



Watershed Wide Soil Health: The Next Frontier in Addressing Water Quality and Water Quantity

S. Satterthwaite, Candy Thomas and Brian Rast |

Watershed Management Section

- Through Environmental Protection Agency (EPA) Section 319 and State Water Plan Funds
 - Develops and Implements the Nonpoint Source Management Plan
 - Issues Section 401 Water Quality Certifications

Water Quality Goals

- No violation of water quality standards for designated uses due to nonpoint sources
- All Kansas' nonpoint sources use water quality protection measures
- Achieve Kansas Water Plan Objectives

Watershed Water Quality Planning

Watershed Restoration and Protection Strategies (WRAPS)

- 1998 Clinton Administration Clean Water Action Plan
 - WRAS-Watershed Restoration Action Strategy
- Restoration of Impaired Waters was based on monitoring, standards, and pollutant loading (Total Maximum Daily Loads)
- What about Protection?
 - WRAPS-Watershed Restoration and Protection Strategy was initiated by Kansas Department of Health and Environment (KDHE) Watershed Management Section (WMS)

A Collaborative Solution – KS-WRAPs

- Provides a framework for multi-faceted stakeholder leadership teams and other stakeholders to protect and restore Kansas watersheds through a collaborative planning and management process.
- This process consists of:
 - Identifying watershed restoration & protection needs
 - Establishing watershed goals
 - Creating plans to achieve goals
 - Implementing plans

kswraps.org



Source: KDHE

Mechanisms for Most Water Quality Protection

Nonpoint Source Pollution Control and the pollutants they address

- **Filter:** nutrients, sediment
- **Cover:** living- nutrients, sediment, pesticides; non-living- sediment, nutrients
- **Settle-nutrients:** sediment
- **Catch and Detain:** nutrients, sediment
- **Infiltrate and percolate: reduce runoff,** nutrients, sediment, bacteria, pesticides
- **Transform:** nutrients, pesticides
- **Neutralize/Kill:** pesticides, bacteria
- **Minimize:** nutrients, sediment, bacteria, pesticides
- **Product/practice:** Alternatives-nutrients, sediment, bacteria, pesticides
- **Avoidance:** physically or using alternatives
- **Stream or shoreline stabilization:** nutrients, sediment
- **Removal (dredge sediment):** nutrients, sediment -most costly

Why Soil Health?

- Increase infiltration and reduce runoff and associated materials
- Decrease erosion
- Reduce chemical inputs
 - Fertilizer
 - Pesticides
- Improve crop production (win-win)
 - Increase organic matter
 - Increase nutrient cycling



Source: envcoglobal.com

Next Up!

Candy Thomas Natural Resources Conservation Service (NRCS) Regional Soil Health Specialist will show you why watershed wide soil health improvement is the key to addressing many of our natural resource issues.



Soil Health in NRCS

Candy Thomas
NRCS-Soil Health Division
Regional Soil Health Specialist
IA, KS, NE



KDHE use permission granted by NRCS for next 5 slides

NRCS | SHD | Introduction to Soil Health | v2.3

How does NRCS Define Soil Health?

The continued capacity of the soil to function as a vital living ecosystem that sustains plants, animal and humans.



Watershed Wide Soil Health



What Functions Would We Like our Soil to Provide?

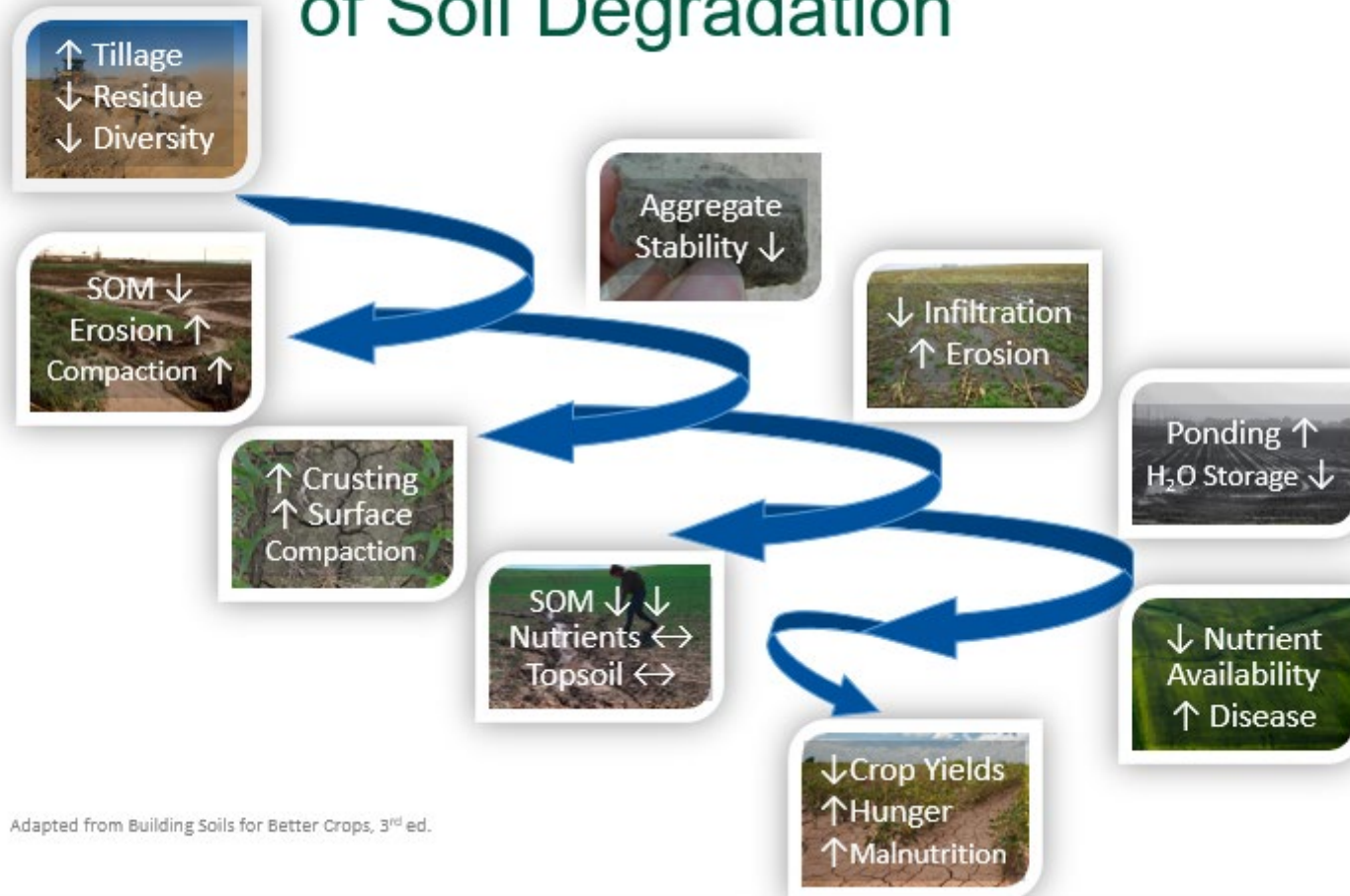
- Produce food, feed, fiber, biofuels & medicine
- Capture, filter, and store water
- Cycle and recycle nutrients
- Resilience to drought, flood & temp extremes
- Protect plants from pathogens and stress
- Detoxify pollutants
- Store C and moderate release of gases
- Resist erosive forces

Source: NRCS

Watershed Wide Soil Health

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Downward Spiral of Soil Degradation



Adapted from Building Soils for Better Crops, 3rd ed.

Source: NRCS

Six Soil Health Principles

- Know your context
- Do not disturb
- Cover and build surface armor
- Diversify plantings
- Keep living root in the soil
- Grow healthy animals and soil together



Source: KDHE

Soil Health Practices

- Minimum soil disturbance
 - No-till
 - Reduce biology-disrupting chemicals
- Rotations
- Cover crops
- Nutrient management
- Livestock grazing
- Field observation and monitoring
- Integrated pest management



Source: KDHE

Peer-to-Peer Mentoring and Resources

- EPA Farmer to Farmer Grant
- Understanding Ag Consulting
- Western Kansas Soil Health Coaching
- Kansas Soil Health Alliance



Source: KDHE

Healthy Soils Ag Management Systems

The potential for much needed added benefits

Most of the water quality impairments in Kansas are caused by runoff and associated materials.



Source: KDHE

Watershed Wide Soil Health

FEMA Building Resilient Infrastructure in Communities- BRIC Pilot Project Nature Based Solutions for (Flash) Flood Mitigation

COMMUNITY AREA SOLUTION	PROS	CHALLENGES	WATERSHED AREA SOLUTION	PROS	CHALLENGES
Wetlands protection, restoration or creation, stormwater infiltration basin:	Structures should be effective as designed and funded as eligible	Initial expense (\$) and maintenance. May fall into disrepair and be a safety hazard. If not kept tidy, could be a nuisance	Dams:	Structures are designed and funded as eligible	(\$ and maintenance
Riparian restoration	May be more attractive to community and improve WQ	(\$ and maintenance probably need volunteers	Strategically Located regenerative ag (ag producer maintains through practices and is profitable, likes it). Could help revive rural communities, produce healthier food.	More sustainable, KDHE has system to help facilitate the implementation. Could help underserved and small communities who can't meet the benefit ration cost needed for FEMA	May not find interested party. Community may not support
Vegetated drainage swales	Ditto from above	(\$ and maintenance	Land purchase/easements (\$) and maintenance	Nature conservancy, KDA and others can help.	Ditto from above

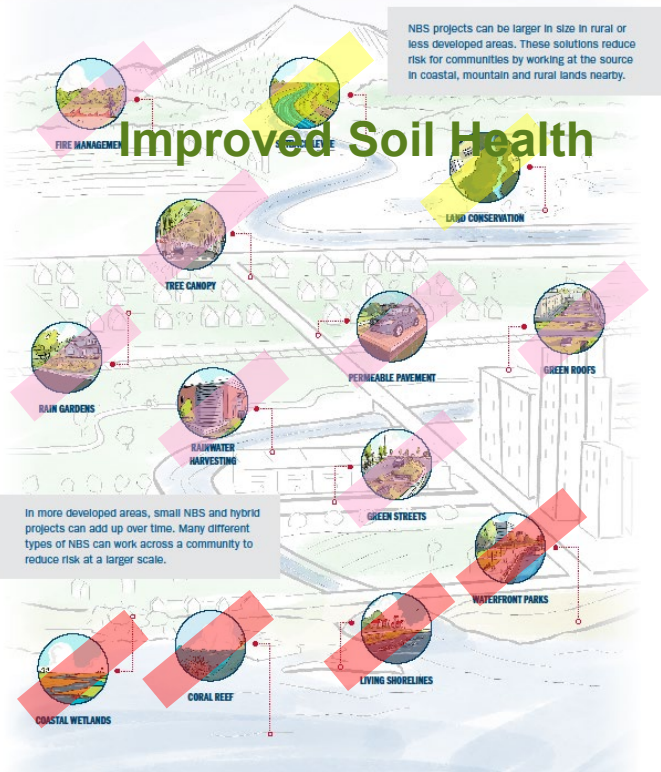
Watershed Wide Soil Health

Remember Federal Emergency Management Agency (FEMA) works with the community impacted; 319 doesn't have too.

USING NATURE-BASED SOLUTIONS
ACROSS LANDSCAPES



NBS projects can be larger in size in rural or less developed areas. These solutions reduce risk for communities by working at the source in coastal, mountain and rural lands nearby.



Legend: Kansas actions with FEMA BRIC?



Caution on trying to buy private Land

Have been demonstrated or not considered a water quality priority in a plan

Not Applicable for Kansas

IMPROVING SOIL HEALTH WATERSHED WIDE CAN HELP BRING THE HYDROLOGY BACK TO EQUILIBRIUM.

Where did this idea come from?

If it does not runoff, it is less of a water quality or a flash flood problem.

- Working with Nonpoint Source in Kansas, it was determined a watershed approach was needed.
- Water quality protection and restoration: the goal is to implement programs for water quality conditions to meet water quality standards for designated uses
- After 30+ years of working on these goals, it was evident the way to make significant progress is to increase infiltration on broad expanses of land.
- Via workshops with producers, we heard about farmers' experiences.



Source: US Army Corps of Engineers

The Economics of Improving Soil Health – Return on Investment

- We need to develop a process for farmers and ranchers to be and stay profitable to improve water quality and reduce flash flooding.
- **Remember the six principles of soil health systems management? Think of how extreme rain and drought events can be addressed through significantly improved soil health.**

The Economics of Improving Soil Health – Return on Investment

- Reduce input costs each year. In two to three years could see a significant trend of:
 - Reduce fertilizer use by increasing diversity after the cash crop and biological diversity under the cash crop field.
 - Nutrient management for improved nutrient cycling, planting nitrogen fixing legumes (creates usable forms from the atmosphere for plant to uptake), cash crop rotation, integrate grazers properly.
 - Keeping soil and nutrients where they are needed on the field for crops and pasture
 - Reducing the need for pesticides (herbicides, insecticides, fungicides) to avoid impacting beneficial insects.

The Economics of Improving Soil Health > Dollars

- Reducing the need for pesticides (herbicides, insecticides, fungicides) to avoid impacting beneficial insects:
 - by using allelopathic characteristics of cover crops
 - using cover species to out compete undesirables that compete with cash crops
 - fewer herbicide applications needed and can be timed to avoid heavy rainfall
 - unused fertilizer by the crop can stimulate weed growth
 - not tilling can avoid bringing up legacy seed resulting in less detrimental weed pressure
 - using grazers is considered weed control
 - predators of insects (spiders, birds etc.) can control other pests

The Economics of Improving Soil Health – Investment

Agricultural fields are by far the largest land uses in Kansas. Why not pay dollars to farmers and landowners what their land is worth for their ability to change the hydrology resulting in improving water quality reducing the hydrograph and peak flows. I.E., pay them to grow “infiltration basins on their farms”. They would maintain the systems because they are profitable, bring back family members to the farm, provide healthier food, more resilient local environments, reduce fed assist.

Peak flows? Flooding? That is the Kansas Department of Agriculture – Division of Water Resources and FEMA’s business, right? With increasing weather extremes and other factors, FEMA, EPA, USDA and U.S. Army Corps of Engineers see a need to try and integrate watershed water quality plans with watershed water quantity plans. Wait, What. How much land, how much infiltration, who is going to pay for it, is this a real deal?

Kansas Healthy Watersheds

- U.S. Army Corps of Engineers (USACE) Silver Jackets Project facilitated through the Kansas Hazard Mitigation Team assisted by the USACE Civil Service group.
- Silver Jackets is not a grant, it is a process by which USACE will use their resources to plan, manage and implement a flood or emergency planning, technical assistance, implementation etc. project with a state hazard mitigation team. <https://silverjackets.nfrmp.us/State-Teams/Kansas>.
- Approved by USACE HQ review board in 2020.
- A technical report titled: “Kansas Healthy Watershed Study Hydrologic Modeling Sensitivity to Soil Parameters Soldier Creek Watershed: Flood Plain Management Program Kansas Healthy Watershed – Soldier Creek.” kswraps.org/kansas-healthy-watersheds-project/.
- Used the Green and Ampt Method to modify the HEC-HMS Model using actual soil health data, that is infiltration rate, organic matter resulting in porosity, KSAT.



Source: Google Earth Pro

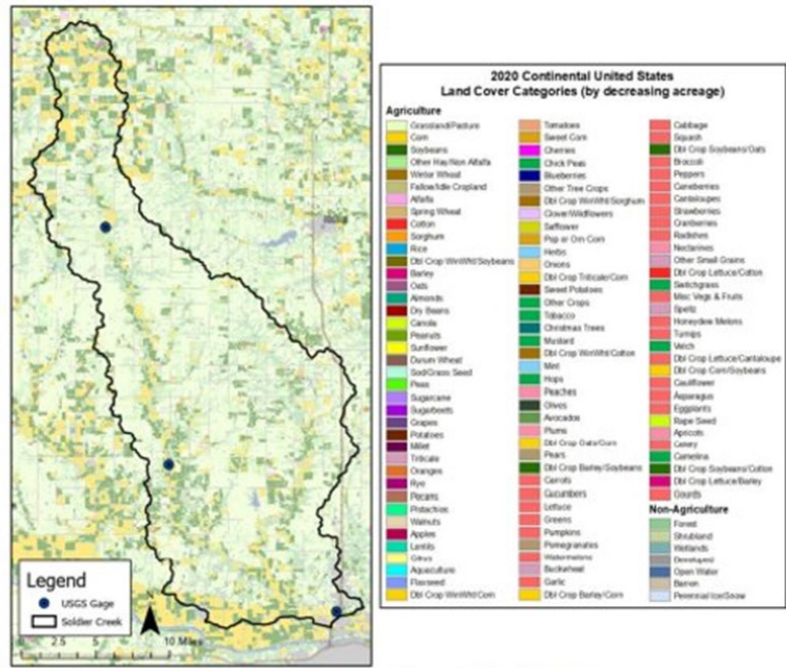


Figure 1. Soldier Creek 2020 Land Cover based on 2020 USDA Crop Data Layer

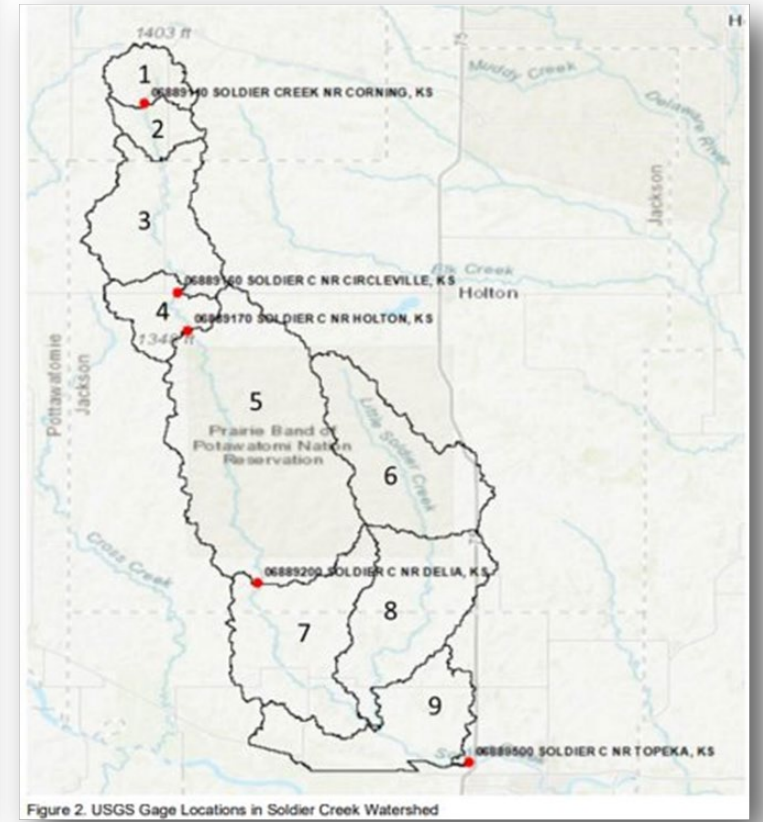


Figure 2. USGS Gage Locations in Soldier Creek Watershed

Source: U.S. Army Corps of Engineers Kansas City District

What does the Kansas healthy watersheds research show?

- There is less runoff and lower flood peaks in a watershed where soil health management systems cause the soil to act more like a sponge. Study showed if we improved the infiltration rate from 2 to 4% and organic matter from 2 to 4%, over 50% of the watershed we could reduce the peak flows and potential flash flooding by 12 percent in the previously described Soldier Creek Watershed.
- The smaller volume and lower speed of runoff water **decreases** the modelled likelihood of downstream **flood damage**.
- The delivery system in the next two slides is the key to successful downstream resiliency.

Watershed Wide Soil Health Implementation

1. The KDHE WRAPS Coordinator funded through EPA 319 identifies potential participants in the focus area of the impacted community.
2. WRAPS has funding to help with cover crop seed.
3. KDHE pays for a consultant coach to get them thinking about their goals and collect soil samples for soil health analysis from a contracted lab.
4. KDHE pays through another Environmental Protection Agency grant for farmer-to-farmer mentorship.

Watershed Wide Soil Health Implementation

5. Through the partnership with WRAPS sponsor and a community with Clean Water Revolving Loan Funds, Hagie/Montag Inter-seeders were purchased. They were leased to producers and Coops for a \$1 with a caveat they had to plant 5,000 acres of cover crops in the WRAPS focus area.
6. We would also investigate other equipment they may need and try to develop a strategy to provide one.
7. **Ag producers may not get responses from their local conservation office or Extension before or after office hours. That is what we pay coaches and mentors for so producers can get counsel in a timely fashion.**

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At the finish line: Brian Rast USACE: new Silver Jackets project called: Soil vs. Structure