

Watershed 101



Materials



Utah State University
Stream Science
Materials

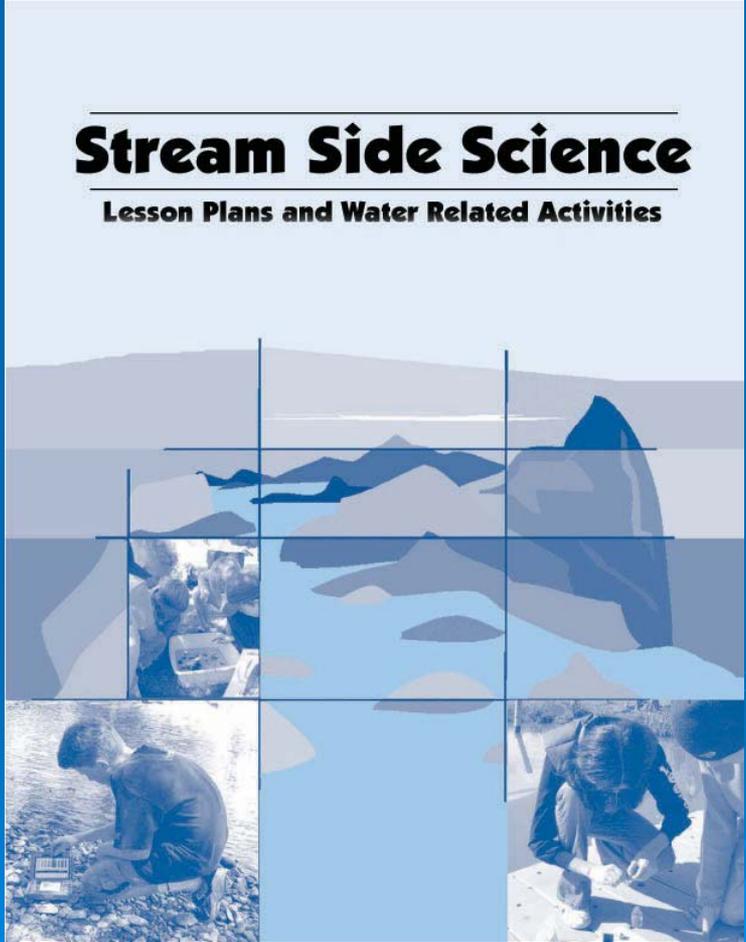


Utah State University
WATER QUALITY EXTENSION

This block features a central collage of seven photographs depicting various stream science activities. The photos show students and adults engaged in fieldwork, such as examining water samples, using equipment, and observing stream environments. The text 'Utah State University Stream Science Materials' is written vertically in a large, blue, sans-serif font. At the bottom right, the Utah State University Water Quality Extension logo is displayed, featuring a stylized building icon.

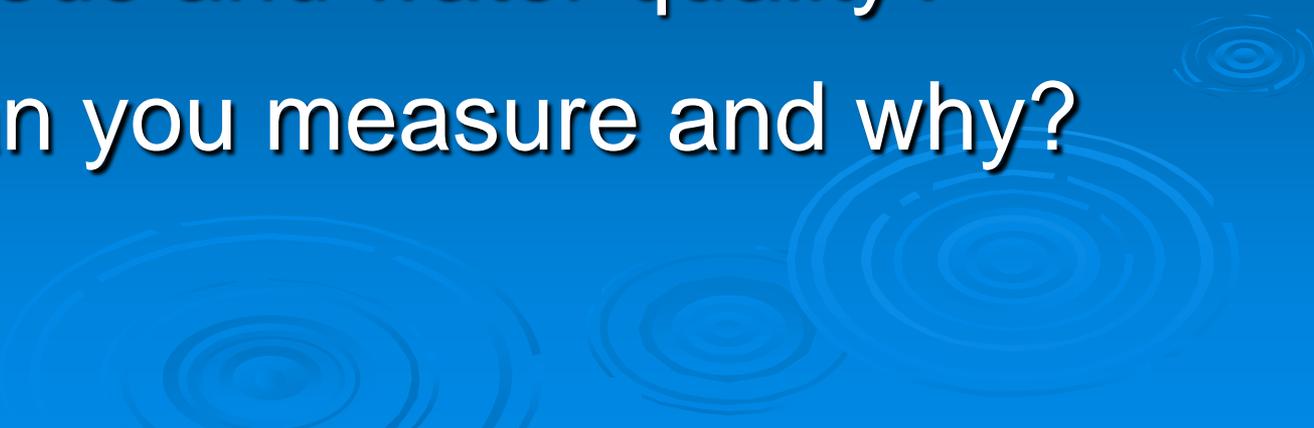
Stream Side Science

Lesson Plans and Water Related Activities



The cover of the 'Stream Side Science' book features a grid of six photographs showing students and adults engaged in various stream science activities. The title 'Stream Side Science' is prominently displayed at the top in a large, bold, black font, with the subtitle 'Lesson Plans and Water Related Activities' below it in a smaller, black font. The background of the cover is a light blue gradient with a stylized mountain range and water ripples. The grid of photos shows students and adults engaged in various stream science activities, such as examining water samples, using equipment, and observing stream environments.

Agenda

- What is a watershed?
 - How does water move through a watershed?
 - What is the connection between watersheds and water quality?
 - What can you measure and why?
- 

What is a watershed?



**Geographic area
within which all
water drains to a
common point.**

Watersheds are defined by *structure* and by *function*



Elements of watershed structure

Geography Size, latitude, longitude, elevation, aspect

Climate Total precipitation, precipitation patterns

Geology Formation - volcanic, sedimentary, basic rock types, soil types and depth, erosion potential

Vegetation / Animals Type, native/non native, riparian areas, uplands, patterns of use and migration

Human uses Development and land use patterns

Functions of watersheds



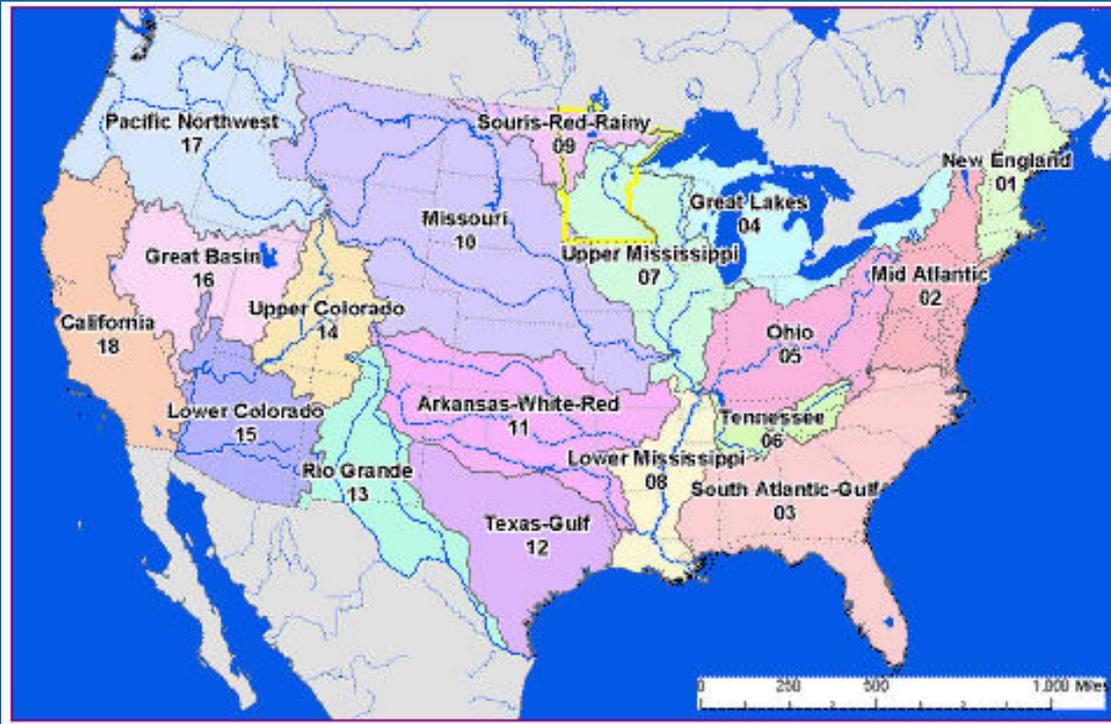
Collect



- Water
- Sediments, soils
- Dissolved minerals, metals, nutrients
- Biological material

Transport





- Watersheds are nested
- The scale you work at depends on the question you want to answer

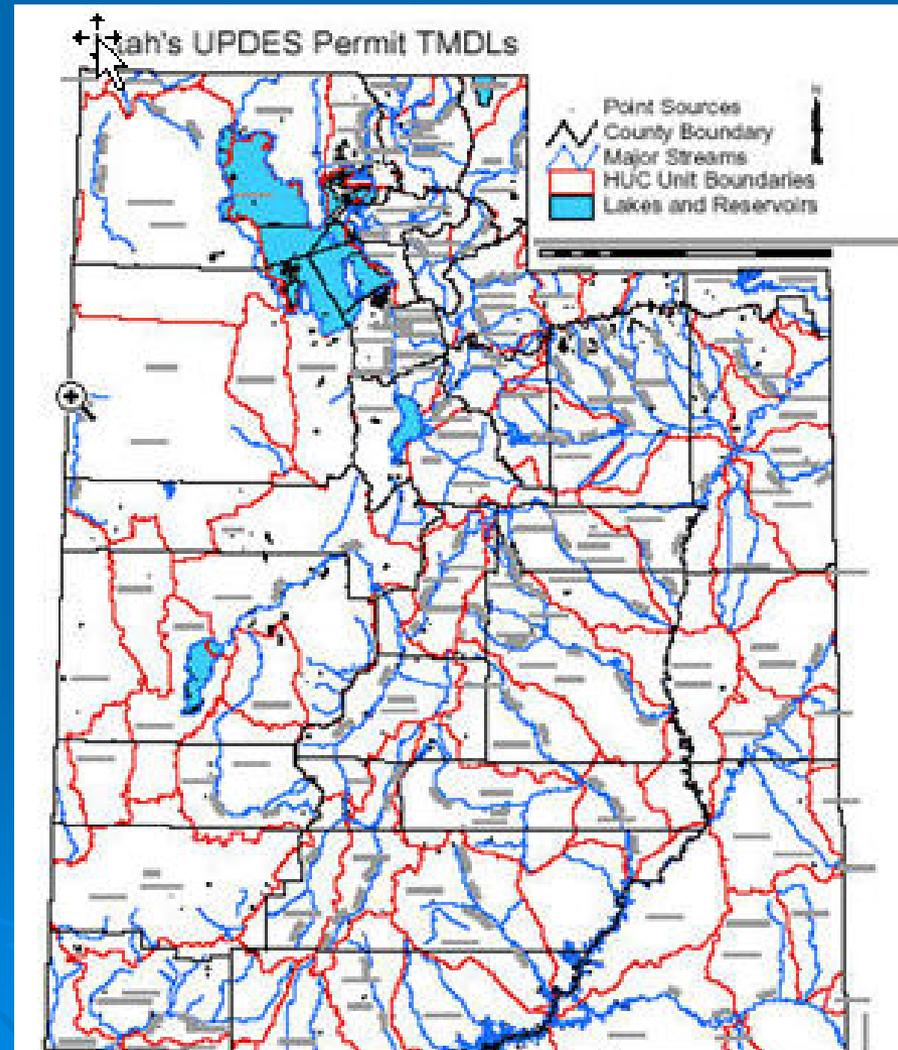
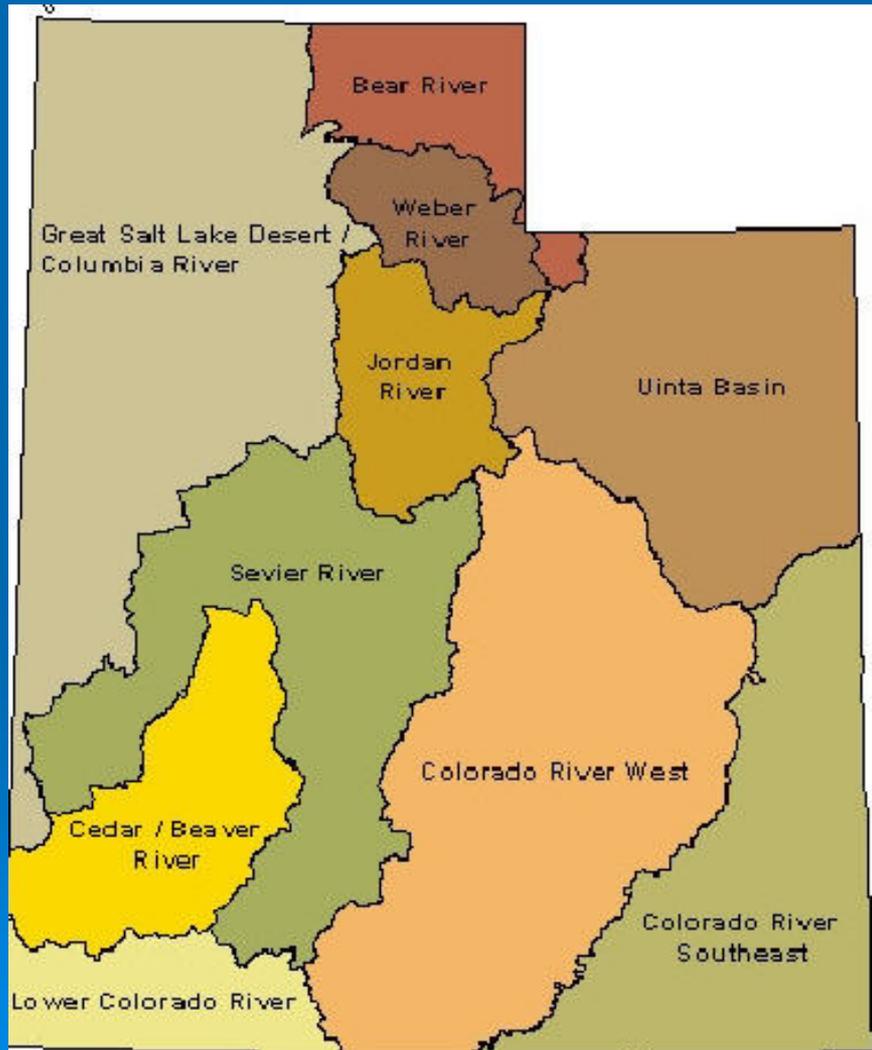
What is causing “dead zones” in the Gulf of Mexico?



What is causing the scum in my back yard pond?

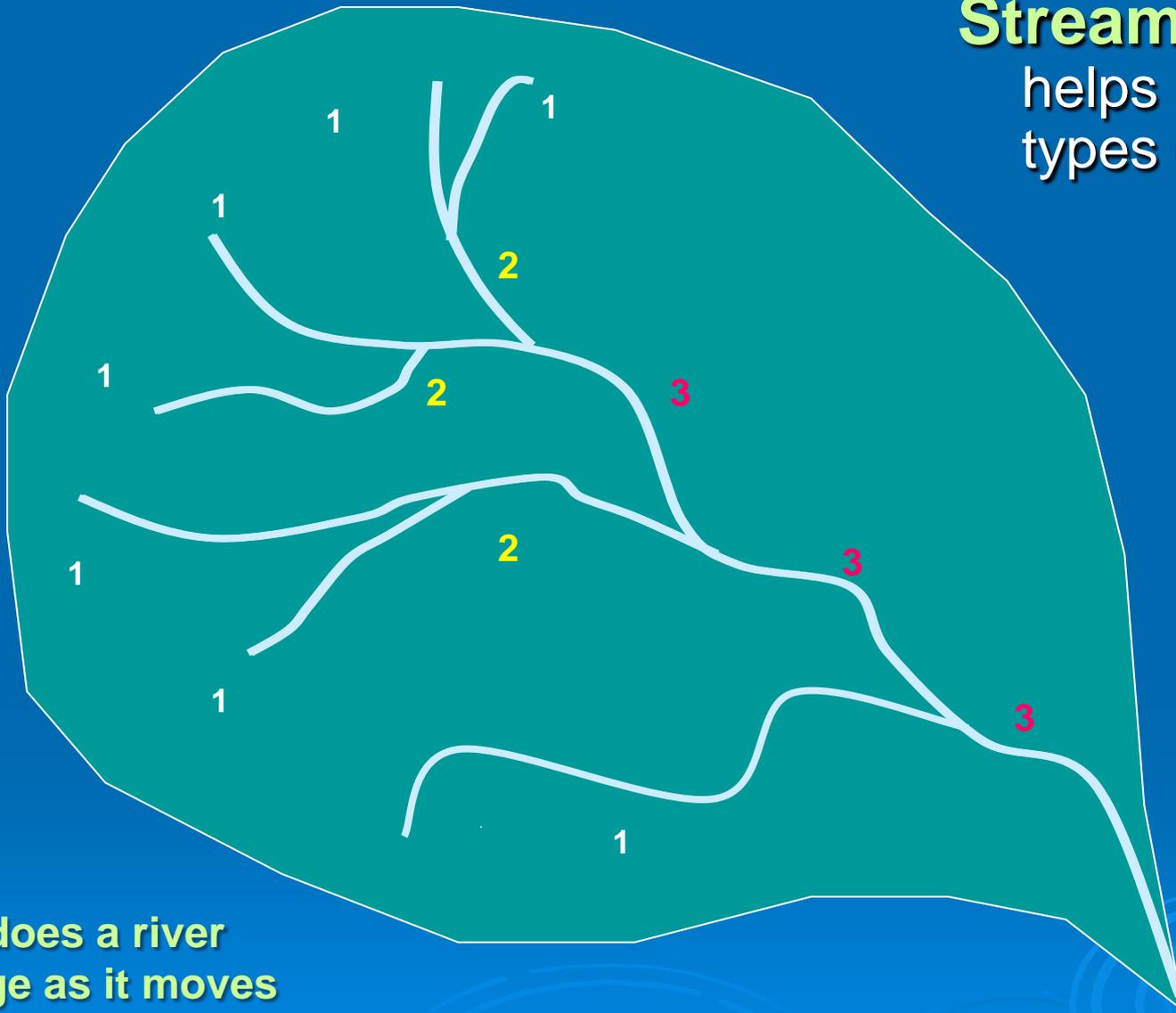


Watersheds are the logical geographic unit for planning:



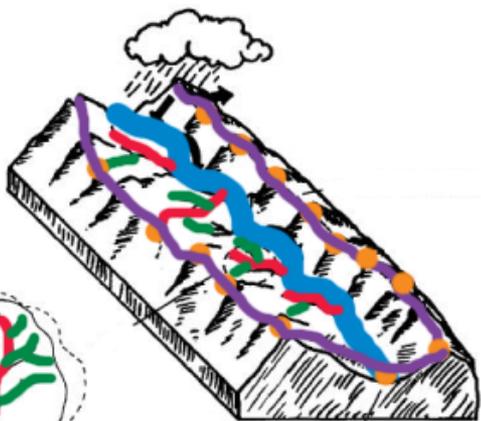
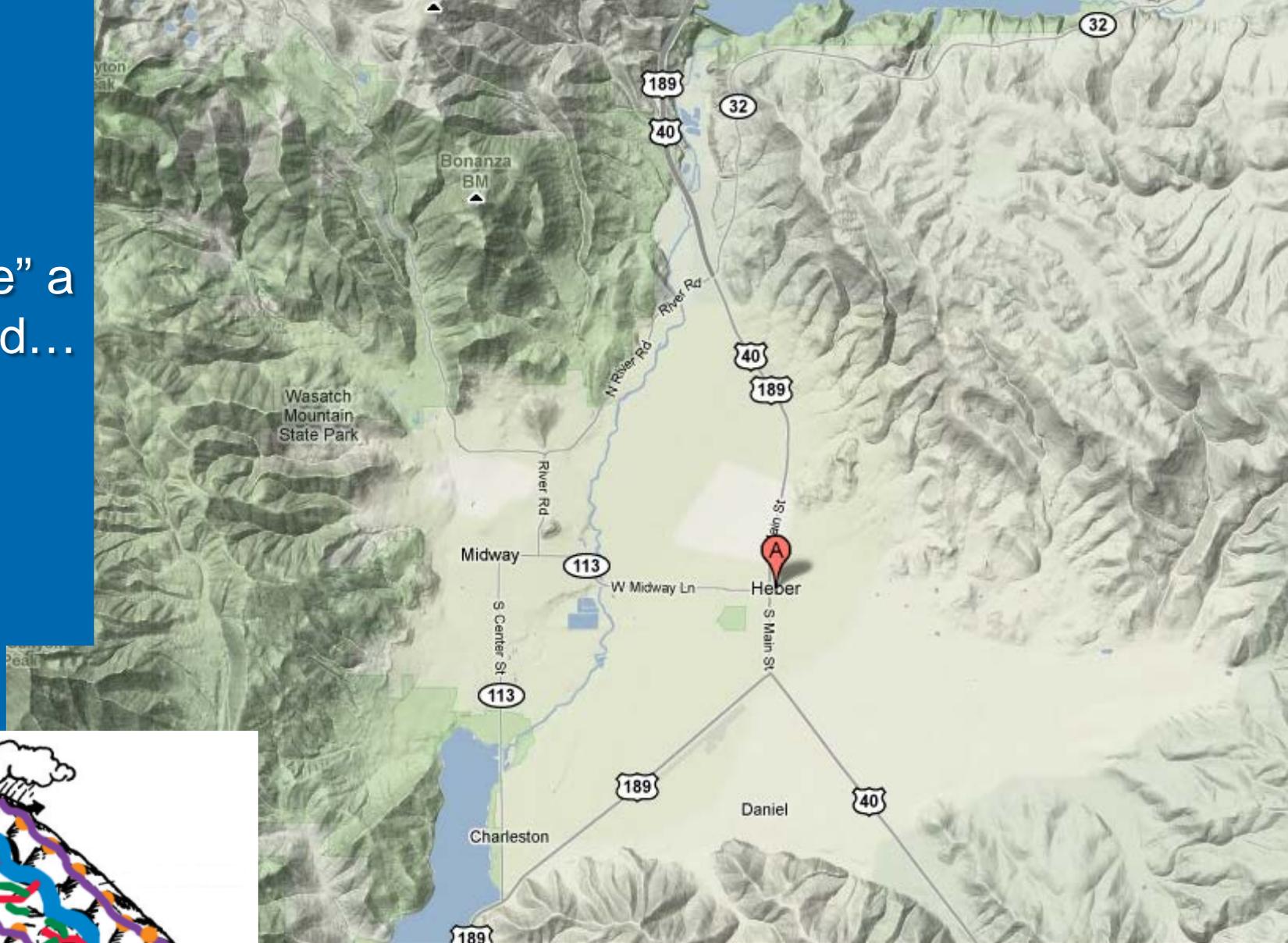
Stream Order

helps characterize
types of streams

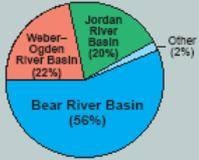


How does a river
change as it moves
from headwaters to
base of watershed?

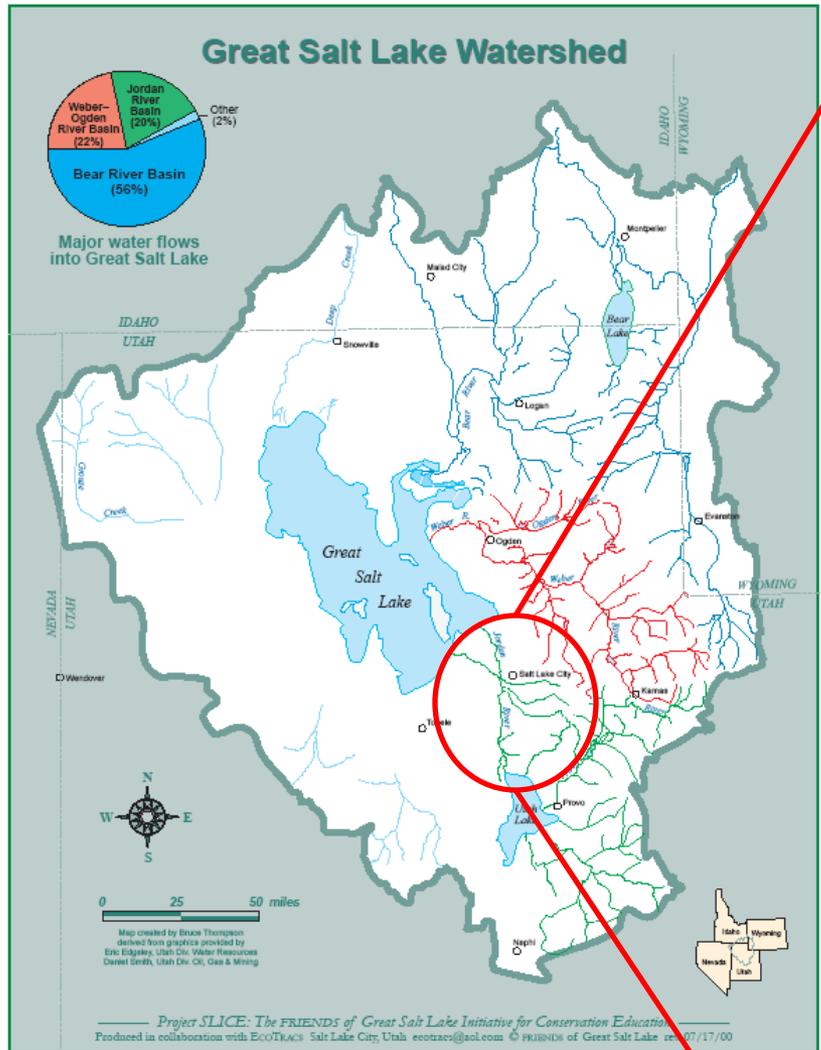
How to
"delineate" a
watershed...



Great Salt Lake Watershed



Major water flows into Great Salt Lake

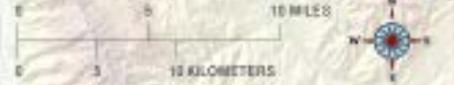


Map created by Brian Thompson
derived from graphics provided by
Eric Engaley, Utah Div. Water Resources
David Greth, Utah Div. Oil, Gas & Mining

Project SLICE: The FRIENDS of Great Salt Lake Initiative for Conservation Education
Produced in collaboration with EcoTRACS Salt Lake City, Utah. ecotracs@aol.com © FRIENDS of Great Salt Lake 07/17/00

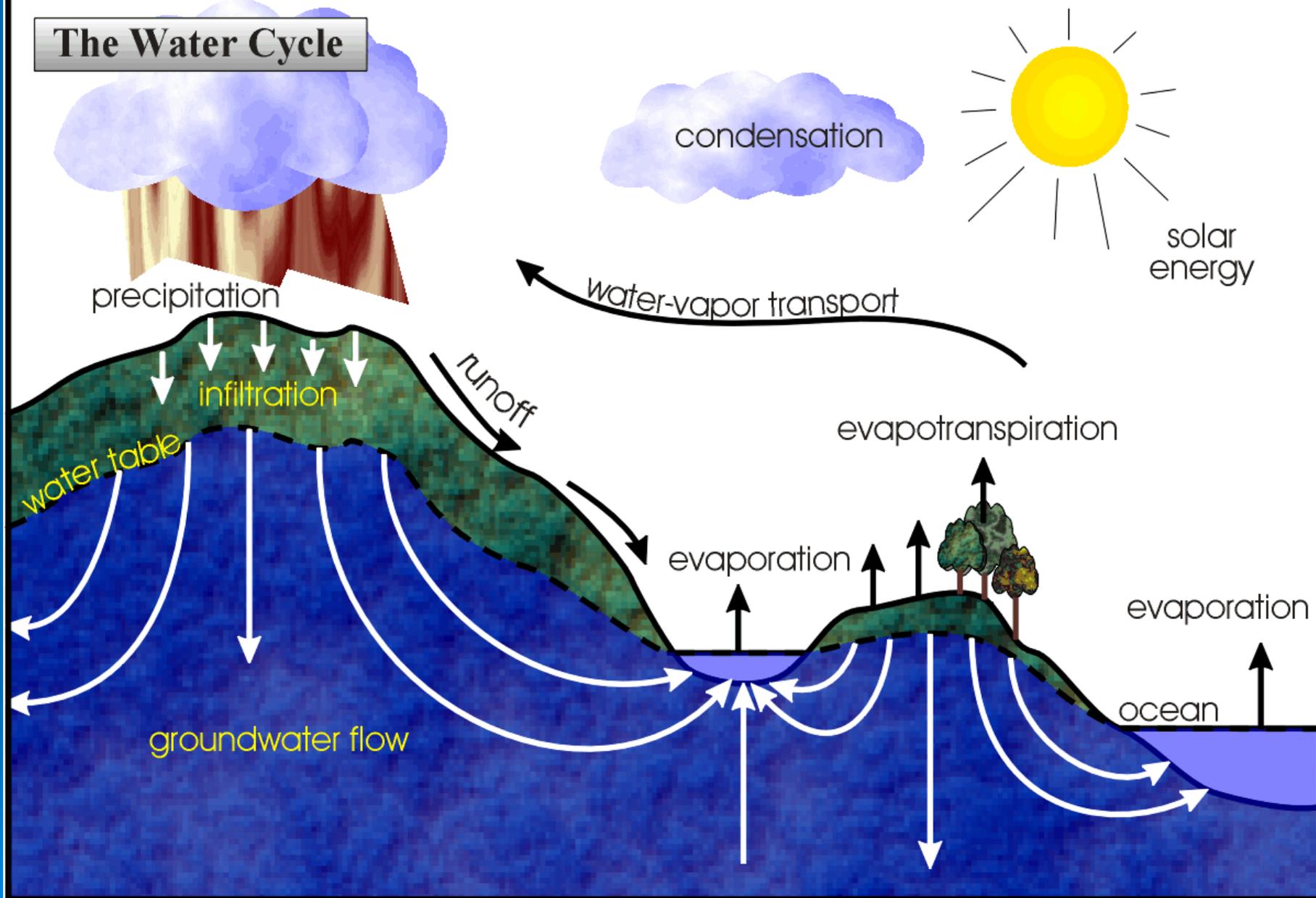
Jordan River Watershed, Utah

9th Grade Teacher Copy

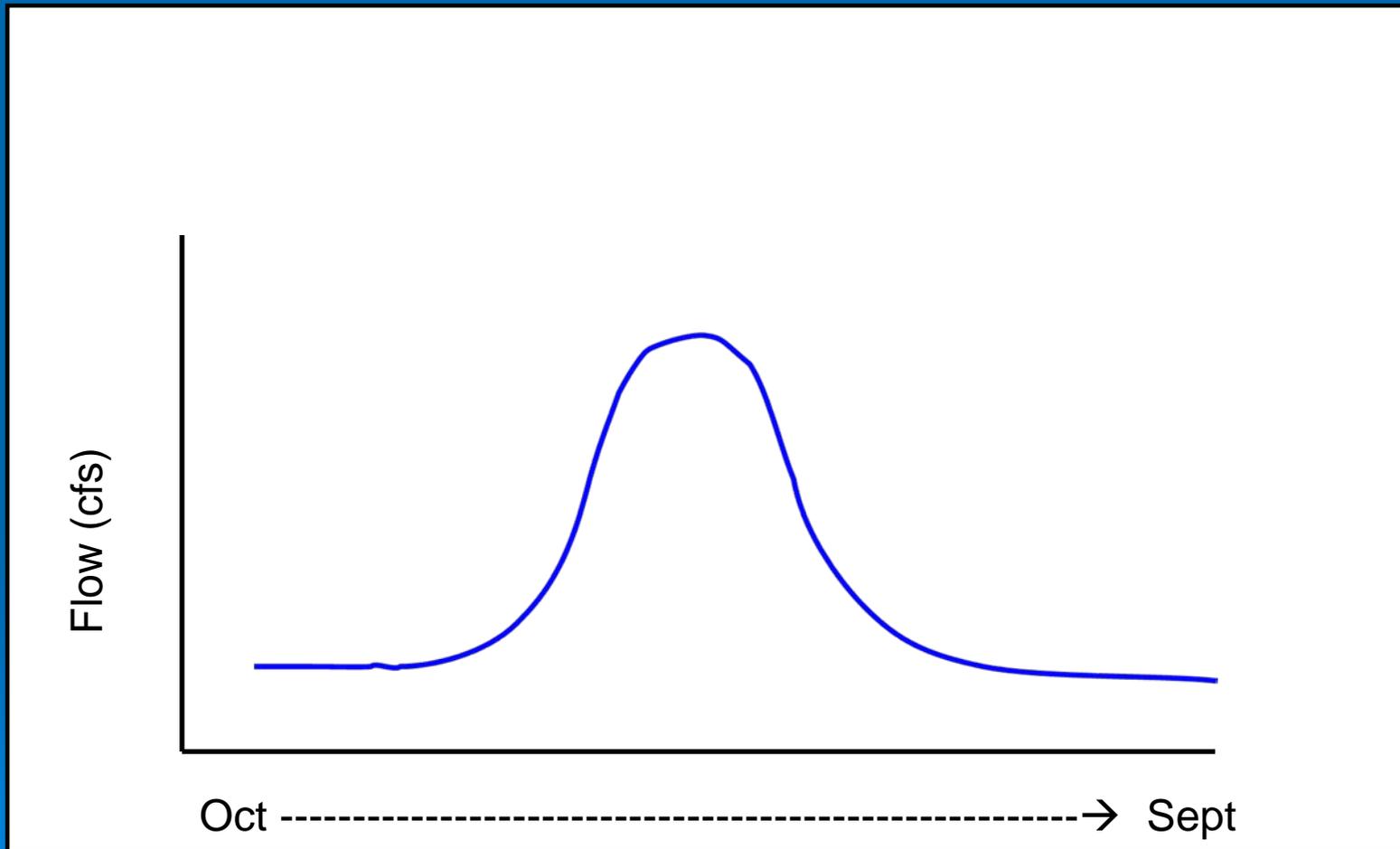


Map developed by
Salt Lake City Public Utilities G.U.S. Division
and Brian Thompson / EcoTRACS
1st March 2005

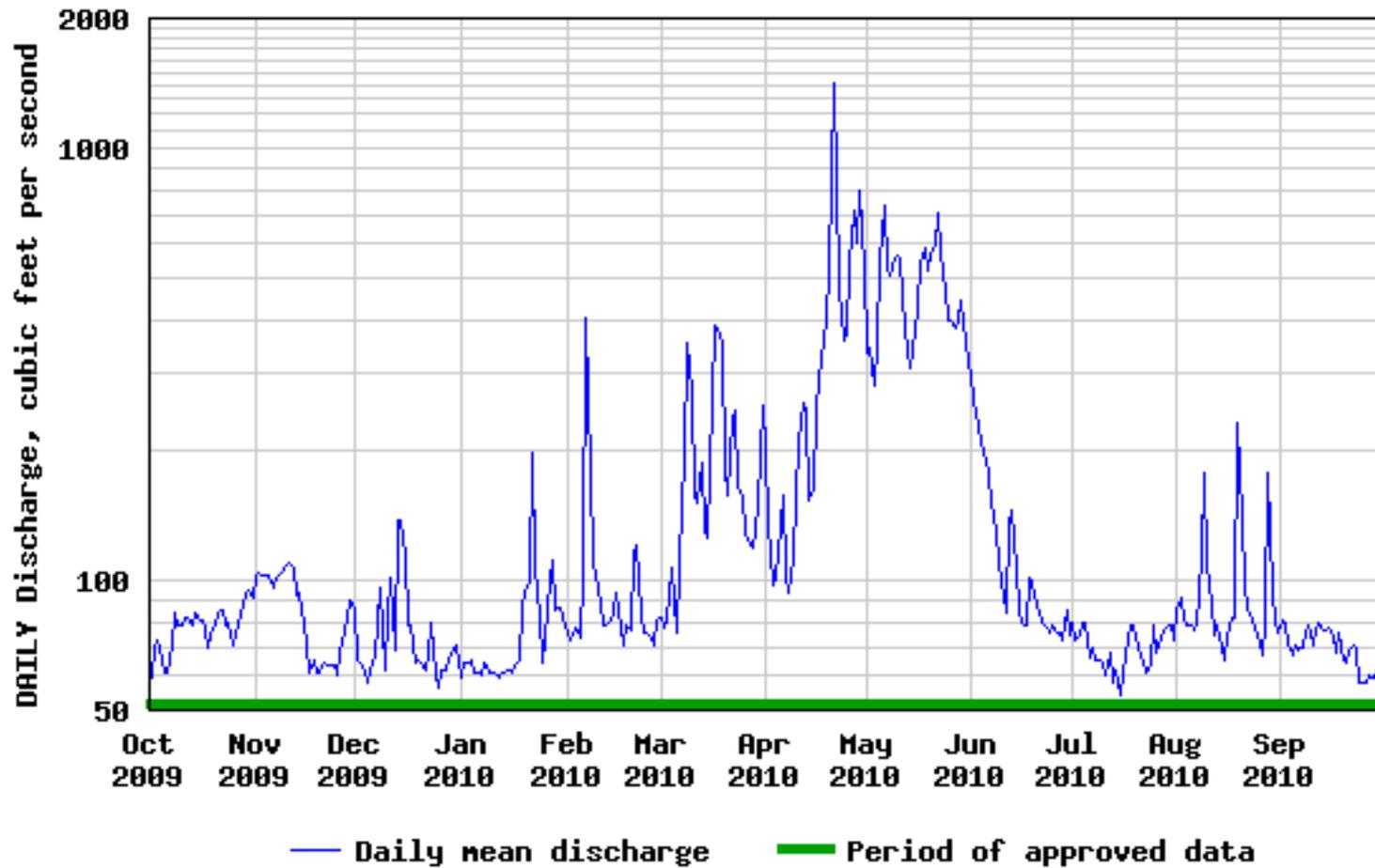
The Water Cycle



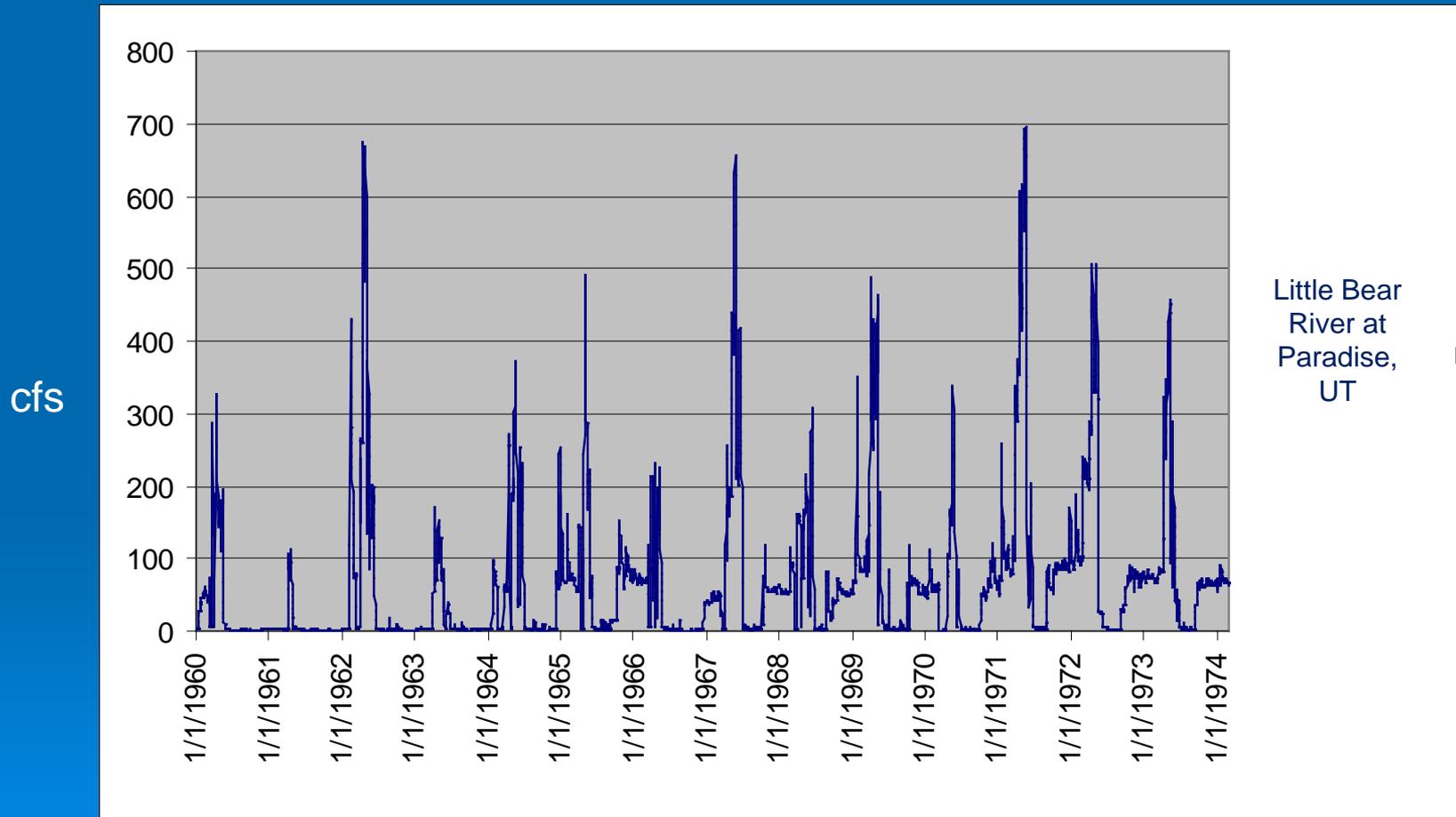
Natural Hydrographs:



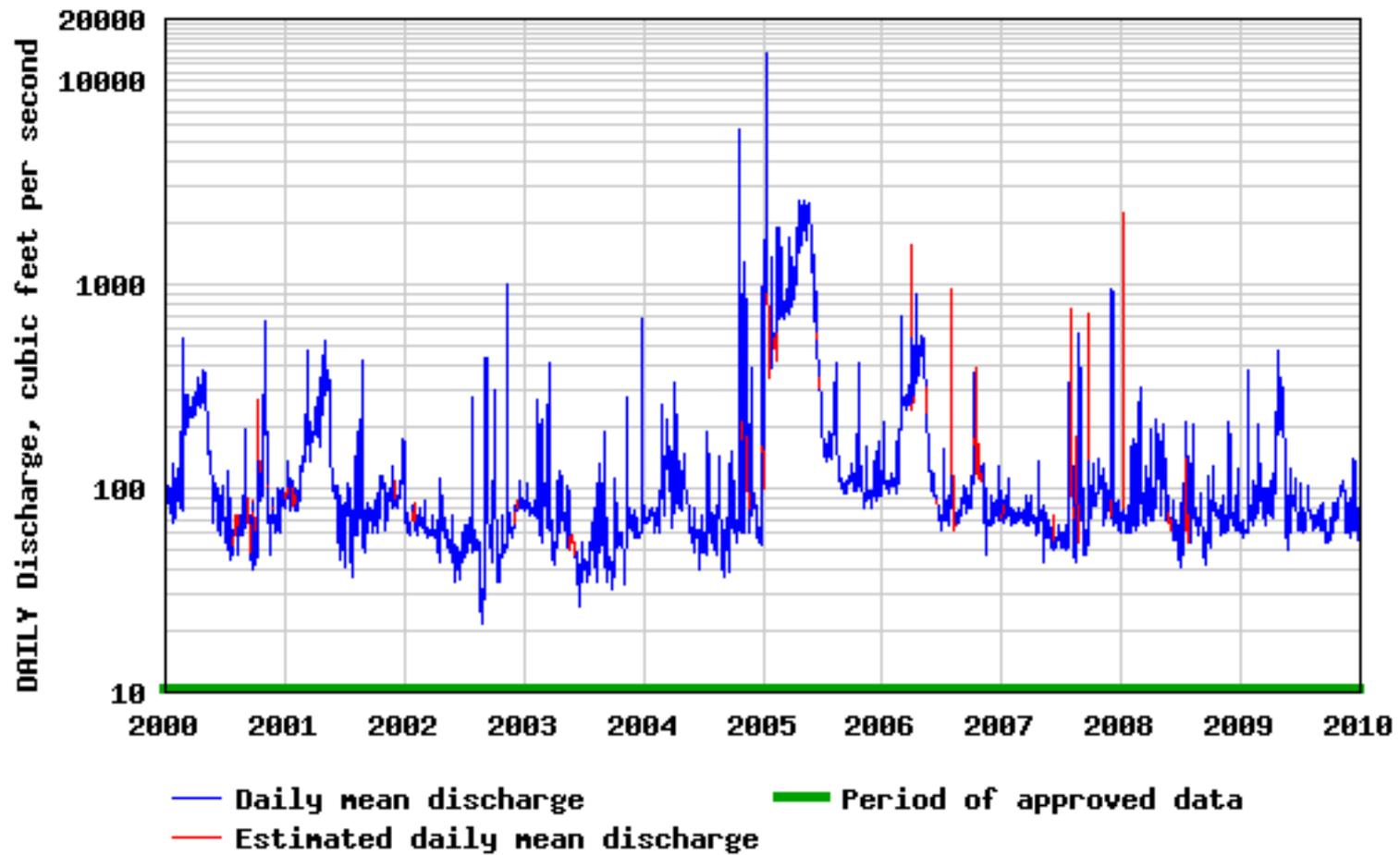
USGS 09408150 VIRGIN RIVER NEAR HURRICANE, UT



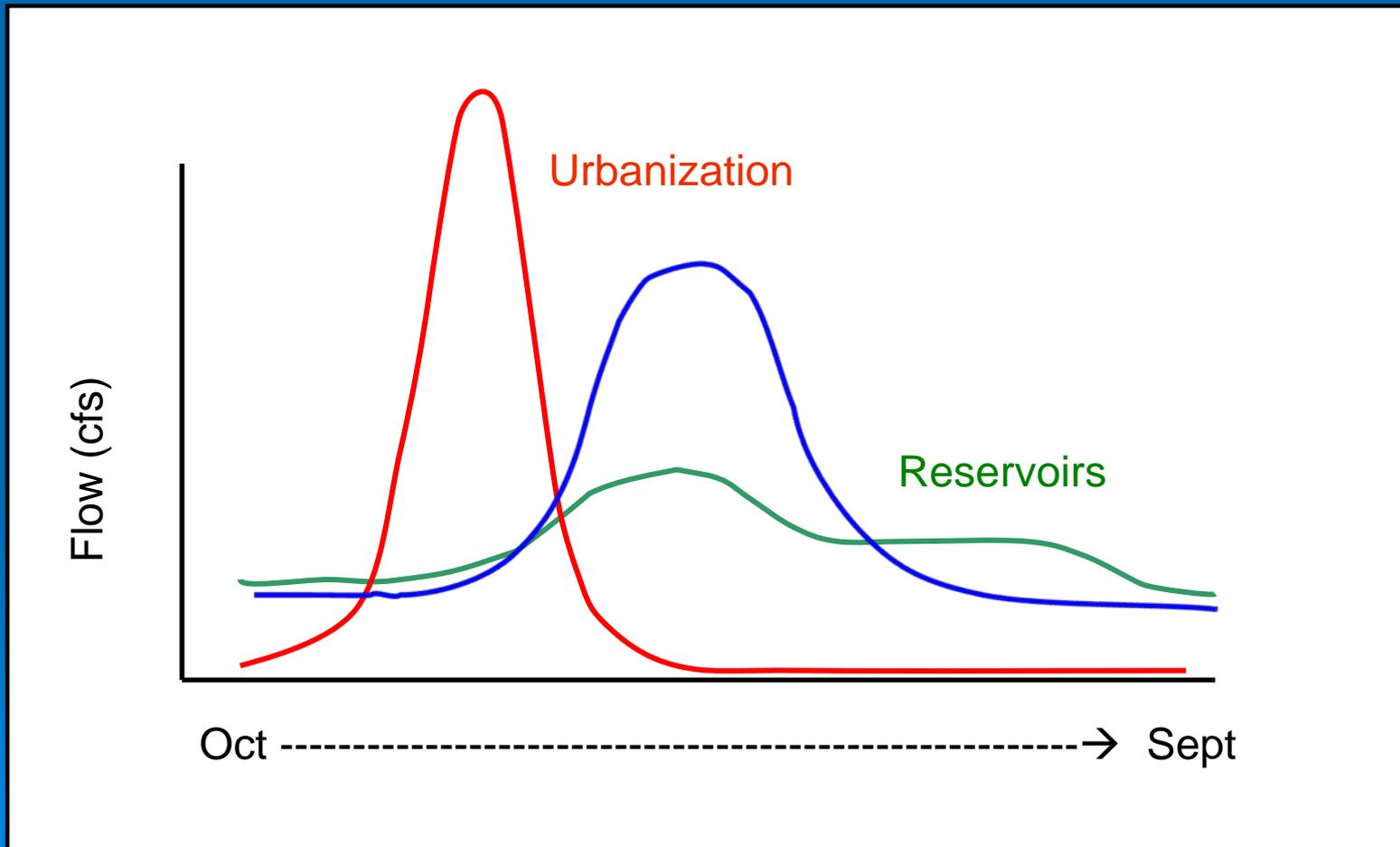
Natural Variability



USGS 09408150 VIRGIN RIVER NEAR HURRICANE, UT



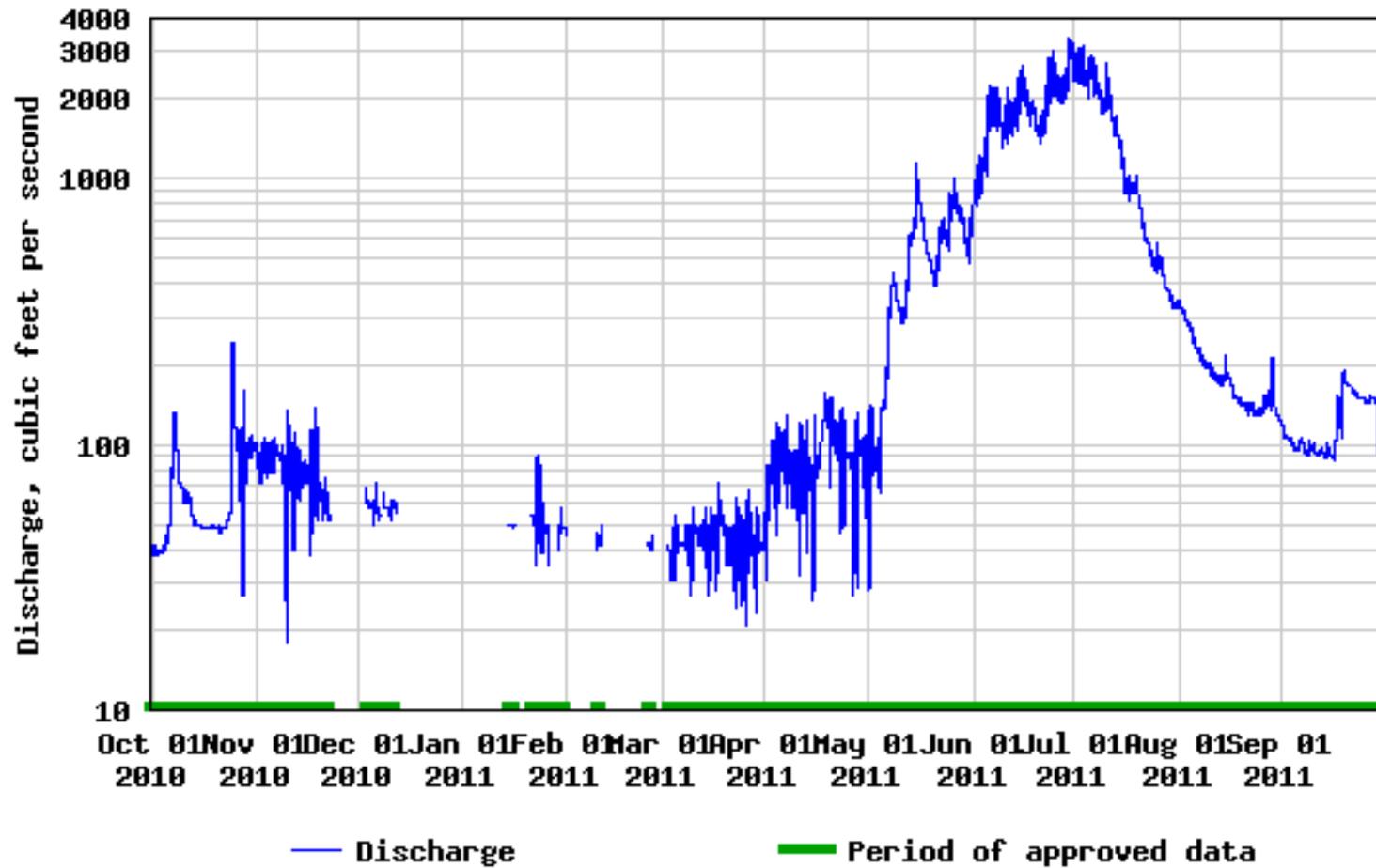
Modified Hydrographs:



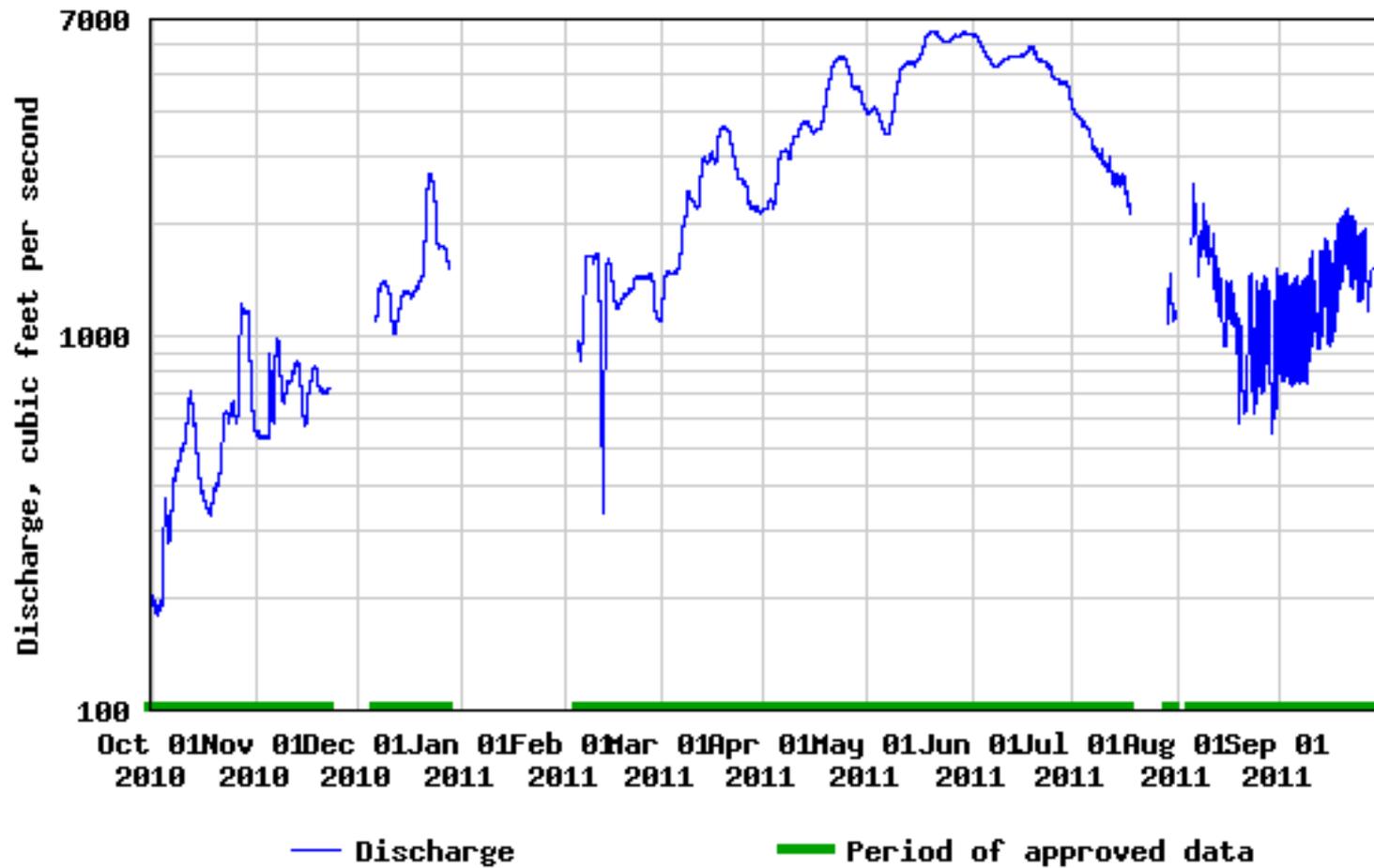
Reservoirs

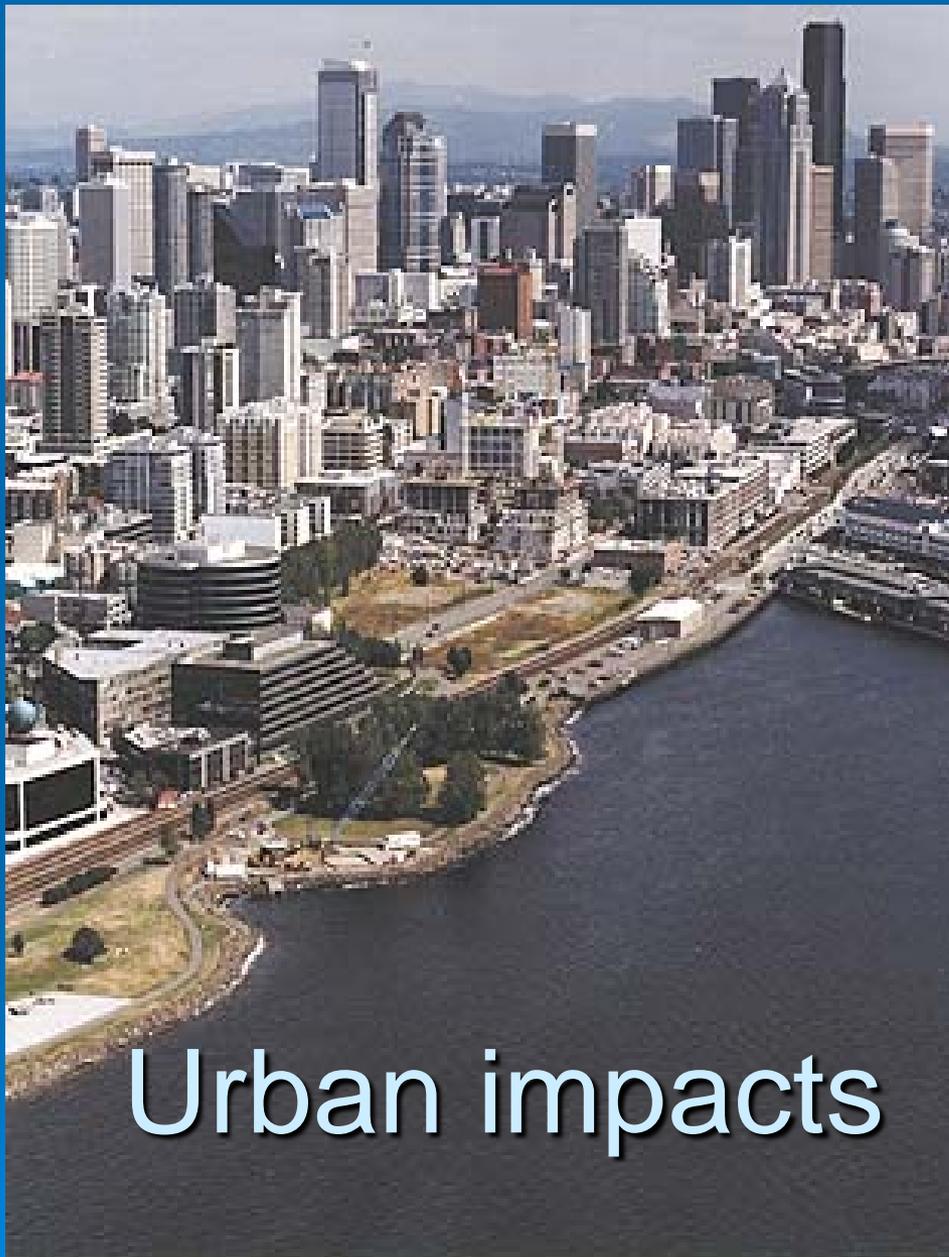


USGS 10011500 BEAR RIVER NEAR UTAH-WYOMING STATE LINE



USGS 10126000 BEAR RIVER NEAR CORINNE, UT



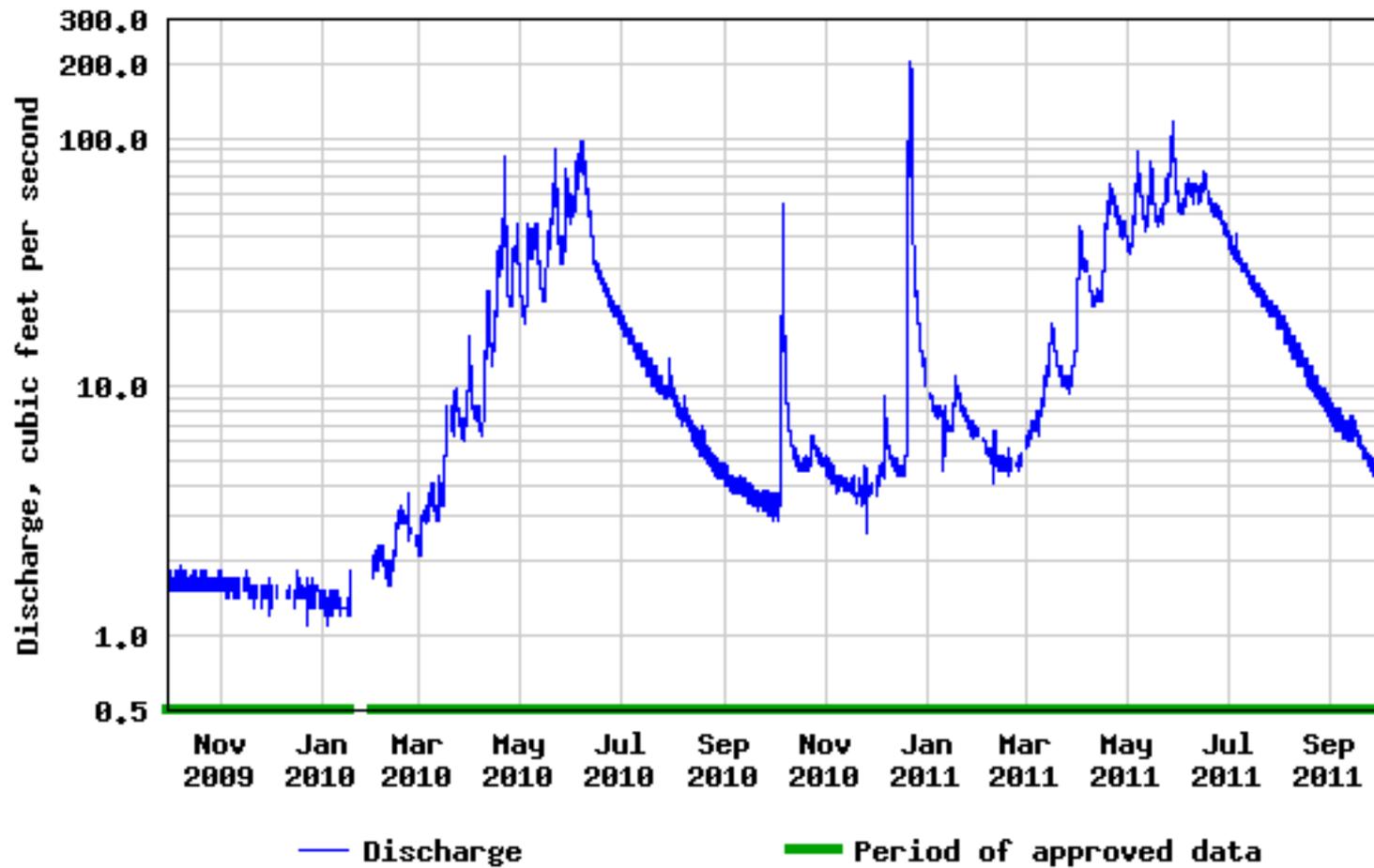


Urban impacts



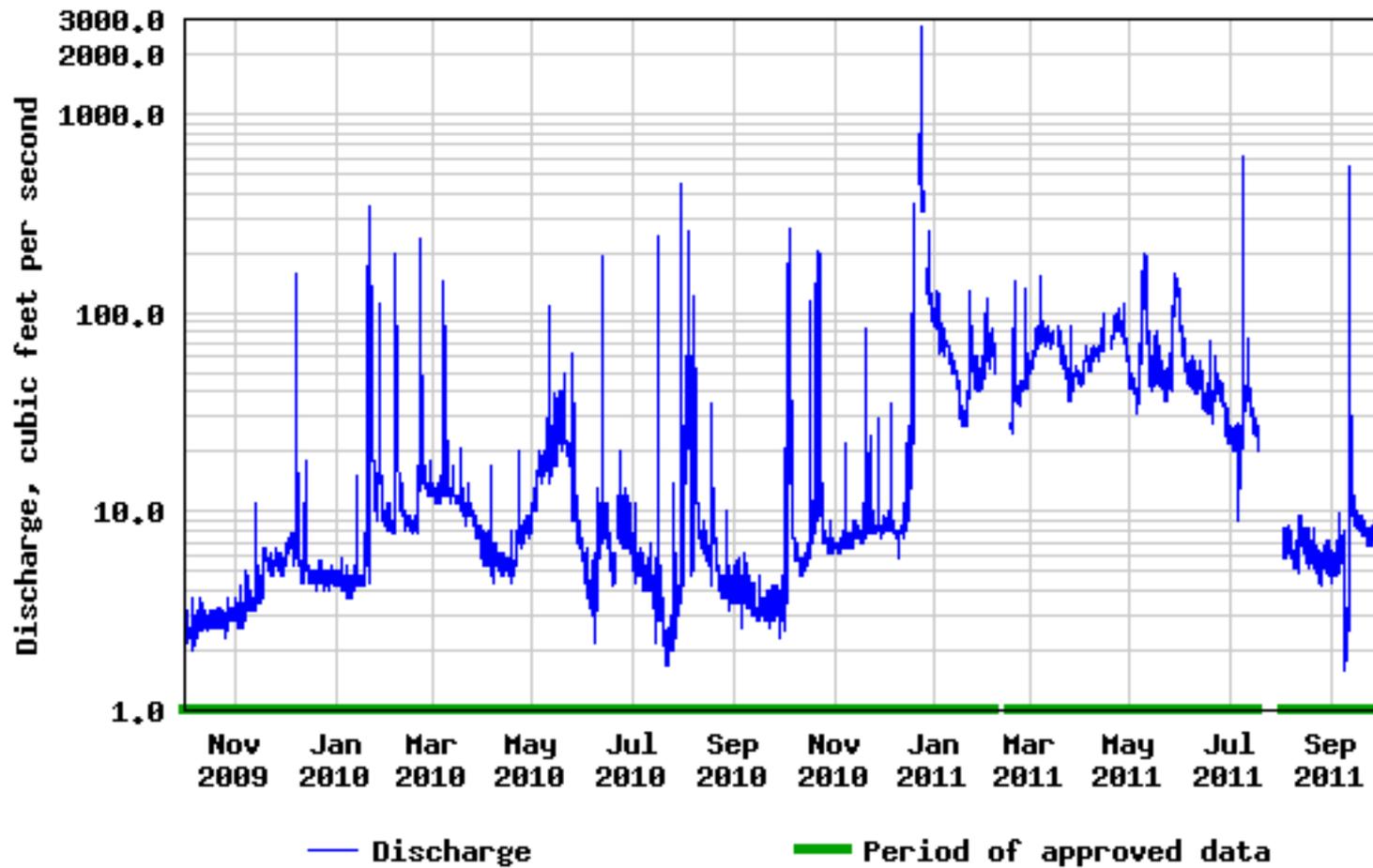


USGS 09408400 SANTA CLARA RIVER NEAR PINE VALLEY, UT

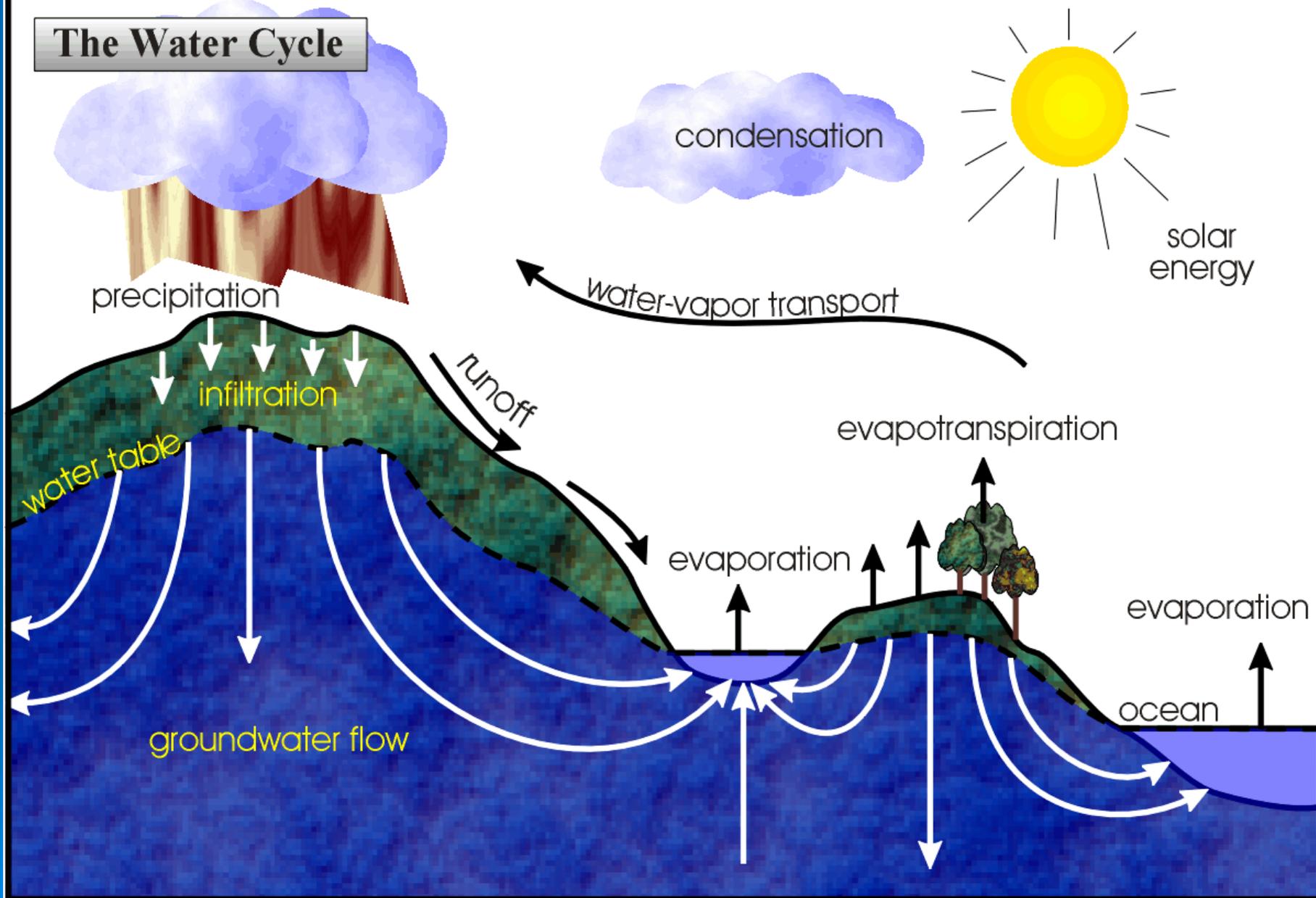




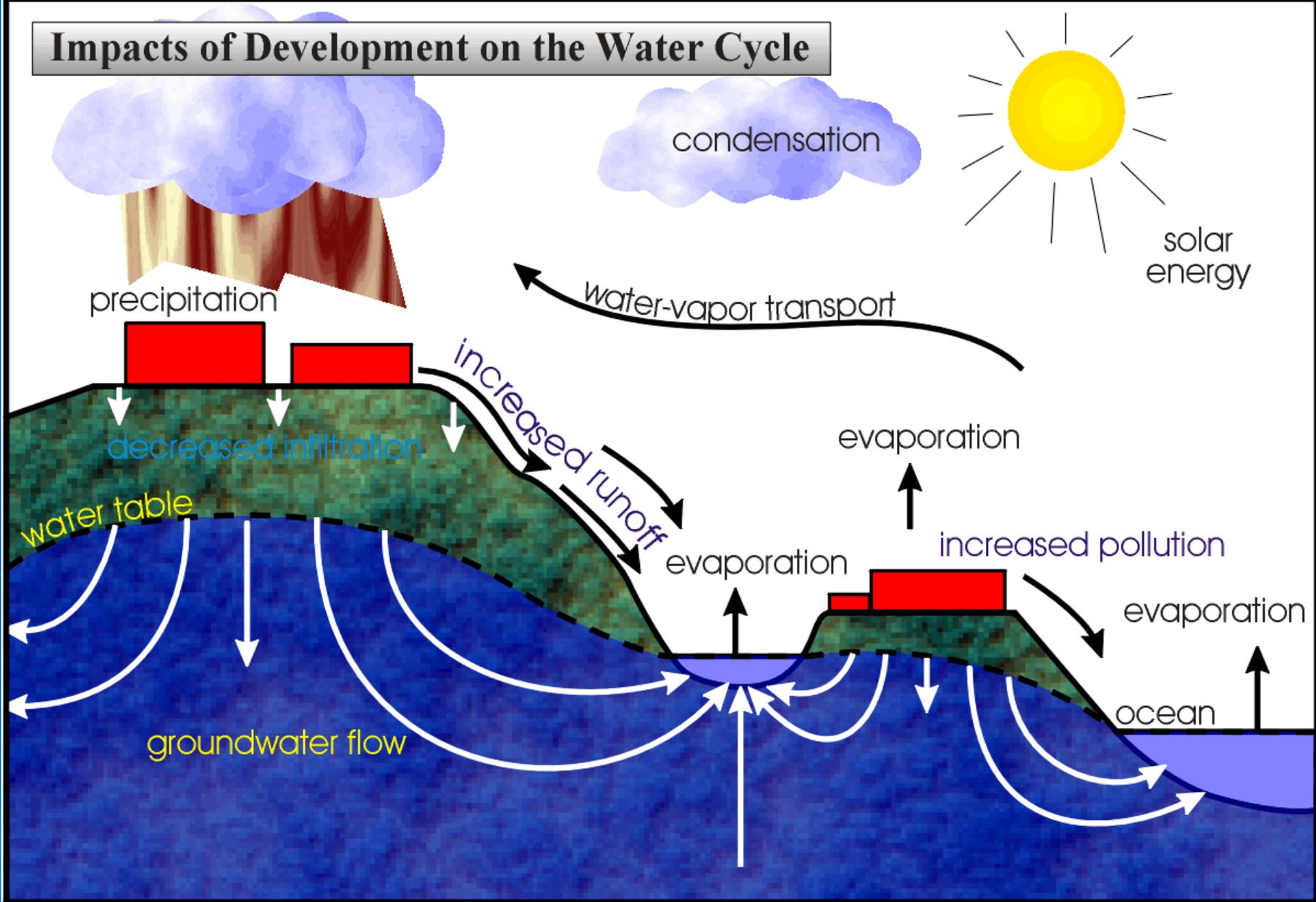
USGS 09413000 SANTA CLARA RIVER AT ST. GEORGE, UT



The Water Cycle



Impacts of Development on the Water Cycle



What is the connection between watersheds and water quality?

Everything that happens in a watershed can affect the quality of the water downstream

....*“we all live downstream”*



Water quality is regulated through Clean Water Act (1972)

- Waters of U.S. must be “fishable and swimmable” by 1983
- Eliminate all pollution discharge to waters by 1985



Cuyahoga River, June 22 1969



What is Clean Water?

Safe to drink ?



Distilled?



Crystal clear?



There is no single definition of clean water.

The Clean Water Act defines clean water according to how we use it.



How do we use water?

Beneficial uses:

Drinking water

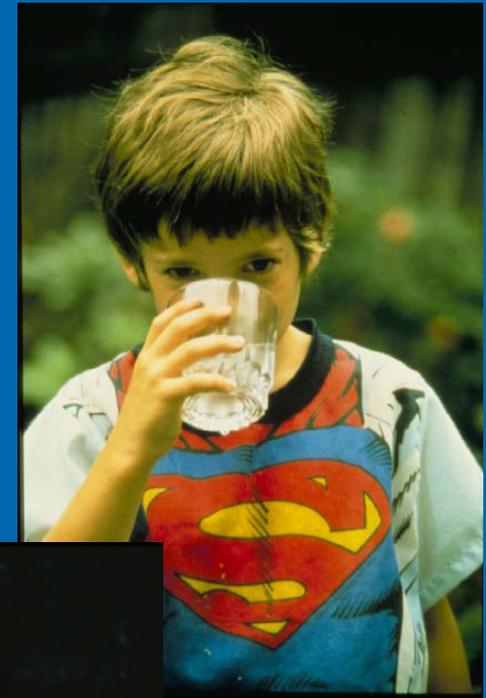
Agriculture

Recreation

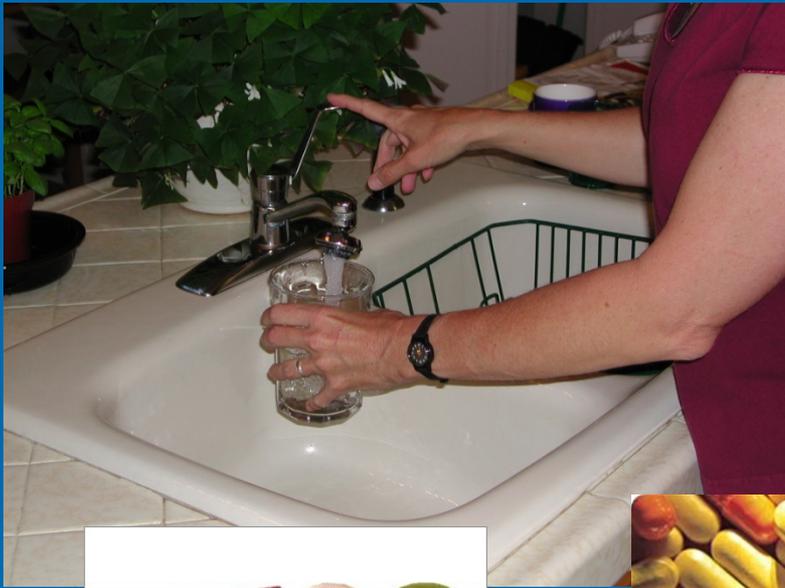
Fisheries and other aquatic life

Aesthetics

Industry



What pollutants affect the use of a drinking water source?



Bacteria, metals, organic pollutants, nitrates, pH, sediments, PPCPs



What pollutants affect the use of an agriculture water source?



Salts and a few metals



What pollutants affect the use of a recreation water source?



Bacteria, pH,
turbidity, nitrate,
phosphorus,
sediments



What pollutants affect the use of a water source for aquatic life?



Metals, organic pollutants, pH, temperature, dissolved oxygen, ammonia, sediments

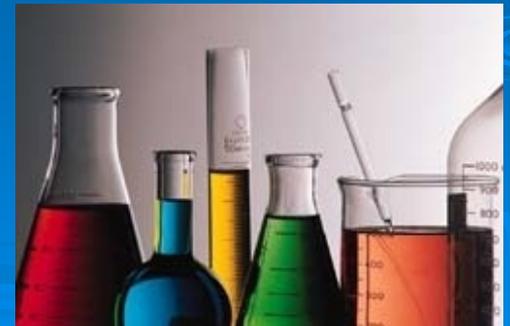
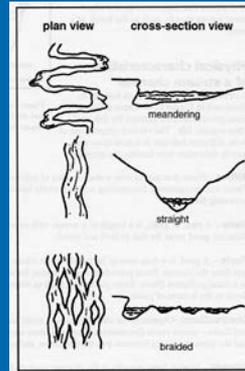


How do you know if you have clean water?



Elements to Consider:

- Physical
- Biological
- Chemical



Physical Monitoring (stream form, substrate)

Advantages:

- Reflects hydrologic impacts
- Relatively low cost

Disadvantages:

- May not reflect actual water quality
- May be subjective
- Lack of repeatability



Biological Monitoring (macroinvertebrates, algae, fish)

Advantages:

Integrates impacts over time

Biological impacts = loss of
beneficial use

Easy to collect

Disadvantages:

Need for reference sites

High degree of heterogeneity in
samples



Chemical Monitoring (water column)

Advantages:

Standardized Methods
(Repeatable, Comparable)
Easy to Collect
Related to toxicity or other
impacts



Disadvantages:

Discontinuous in time and
space

Pollution Source Types:

Point sources



**Nonpoint
sources**

Water quality testing targets the pollutants that affect different beneficial uses.



Water measurements we will make or observe in the field are:

- Temperature
- Dissolved Oxygen
- Nitrates
- pH
- Turbidity
- Land uses
- Flow (qualitative)



Features of the watershed and sources of pollutants that may cause water quality to change.

Structural Elements

Narrow valley, steep, fast river

Wide valley, wide slow river

Shade near the stream

Vegetated banks

Human Impacts

Pipes

Canals coming in

Changes in flows

“rip rap”

Nearby land uses

Animals

Temperature



Why do we care about temperature?

- Fish and other aquatic life
- Other effects....
 - How much oxygen water can absorb
 - The toxicity of ammonia



What causes temperatures to rise?

Natural causes:

Seasons

Length of river

Location of river

Hot springs



Human causes:

Removal of streamside vegetation (shade)

Runoff over concrete and other heated surfaces

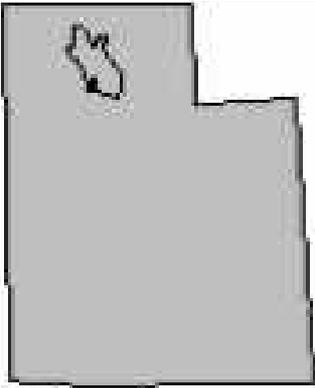
Changes in stream shape

Reductions in flow

Impoundments

Industrial discharges





In Utah....

Temperature standards for fish in Utah

Maximum Temperature :

for warmwater fish is 27°C (80.6°F)

for coldwater fish is 20°C (68°F)

Dissolved Oxygen



Why do we care about dissolved oxygen (DO)?

- Fish and other aquatic life
- Other effects...
 - Oxygen in water affects solubility of metals and other chemicals



What causes oxygen concentrations to change?

Natural causes:

Uptake by organisms

Natural increases in temperature

Quiet water (low re-oxygenation)

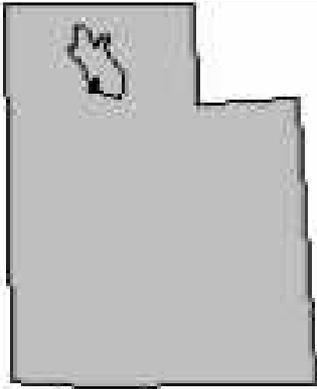
Human causes:

Any source of biological material that will decay in water

High temperatures or low flows

Excessive plant growth in water





In Utah....

DO standards for fish in Utah

Minimum Dissolved Oxygen (mg/L or ppm)

	Cold water	Warm water	Nongame
30 Day Average	6.5	5.5	5.0
1 Day Average	8.0/4.0	5.0/3.0	3.0

Nitrates



Why do we care about nitrates?

- Excessive plant growth
- Health concerns



What causes nitrogen concentrations to change?

Natural causes:

Seasonal changes

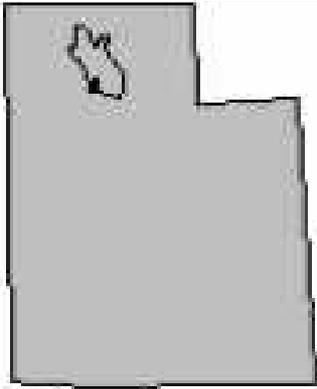
Plant uptake

Human causes:

Land uses in the watershed

- Fertilizers, animal manure
- Malfunctioning septic systems
- Discharges from sewage facilities and acid precipitation





In Utah....

Nitrate Standards for Utah

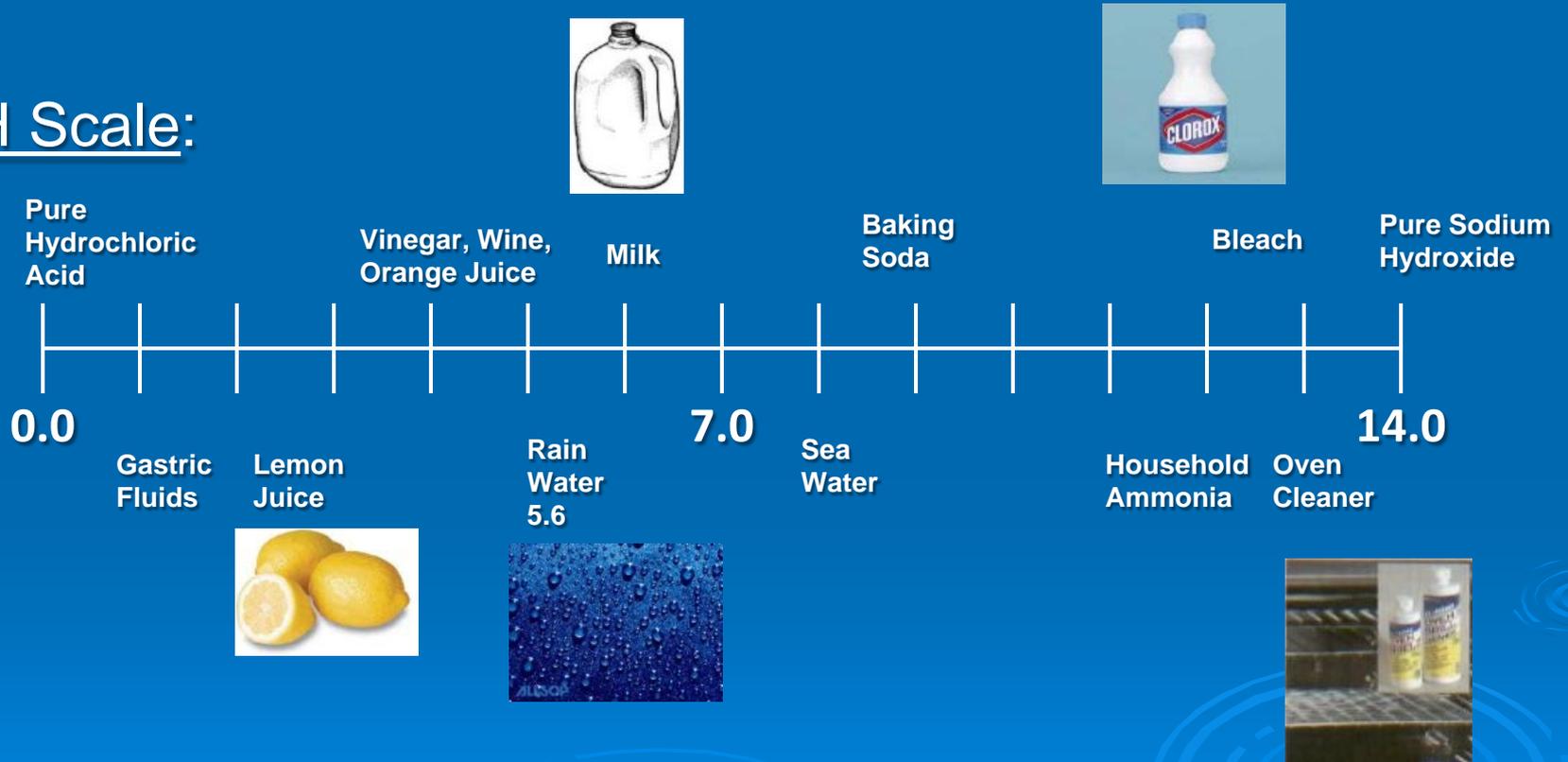
- The maximum concentration of nitrate allowed in drinking water is 10 mg/L.
- The state of Utah considers nitrate concentrations of 4 mg/L to be an indicator of pollution problems.

pH



pH = the level of acidity or alkalinity in a solution

pH Scale:



Why do we care about pH?

- Low pH can affect membranes
(eg. gills of fish or macroinvertebrates and eggs)
- At low pH, causes some metals to dissolve into a more toxic form
- At high pH, ammonia is more toxic



What causes pH to rise or fall?

Natural causes:

Rain is naturally acidic

Rapid snow melt

Photosynthesis in water → higher pH

Human causes:

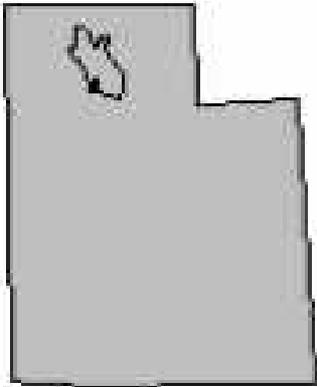
Combustion causes acids in the atmosphere

→ acid precipitation

Industrial discharge

Mine drainage





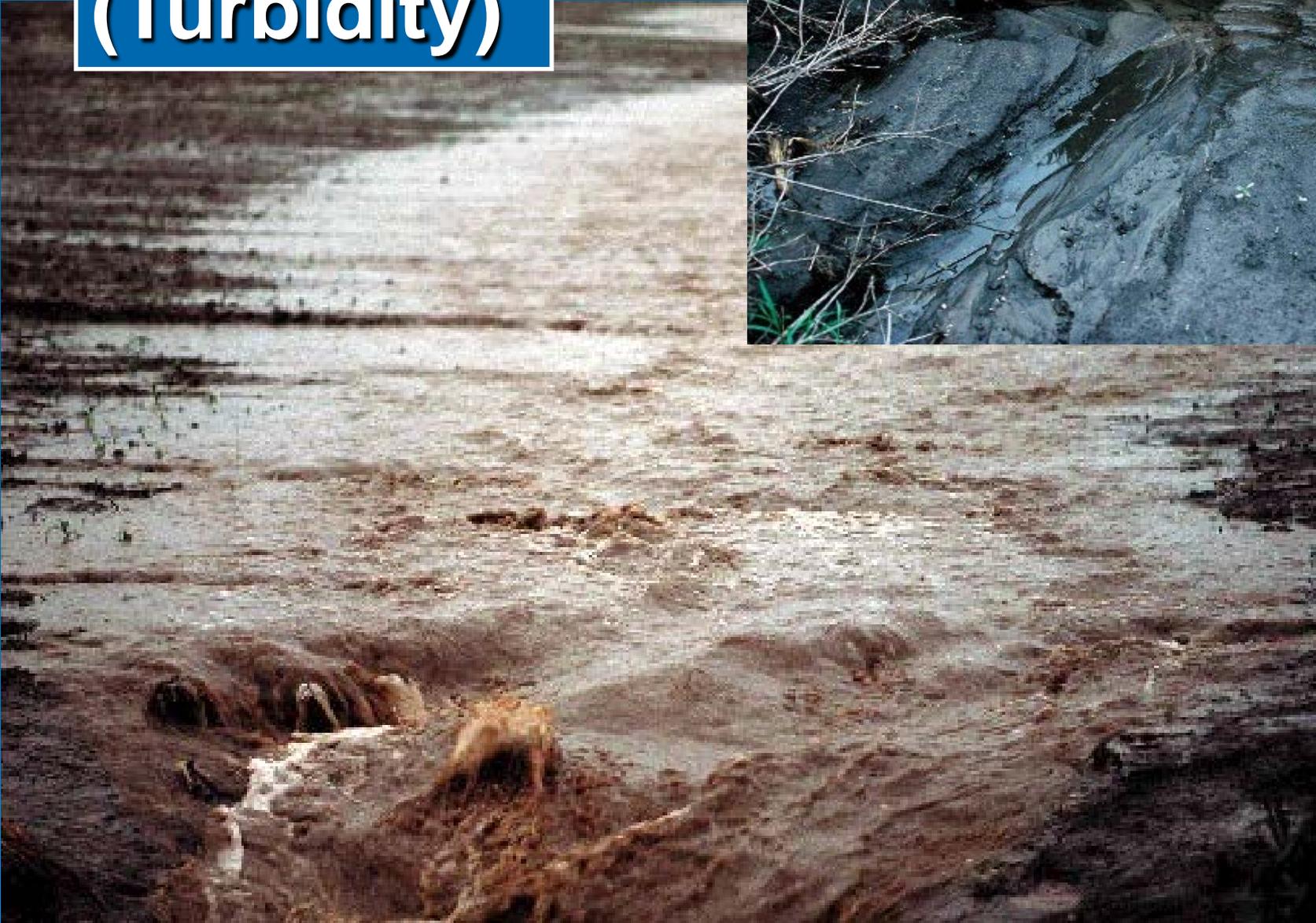
In Utah....

pH standards for fish in Utah

An acceptable pH range is 6.5 – 9.0



Sediment (Turbidity)



USDA NRCS



Why do we care about sediments in streams and lakes?

- Can fill space between cobble in stream and smother fish eggs and tiny aquatic life
- Very cloudy water affects visual predators
- Sediments fill in reservoirs
- Sediments bring nutrients, metals, and more into water



What are sources of sediment in rivers?

Natural causes:

Natural “reworking” of flood plain as stream meanders

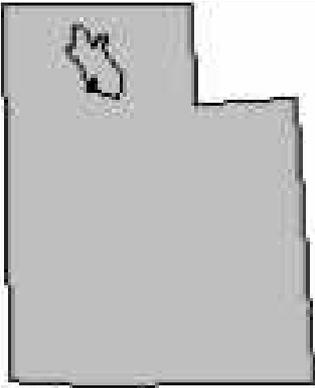
Remobilized bedload sediment under high flows

Seasonal effects

Human causes:

runoff (construction, agriculture, forestry, mining)

stream banks erosion



In Utah....

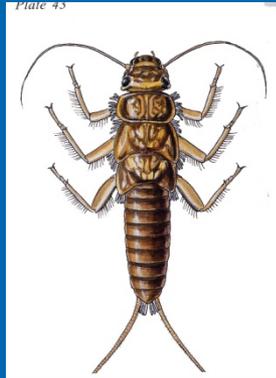
Turbidity standards for fish in Utah

Turbidity should not increase rapidly from site to site

An increase of more than 10 NTUs violates water quality criteria

Macroinvertebrates

- Good Water Quality vs. Poor Water Quality



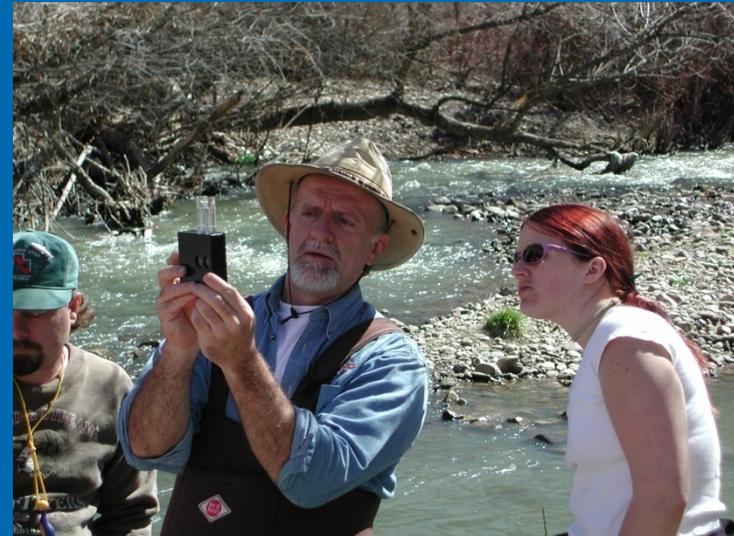
Education and Outreach

- Curricula and teacher training

Stream Side Science
Lesson Plans and Water Related Activities



Utah
State
Water
Center
Team



Education and outreach

➤ Program delivery

- Over 8,000 kids per year
 - Camps and field days
 - Classrooms and water fairs



For more information, contact USU Water Quality Extension at (435)797-2580 or visit <http://extension.usu.edu/waterquality/>

