Nature-Based Solutions to Flooding, Drought, and Groundwater Declines

Bryan Hummel

Non-Point Source Pollution Scientist

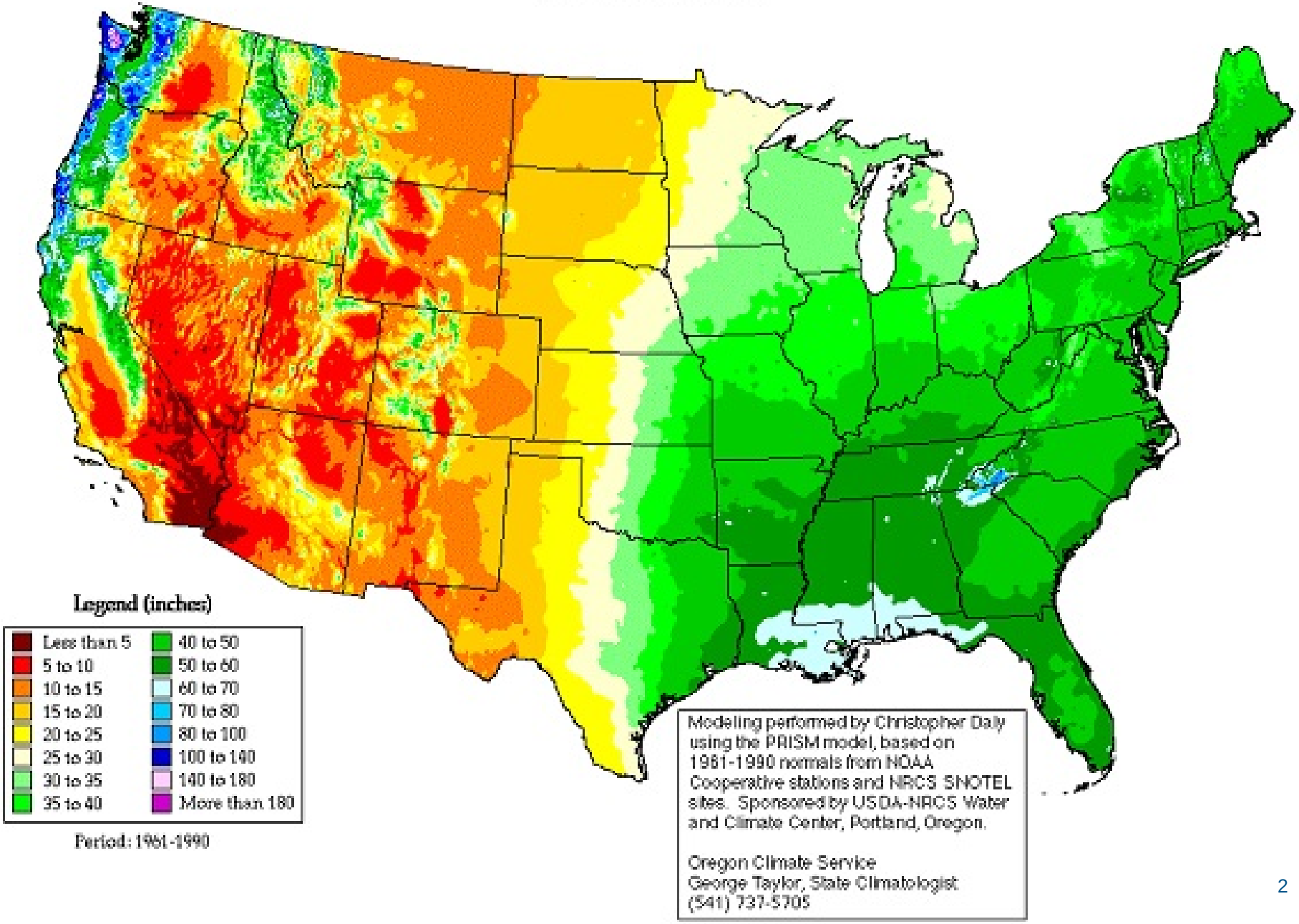
EPA Region 4

ASFPM 2019 Flood Fest

May 23, 2019

Annual Average Precipitation

United States of America

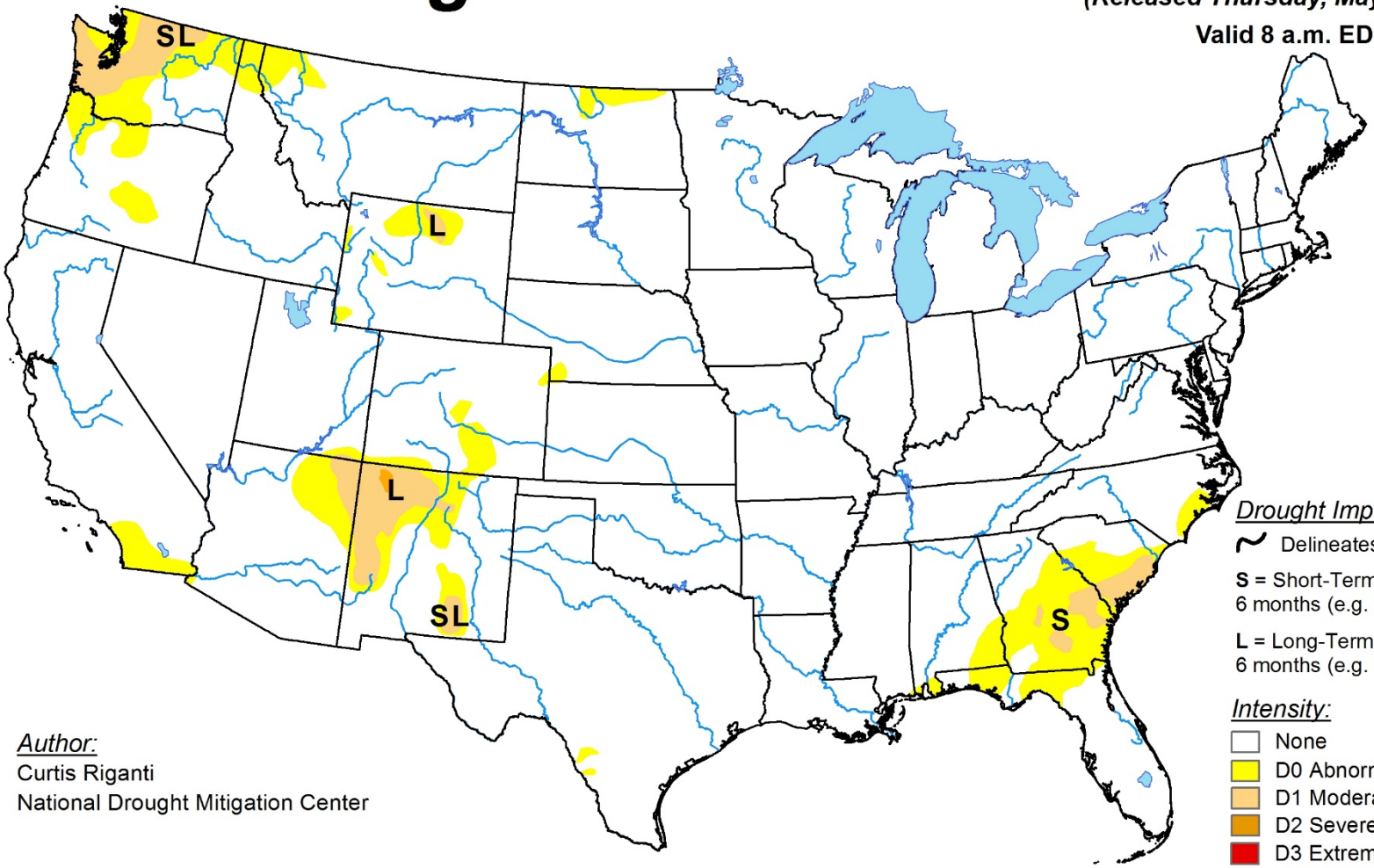


U.S. Drought Monitor

May 14, 2019

(Released Thursday, May. 16, 2019)

Valid 8 a.m. EDT



Drought Impact Types:

Delineates dominant impacts

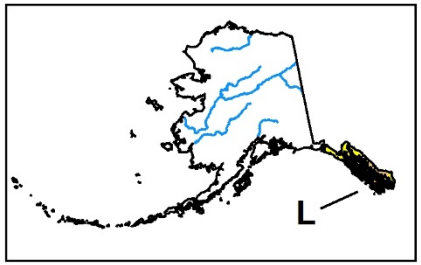
S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

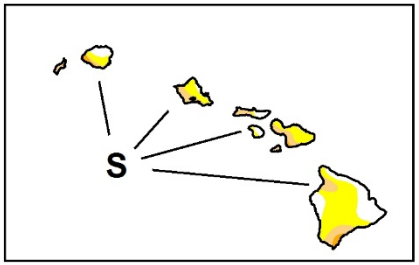
L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

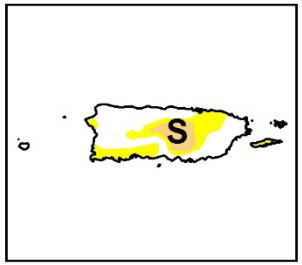
Intensity:

- None
- D0 Abnormally Dry
- D1 Moderate Drought
- D2 Severe Drought
- D3 Extreme Drought
- D4 Exceptional Drought

Author:
Curtis Riganti
National Drought Mitigation Center



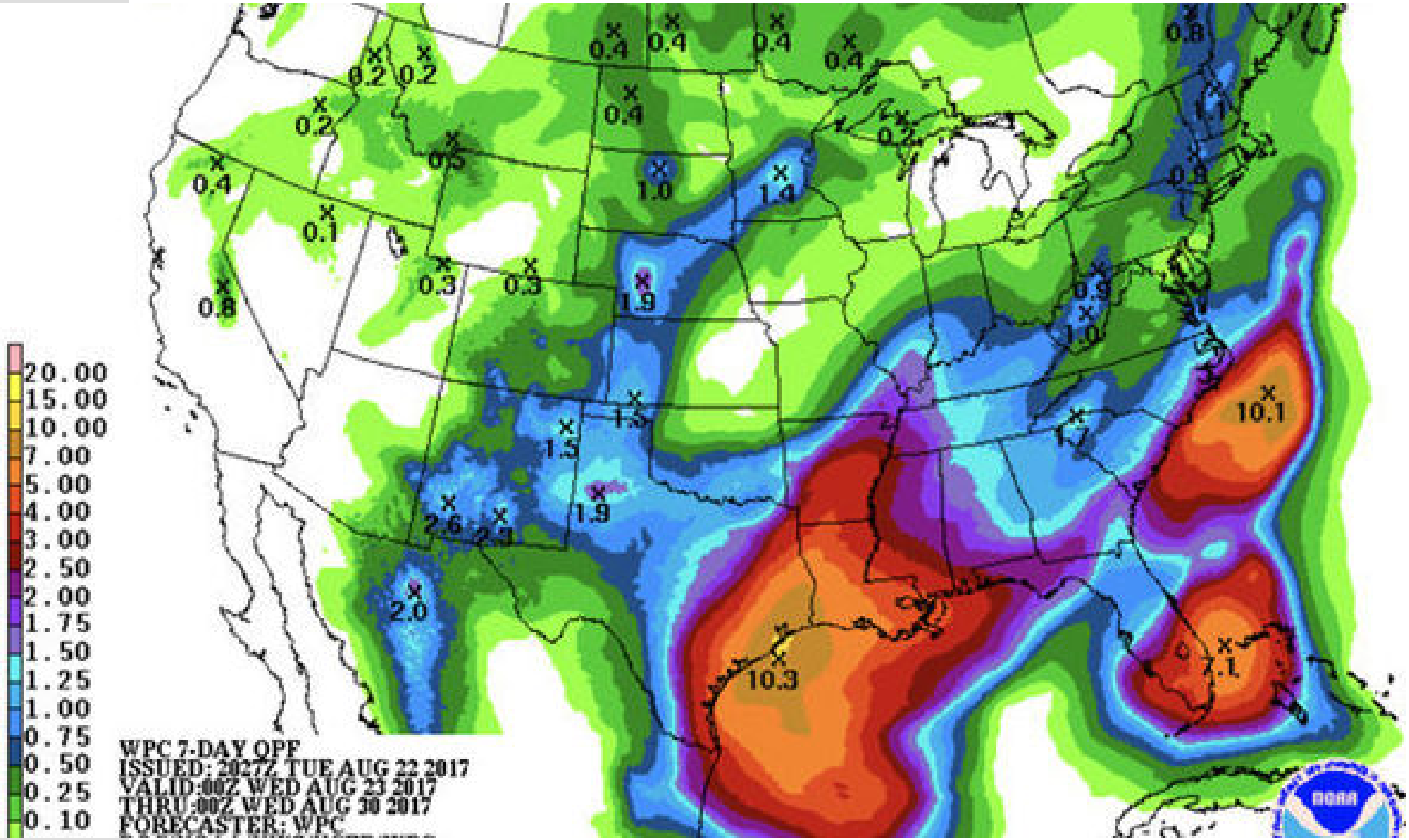




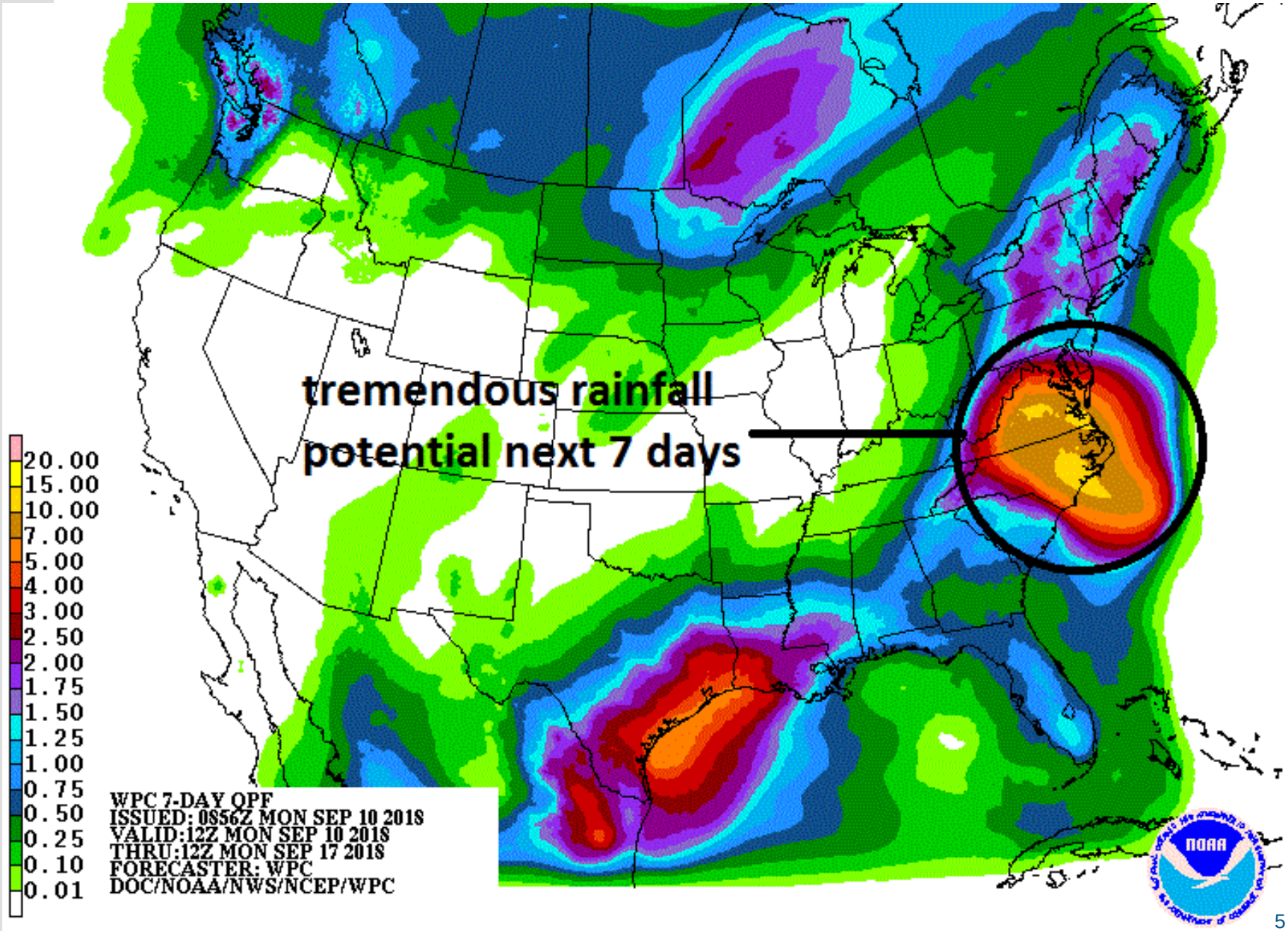
The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

droughtmonitor.unl.edu

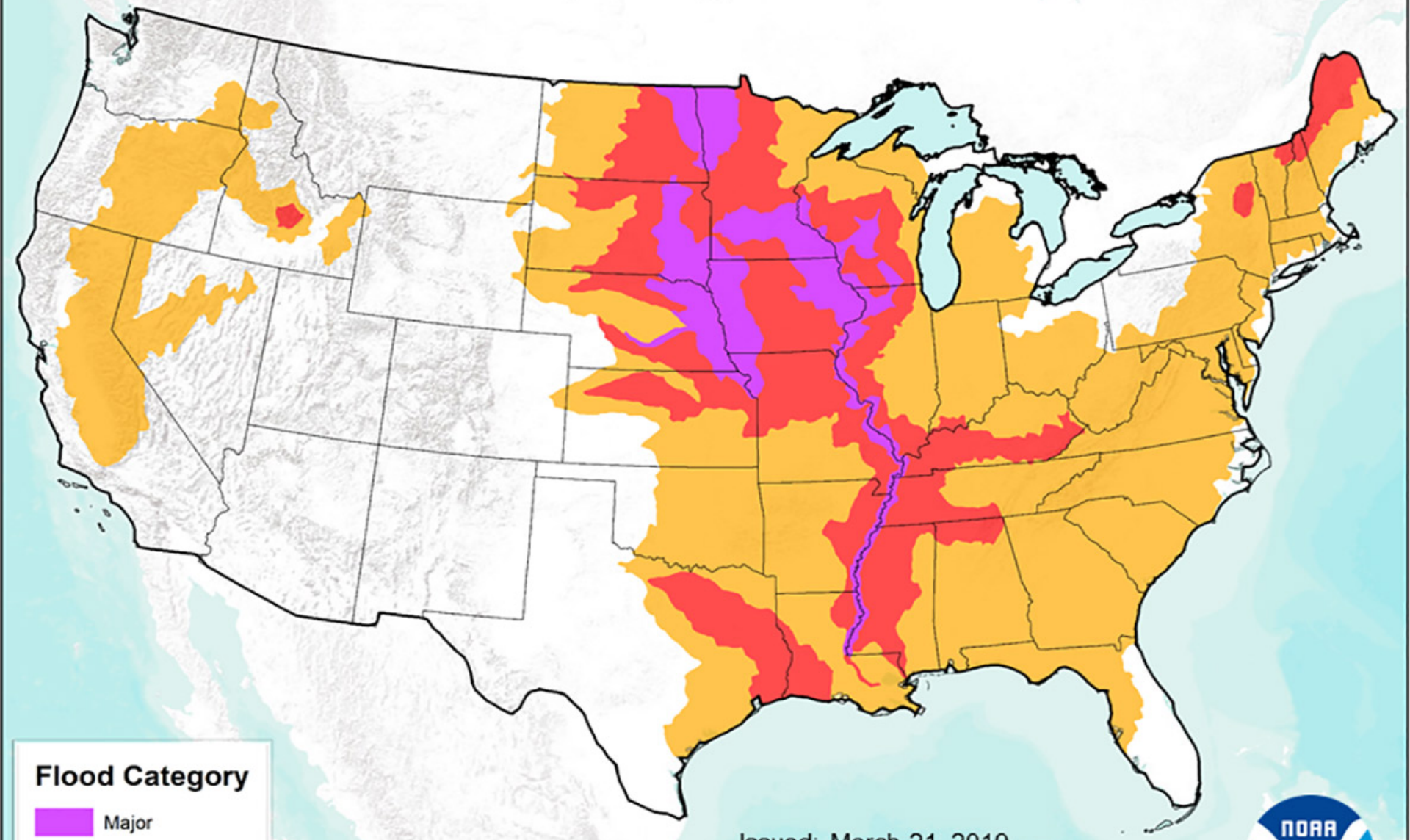
Hurricane Harvey 2017



Hurricane Florence 2018



2019 U.S. Spring Flood Outlook

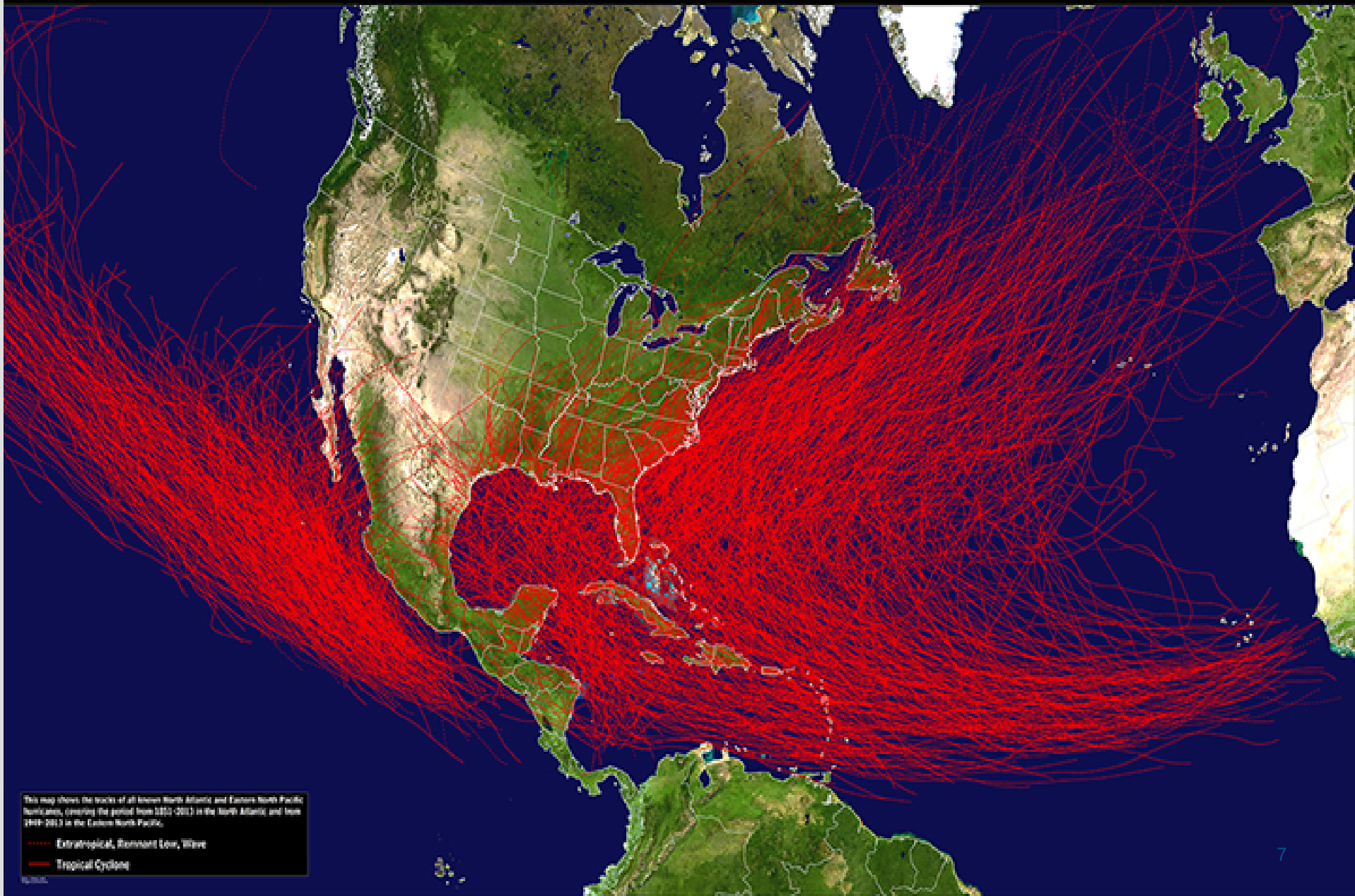


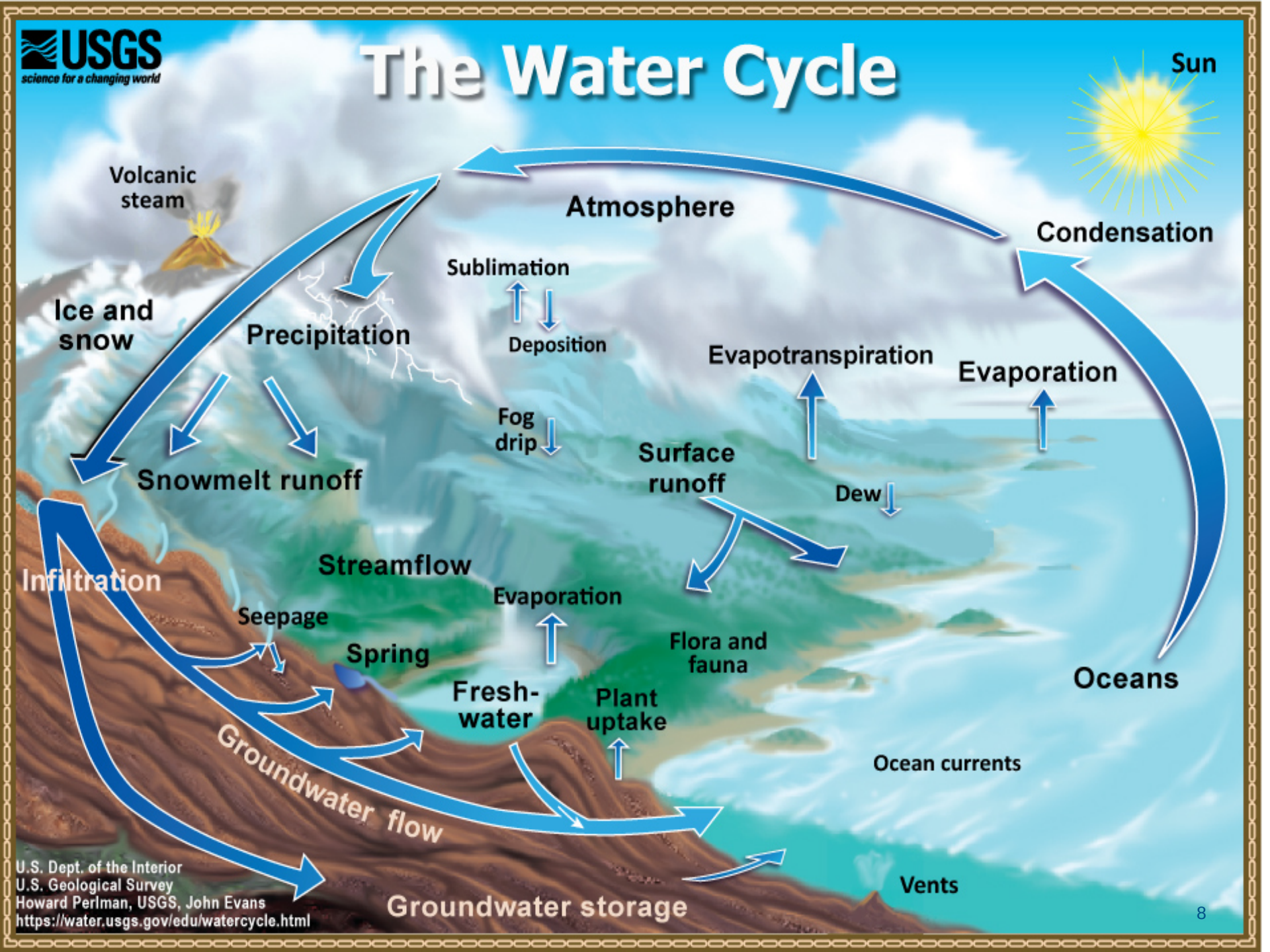
Issued: March 21, 2019

This U.S. map depicts locations where minor, moderate or major flooding is likely (>50% chance) during March – May 2019.

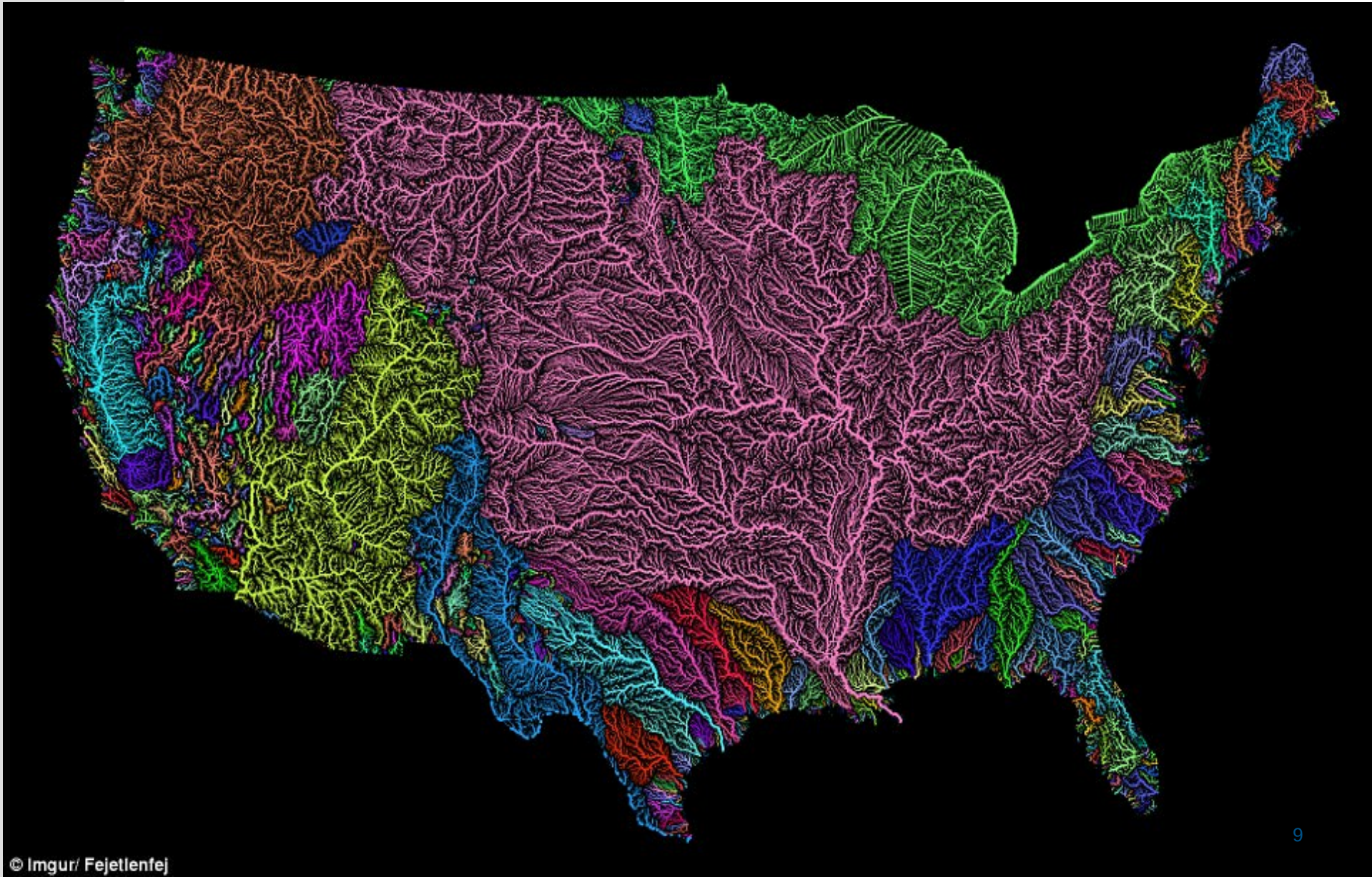
Hurricane History

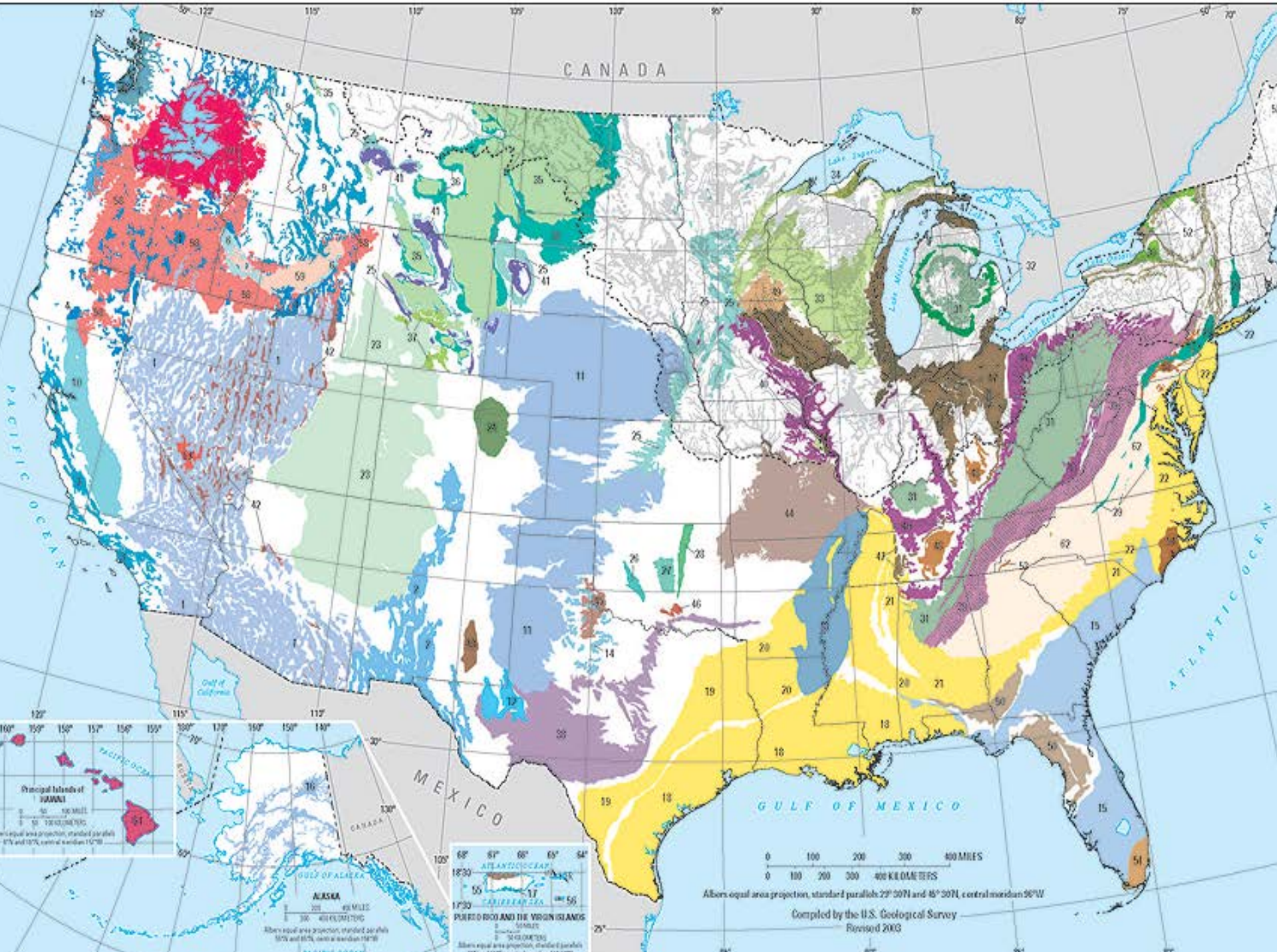
Data from 1949 in the Pacific, from 1851 in the Atlantic



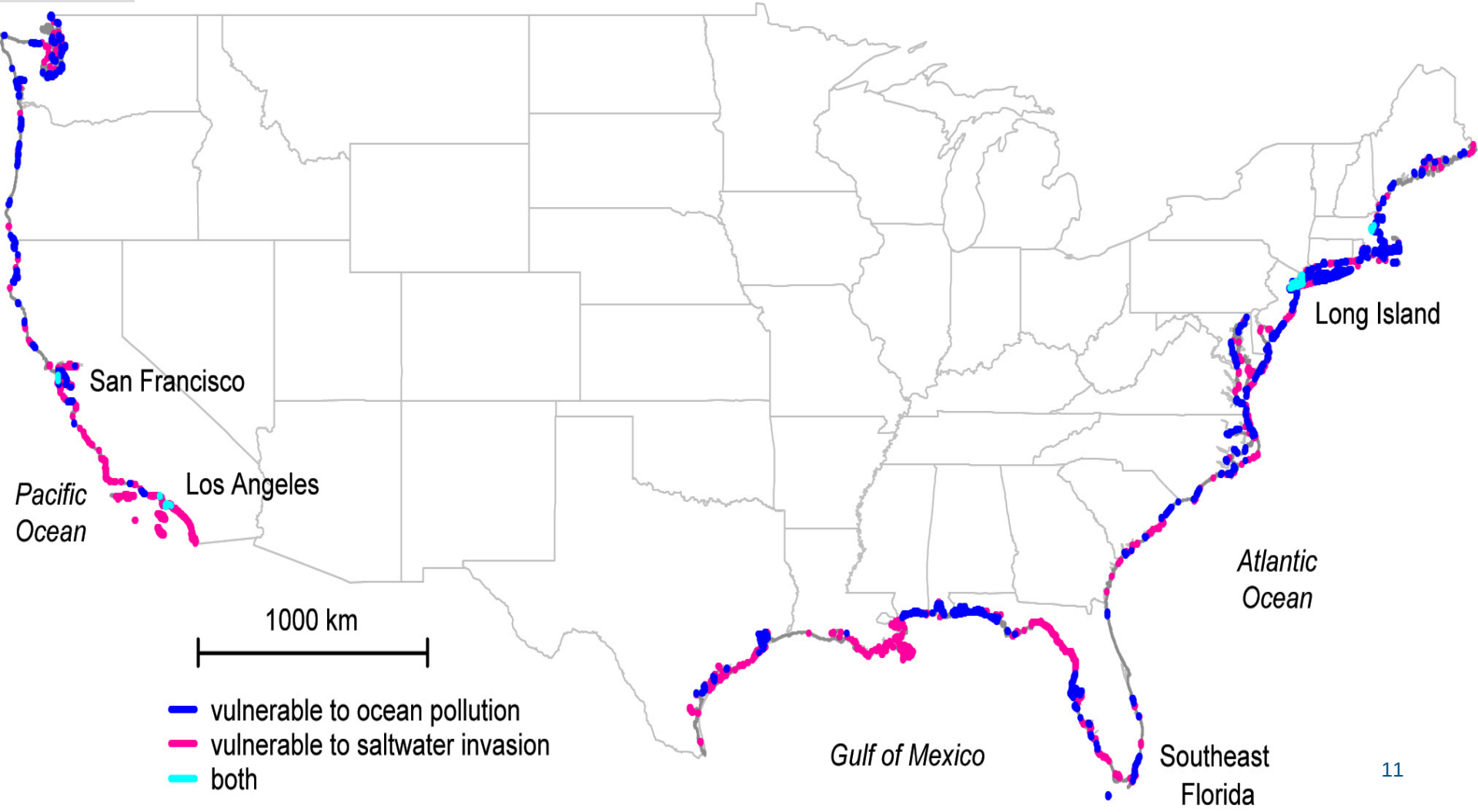

USGS
science for a changing world
The Water Cycle
Sun
Volcanic steam
Atmosphere
Condensation
Sublimation
Deposition
Ice and snow
Precipitation
Evapotranspiration
Evaporation
Fog drip
Surface runoff
Snowmelt runoff
Dew
Streamflow
Infiltration
Evaporation
Seepage
Spring
Flora and fauna
Oceans
Fresh-water
Plant uptake
Groundwater flow
Ocean currents
Vents
Groundwater storage
U.S. Dept. of the Interior
U.S. Geological Survey
Howard Perlman, USGS, John Evans
https://water.usgs.gov/edu/watercycle.html

Rainfall Enters Rivers

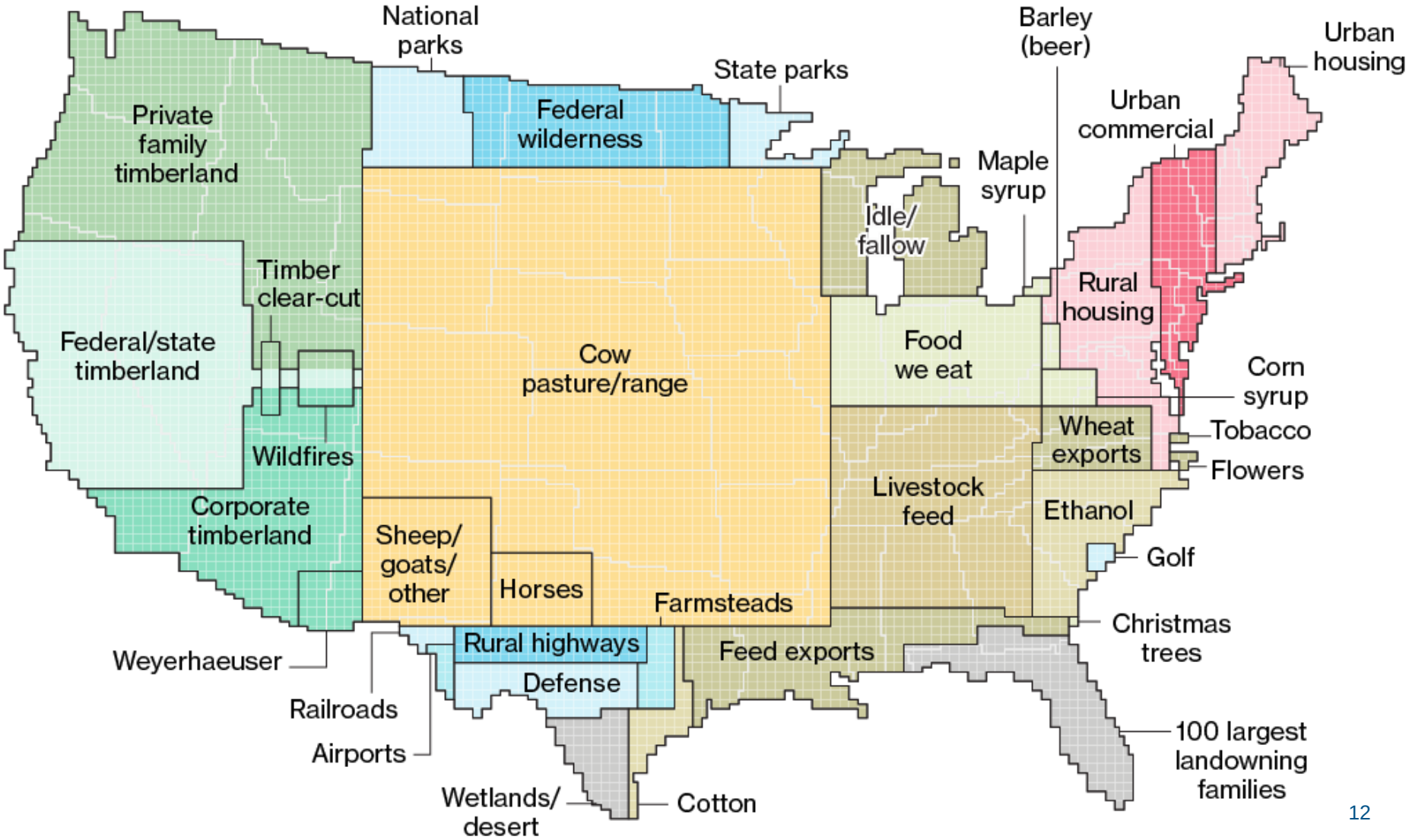


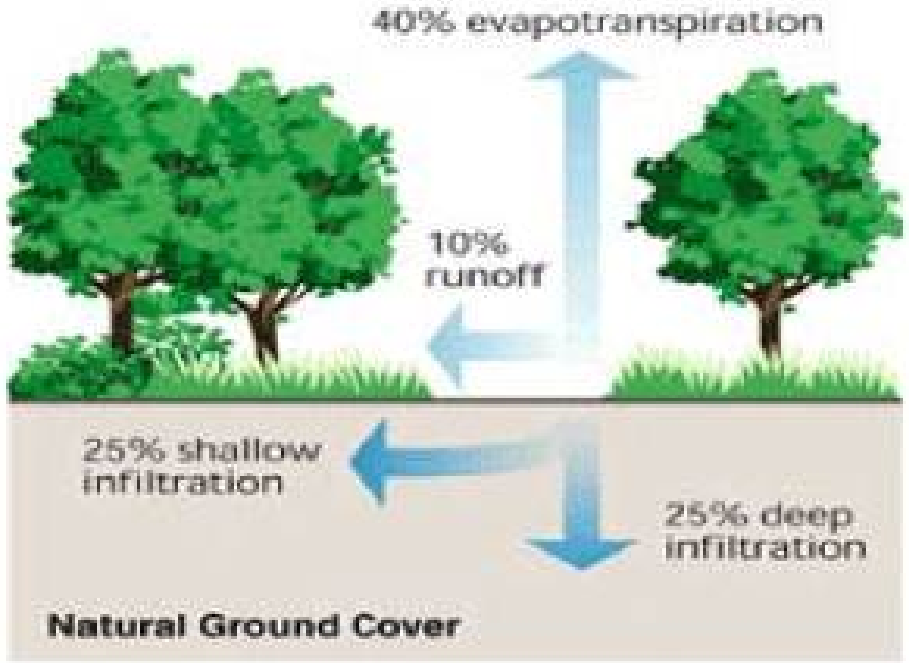

CANADA
MEXICO
PACIFIC OCEAN
ATLANTIC OCEAN
GULF OF MEXICO
Lake Superior
Lake Michigan
Lake Huron
Lake Erie
Lake Ontario
Gulf of California
Principal Islands of HAWAII
ALASKA
GULF OF ALASKA
PUERTO RICO AND THE VIRGIN ISLANDS
ATLANTIC OCEAN
CARIBBEAN SEA
0 100 200 300 400 MILES
0 100 200 300 400 KILOMETERS
Albers equal area projection, standard parallels 29° 30'N and 45° 30'N, central meridian 96°W
Compiled by the U.S. Geological Survey
Revised 2003

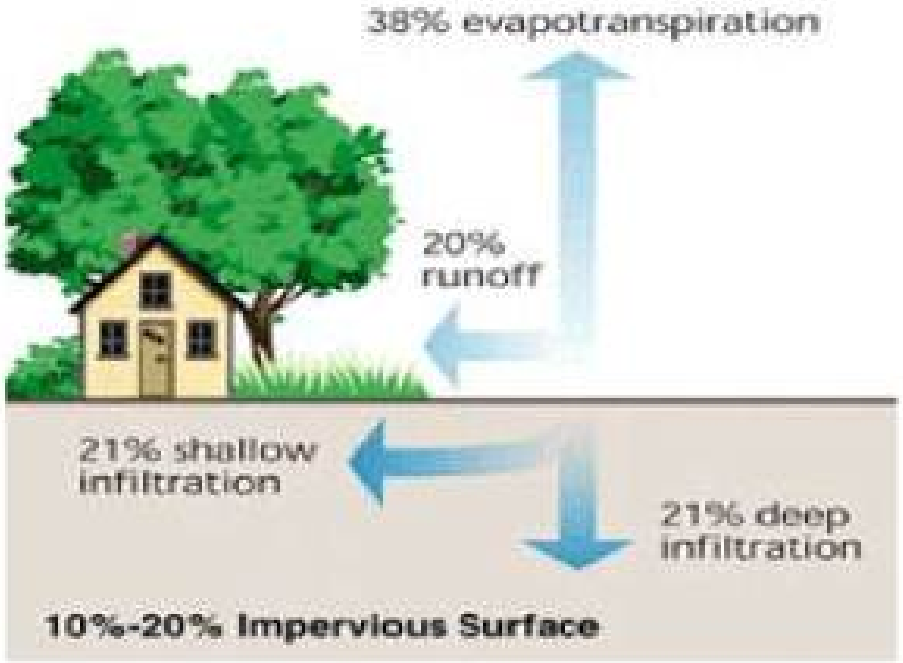
Salt Water Intrusion is a Threat…

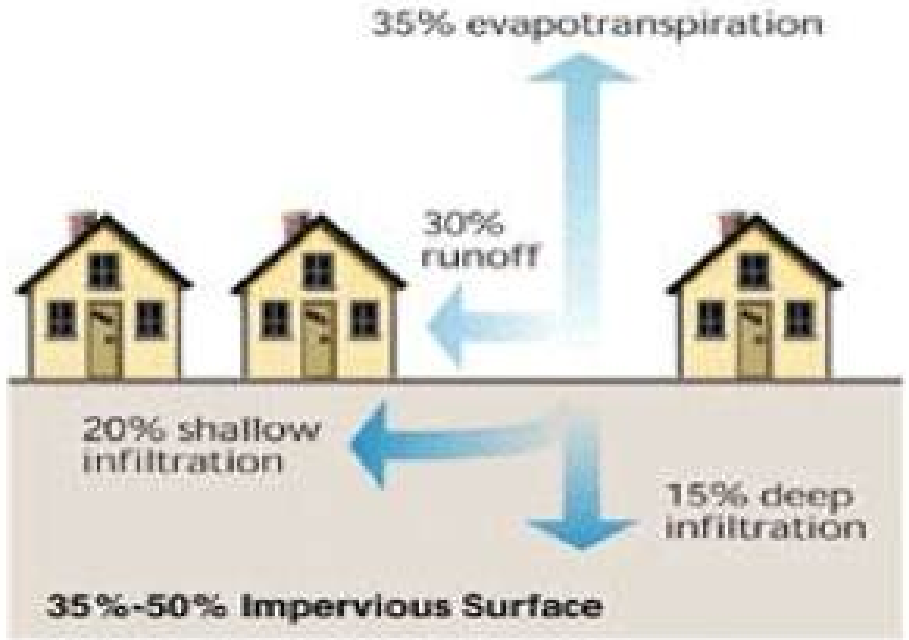


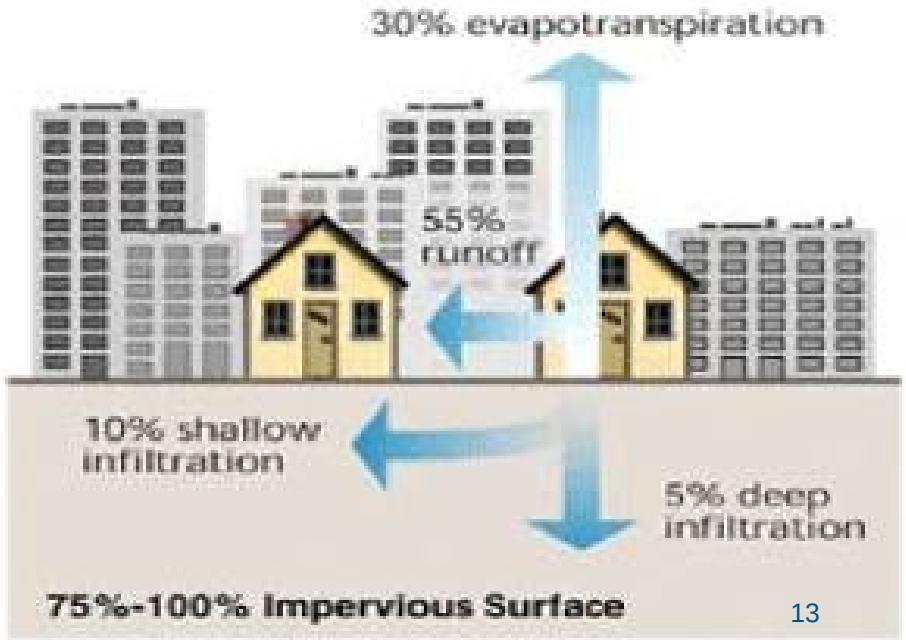
Another Way to look at the USA




40% evapotranspiration
10% runoff
25% shallow infiltration
25% deep infiltration
Natural Ground Cover


38% evapotranspiration
20% runoff
21% shallow infiltration
21% deep infiltration
10%-20% Impervious Surface


35% evapotranspiration
30% runoff
20% shallow infiltration
15% deep infiltration
35%-50% Impervious Surface


30% evapotranspiration
55% runoff
10% shallow infiltration
5% deep infiltration
75%-100% Impervious Surface

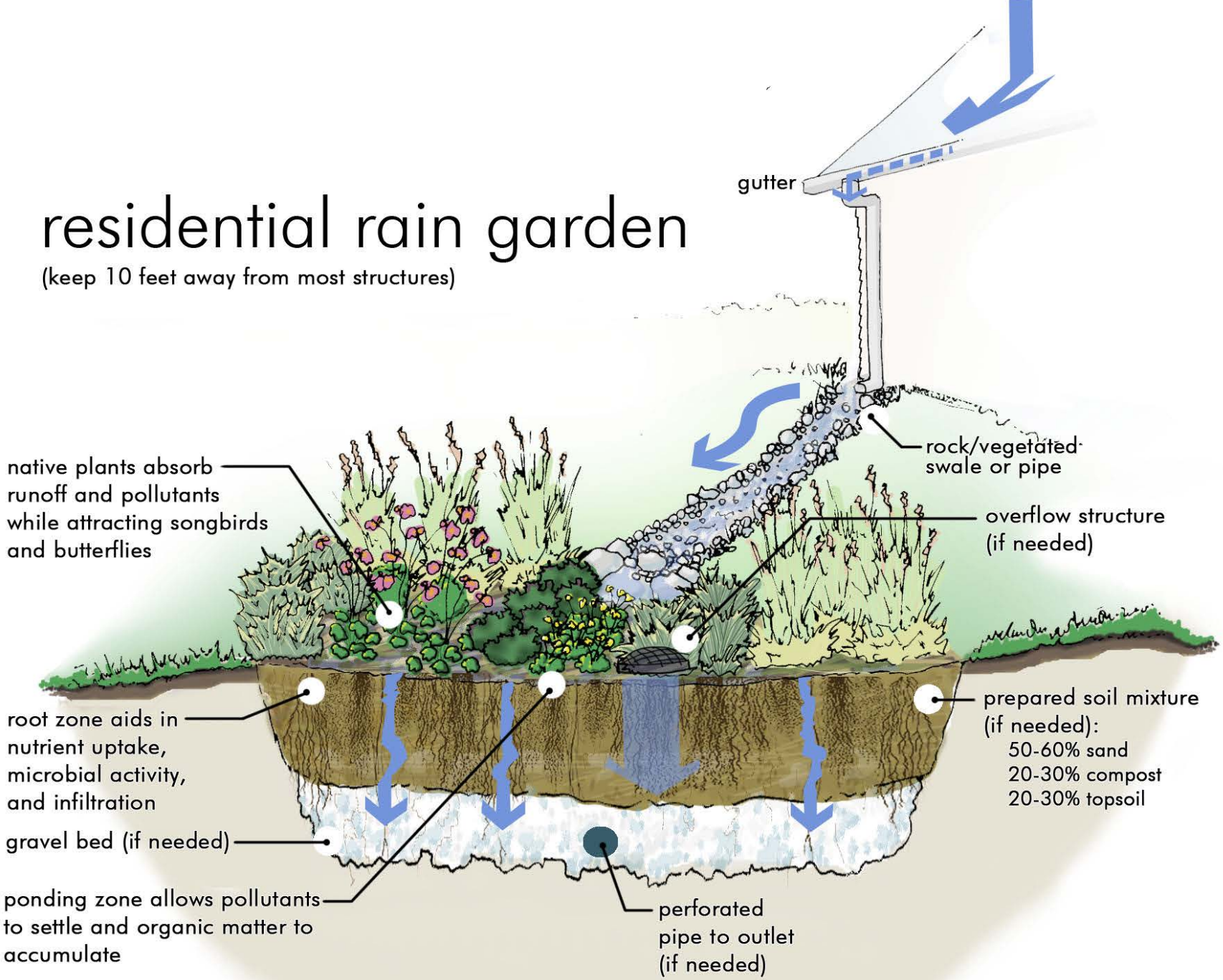
Microdetritus Berms Post Rain

Beaver lodges
Near Pakwaw Lake, Saskatchewan , Canada
Drainage direction
Jean.thie@ecoinformatics.com
Image © 2008 DigitalGlobe
©2007 Google
198 m
Pointer 53°28'28.30" N 102°36'32.08" W elev 294 m
Streaming 100%
Eye alt 980 m

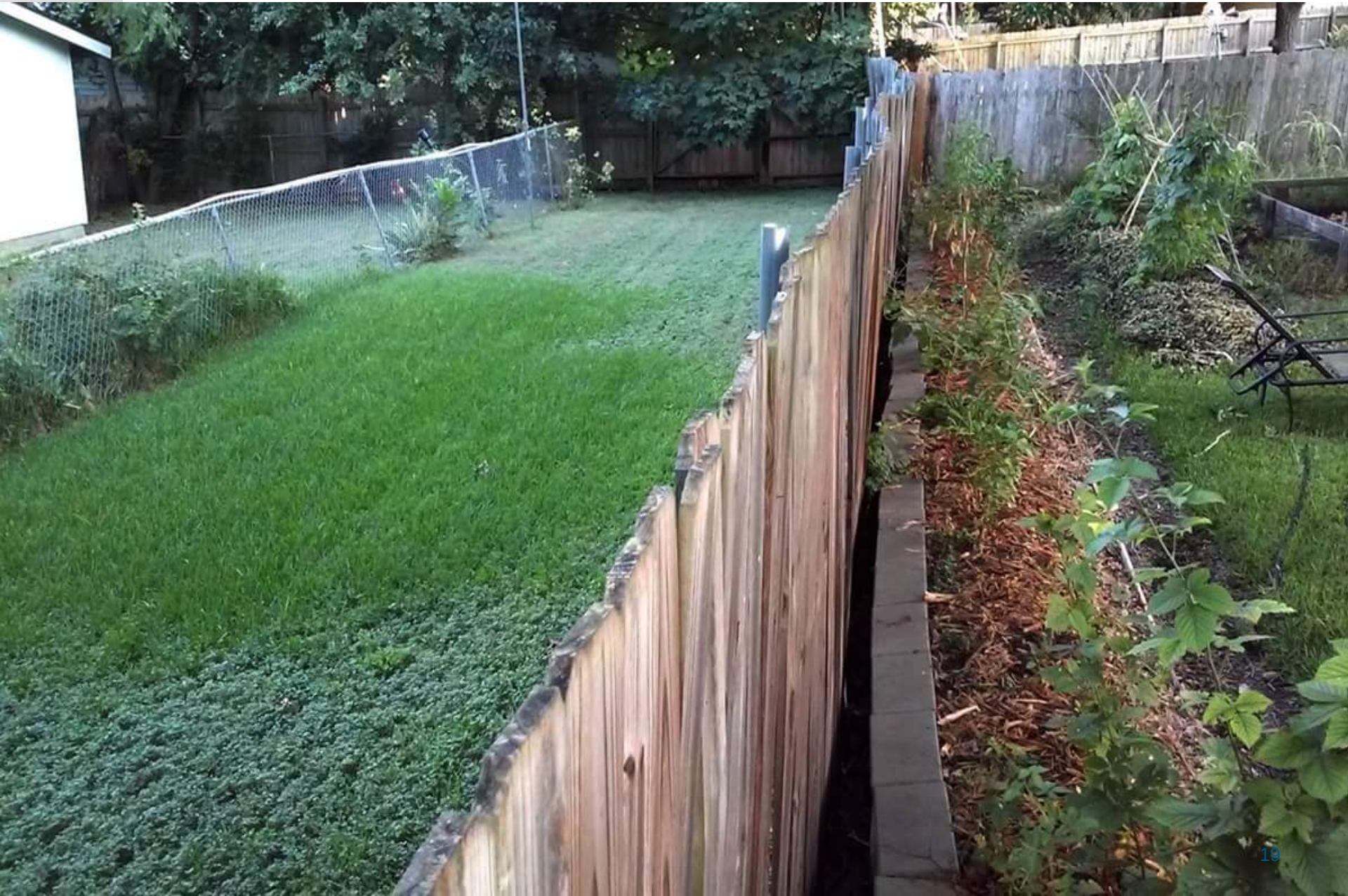
Several hundred million beaver removed

residential rain garden

(keep 10 feet away from most structures)



Backyard BioSwale with “Swale Plume”



Olmos Park Terrace 2017 EPA Green Infrastructure Award Winner

Volunteer Learning Opportunity.
Long Term Educational Opportunity.
Community Gardens & Food Forest.

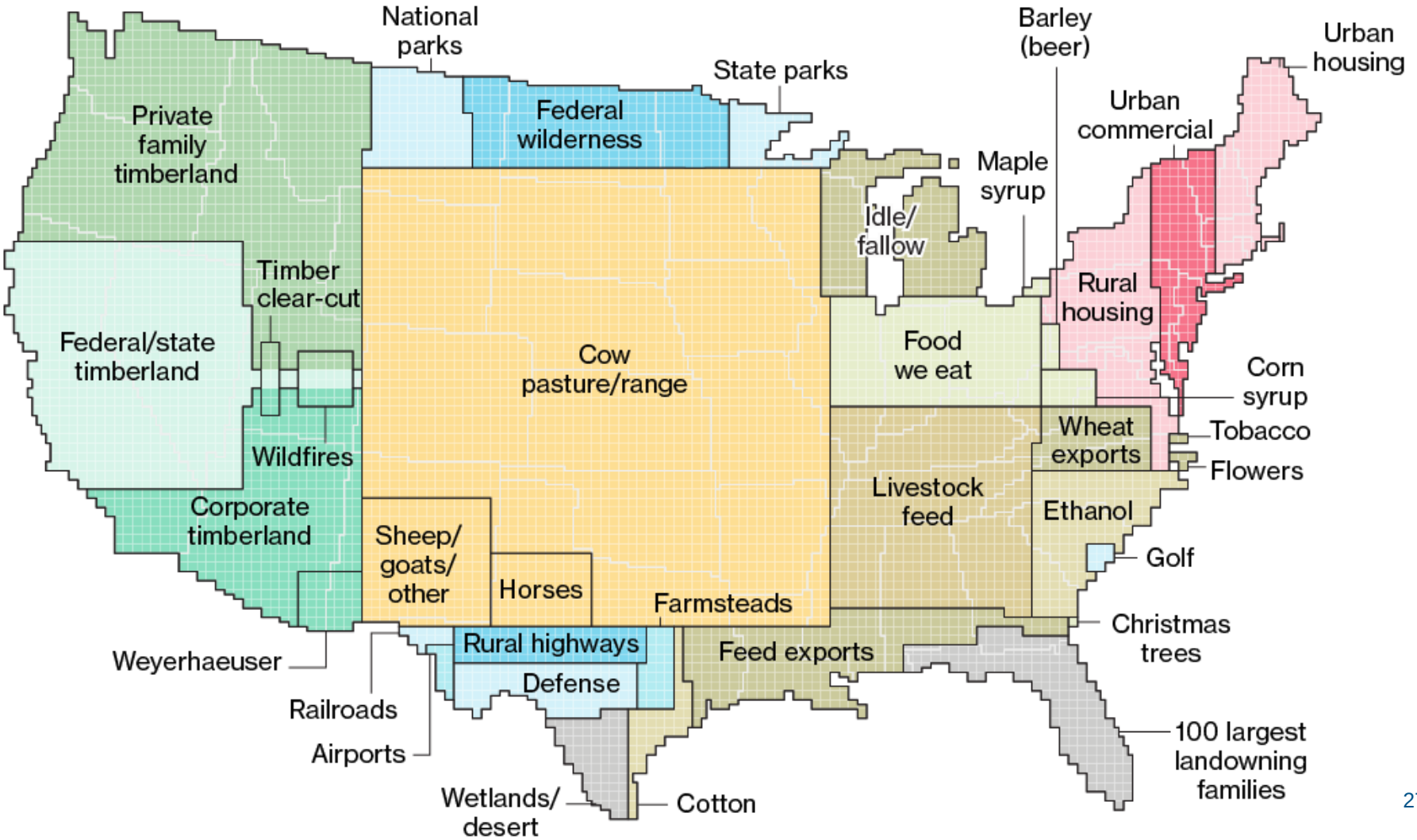
Stonebrook Estates; Houston

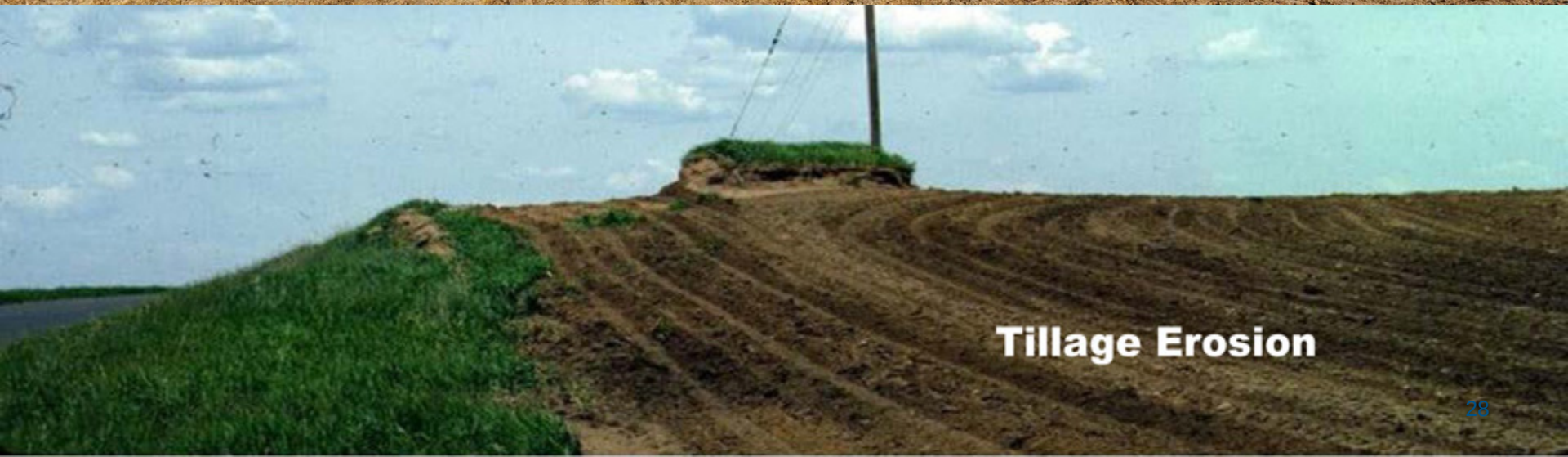
Clear Lake StormWater Wetland. TAMU.

©joe bibby

Cascades Park in Tallahassee Florida.

The Vast Majority of the land is Ag.




Tillage Erosion

"Tractored out"

Power farming displaces tenants from the land in the western dry cotton area, Childress County, Texas panhandle.
June, 1938.

US DEPT.AGRIC. FARM SECURITY ADMIN. LC-USF 34-Negative No. 18281-C PHOTO BY Dorothea Lange LC-USF 34-18281C

David Bamberger; Water From Stone

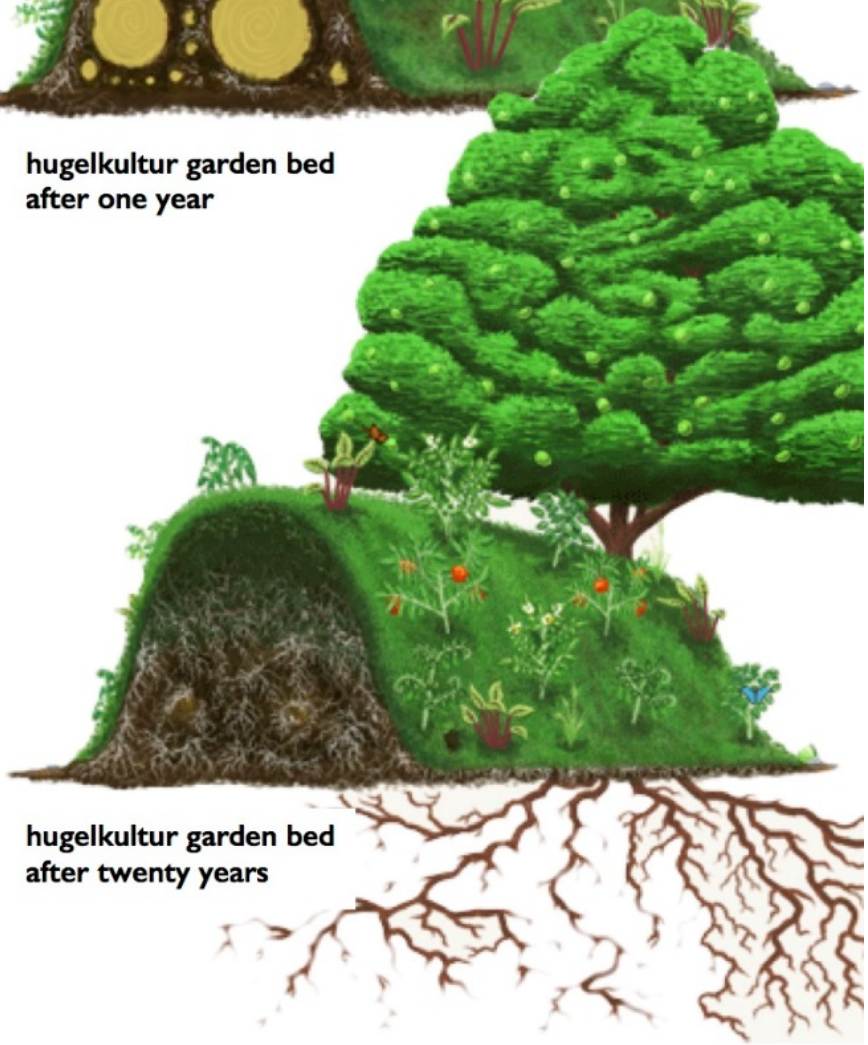
Beaver Biomimicry. BEFORE

Beaver Biomimicry. AFTER

hugelkultur garden bed
after one month

hugelkultur garden bed
after one year

hugelkultur garden bed
after two years



hugelkultur garden bed
after twenty years

images courtesy Paul Wheaton / RichSoil.com

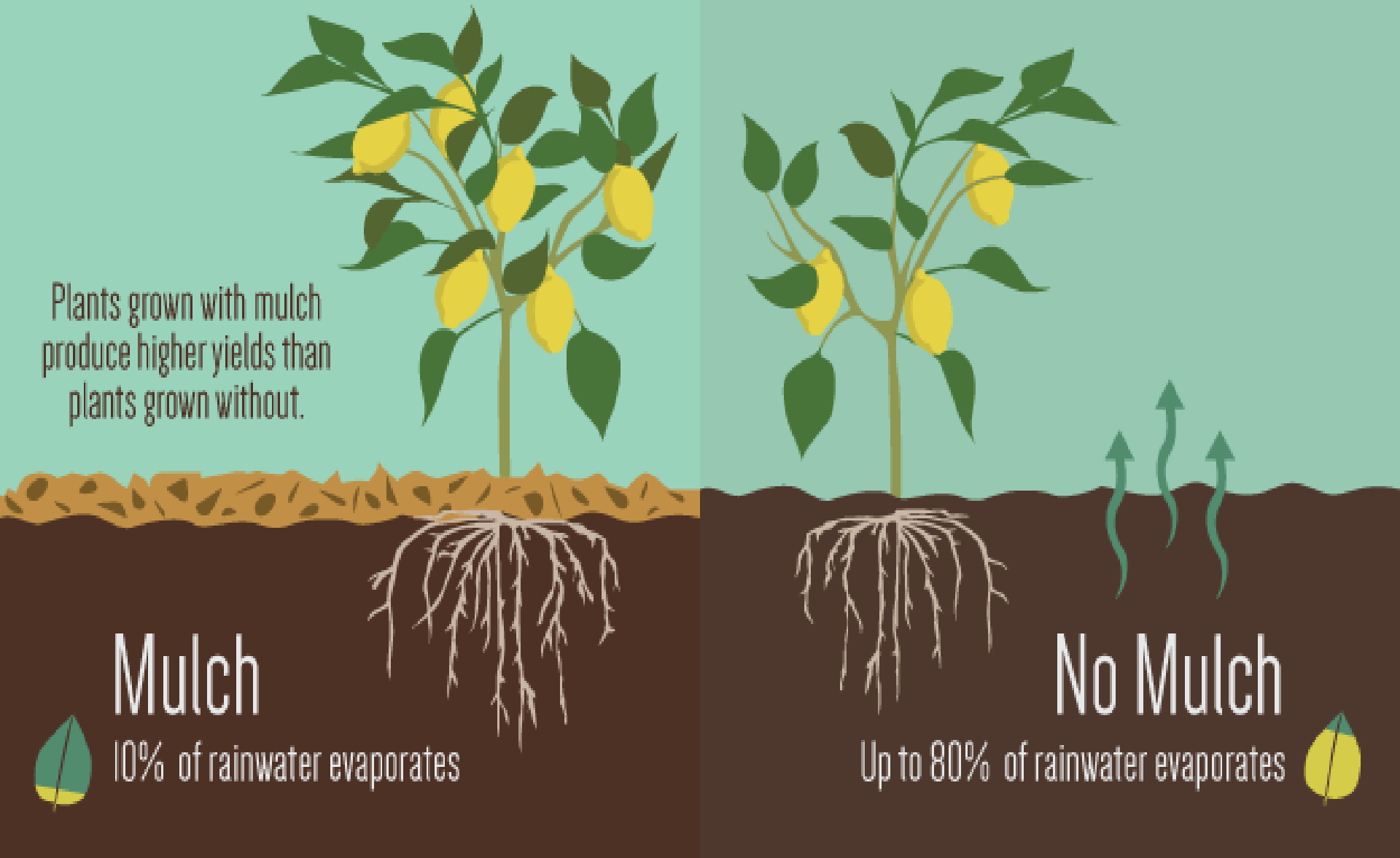
What is there lots of after a storm?

Woody Debris

Mulch vs. No Mulch

Moisture Retention and Yields

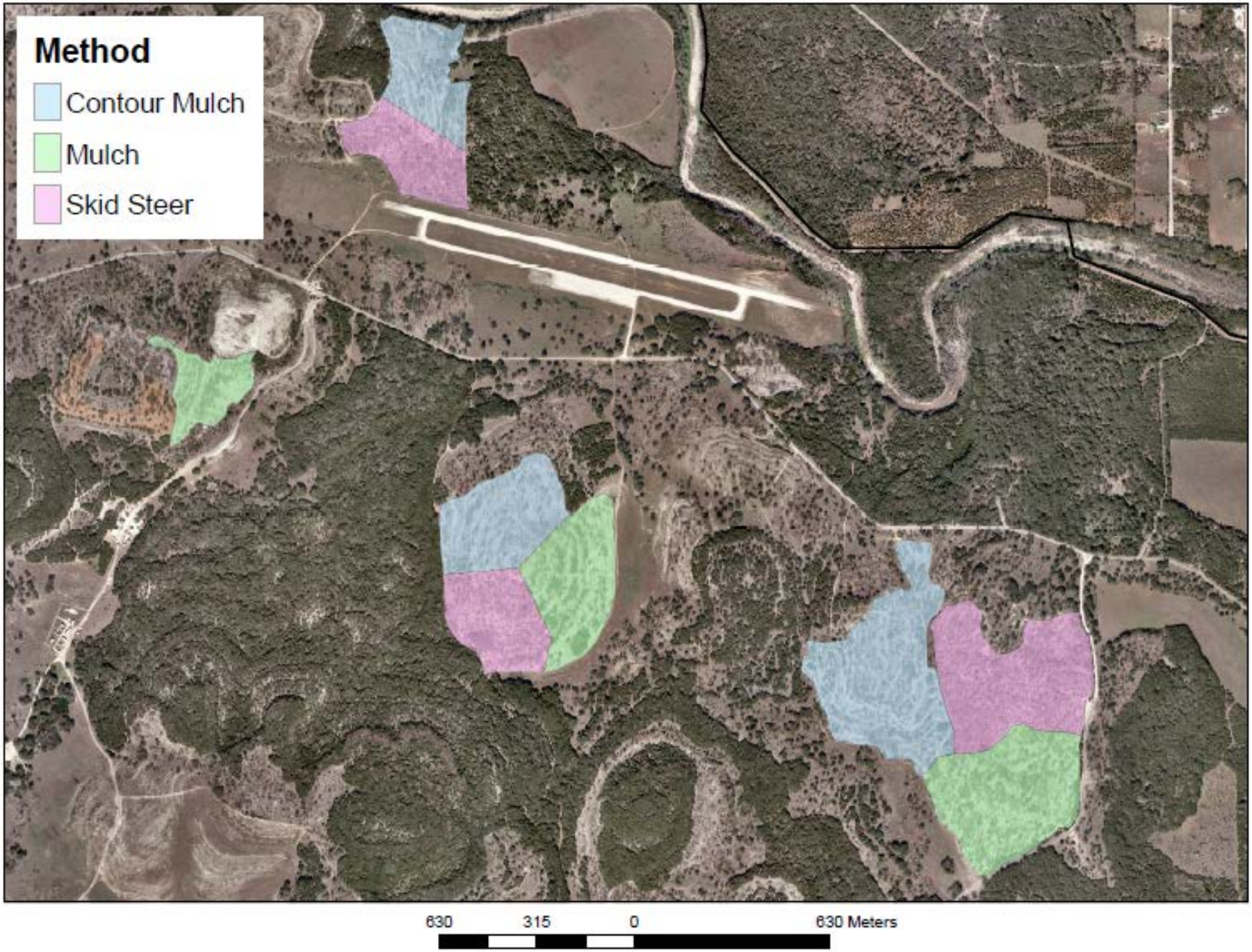
Plants grown with mulch produce higher yields than plants grown without.



Why Haul it?

Mulch It,
Spread It,
Grow Plants,
Build Soil.

Wood Mulch to
Wild Flowers


Method
Contour Mulch
Mulch
Skid Steer
630
315
0
630 Meters

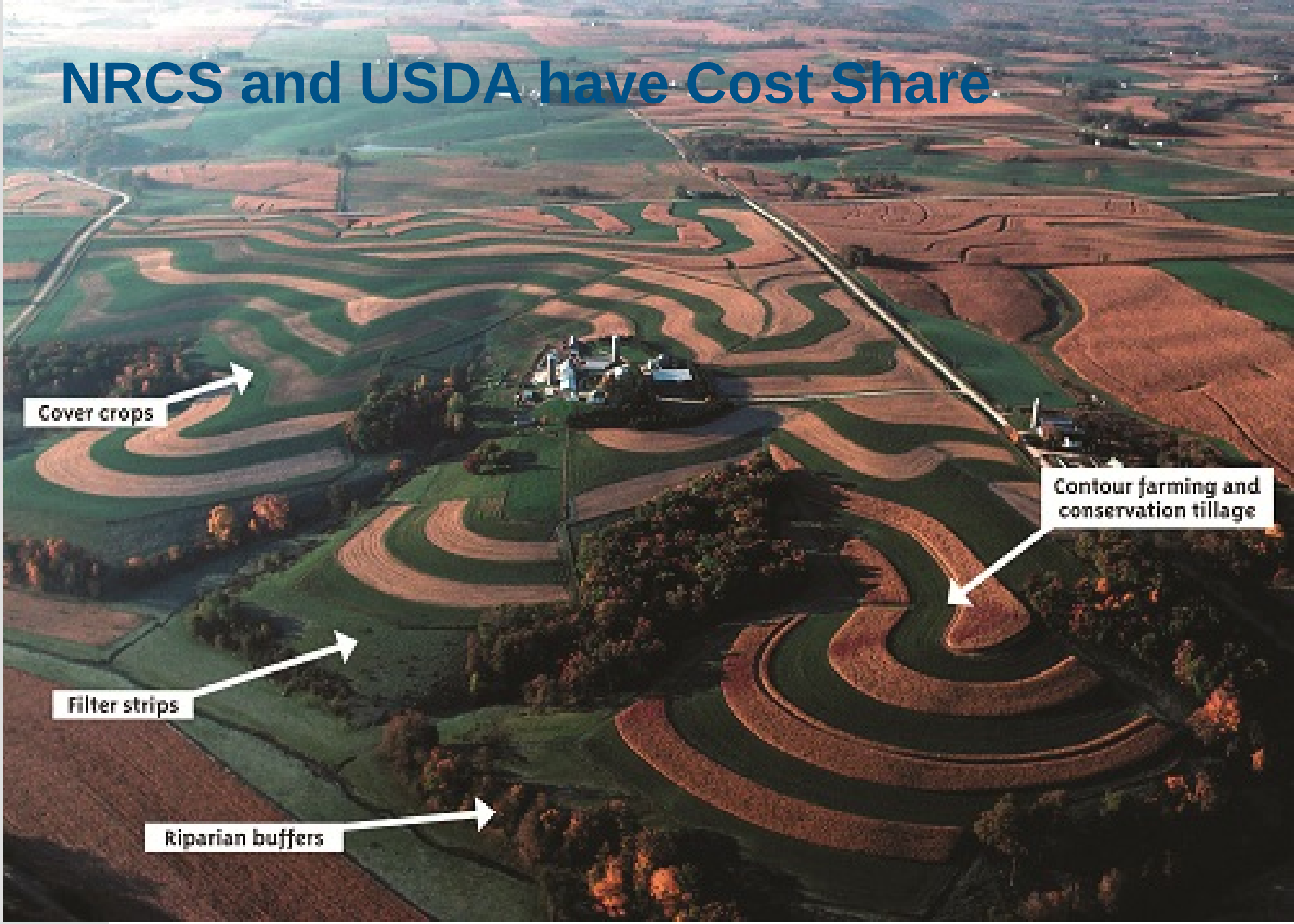
Mulching brush/trees on contour

Contour Mulch / Beaver Biomimicry

800 acres of mulch on contour, no runoff

Slow, Spread and Sink water into uplands

NRCS and USDA have Cost Share



Agroforestry

Working Trees for Agriculture

USDA National Agroforestry Center

USDA National Agroforestry Center

A partnership of NRCS

Wind Breaks: Straight vs. Level

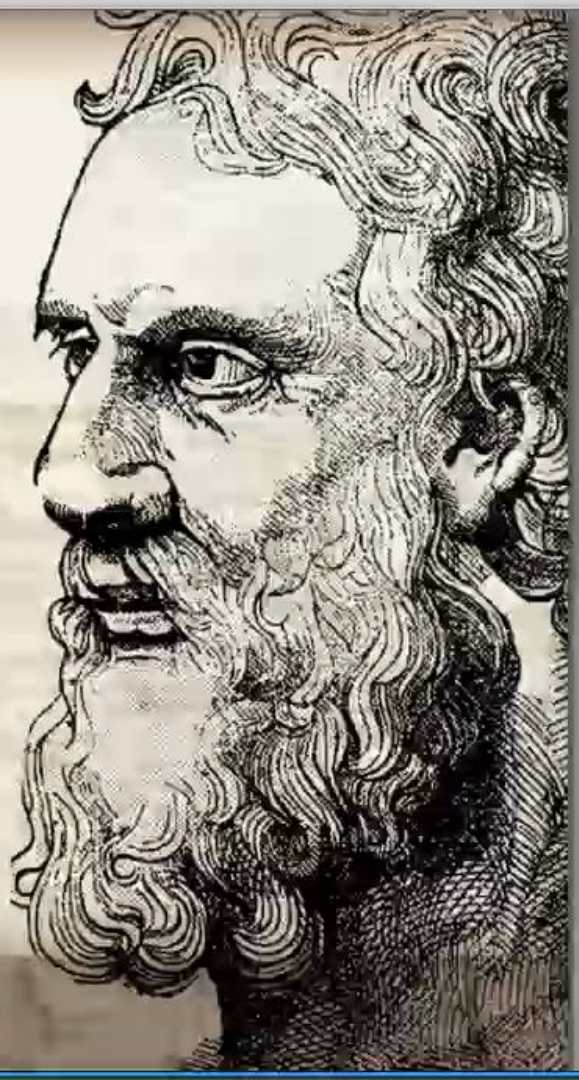
Soil Health Pioneers. From Dr. Montgomery.

ed Presentation.pptx

Plato

427-347 B.C.

The rich, soft soil has all run away leaving the land nothing but skin and bone. But in those days the damage had not taken place, the hills had high crests, the rocky plain of Phelleus was covered with rich soil, and the mountains were covered by thick woods, of which there are some traces today.



Today's Handouts

Name	Size
Presentation slides.pdf	14 MB

Today's Links

Live captions (4/26/2016)

CEU Redirect

Founding Farmers

In a 1796 letter to Alexander Hamilton…

A few years more of increased sterility will drive the Inhabitants of the Atlantic States westward for support; whereas if they were taught how to improve the old, instead of going in pursuit of new and productive soils, they would make these acres which now scarcely yield them any thing, turn out beneficial to themselves.

- [G. Washington, 1892, v. XIII, p. 328-329]

Soils

Soil Health

Watch Our Videos

Profiles in Soil Health

In these short video profiles you can hear directly from
they're using soil health management systems to make

*The views and opinions expressed in these videos are
necessarily represent the official policy or position of an

Grinnell Heritage Farm
Melissa Dunham, has
22 acres today and pr
certified organic plants
understand that the h
healthier crops and a
generation farmer on
made improving the h

Soil Health Pioneers; Gabe Brown ND.

Awarded a Young Farmers grant.

Contour Terraces, First Big Rain

2017 EPA Green Infrast. Award Winner

Terra Purezza Spice-wood, Texas

Another Young Farmer Grant

Mitigating Drought and Flooding,
One Scoop at a Time.
HITACHI

Contour Orchards; Perennial Polyculture. Wisconsin.

Water Harvesting for Drylands: Brad Lancaster.

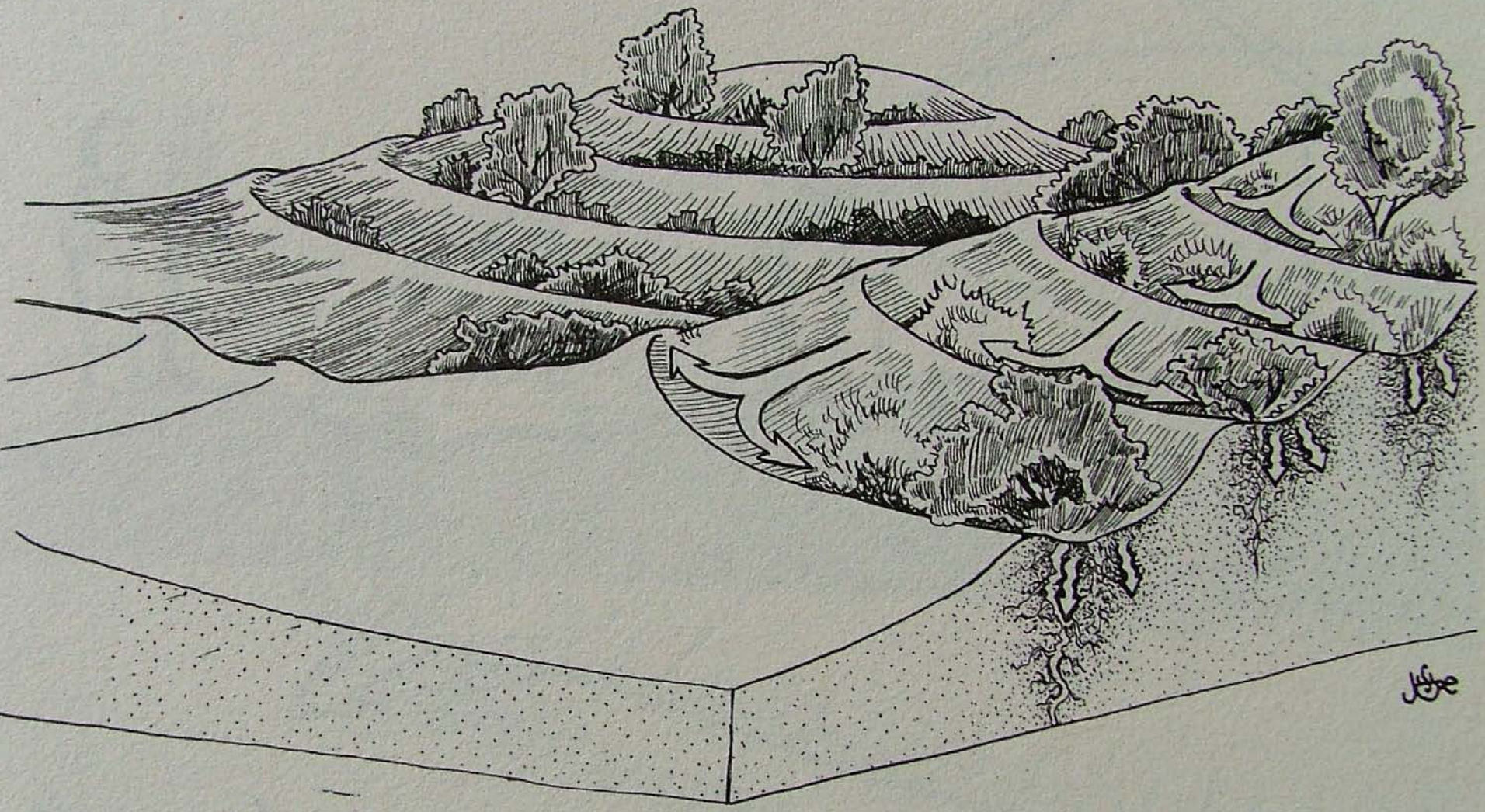


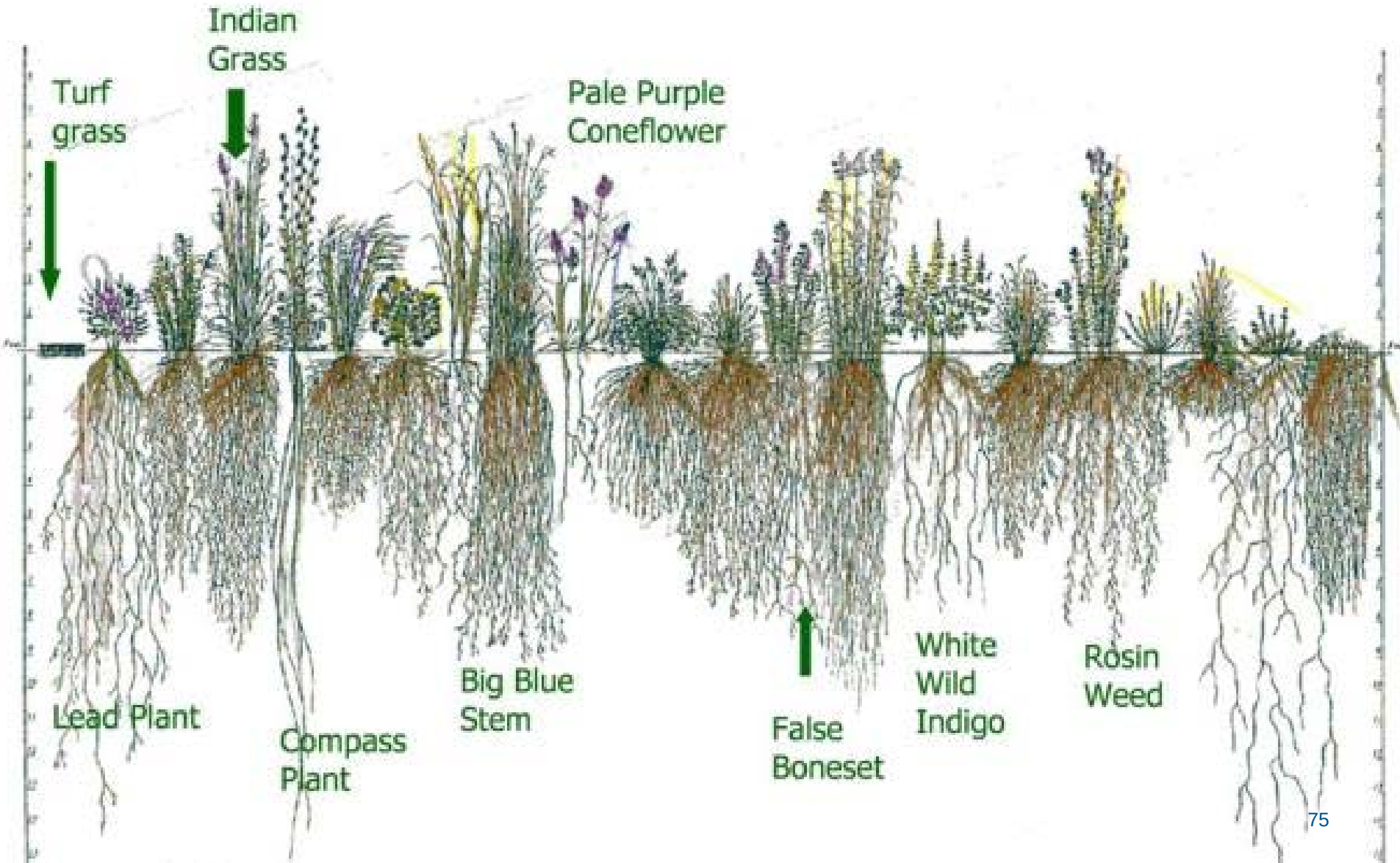
Fig. 2.20. Contour berms

“Swale Plumes” from Satellite

Jeff Cohen
MOONSHINE IMAGES

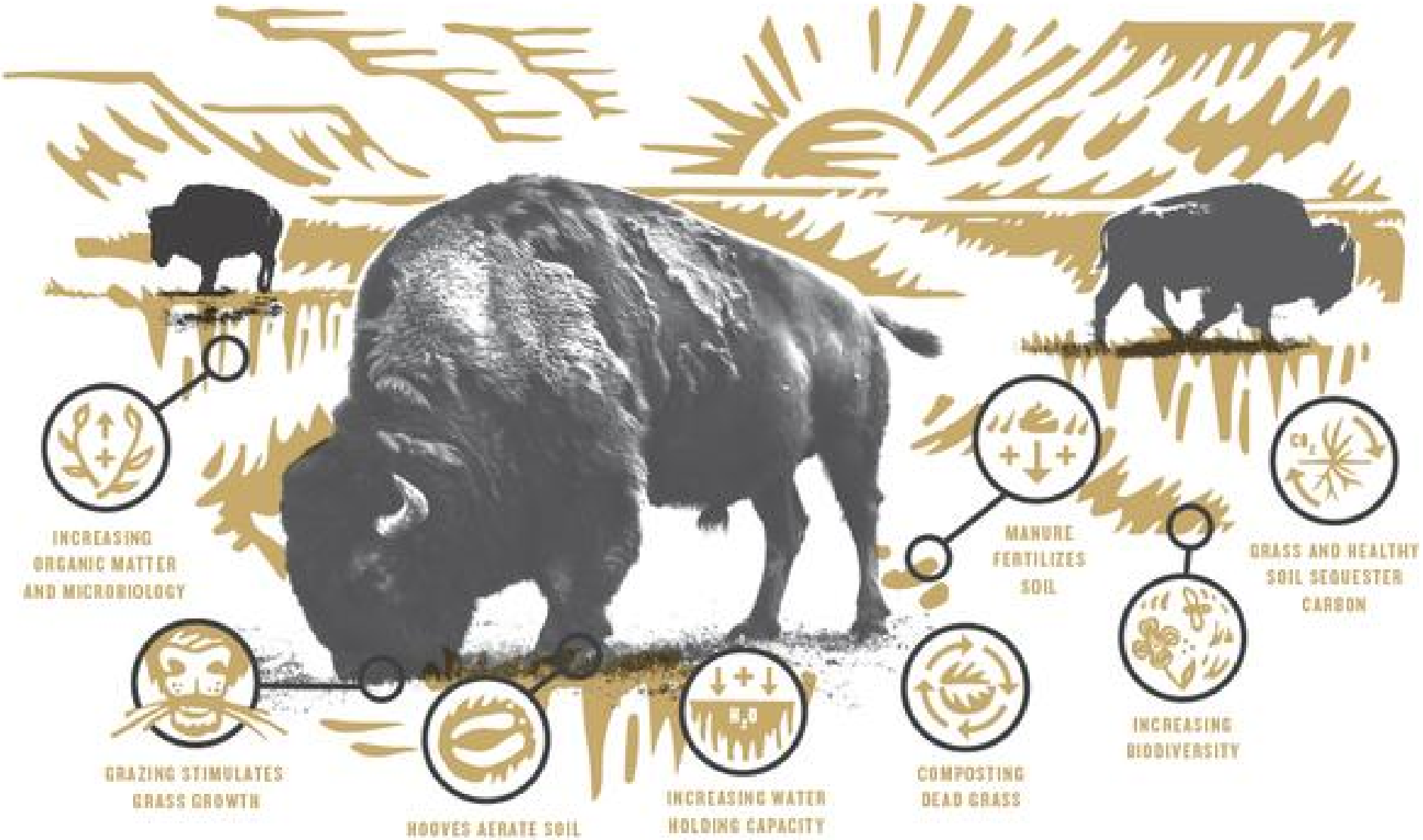
GI improves water quantity and quality

Native Plant Roots Run Deep

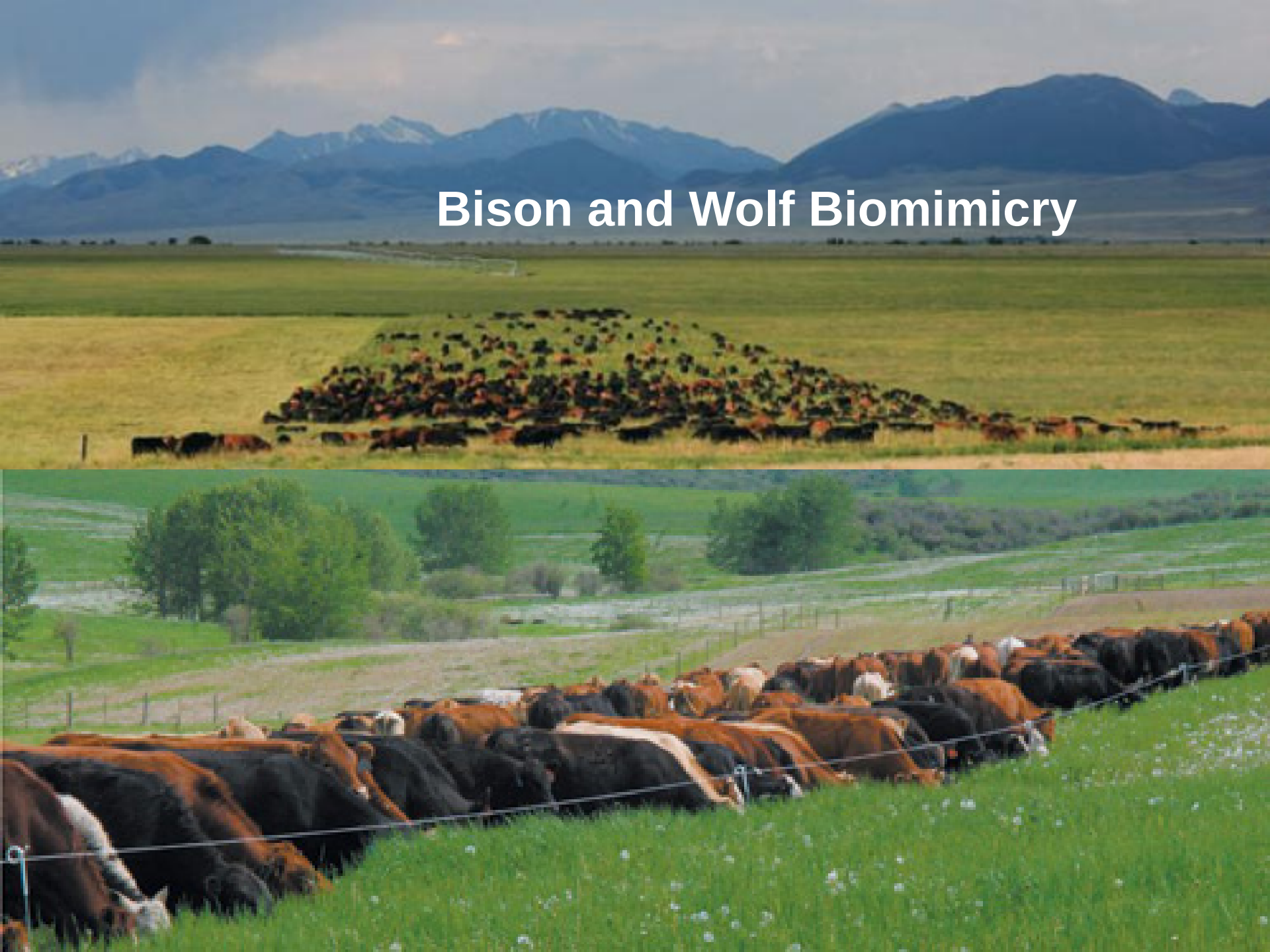


Plant Roots help increase Soil Organic Matter and Increase Infiltration Rates.

27,154 gallons/ Acre Inch


INCREASING ORGANIC MATTER AND MICROBIOLOGY
MANURE FERTILIZES SOIL
GRASS AND HEALTHY SOIL SEQUESTER CARBON
INCREASING BIODIVERSITY
GRAZING STIMULATES GRASS GROWTH
HOOVES AERATE SOIL
INCREASING WATER HOLDING CAPACITY
COMPOSTING DEAD GRASS

Bison and Wolf Biomimicry



High density livestock & long rest periods.

Land Stewardship makes a difference.

Climate of the Mind

Virginia

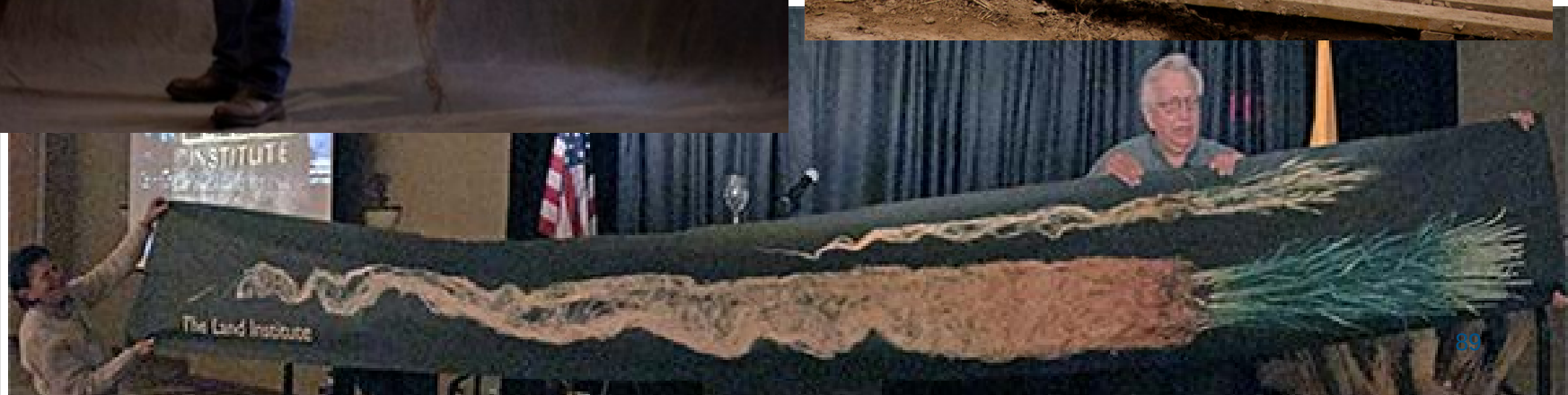
NRCS “Rainfall Simulator”

Oklahoma Corn Yield Winner
“Ugly Fields have Higher Yields”

Oklahoma Farmers Soaking up rainfall and winning awards

Missouri; “I Sell Water and Sunshine”

Kansas grass and soil farmers
“During the Drought”
The Land Institute
Michael Thompson

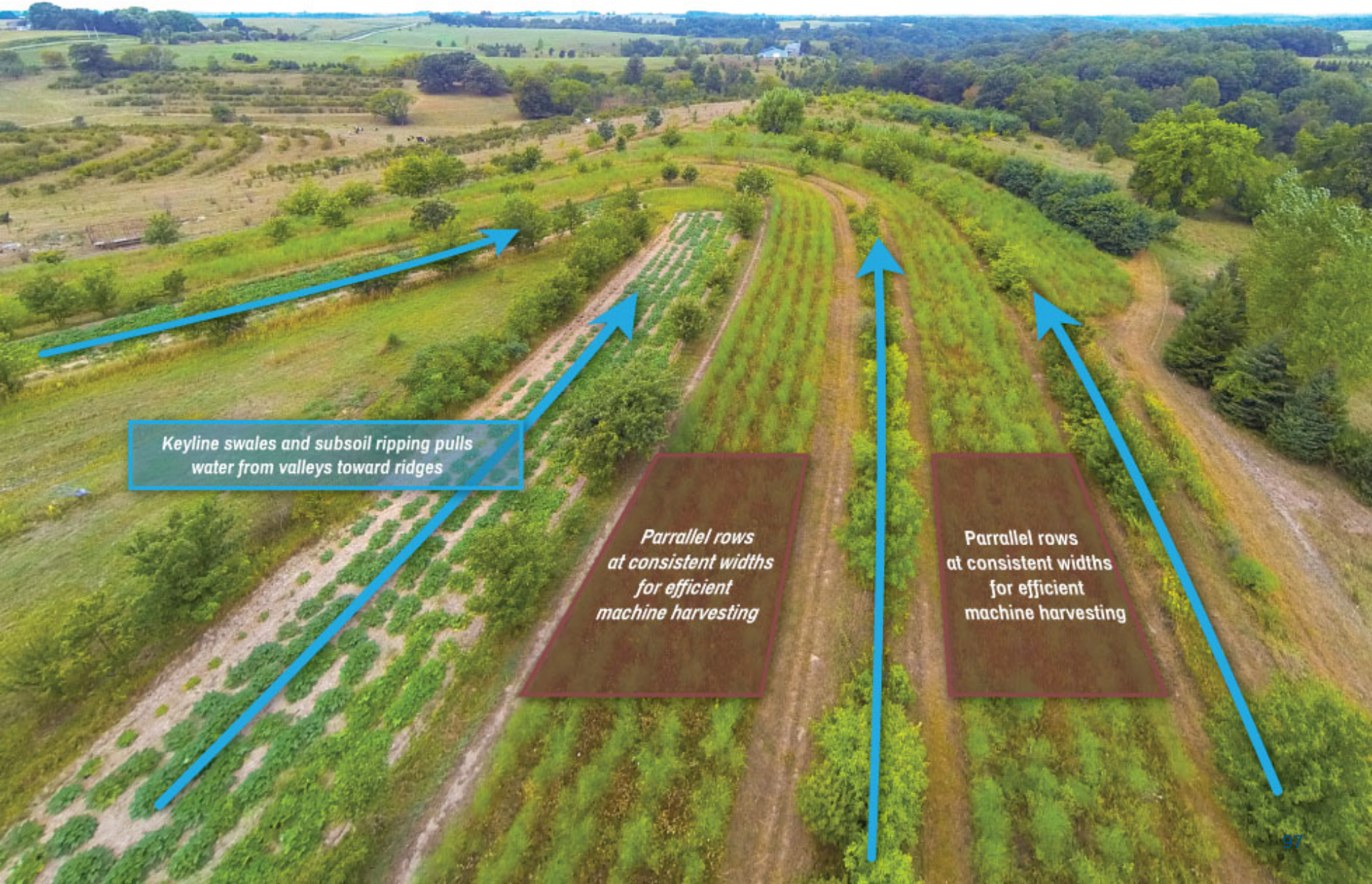

INSTITUTE
The Land Institute

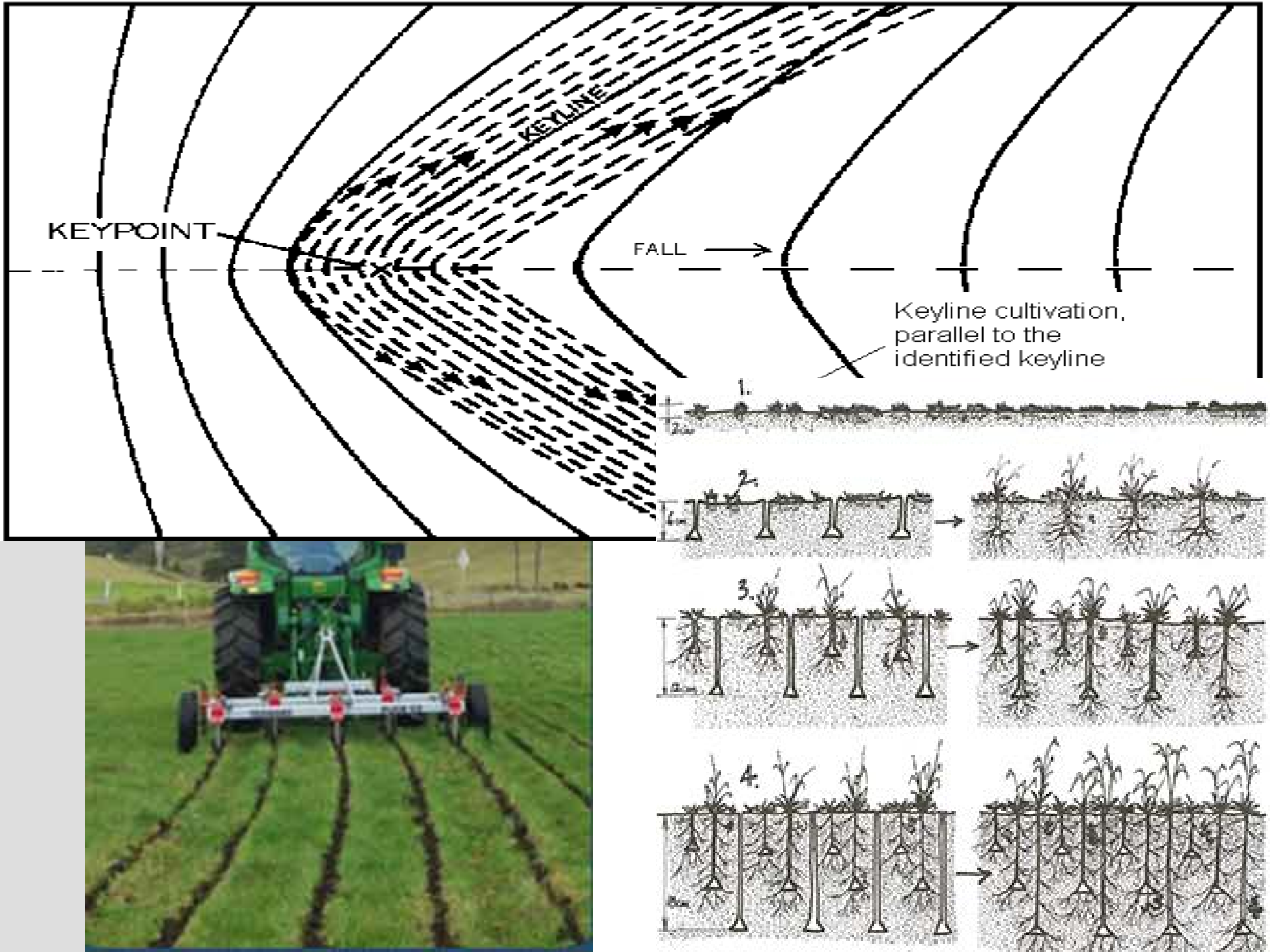
Annual wheat (on left in each panel) and Perennial wheatgrass

Iowa

SPEED
LIMIT
45

Keyline offers consistent width for crops




KEYLINE
KEYPOINT
FALL
Keyline cultivation, parallel to the identified keyline
1.
2.
3.
4.

Nebraska; Michigan; Ohio;

unlock the SECRETS IN THE SOIL

Biodiversity increases the success of most agricultural systems.

Biodiversity helps to prevent disease and pest problems associated with monocultures. Using cover crops and increasing diversity within crop rotations improves soil health and soil function, reduces costs, and increases profitability. Diversity above ground improves diversity below ground, which helps create healthy productive soils.

Cover Crops

Cover crops can be an integral part of a cropping system. Cover crops can be managed to improve soil health, as they help to develop an environment that sustains and nourishes plants, soil microbes and beneficial insects.

Cover crops are typically planted in late summer or fall around harvest and before spring planting of the following year's crops. Examples of cover crops include rye, wheat, oats, clovers and other legumes, turnips, radishes, and triticale. Planting several cover crop species together in a mixture can increase their impact on soil health. Each cover crop provides its own set of benefits, so it's important to choose the right cover crop mixture to meet management goals.

USDA NRCS United States Department of Agriculture Natural Resources Conservation Service

September 2012

unlock the SECRETS IN THE SOIL

SOIL HEALTH DEFINED

Soil health is **the continued capacity of a soil to function as a vital, living ecosystem that sustains plants, animals, and humans**. Only living things can have "health," so viewing soil as a living, breathing ecosystem reflects a shift in the way we view and manage our nation's soils. Soil isn't an inert growing medium, but rather is the home of billions of bacteria, fungi, and other organisms that together create an intricate symbiotic ecosystem. This ecosystem can be managed to support plants and animals, by cycling nutrients, absorbing, draining and retaining rainwater and snowmelt for use during dry periods, filtering and buffering water to remove potential pollutants, and providing habitat for the soil biological population to flourish and diversify to keep the ecosystem functioning well.

KEY SOIL HEALTH MANAGEMENT PRINCIPLES

These principles are represented in the circular diagram to the left to emphasize their relationship as a continuum where each complements the others and also depends on the others.

1. Minimize disturbance
2. Maximize soil cover
3. Maximize biodiversity
4. Maximize presence of living roots

PROTECTING THE SOIL HABITAT

The first two principles, shown on the right side of the diagram above focus on protection of the soil habitat: minimize disturbance and maximize soil cover. Practices that use these principles maintain or increase stable soil aggregates and soil organic matter (SOM), and protect the surface of the soil that is most susceptible to the degrading forces of wind and water. Maximizing soil cover also buffers against temperature fluctuations that stress plants and soil organisms, reduces evaporation rates, and increases the amount of water entering the soil profile from precipitation and irrigation.

USDA United States Department of Agriculture

USDA is an equal opportunity provider, employer, and lender.

Illinois meeting of soil experts

CONSERVATION CROPPING
2019
SEMINARS
Managing your inputs for healthy soils...

th Carolina Corn Yield Winner
llars and Cents of Soil Health”
o more yield
o less inputs

South Carolina Conservation Innovation "Farmer Scientists"

Farmer Scientists: Five Trials in Managing for Soil Health

The Marin Carbon Project
John Wick, Director
Jeff Creque Ph.D., Co-founder
Range Science and Range Management:
Finding Common Ground

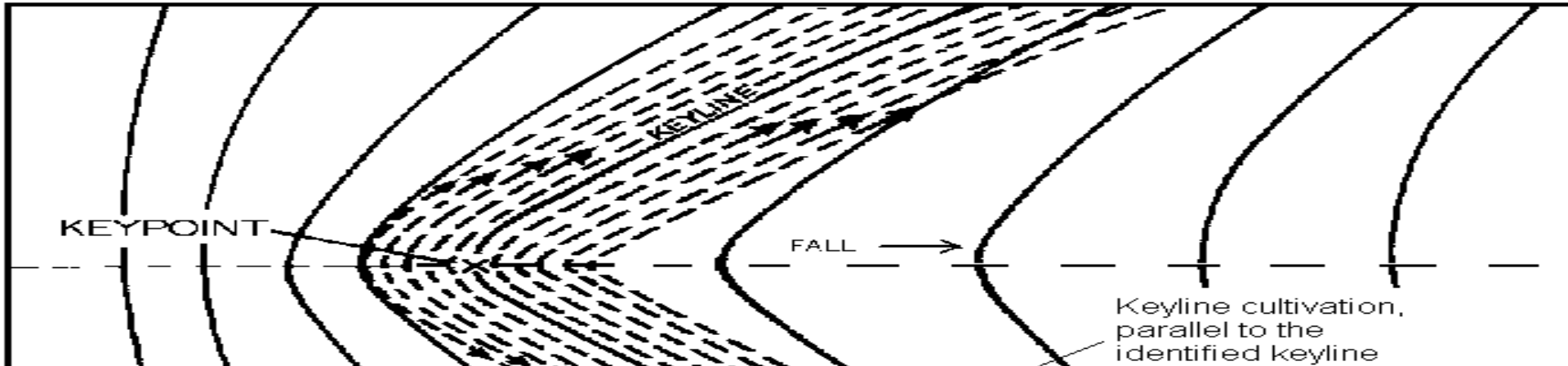
Fort Ancient Ohio. 3.5 miles,
131 ponds, 2,000 years old.

2,000 Year old Green Infrastructure Installed with Hand Tools, 1,800 years with No Maintenance

Thank You

Bryan Hummel
Watersheds and Technical Assistance
Hummel.Bryan@epa.gov

404-562-9284 desk
404-640-9287 cell



File Edit View Favorites Tools Help

People Plus | Dogpile | EPA Remote Access | Daily News | Google | One EPA Workplace | Suggested Sites | Desktop

NASA

earth observatory

NASA and USGS have a slide tool Google Earth Engine time lapse feature