are unaware of the benefits of regenerative agriculture
- Better describe alternatives including the with and without conditions

# ACTION – THE SELECTED WATERSHED FOR THE SENSITIVITY ANALYSIS

**Soldier Creek Watershed**

The screenshot shows a Cisco Webex meeting interface. In the foreground, a presentation slide is displayed, featuring a table of watershed data and a map of Kansas. A callout box labeled "Soldier Creek Watershed" points to a specific area on the map. The table lists various watersheds with their drainage areas, USGS gage locations, and streamflow data availability.

Watershed Name	Total HUC Drainage Area (sq. mi)	DS USGS Gage	Gages Located Throughout Watershed	Streamflow Data Availability	Downstream Towns
1 Soldier Creek	339	06889500 Soldier Creek Near Topeka, KS	Two additional USGS gages, plus more gages located within the PBPN	Topeka, KS: annual peak: 1929-2020, instantaneous: 1990-2021, daily: 1929-2020 (missing some data in the 1930s). Delta: Annual Peak; Instantaneous: 1990-2021, Daily: 1990-2021	North Topeka, KS. There is also a federal levee project located downstream
2 Cross Creek	177	06887900 Cross Creek at Rossville, NA	NA	Instantaneous: 2008-2021. Some historic crests available back to 1973 on ahrs.	Rossville, KS
3 Rock Creek	196	06888300 Rock Creek near Louisville, KS	NA	Annual Peak: 1959-1990, 2018-2020 Instantaneous: 2016-2021, Daily: 1959-1966, 2016-2021	Louisville, KS
4 Mill Creek	318	06885500 Mill Creek near Paxico, NA	NA	Annual Peak: 1951-2020, instantaneous: 1990-2021 (missing some data around 1993), Daily: 1953-2021	Paxico, KS. Alma, K is located a bit further upstream but does not have gage
5 Salt Creek	98	06911490 Salt Creek at Lyndon, NA	NA	Annual Peak: 2000-2020, instantaneous: 2000-2021, Daily: 1990-2021	Lyndon, KS. Osage City also on the northern edge of watershed about midstream
6 Wildcat Creek	93.3	06879815 Wildcat Creek at Seth Childs Rd, Manhattan, KS	Two additional USGS gages located upstream.	Seth Childs Road: Annual Peak: 1976-1988. All other datasets = gage height. Scenic Drive:	Manhattan, KS

The map shows the state of Kansas with several watersheds highlighted in blue. A callout box points to the Soldier Creek Watershed in the western part of the state.

Participants (11)

- Brian Rast [he-...]
- Erin Reinkemeyer
- Chris Janssen
- Gregory Karlovits

Chat

from Steve Samuelson to everyone: 9:51 AM  
Morning Brian

from Steve Samuelson to everyone: 10:07 AM  
Bobby D's Merchant Street BBQ at 617 Merchant in Emporia, KS just down from the post office. Several sauces but I like their hot version.

from Chris Janssen to everyone: 10:07 AM  
I don't disagree with that!

To: Everyone

Enter chat message here

# ACTION – MAP THE AREAS ABLE TO IMPLEMENT THE PRACTICES

## Regenerative Agriculture land use practices:

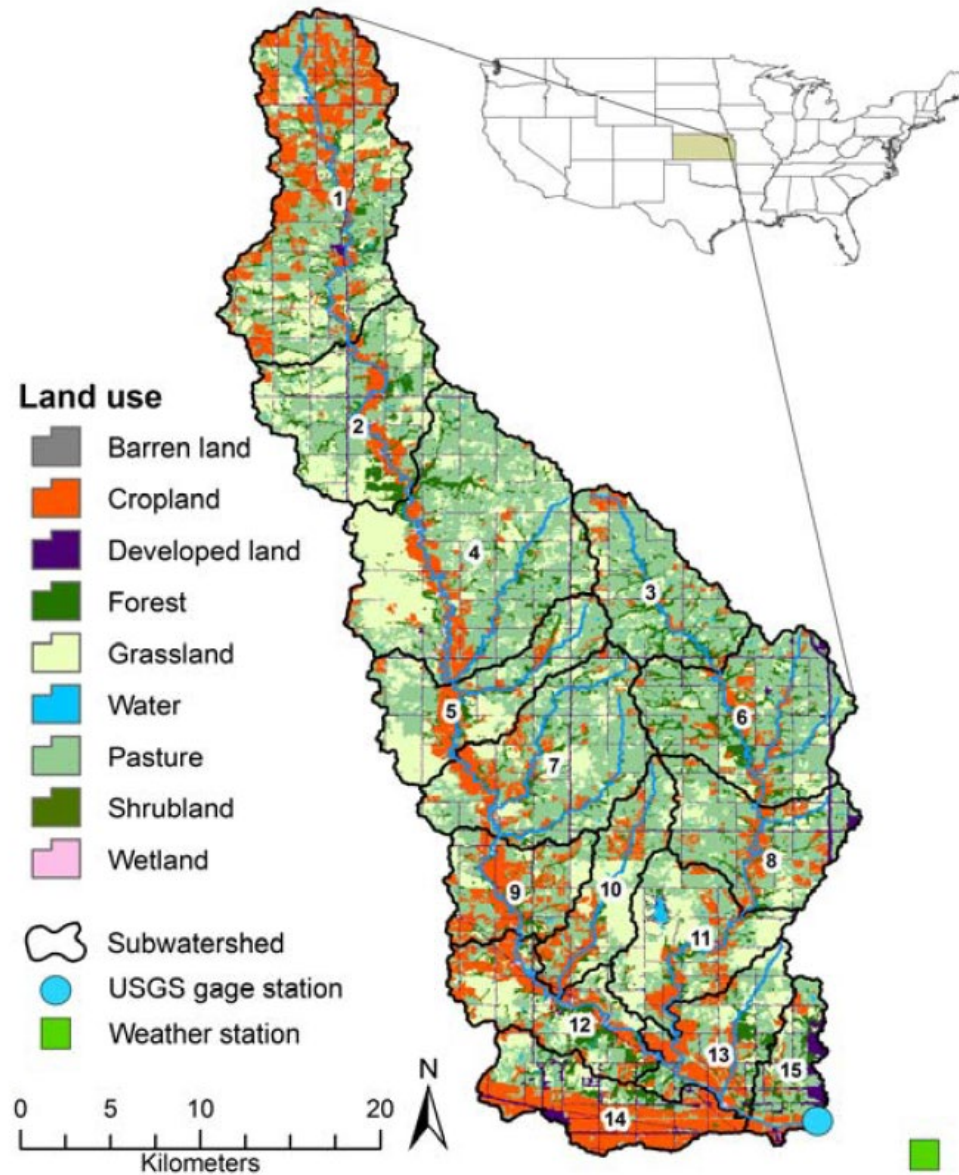
1. No till
2. Cover crops
3. Perennials & trees
4. Compost / mob grazing

These practices may be partially or fully adopted by farmers or range managers on **Grazing Land** or **Crop Land** within a watershed.

The Area Affected is uncertain, depending on the level of adoption of the land use practices.

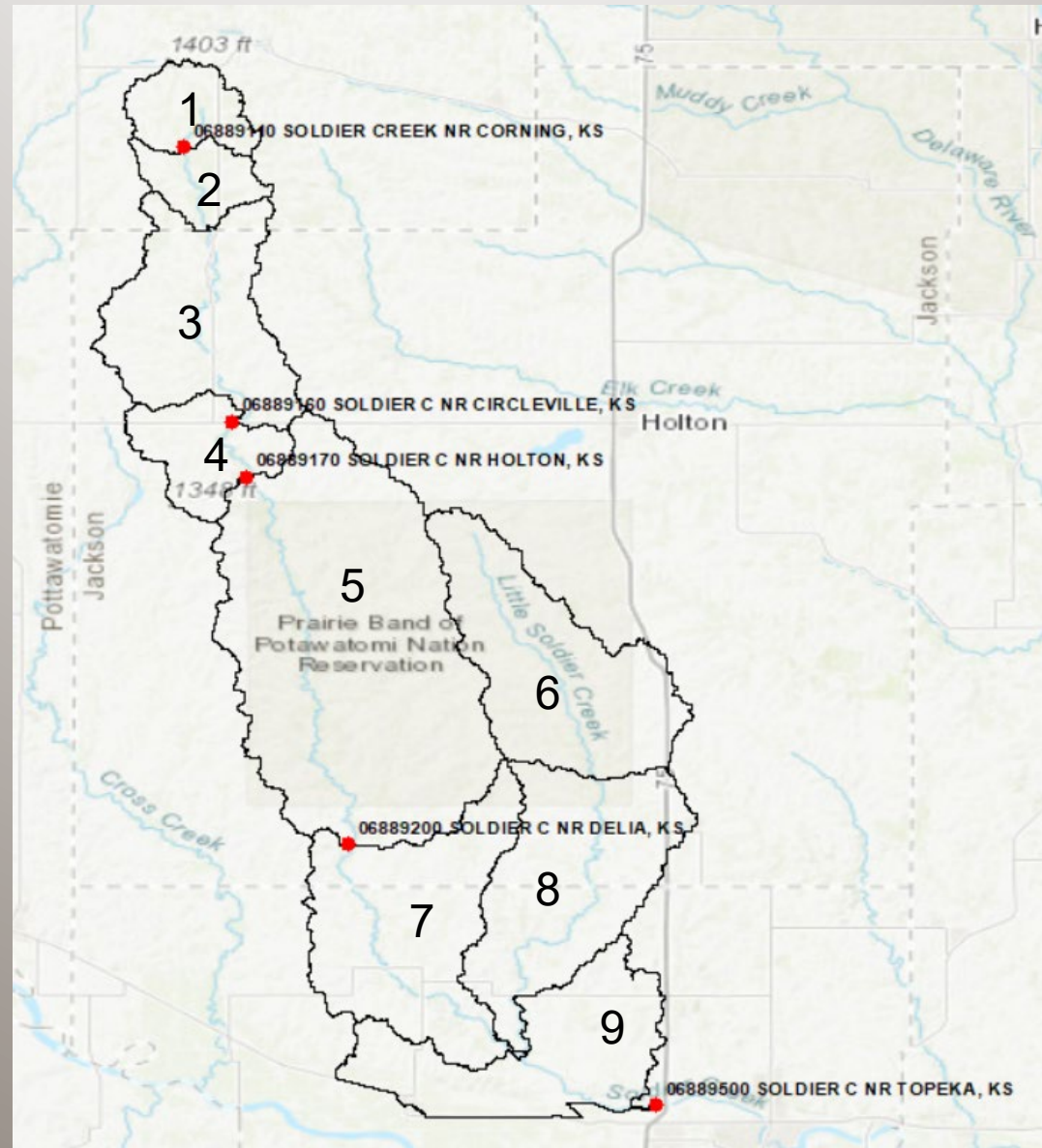
The team assumes two levels of adoption: 50% or 100% of the land





# ACTION – NEW HEC-HMS MODEL HYDROLOGIC ANALYSIS

## Hydrologic Engineering Center – Hydrologic Modeling System



Speaking: Gregory Karlovits

Jack Fitzgerald

Chris Janssen

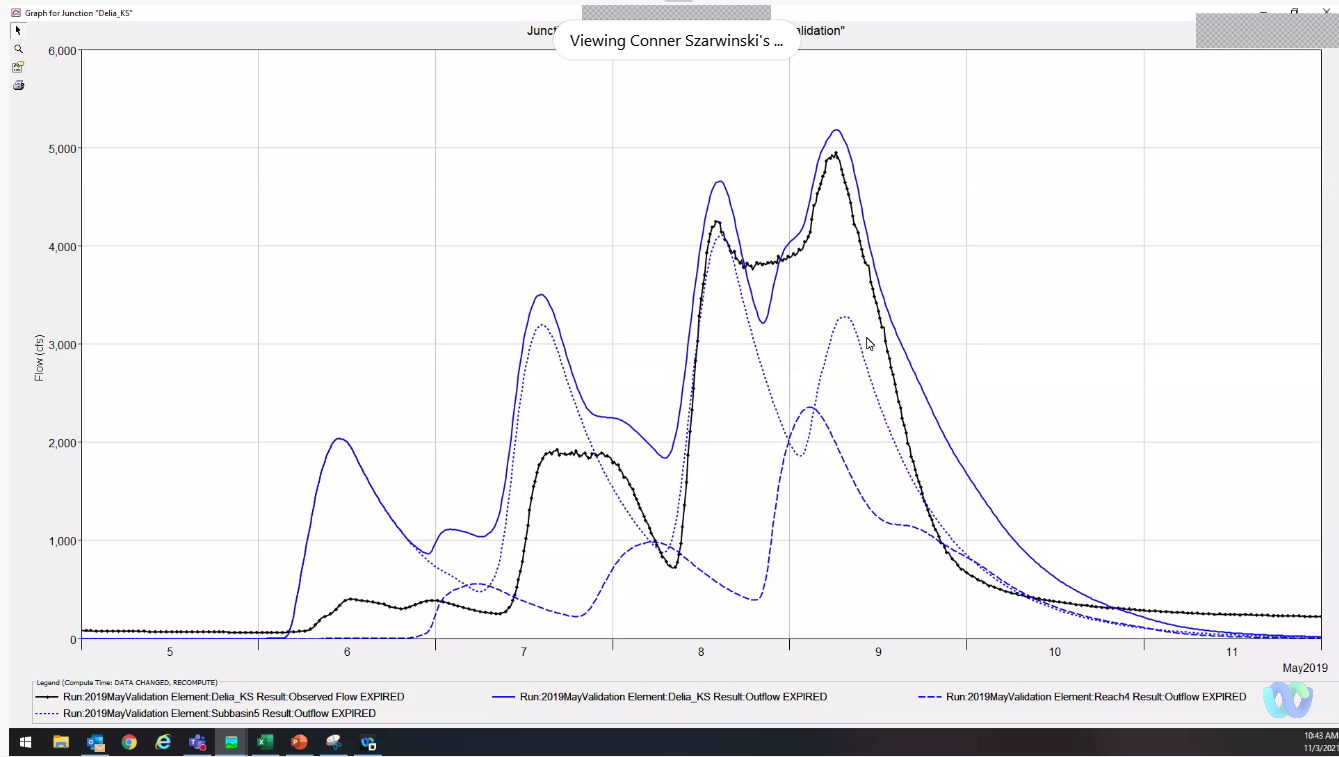
9136\*\*\*\*11

Emily Nusz

jchandle

Scott Satterthwaite

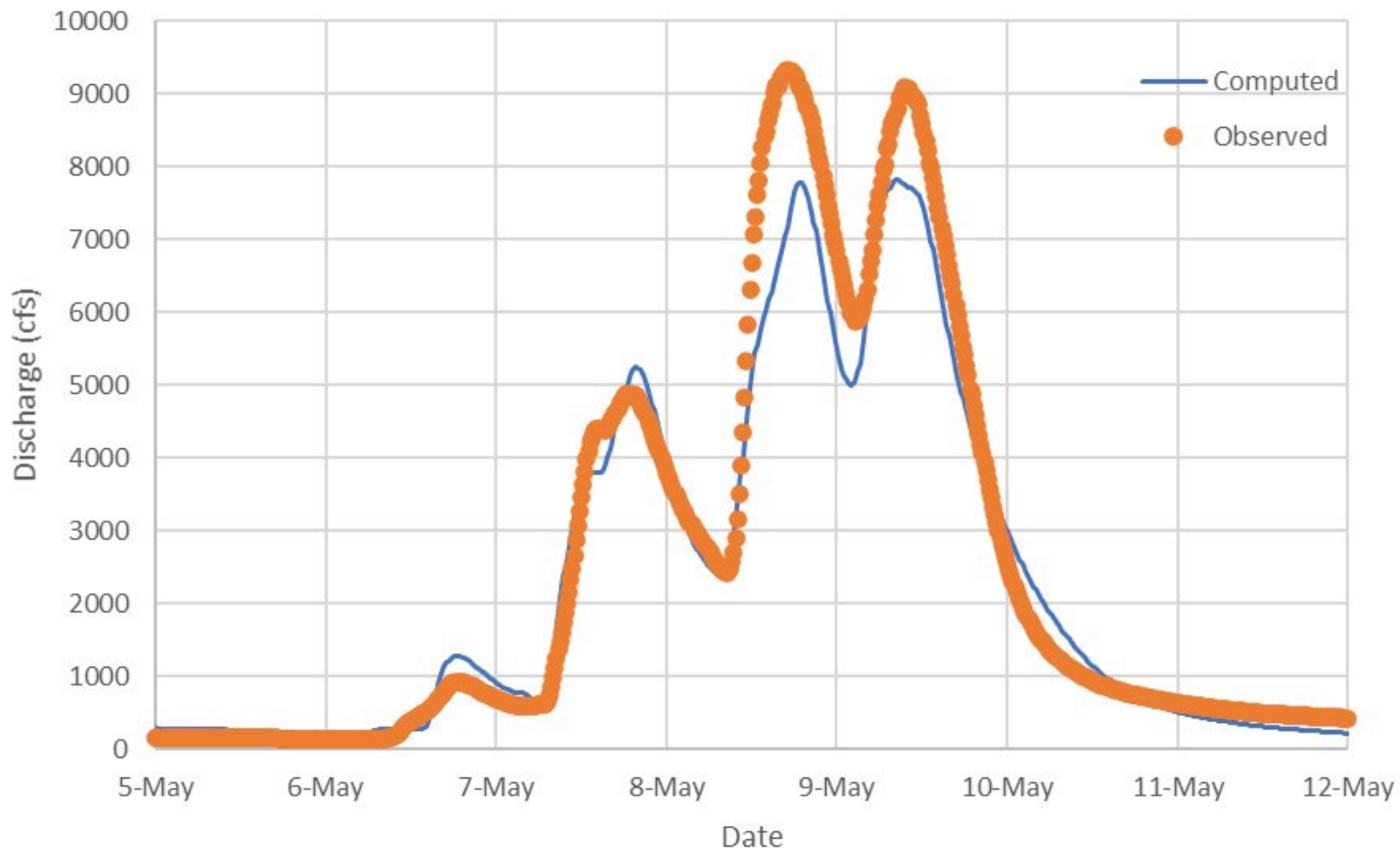
Layout



Mute Stop video Share Record

Participants Chat

## May 2019 near Topeka, KS



# ACTION – MAP THE AREAS ABLE TO IMPLEMENT THE PRACTICES

## Geospatial analysis

The team collected geographic data for land uses in each subbasin.

**Grazing Land** – including Pasture, Grassland, etc

**Crop Land** – varying between Corn, Soybeans, Wheat, etc



For the first 3 **scenarios**, these values were used:

**Organic Matter** content of the soil is 5 or 10%.

Each subbasin has a value **porosity**.

Next, 3 scenarios more scenarios evaluate saturated **hydraulic conductivity** increases of 50 and 100%.

Finally, 2 scenarios acknowledge how both **Organic Matter** and **hydraulic conductivity** for a 5% OM and a Ksat increase of 50%.



The analysis is centered on a sensitivity analysis of two variables in the hydrologic model that can characterize the soil that develops from regenerative agriculture.

- **Porosity** – air pockets in soil, which can be affected by Organic Matter (OM%)
- **Saturated Hydraulic Conductivity** pathways for water flow using the air pockets (Ksat), which are air pockets created by plants and animals in soil

The values vary based on how much organic matter, the plants and animals in the soil, and the type of soils.

The team established various **scenarios**. Scenarios were set up to represent the possible uncertainty in OM% and variation to the increase in Ksat based on land use that is under regenerative agriculture.

The changes to these soil characteristics tested how much affect is possible to the runoff and downstream flood peaks.

Organic carbon and aggregate stability are behind that porosity.



For the first 3 **scenarios**, these values were used:

**Organic Matter** content of the soil is 5 or 10%.

Each subbasin has a value **porosity**.

Next, 3 scenarios more scenarios evaluate saturated **hydraulic conductivity** increases of 50 and 100%.

Finally, 2 scenarios acknowledge how both **Organic Matter** and **hydraulic conductivity** for a 5% OM and a Ksat increase of 50%.



Scenarios, such as Scenario #8, capture varying degrees of implementation of the land use practices.

Research from previous studies provides supporting evidence on the effect of various levels of adoption of regenerative agriculture on both the Organic Matter content and the possible increases to the Saturated Hydraulic Conductivity.

Scenario	Subbasin	Grazing Land			Crop Land			Porosity	K <sub>Sat</sub>
		% Adoption	OM (%)	K <sub>Sat</sub> % Increase	% Adoption	OM (%)	K <sub>Sat</sub> % Increase		
08_5%OM 50%incr Ks 50% Area	1	50	5	50	50	5	50	0.498	0.029
	2	50	5	50	50	5	50	0.498	0.028
	3	50	5	50	50	5	50	0.487	0.061
	4	50	5	50	50	5	50	0.480	0.060
	5	50	5	50	50	5	50	0.486	0.020
	6	50	5	50	50	5	50	0.488	0.051
	7	50	5	50	50	5	50	0.491	0.051
	8	50	5	50	50	5	50	0.490	0.051
	9	50	5	50	50	5	50	0.499	0.045

Scenarios		Delia				Outlet (near Topeka)			
		Results		% Reduction		Results		% Reduction	
		Peak Flow (cfs)	Volume (in)	Peak Flow (cfs)	Volume (in)	Peak Flow (cfs)	Volume (in)	Peak Flow (cfs)	Volume (in)
Baseline	01	11,790	4.44	-	-	23,579	3.85	-	-
OM%	02	11,671	4.39	1.01%	1.13%	23,337	3.8	1.03%	1.30%
	03	11,559	4.35	1.96%	2.03%	23,108	3.75	2.00%	2.60%
	04	11,265	4.24	4.45%	4.50%	22,520	3.63	4.49%	5.71%
K <sub>Sat</sub>	05	11,427	4.31	3.08%	2.93%	22,824	3.71	3.20%	3.64%
	06	11,070	4.18	6.11%	5.86%	22,087	3.57	6.33%	7.27%
	07	10,356	3.93	12.16%	11.49%	20,702	3.31	12.20%	14.03%
Both	08	11,303	4.27	4.13%	3.83%	22,572	3.66	4.27%	4.94%
	09	10,813	4.09	8.29%	7.88%	21,582	3.46	8.47%	10.13%



Climate change sensitivity analysis, **NOAA Atlas-14** rainfall intensity factors for future flow projections. Existing conditions 1% AEP=47,568 cubic feet / second

## HEC-HMS Results for the 1% annual exceedance probability.

Future Without Project	Scenario (Future name)	Future Flow (cfs)	Percent Change for 2055 (min)
2055 (min)		55,188	
2055 (max)		58,543	
2085 (min)		57,181	
2085 (max)		67,123	
	02 (6)	54,639	-1.0%
	03 (7)	54,121	-1.9%
	04 (8)	52,761	-4.4%
	05 (9)	53,716	-2.7%
	06 (10)	52,257	-5.3%
	07 (11)	49,842	-9.7%
	08 (12)	53,130	-3.7%
	09 (13)	51,209	-7.2%

Combination effects of both variables in Scenarios 08 and 09





**US Army Corps  
of Engineers** ®  
Kansas City District

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KANSAS HEALTHY WATERSHED Study  
Hydrologic Modeling Sensitivity to Soil  
Parameters  
Soldier Creek Watershed

September 2021



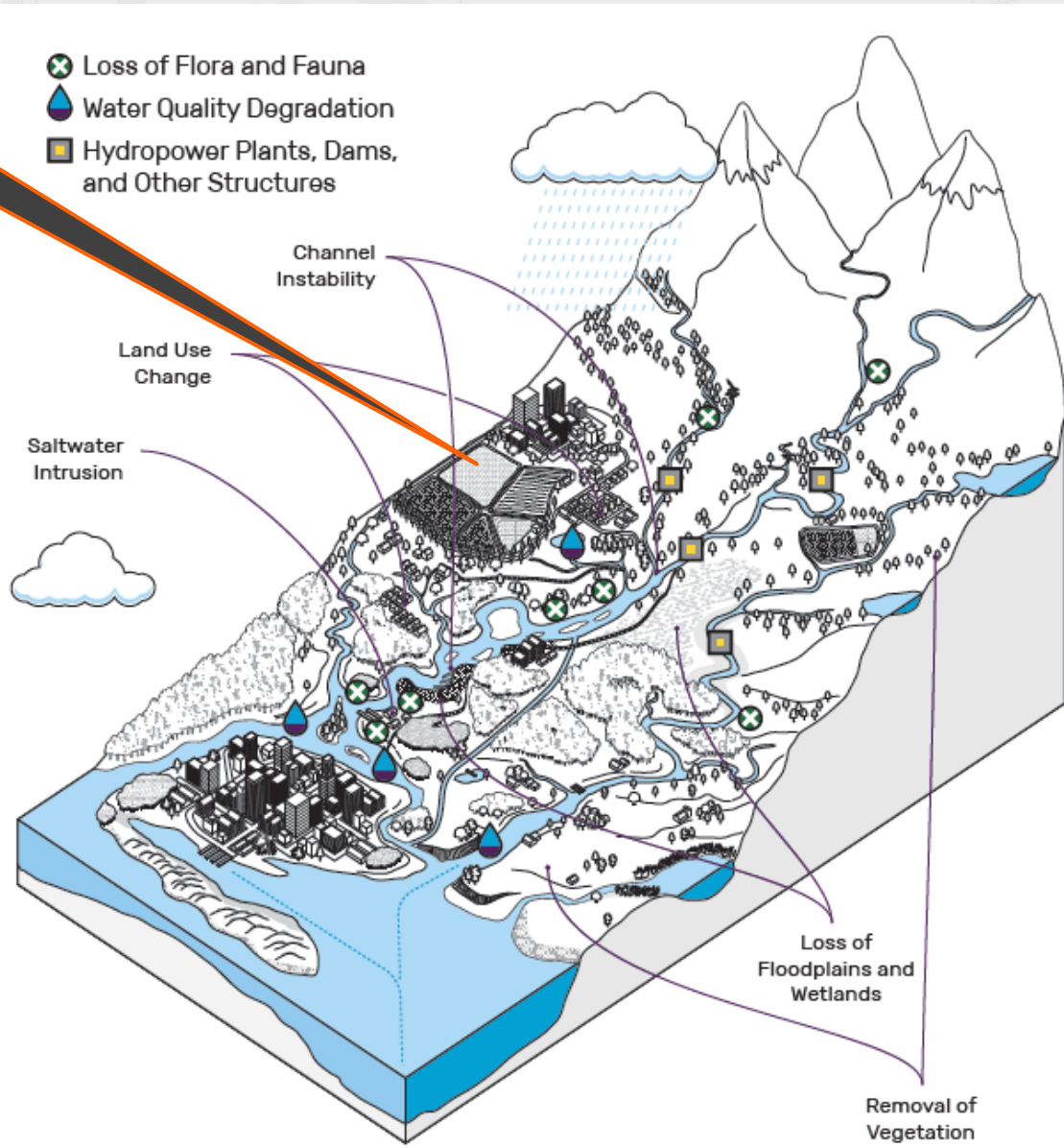
- Add climate change analysis for rainfall intensity projections
- Silver Jackets proposal
  - **Soils versus Structures:** Tradeoff Analysis
  - Watershed planning
- USACE Engineering Research and Design Center request for soil analysis on long-term effects of soil health practices on variables used in hydrologic models
- FEMA Direct Technical Assistance for a BRIC grant in the Big Blue Watershed (spans KS and NE)

# CONCLUSION



**Agriculture**

Potential  
solution  
to  
multiple  
issues

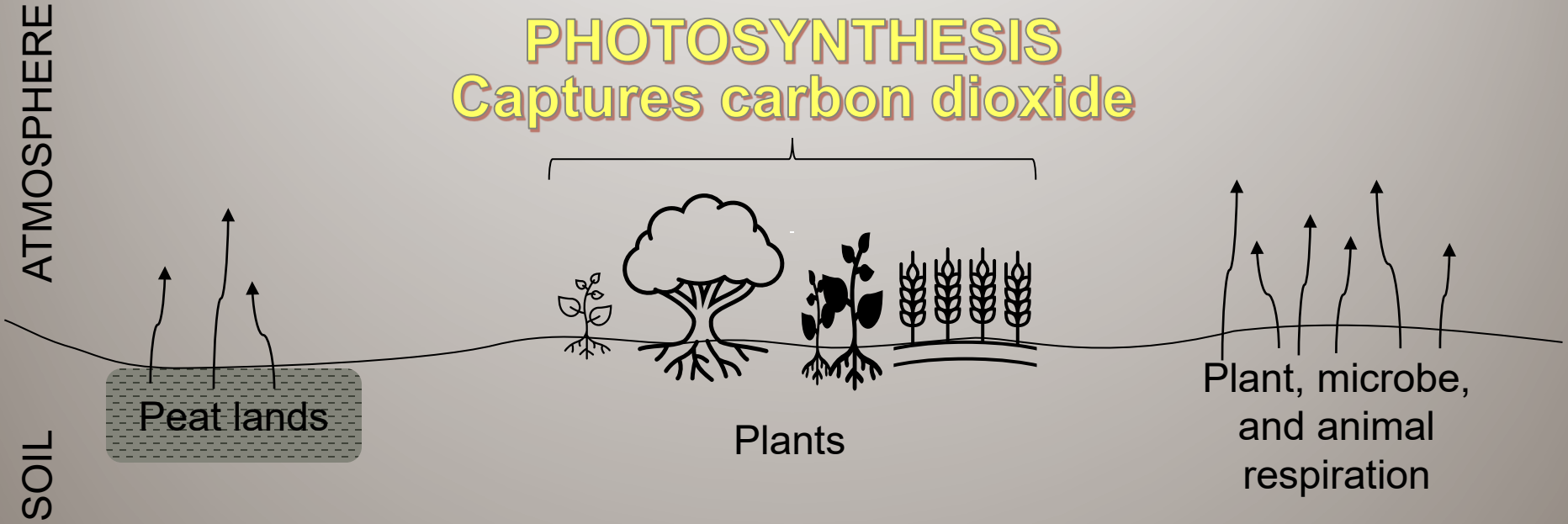


# CLIMATE CHANGE – CO-BENEFIT OF LAND USE PRACTICES (NO TILL FARMING, COVER CROPS, ETC)



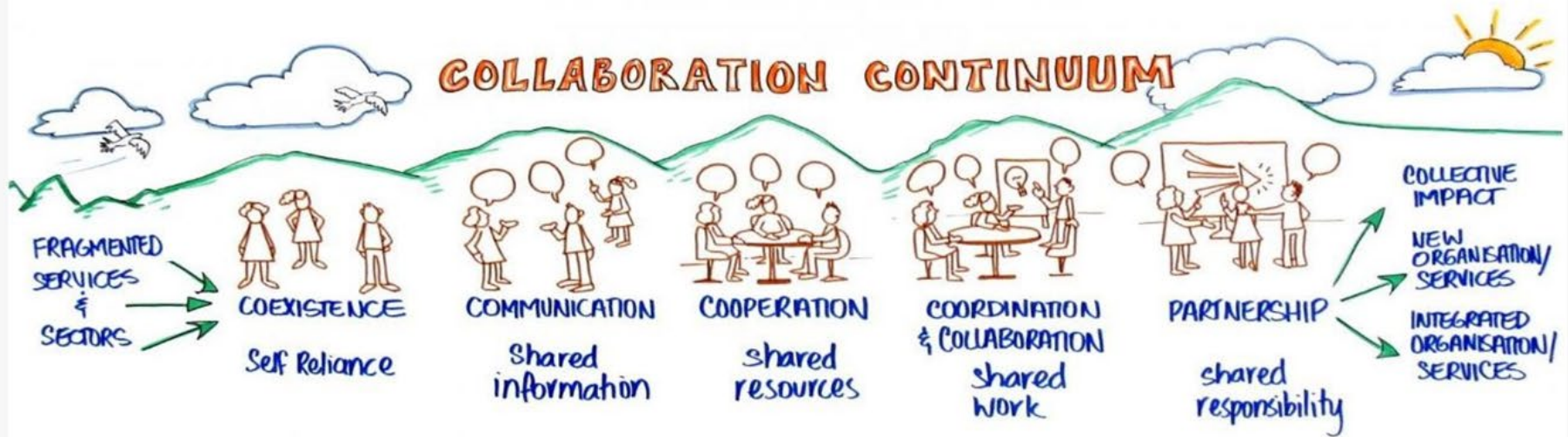
Earth's atmosphere stores 880 gigatons of carbon

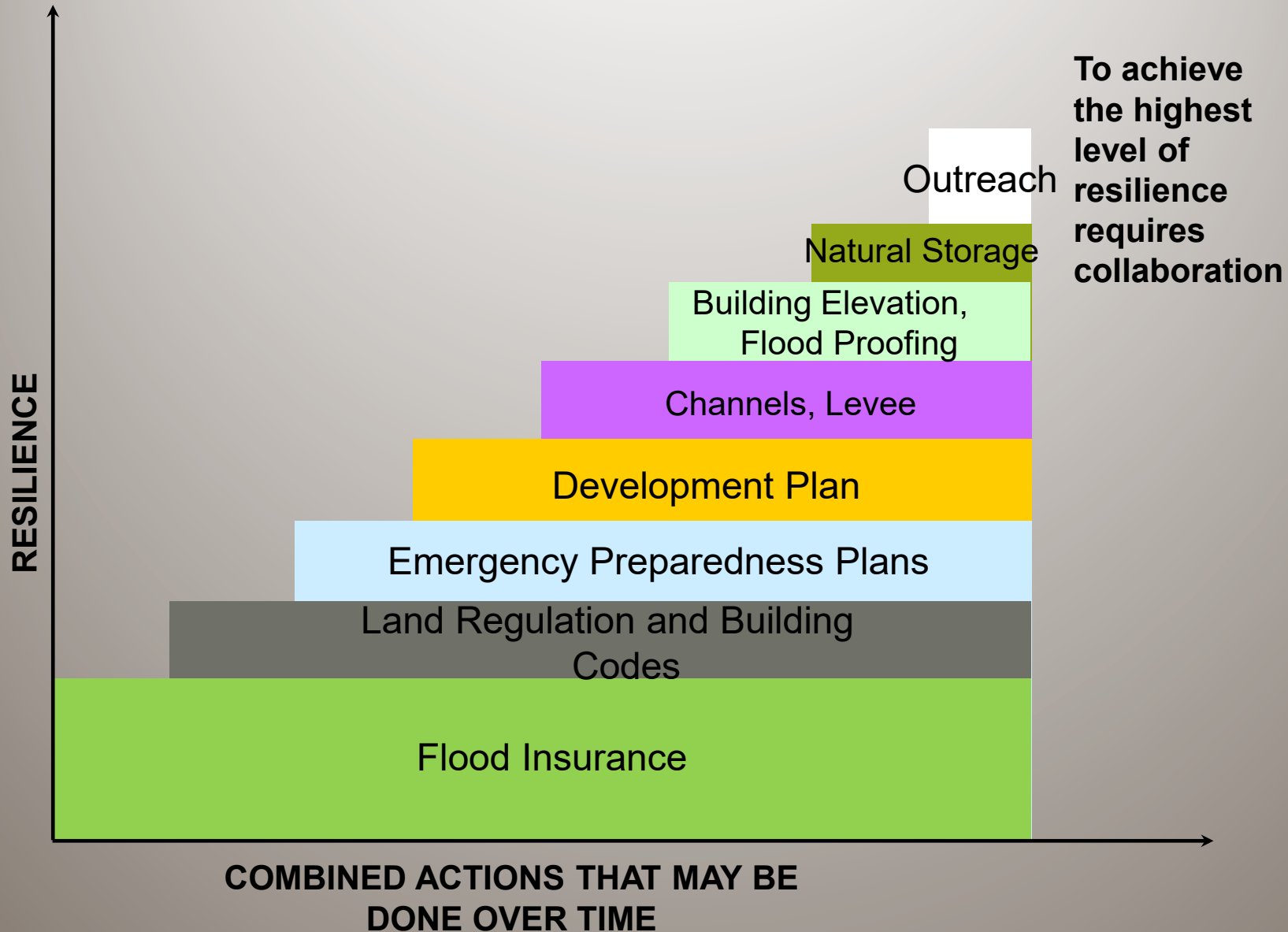
**PHOTOSYNTHESIS**  
Captures carbon dioxide

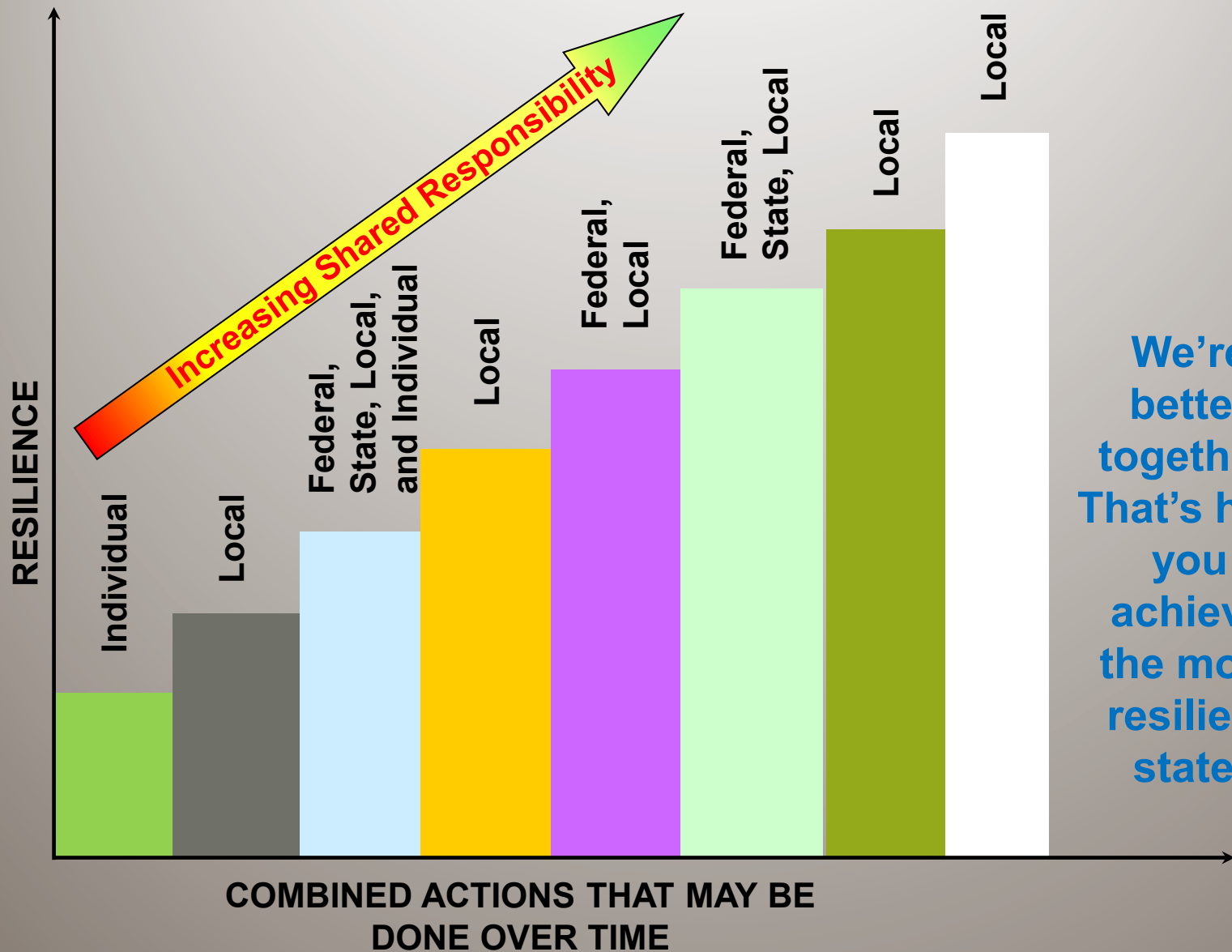


**CARBON DEPOSITION**

Top 1 meter of Earth's soil stores **2,500** gigatons of carbon







We're better together. That's how you achieve the most resilient state.

Kansas Dept of Health and Environment

- <https://www.kdhe.ks.gov/>

Kansas Natural Resources Conservation Service

- <https://www.nrcs.usda.gov/wps/portal/nrcs/site/ks/home/>

Kansas Watershed Restoration and Protection Strategy (WRAPS)

- <https://kswraps.org/links/>

USACE, Kansas Recent Projects

- <https://silverjackets.nfrmp.us/State-Teams/Kansas/Kansas-Recent-Projects>

USACE, Kansas River Basin Study (Section 729 authority)

- <http://tba>

USACE, Hydrologic Engineering Center, HEC-HMS software

- <https://www.hec.usace.army.mil/software/hec-hms/>

