Center for Environmental Research at Hornsby Bend

Austin WATER

The Aquatic City: The Nature of Urban Waterways

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Austin Water – Center for Environmental Research

Ecological Expectations: Ratty and The Aquatic City

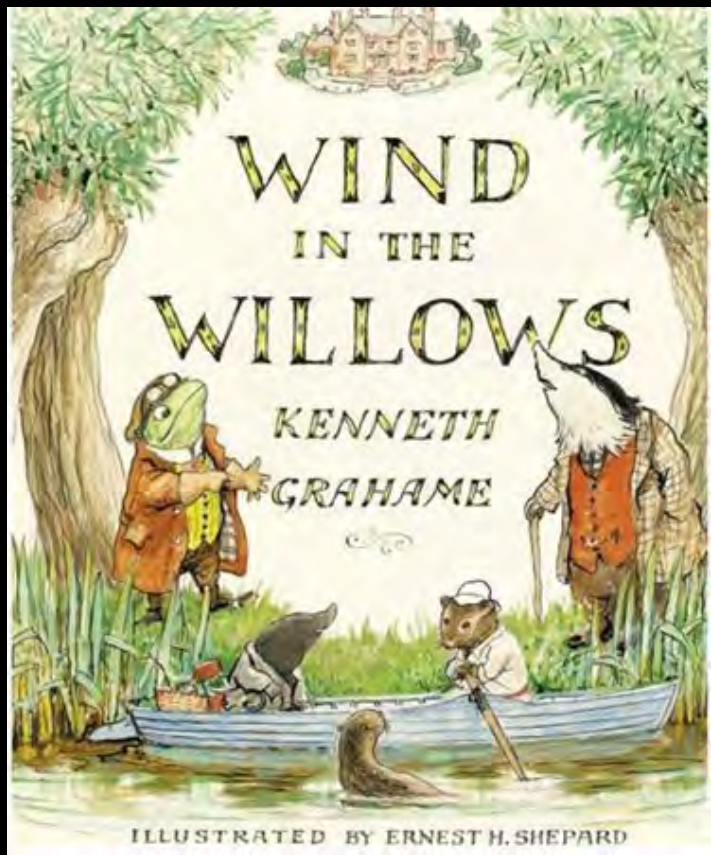
"I'll learn'em to steal my house!" Toad cried. "I'll learn'em, I'll learn'em!"

"Don't say 'learn'em,' Toad," said the Rat, greatly shocked. "It's not good English."

"What are you always nagging at Toad for?" inquired the Badger, rather peevishly. "What's the matter with his English? It's the same what I use myself, and if it's good enough for me, it ought to be good enough for you!"

"I'm very sorry," said the Rat humbly. (1908)
"Only I think it ought to be 'teach'em,' not 'learn'em.'"

"But we don't want to teach'em," replied the Badger.
"We want to learn'em – learn'em, learn'em!
And what's more, we're going to do it, too!"

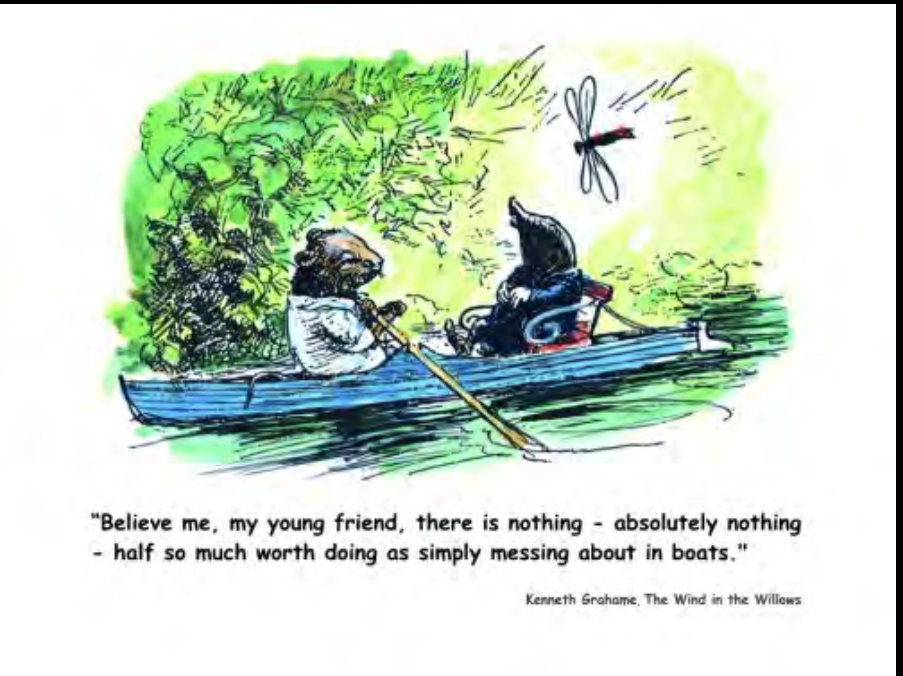


Water Rats - Decline of UK Population

The water vole is found throughout riparian habitat in mainland Britain. However the water vole suffered a catastrophic decline in the latter part of the 20th century through habitat lost from agricultural intensification and development of the floodplain, and predation by the introduced American mink.

A survey carried out by the Mammal Society (1989-90) showed that the species had been lost in 94% of the sites where it had occurred earlier in the century.

But then, a survey conducted by the Urban Wildlife Trust (1997) indicated that population decline in urban areas might not be as dramatic as elsewhere. The urban landscape appears to provide a stronghold for the water vole.

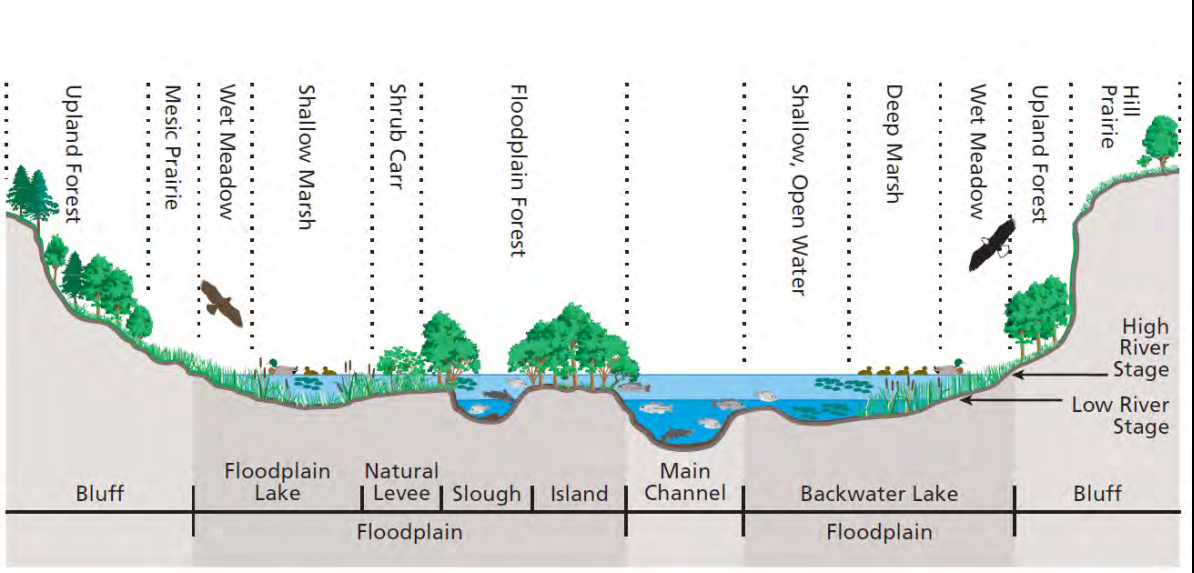


Ratty – the Water Vole (Arvicola terrestris)

Messing about in cities - Urban water voles

Lancashire Wildlife Trust has discovered healthy populations of endangered water voles on some stretches of the Leeds & Liverpool Canal and is actually widespread there because the canal still has brickwork banks in many places and water voles are able to burrow between the bricks.

Ecologists have discovered that urban water vole populations are doing much better than rural populations probably because there is less intensive management of riparian areas in urban wastelands and abandoned canals and no American minks, since they avoid urban habitat.

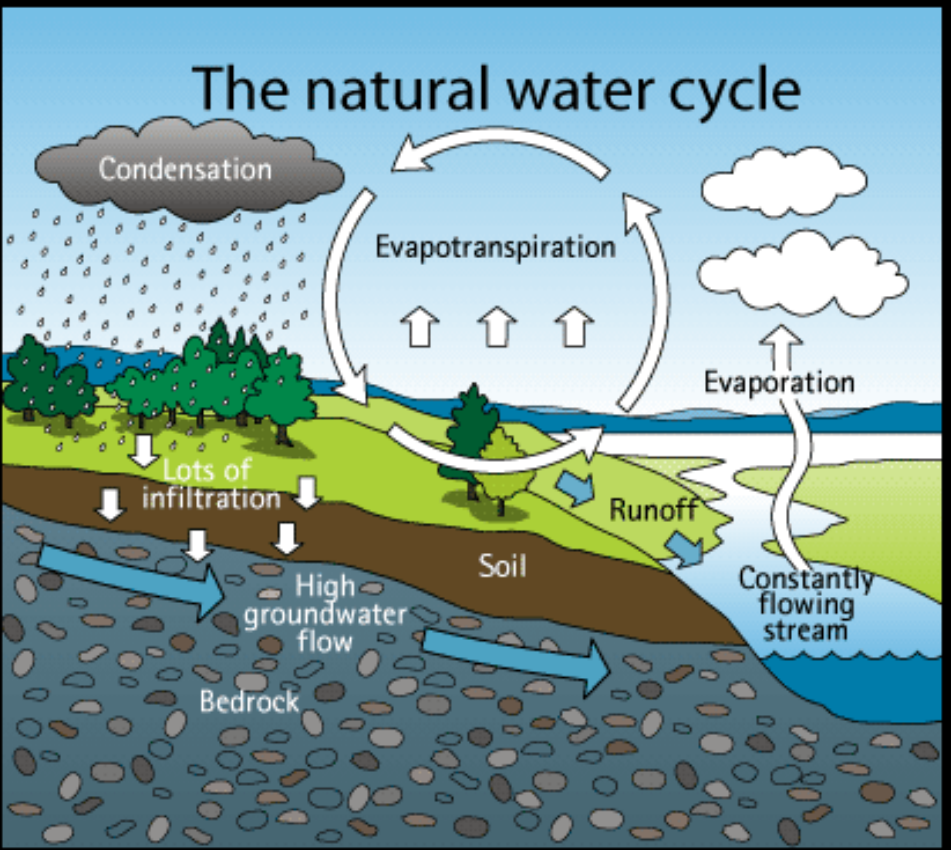


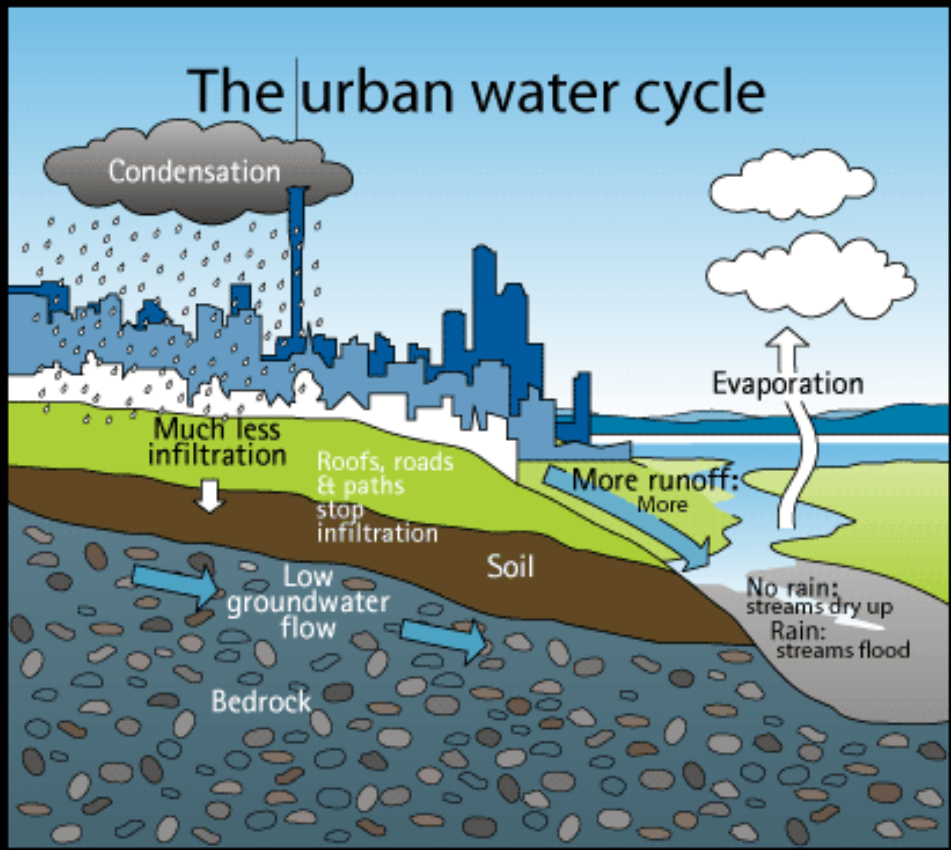
The (Socio)Ecology of Urban Waterways

Abiotic, Biotic, and Human Society

The Physical Geography of an Urban Stream

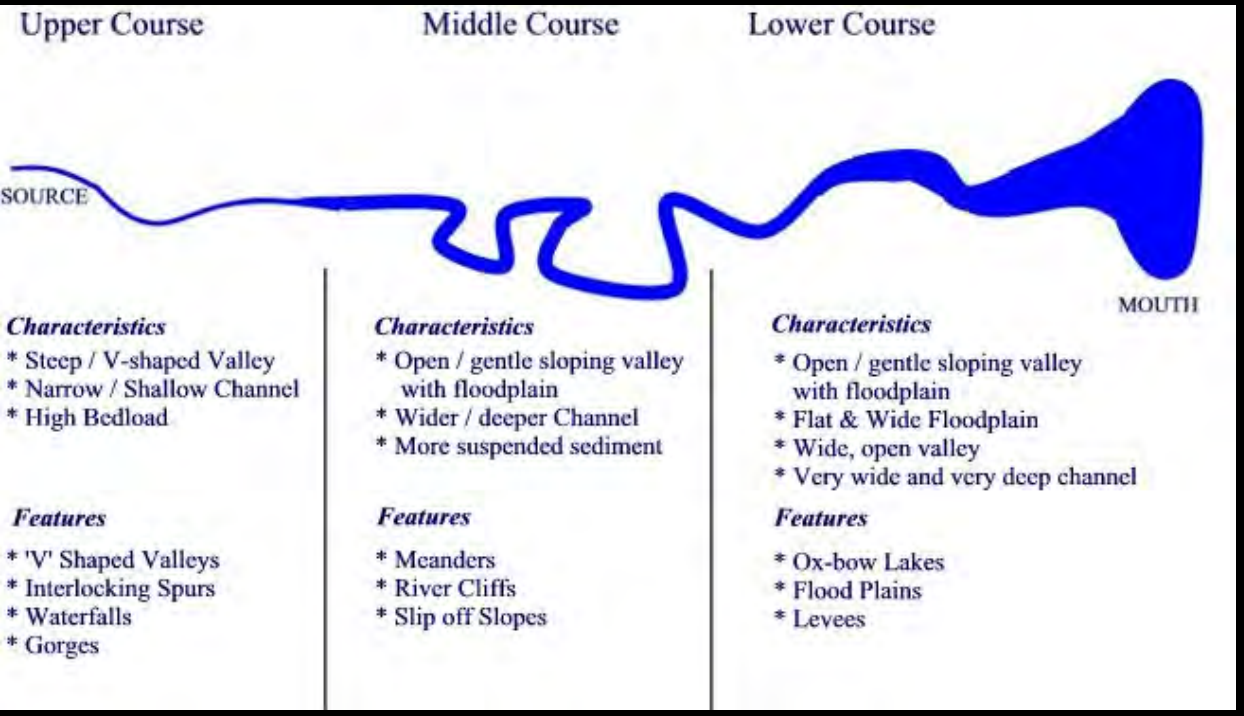
Natural Hydrology vs. Urban Hydrology

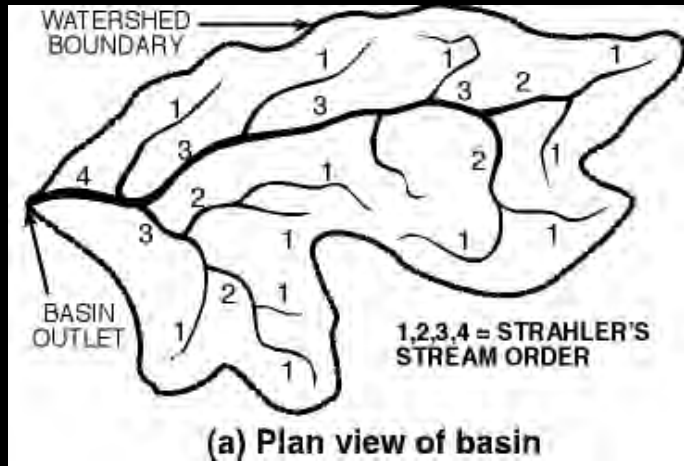




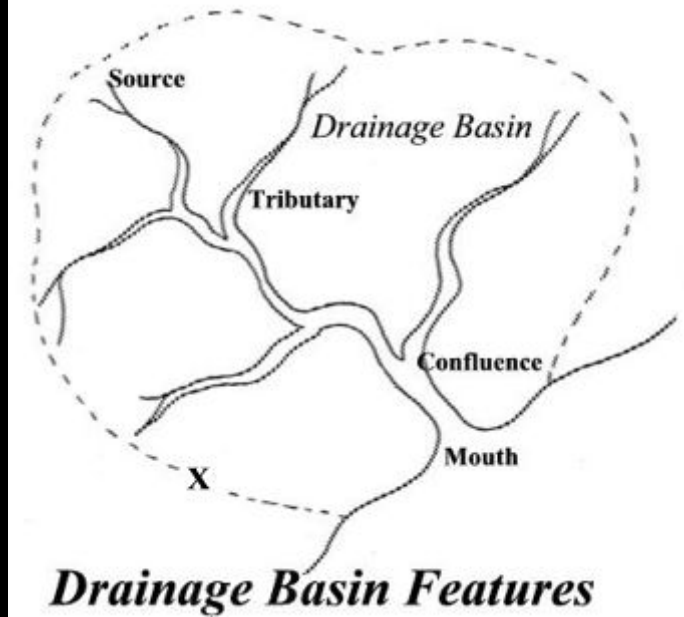
The Science of "Natural" Patterns

The Abiotic Structure of a "Natural" Waterway

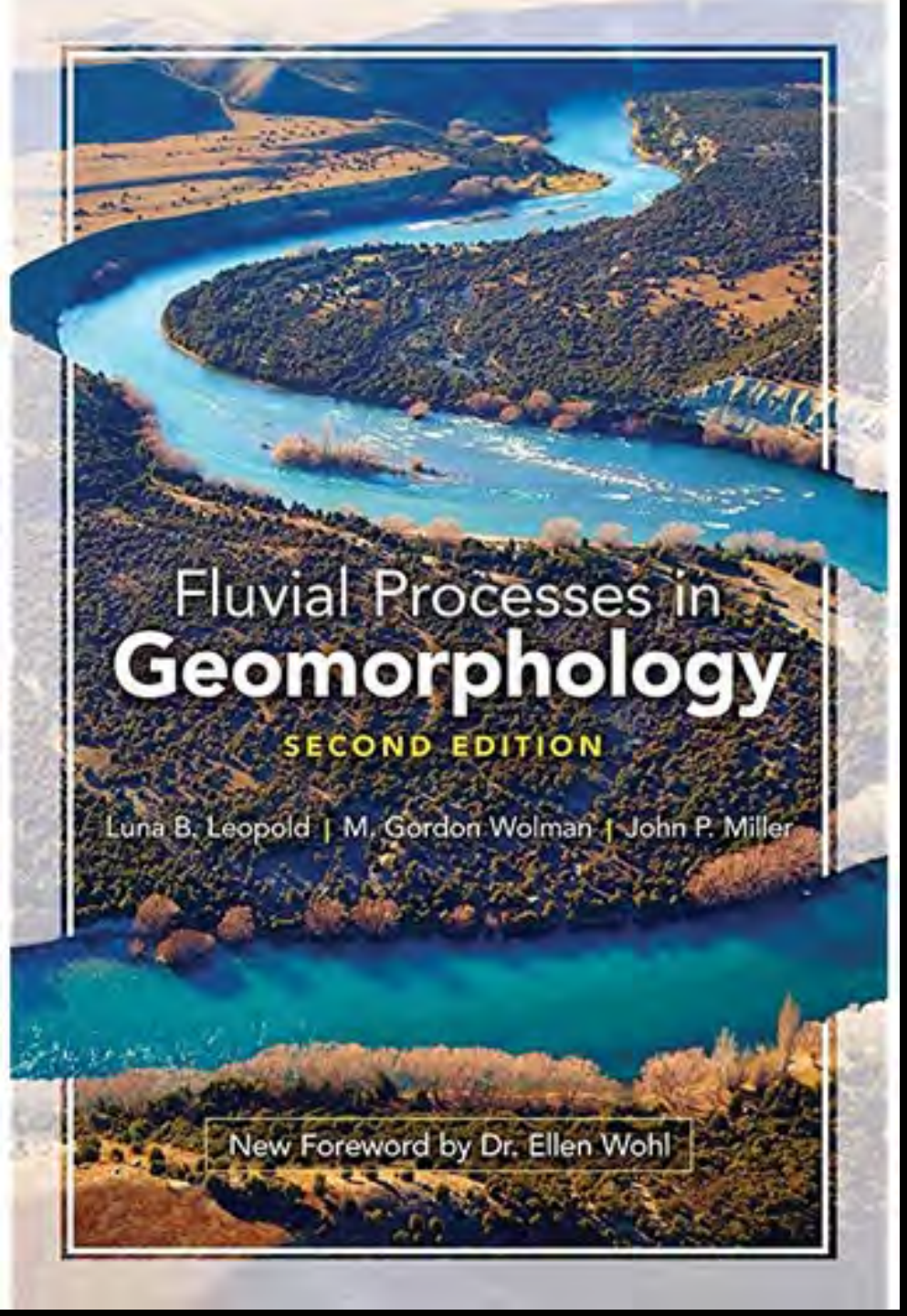




(a) Plan view of basin



Drainage Basin Features



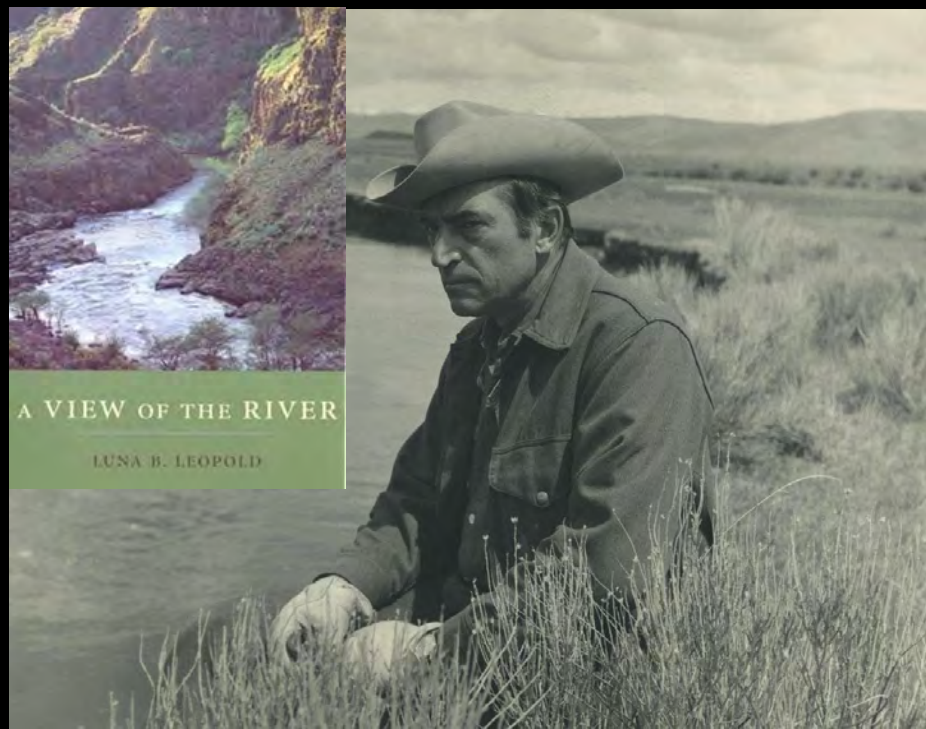
Fluvial Geomorphology

The study of how moving water shapes a landscape over time

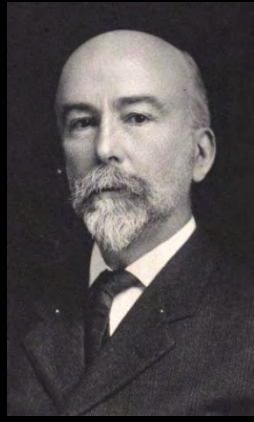
Flowing water always wants to carry a sediment load

Sinuosity is inversely proportional to slope

Luna Leopold 1915-2006



The Life of a River – The Ideal Waterway



William Morris Davis (1850 - 1934) is often called the "father of American geography". His most influential scientific contribution was **the cycle of erosion**, first defined around 1884, which was a model of **how rivers create landforms**.

"Its **youthful headwaters** are steep and rugged. It rushes toward the sea, eroding bed and bank on its way.

In its central part, it is mature, winding sedately through wide valleys adjusted to its duty of transporting water and sediment.

Near its mouth it has reached, **in its old age**, a nearly level plain through which it wanders in a somewhat aimless course toward final extinction as it joins the ocean that had provided the sustaining waters through its whole life span."

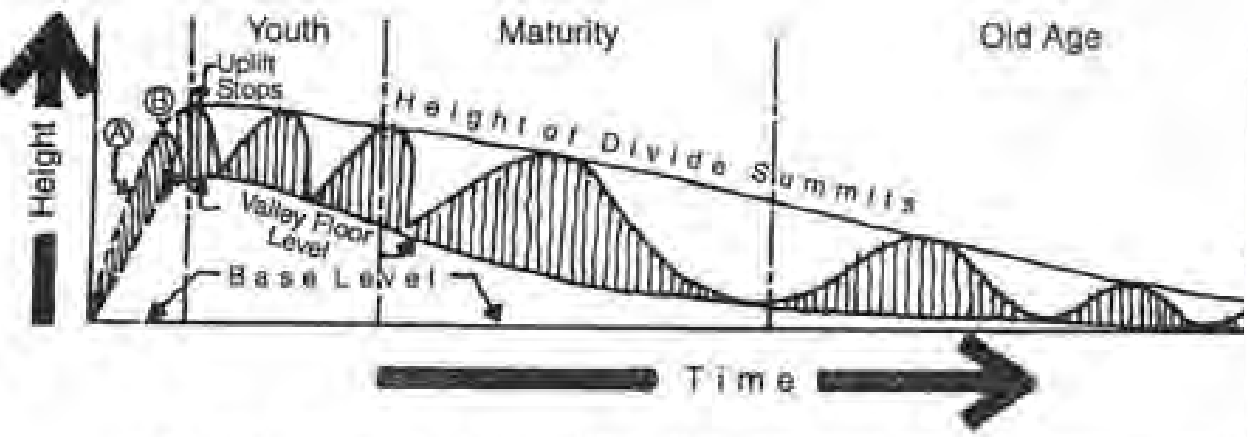
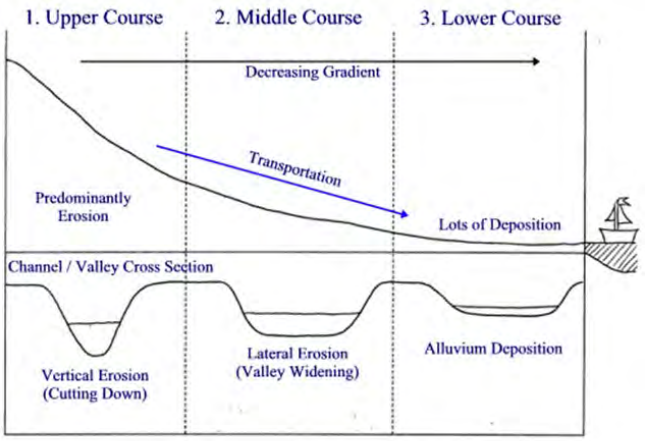


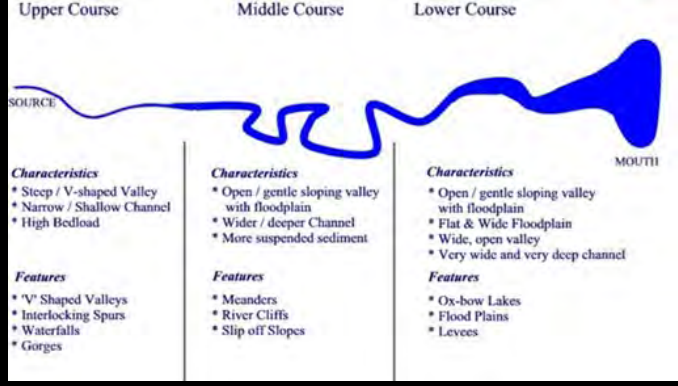
Fig. 1.44 A graphical presentation of geographical cycle proposed by W.M



Upper Course – Source or Headwaters

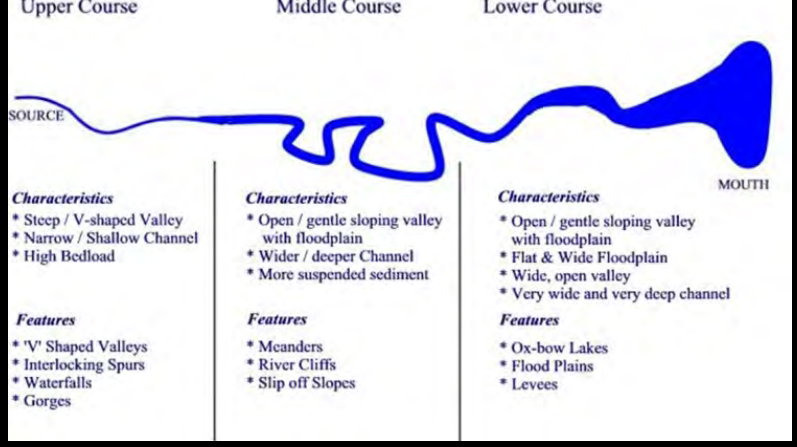
"youthful headwaters are steep and rugged"

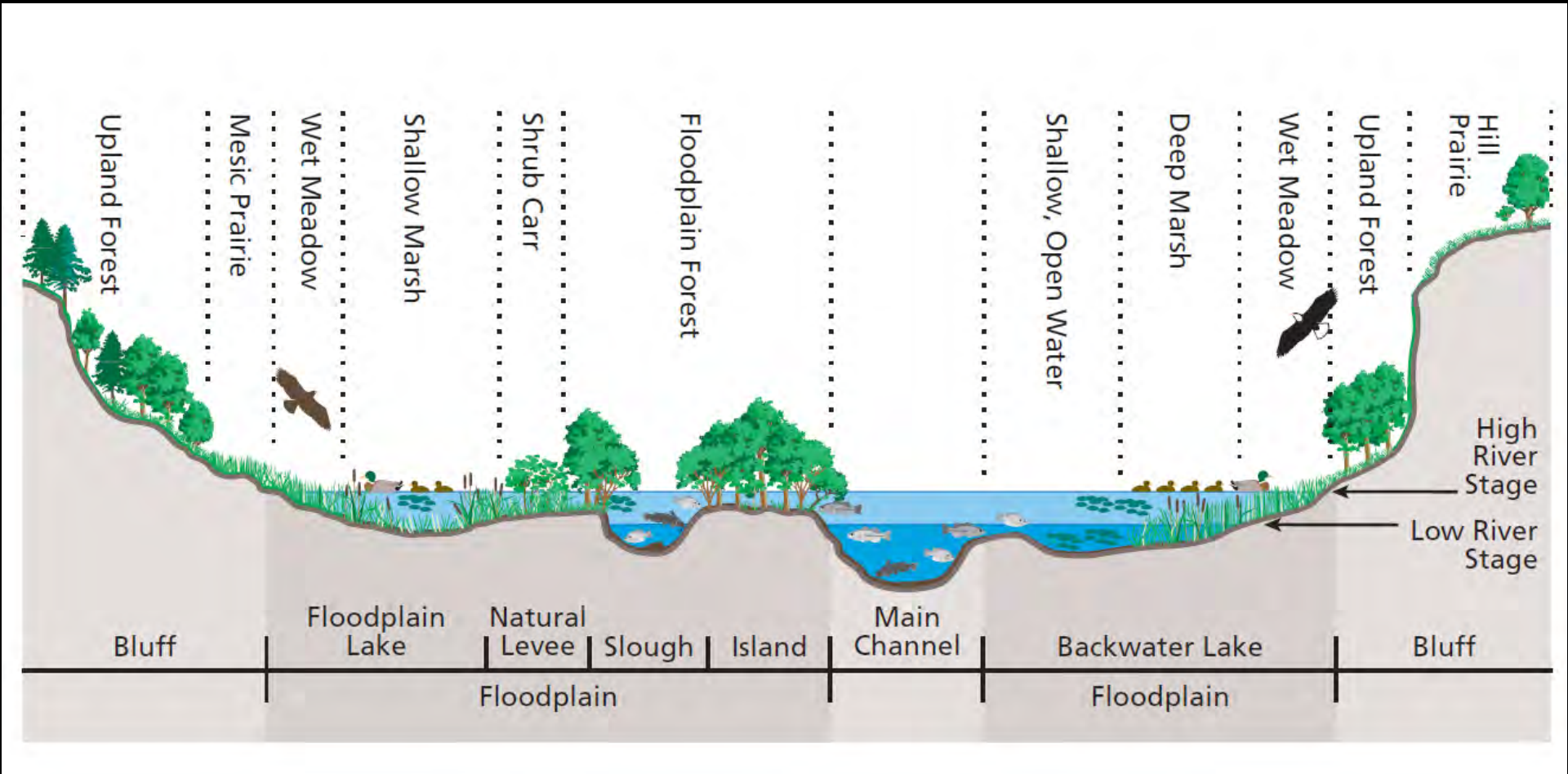
- In temperate environments, small streams tend to be shaded by an interlocking, overhead tree canopy.
- Such conditions result in cool, well-oxygenated streams that are abundantly supplied with a food base of leaves.
- Fine particles of organic matter are released as the leaves are broken down by biological communities in the streams



The Middle Course:
Habitat Diversity in the Meander Belt

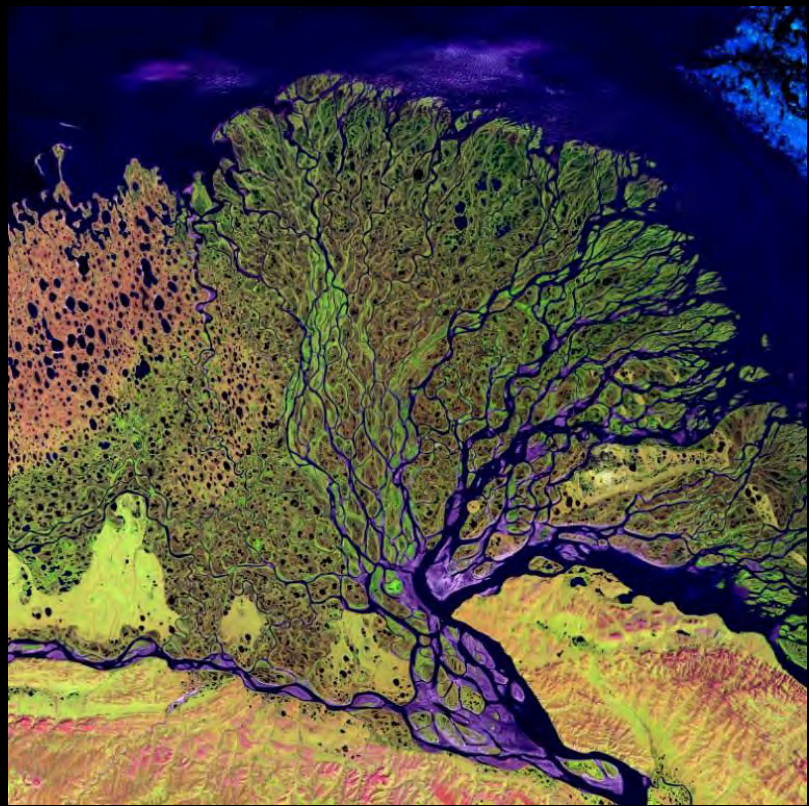
"mature, winding sedately through wide valleys"





The Lower Course: the Delta - "toward final extinction as it joins the ocean"

- Very large rivers are usually low gradient and very wide, resulting in negligible influence of riparian canopy in terms of shading and leaf-litter input.
- Water currents keep fine solids in suspension, reducing light penetration to the benthos.
- Organic matter in suspension is by far the largest food base in these very large rivers.
- Larger alluvial rivers in their natural state are diverse habitats with side channels, sand and gravel bars, and islands that are formed and reformed on a regular basis.

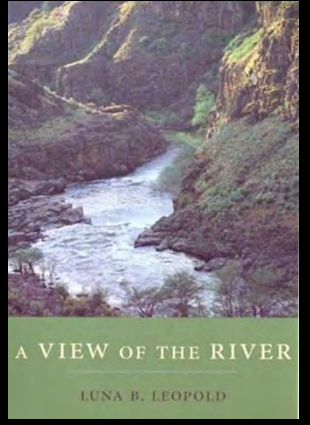


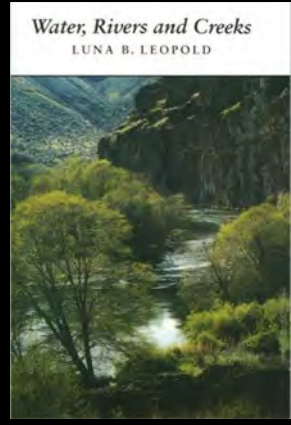
Fluvial Transportation – Abiotic and Biotic

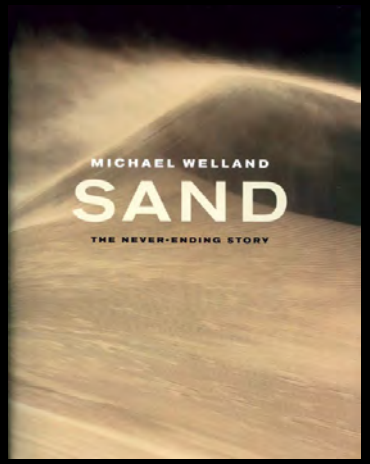
Flowing water always wants to carry a sediment load

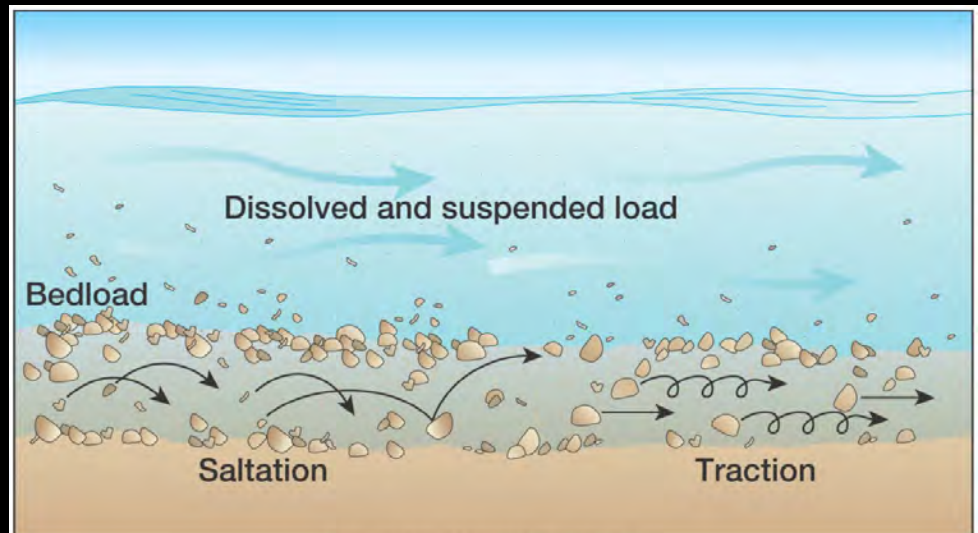
Waterways transport three main materials downstream – water, sediment, and organic material.

- The abiotic components – water and sediment – most directly affect the shape of the channel.
- A change in either the flow of water or the sediment load can lead to increased deposition or erosion.
- The biotic components of a waterway's transported load range from dissolved organic matter to large woody debris.





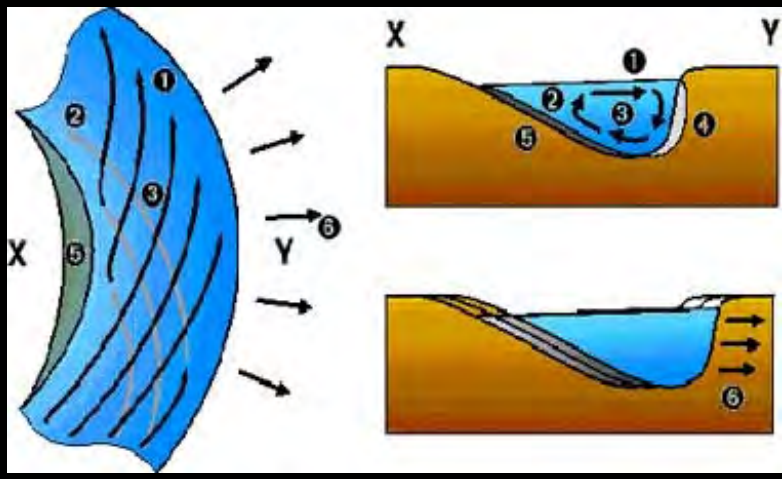


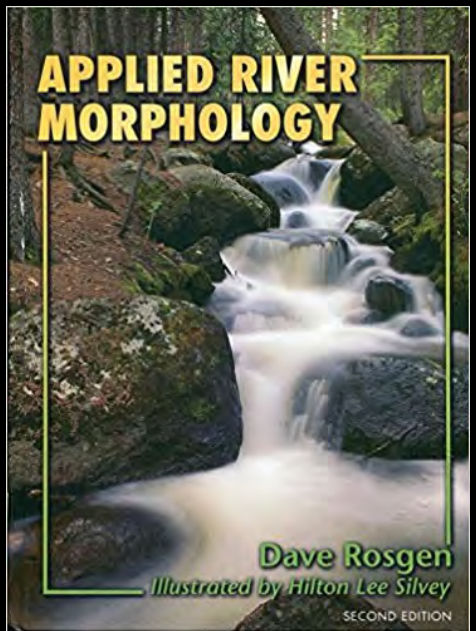


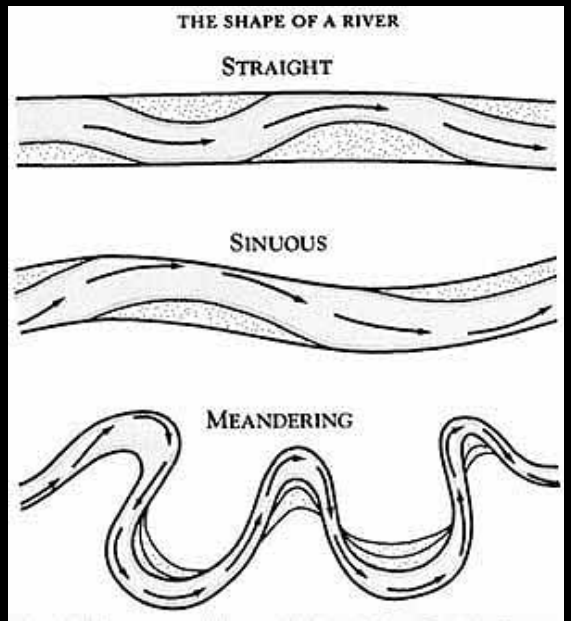
Abiotic Fluvial Process – Erosion, Deposition, and Meanders

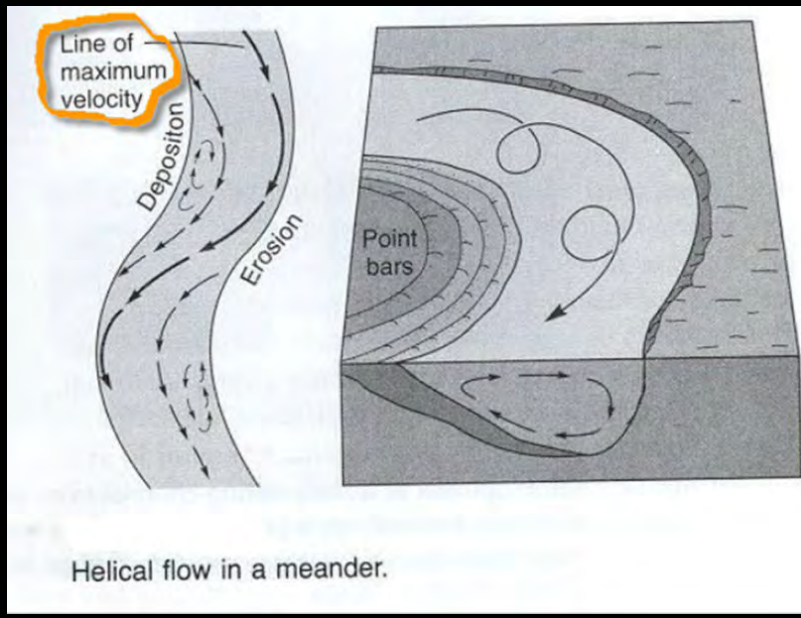
The helical flow of water plays an important role in the formation of meanders

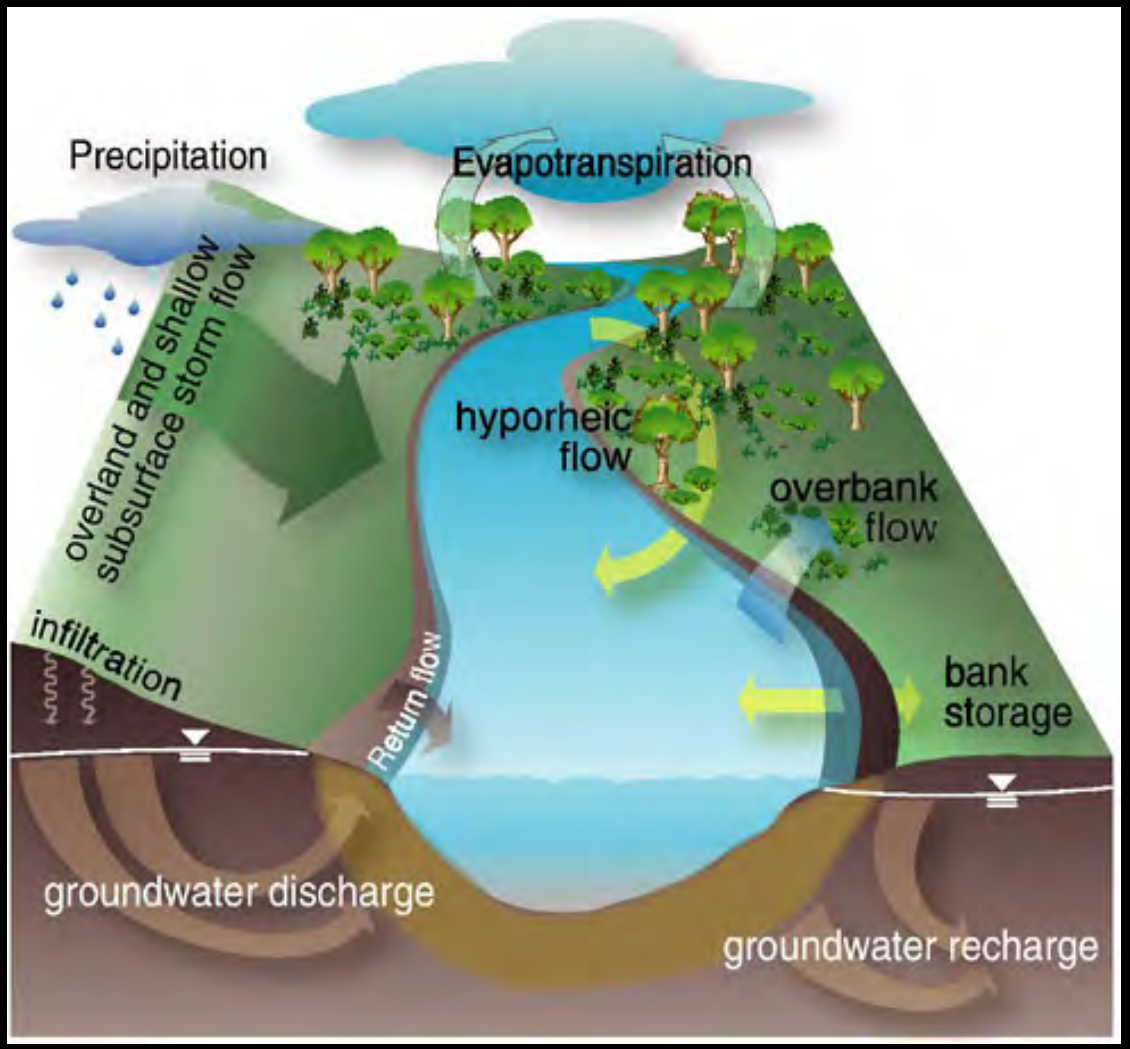
- The helical flow erodes the outside of a bend and deepens the pool.
- Redistributes scoured material and deposits it on the slip-off slope and riffle section.
- This continuous process cause meanders to migrate and contract at their neck until the flow cuts directly through, forming a new channel









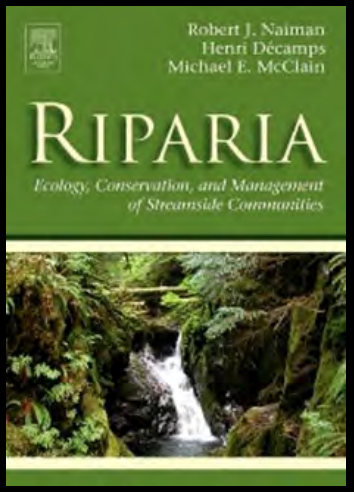


Riparian Zone and Hyporheic Flows – Hydrological Interface

They are areas through which surface and subsurface hydrology connect water bodies with their adjacent uplands.

The Riparian Sponge – Soil and Roots

- One of the attributes of a properly functioning riparian area is the sponge effect and water storage capacity within the riparian area.
- This large absorbent sponge of riparian soil and roots will soak up, store, and then slowly release water over a prolonged period.
- This riparian sponge can be managed in a way to greatly increase and improve this storage or it can be managed in a way to decrease and degrade water storage.



Subsurface Habitat – The Microbial Zone

Streams exchange water, nutrients, and organisms with surrounding aquifers.

The interstitial, water-filled space beneath river beds, where most active aquifer-river water exchange occurs and is an important habitat for a number of aquatic organisms and for fish spawning.

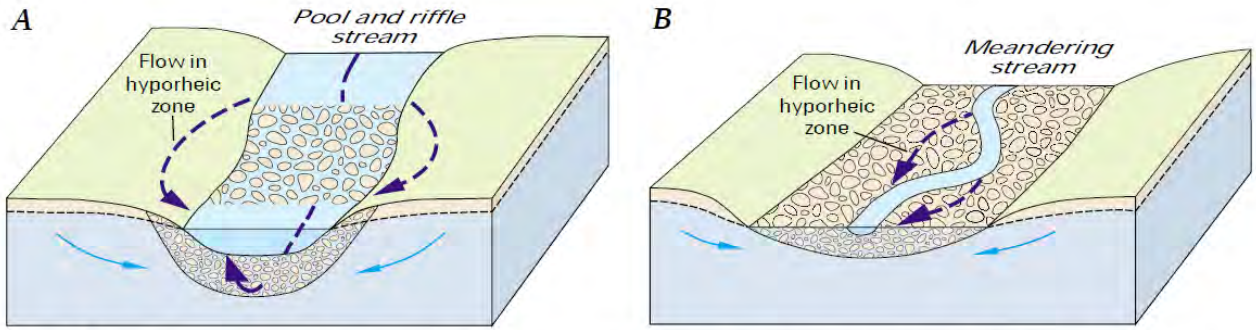
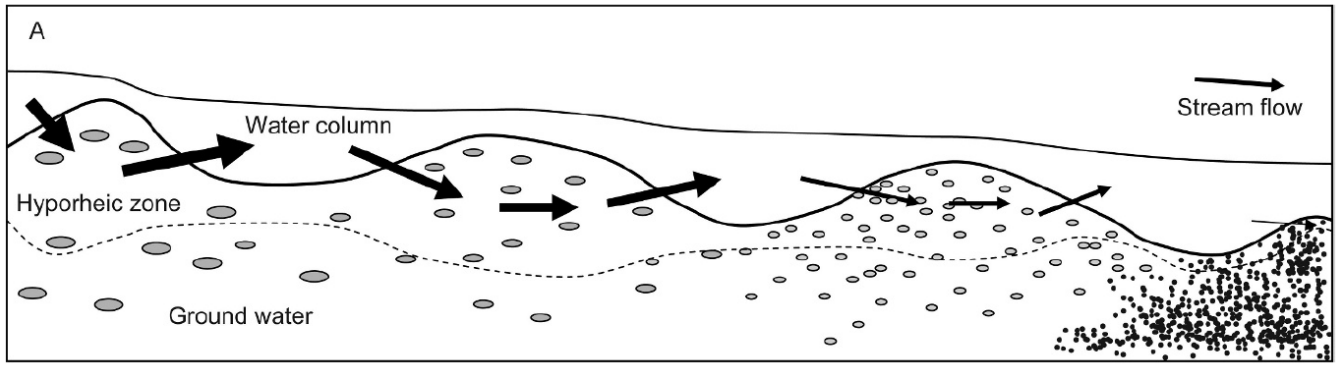


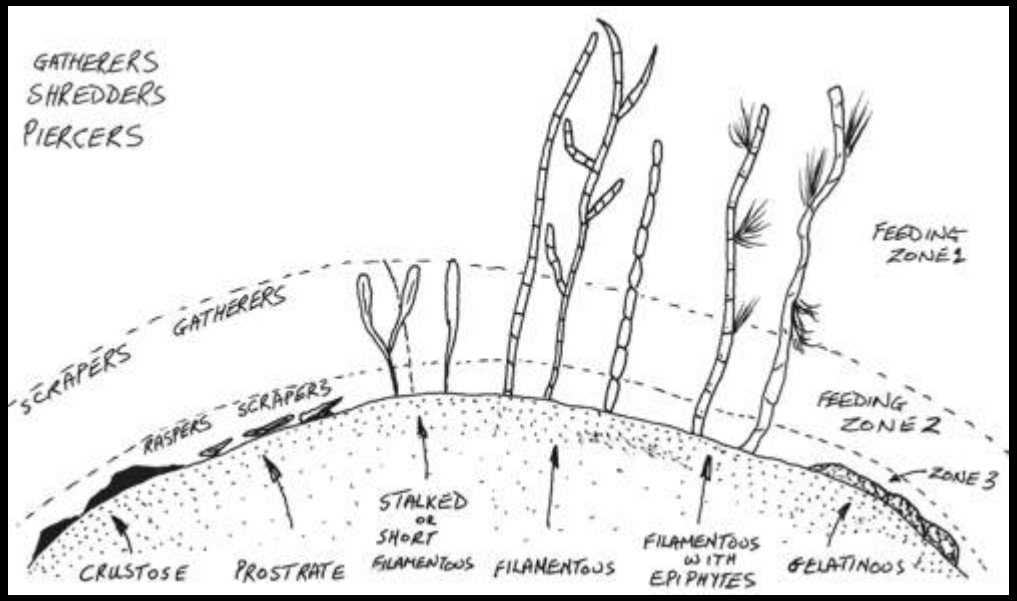
Figure 14. Surface-water exchange with ground water in the hyporheic zone is associated with abrupt changes in streambed slope (A) and with stream meanders (B).



Ecology of Stones - Periphyton

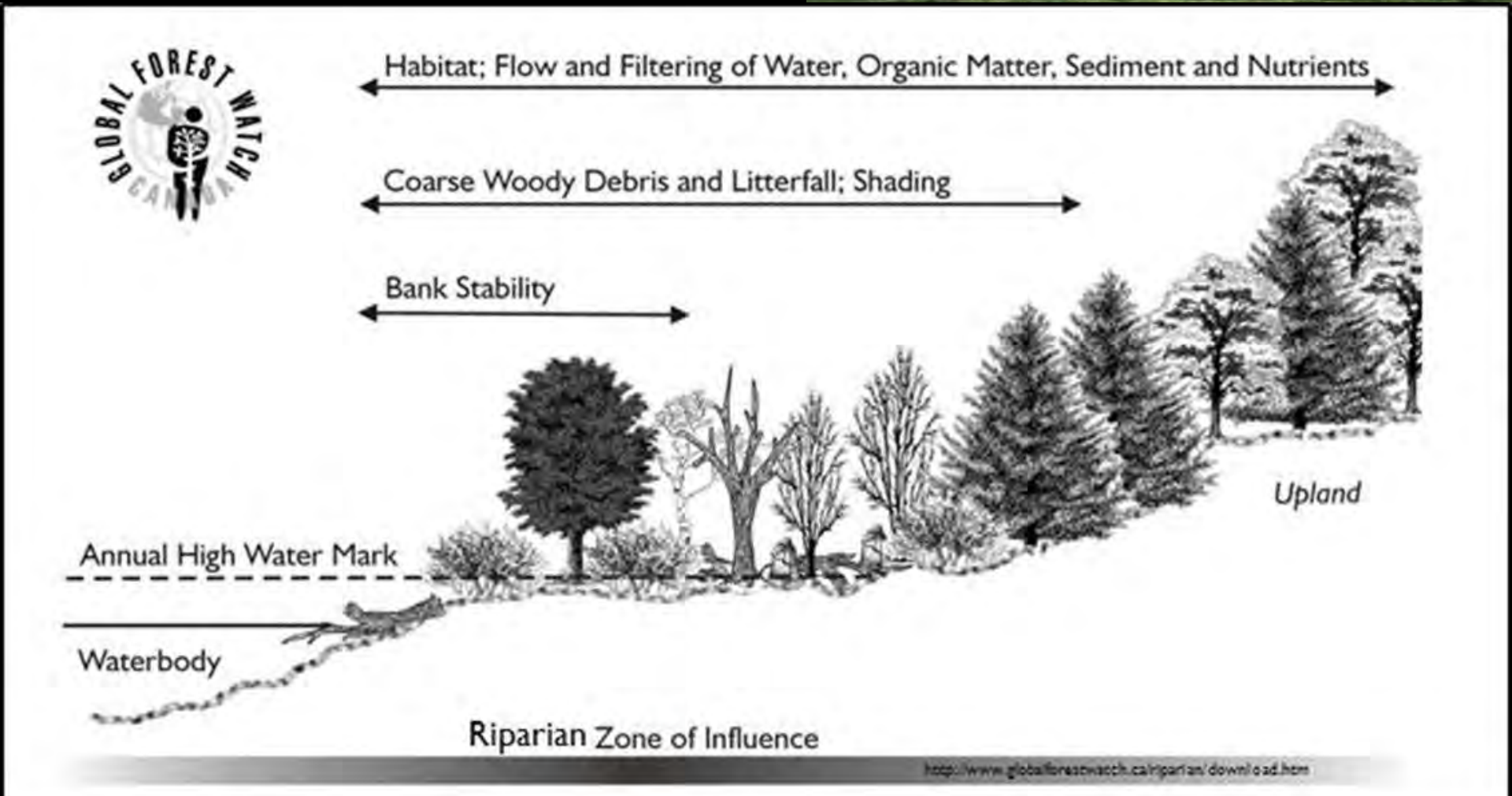
The three zones of Periphyton on stones.

Zones relate to the ability of the animals to consume the material



Riparian Vegetation

- Plant community structured by hydrology
- Hydric Soils
- Different plant species support riparian zone ecosystem function.



Scientific Models of "Natural" Rivers and Streams

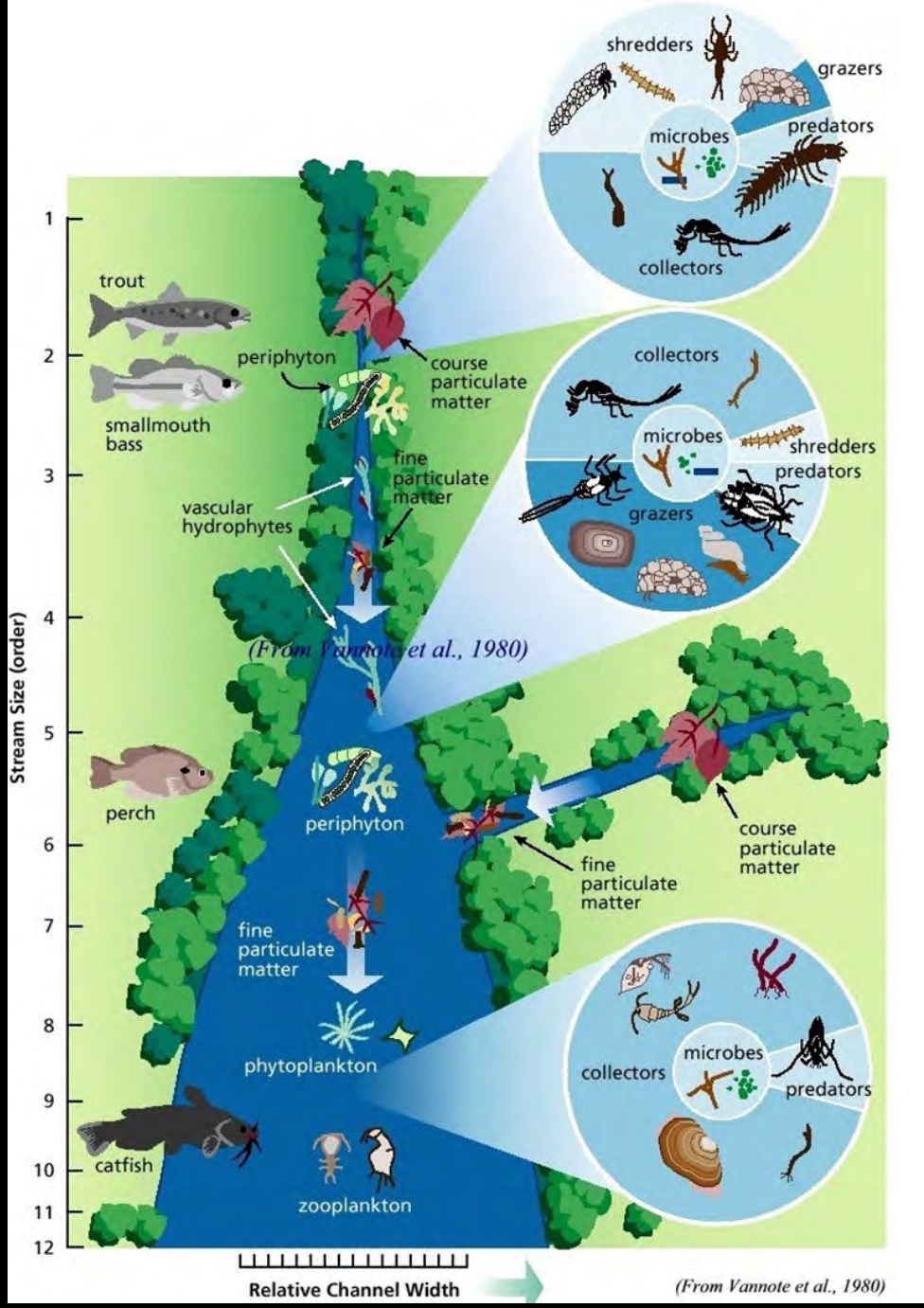
The River Continuum Concept [RCC]

The River Continuum Concept is a model that tries to explain how the physical and biological characteristics of a river change in a downstream direction.

The RCC largely focuses on the interaction of stream invertebrates with their habitat and food resources.

The RCC is a model that might apply to pristine rivers, but few rivers remain unchanged or unaffected by human activities.

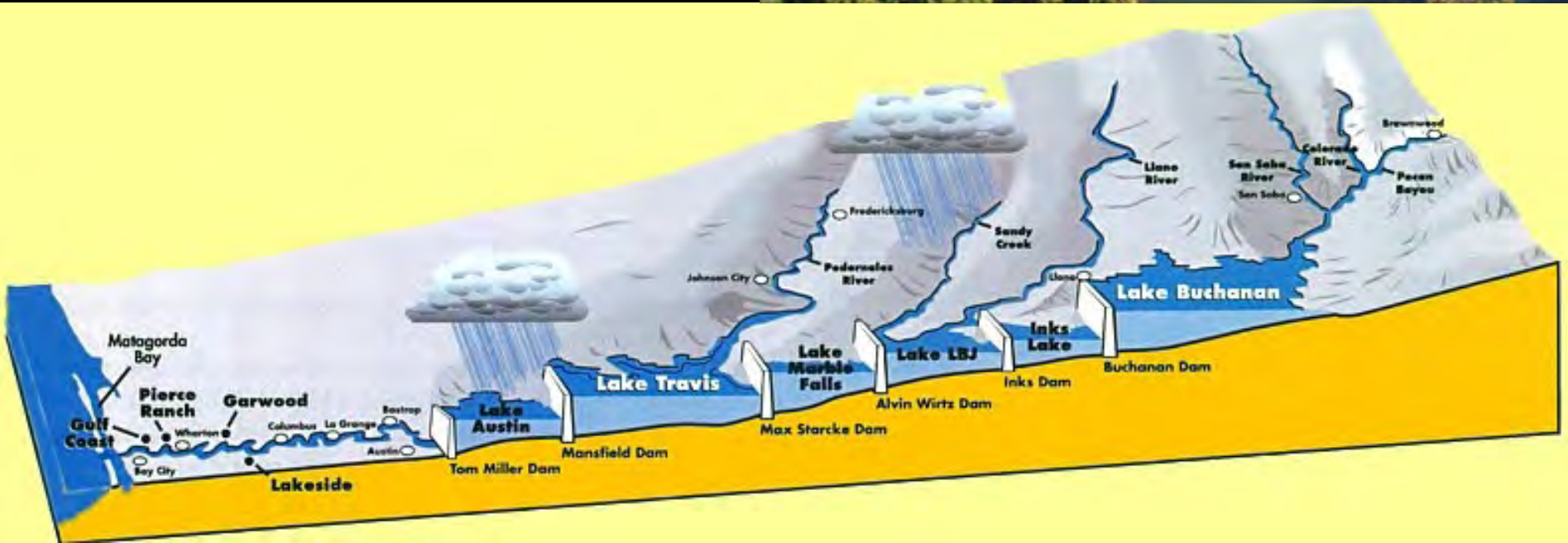
Developed by Dr. Robin Vannote - The Stroud Water Research Center



The Serial Discontinuity Concept

Dams are certain to have an impact on the organization of aquatic communities, since the flow is blocked and the longitudinal transition of conditions along the river is altered.

Dams creates a "serial discontinuity" in the river because the gradual downstream transition in conditions is disrupted, and the longitudinal transfer of material is prevented.



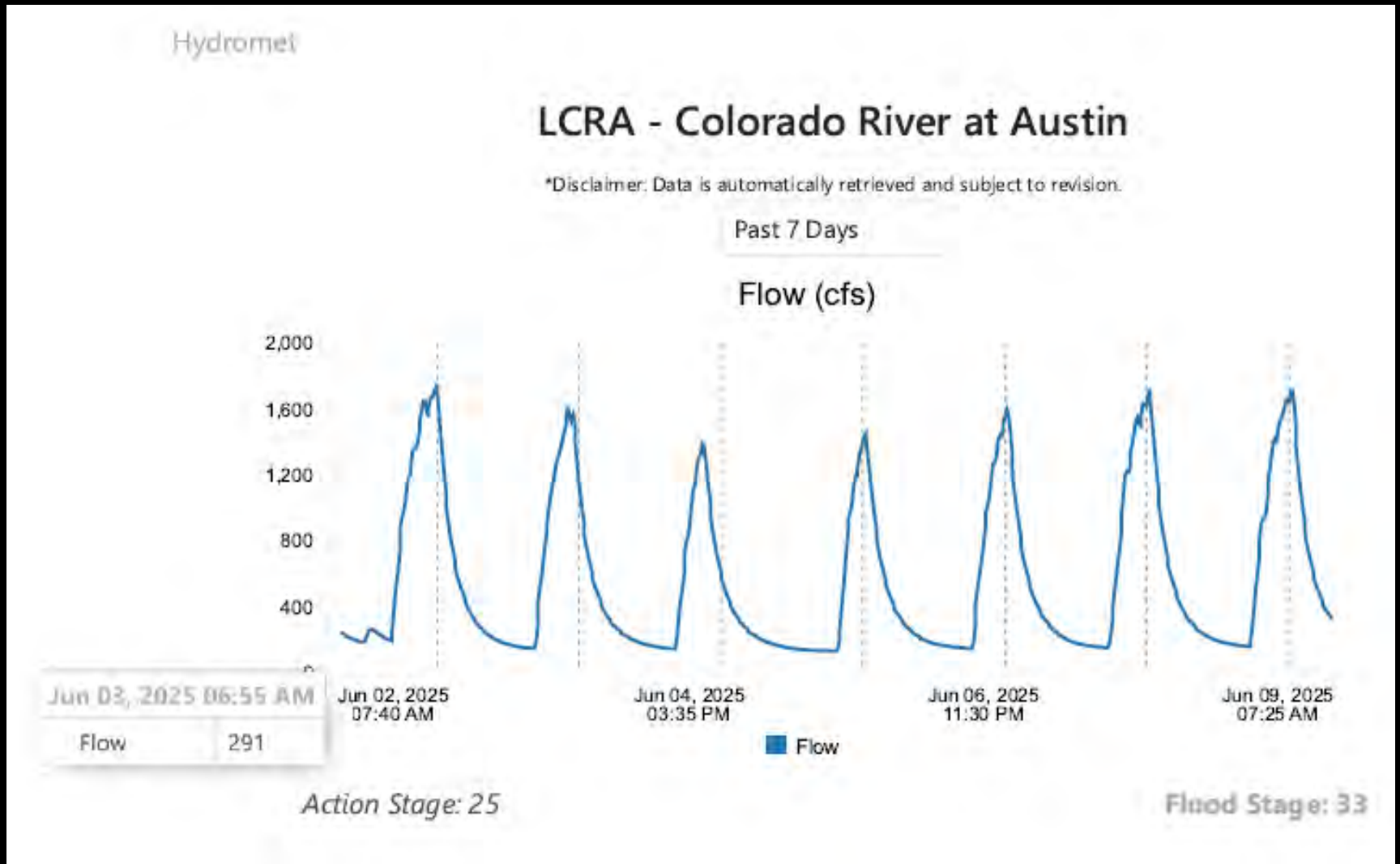
The Serial Discontinuity Concept: Urban River

- Suspended sediments are deposited behind the dam.
- Water released from the dam will pick up a 'normal' sediment load downstream where it may erode the riverbed and banks.
- The downstream transition of water temperature is altered, and water released from the dam may be either warmer (if it is taken from the surface) or cooler (if it is taken from the depths) than natural conditions.

The Serial Discontinuity Concept: Urban River

The seasonal patterns of flow will be altered, especially if the function of the dam is

- to provide water for irrigation (dry-season flows downstream will be reduced)
- to control flooding (wet-season flows and floodplain inundation will change).



The Urban Hyporheic Zone Research at Hornsby Bend

THE UNIVERSITY OF TEXAS AT AUSTIN
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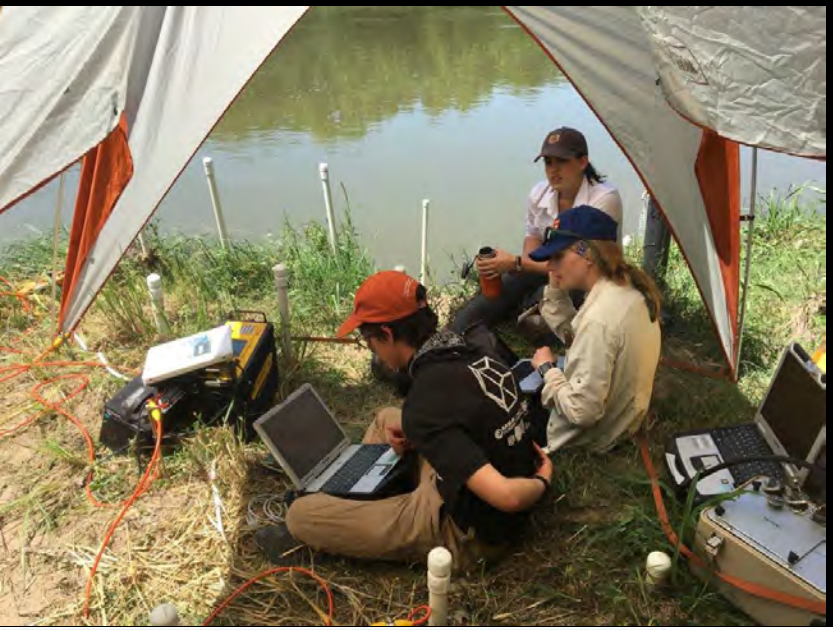
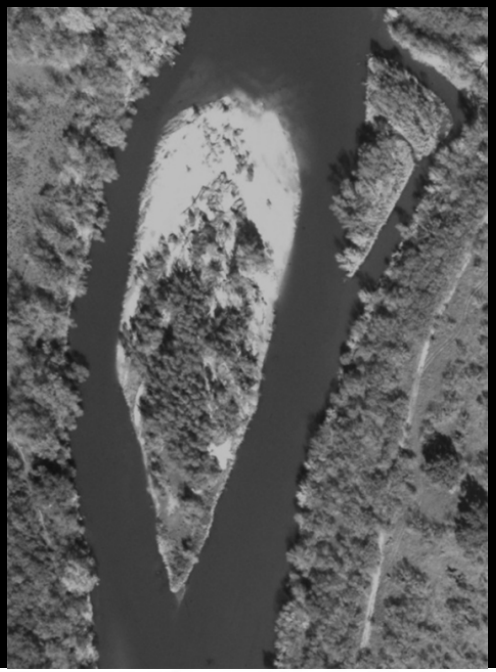




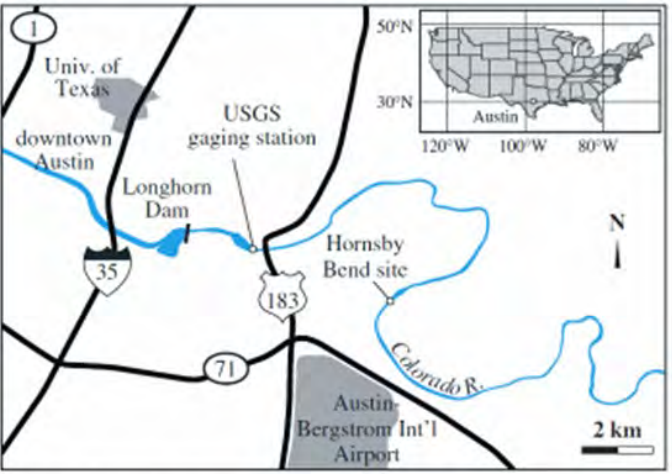


Figure 1. Location of study site on the Colorado River in relation to Austin, Texas, USA. USGS gaging station 08158000 is 2 km downstream from Longhorn dam, and the study site is another 13 km downstream

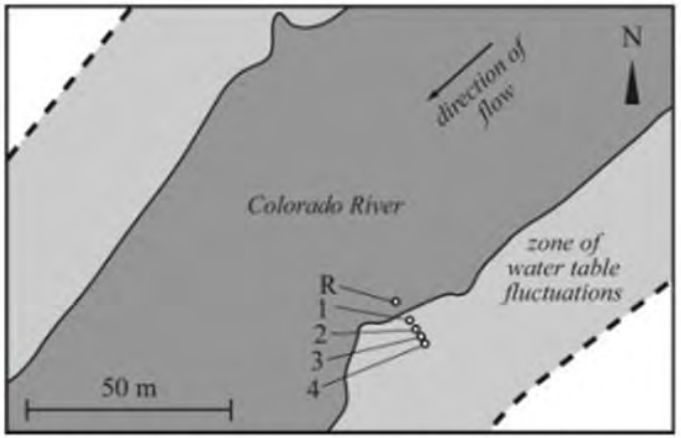


Figure 2. Map of Hornsby Bend piezometer transect. Bank piezometers are numbered in order of distance from the river, and the river stage recorder is denoted as (R). Dashed lines indicate the estimated extent of dam influence on the water table

The Colorado River and Hyporheic Flows

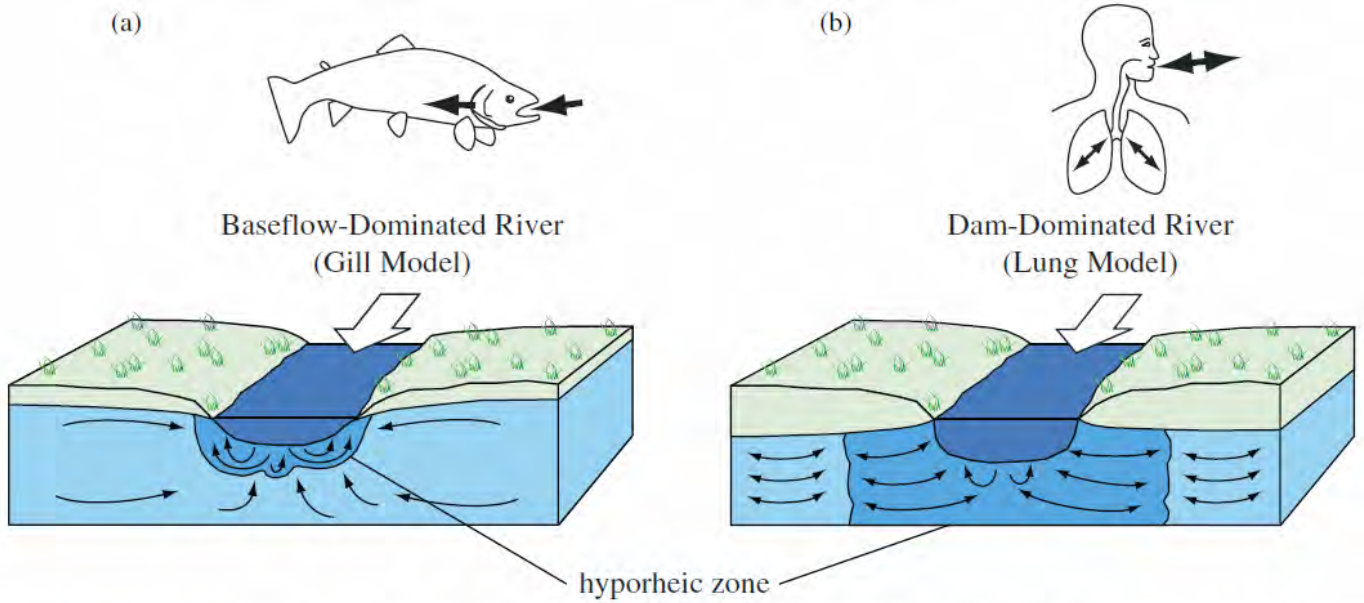
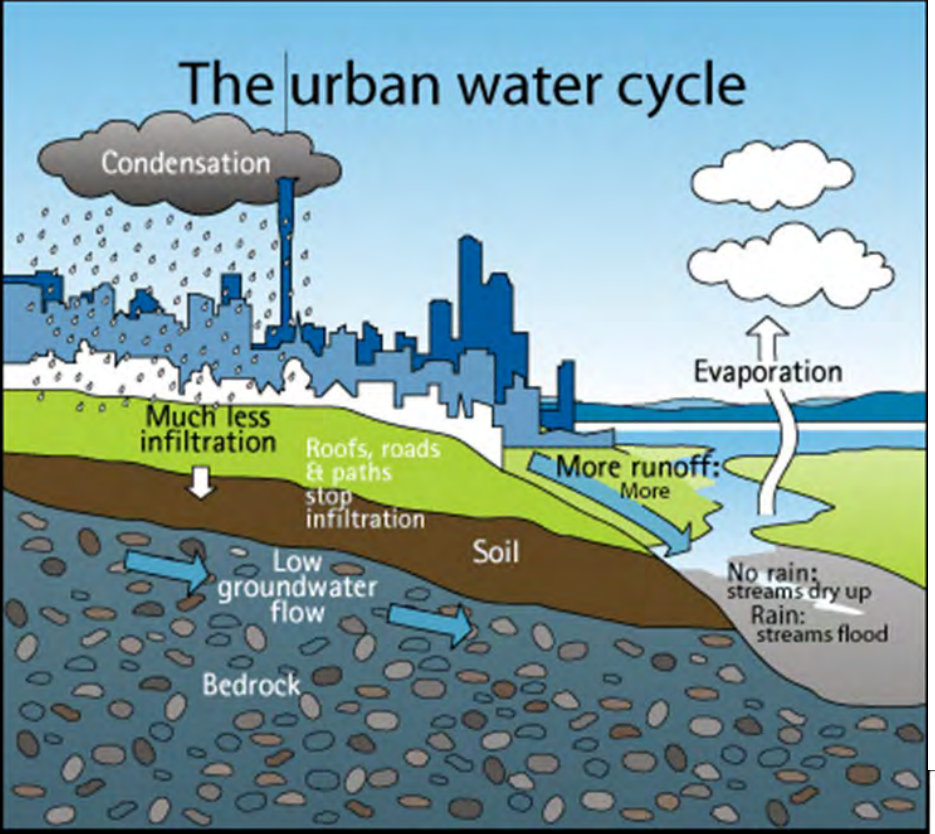
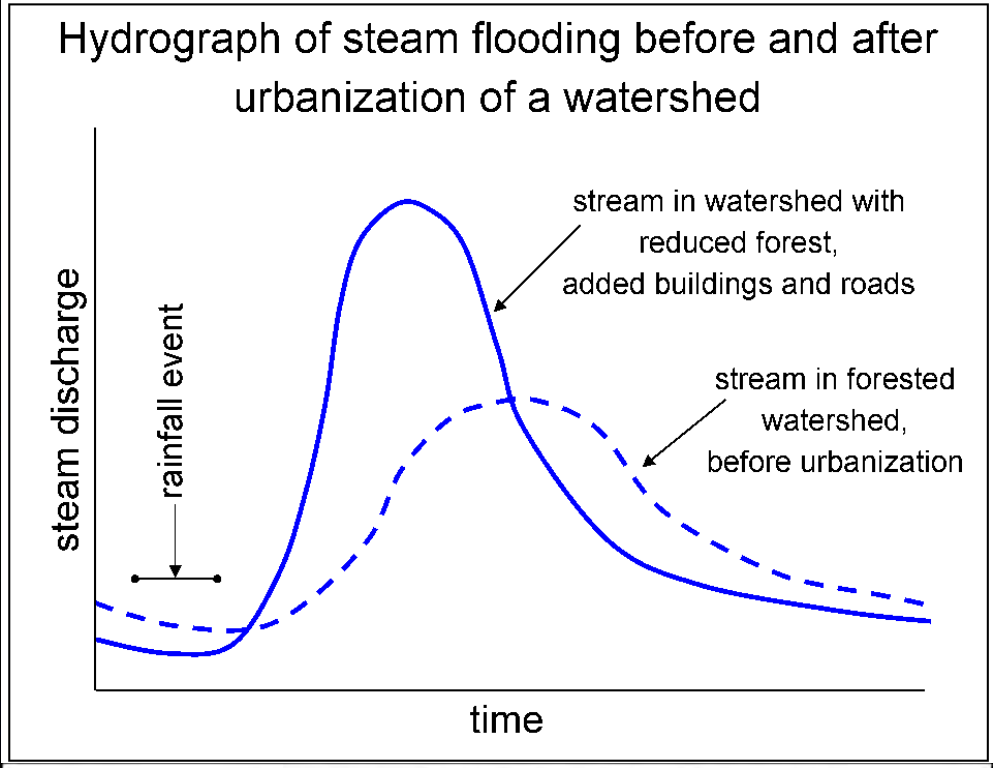


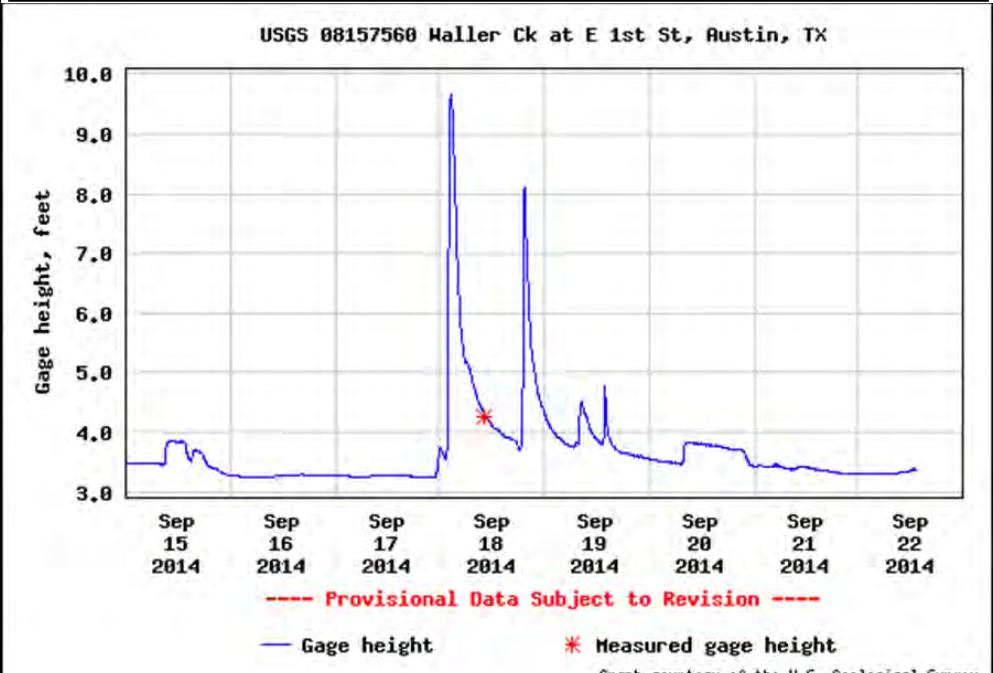
Figure 10. (a) Conceptual model of a natural river-groundwater system in a reach dominated by baseflow. During most of the year, groundwater flows steadily through the riparian aquifer in one direction like water through a gill. Groundwater discharge to the river limits the size of the hyporheic zone. (b) Conceptual model of a river-groundwater system downstream of a dam. Due to frequent stage fluctuations, river water flows in and out of the riparian aquifer like air flowing in and out of lungs. The hyporheic zone includes all flow paths that start and end in the channel

Human Impacts and Urban Creeks

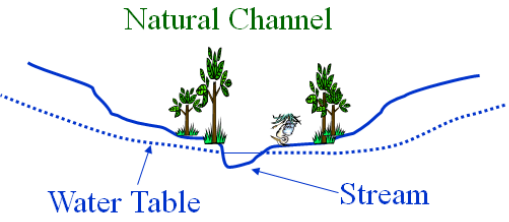


Urban Hydrology



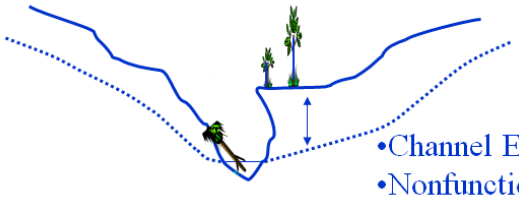


Urban Fluvial Geomorphology

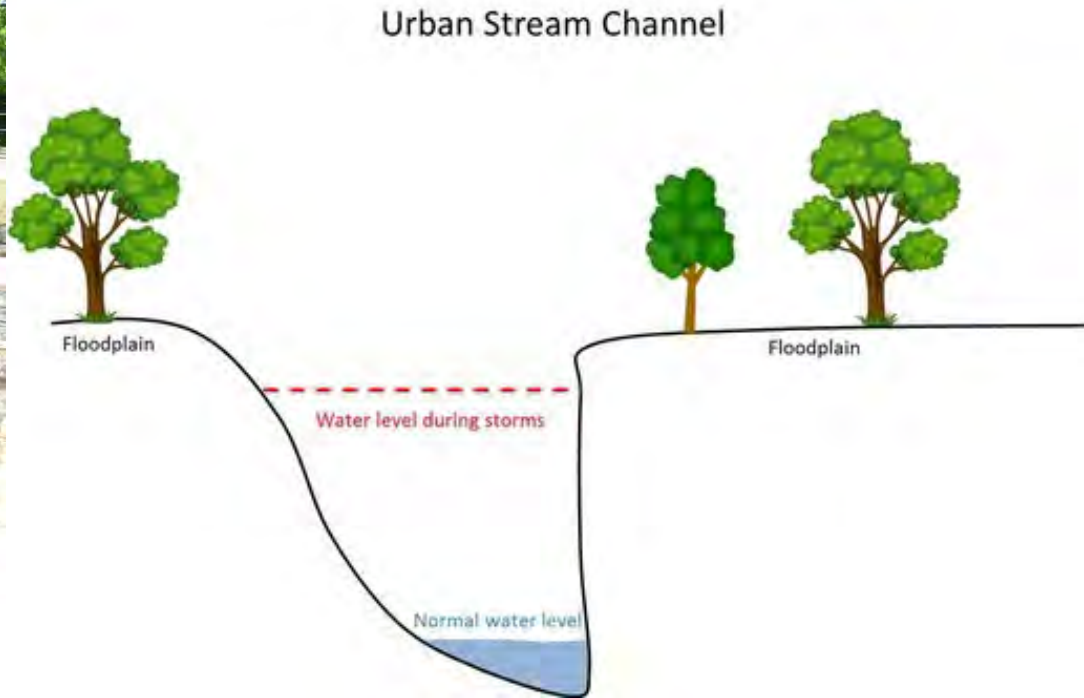


- Urban stream syndrome:
  - High storm flows.
  - Incised channels.
  - Drier riparian zones with lower water tables.

Channel with Incision
Due to Increased Runoff



- Channel Erosion
- Nonfunctional Floodplain
- Dry Riparian Soils

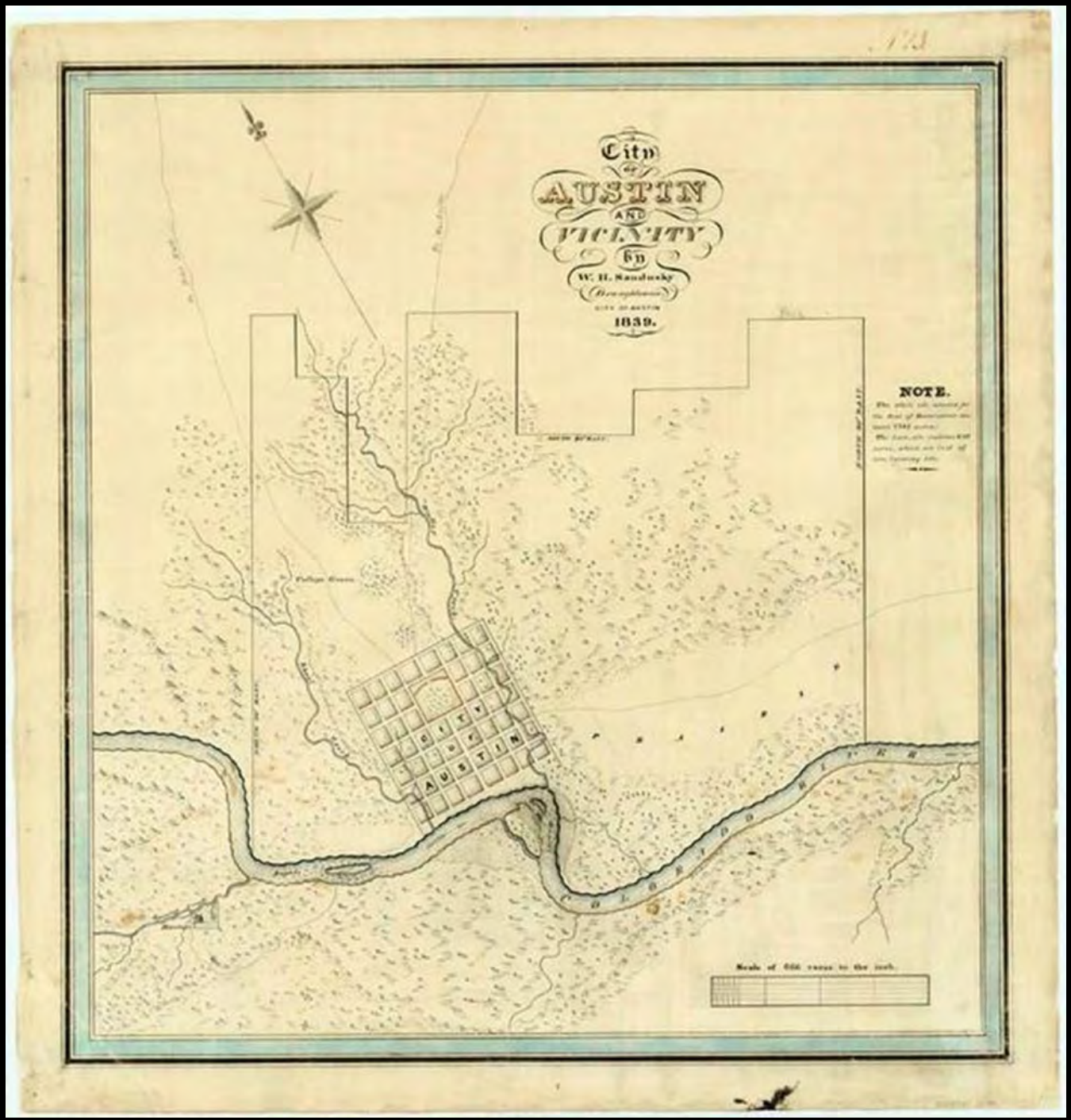


Urbanizing Waller Creek

Physical Geography

Transforming the Hydrological Landscape

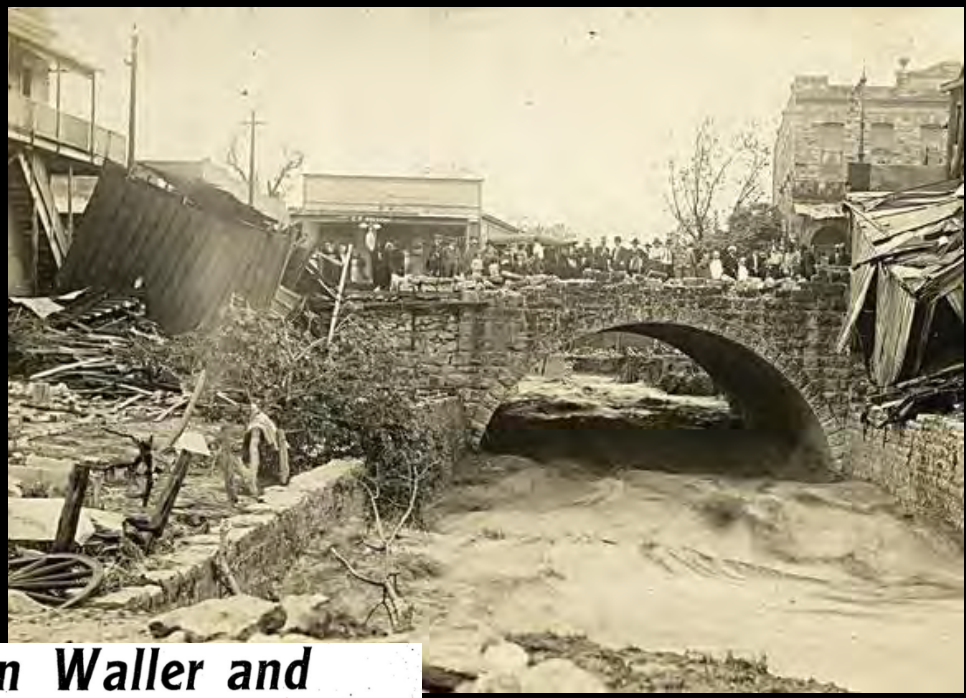
Austin 1839



Disrupted Geography of Flowing Water 1890

1915 Flood

PICA 14517, Austin History Center, Austin Public Library



Flood Sweeps Down Waller and Shoal Creeks With Heavy Loss of Life and a Big Property Damage

Life and property were taken unmerifully as the toll of the waters that swept down Waller creek and through the streets of that vicinity on the east side last night.

The list of those who were drowned, according to all knowledge gained last night, includes:

Mrs. C. S. Ezell, 701 East Seventh street; Elbert Edwin Ezelle, nine years old, 701 East Seventh street; Martha Virginia Ezelle, five years old, 701 East Seventh street; Harvey King, twenty years old, employee of William P. Carmichael Company at Austin Dam, 701 East Seventh street; Helen King, sister of Harvey King, 701 East Seventh street; Mr. and Mrs. King, parents of Harvey King, 701 East Seventh street; Minnie Clanton, negress, to rear 416 East avenue; Negro man and woman in house on Waller creek bank between Tenth and Eleventh streets; three negro children named Chambers, four, ten and twelve years old, the two older being boys. Bodies were recovered at Nineteenth and Trinity streets.

It was impossible to estimate the damage to property. Reports were that the bridge across Waller creek at Nineteenth street was swept away. The concrete balustrade on the bridge across Waller street between Sabine street and East avenue was swept away by houses that were hurled downstream by the raging waters of the creek. The H. & T. C. bride at Fourth street was swept away for the most part and was entirely wrecked.

From along the banks of Waller creek small houses were caught in the rising, boiling waters and carried down stream to pile up against the bridge on East Sixth street between Sabine street and East avenue. The stables of the city just above the bridge on East Sixth street were washed away and wagons were carried as far as Sixth street where they were piled and jammed in a pile of wreckage. Houses below Sixth street were washed away. It was impossible to learn just how many because of the complete darkness of the city as the result of wire confusion and the abscence consequently of any electrical lights.

Six houses occupied by negroes and located on Sabine street were gathered into the maw of the hungry waters and swept down stream. Nearly every house on the bank of Waller creek was either flooded or moved by the waters.

A big pile of wreckage now marks the site of East Sixth street where the combination store and house of I. Joseph stood. Lying on the north side of the East Sixth street bridge across Waller street is a towering pile of timbers, what is left of the residences along along the Waller creek banks near the Sixth street bridge.

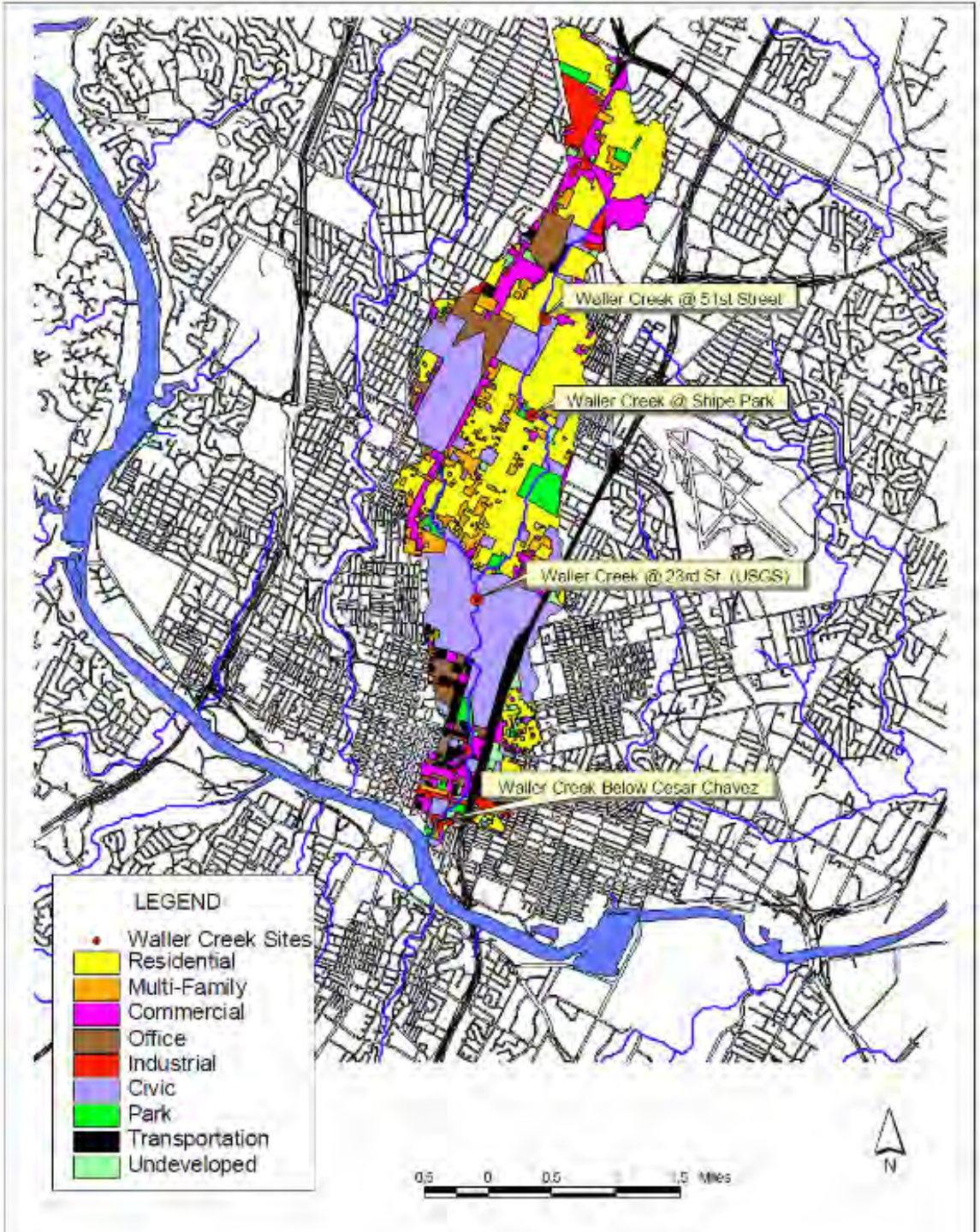
Business houses on East Sixth street in the near vicinity of the Waller creek bridge were flooded with water. The waters unseated houses scattered throughout the East avenue district and to the north of East Sixth street in the vicinity of the Waller creek, and toppled them over to be carried down the breast of the stream.

The approach to the Congress avenue bridge on the south side was washed away completely and connections with South Austin were broken. The I. & G. N. railroad bridge embankment south of the river was washed away and the tracks have slipped down, all out of line and useless for service.

A pitiful, heartsickening pandemonium reigned on the east side all along the vicinity of Waller creek, particularly just to the north and south of the Sixth street bridge.

Highly Urbanized Watershed

Waller Creek is a 3662 acre watershed located within the urban core of Austin

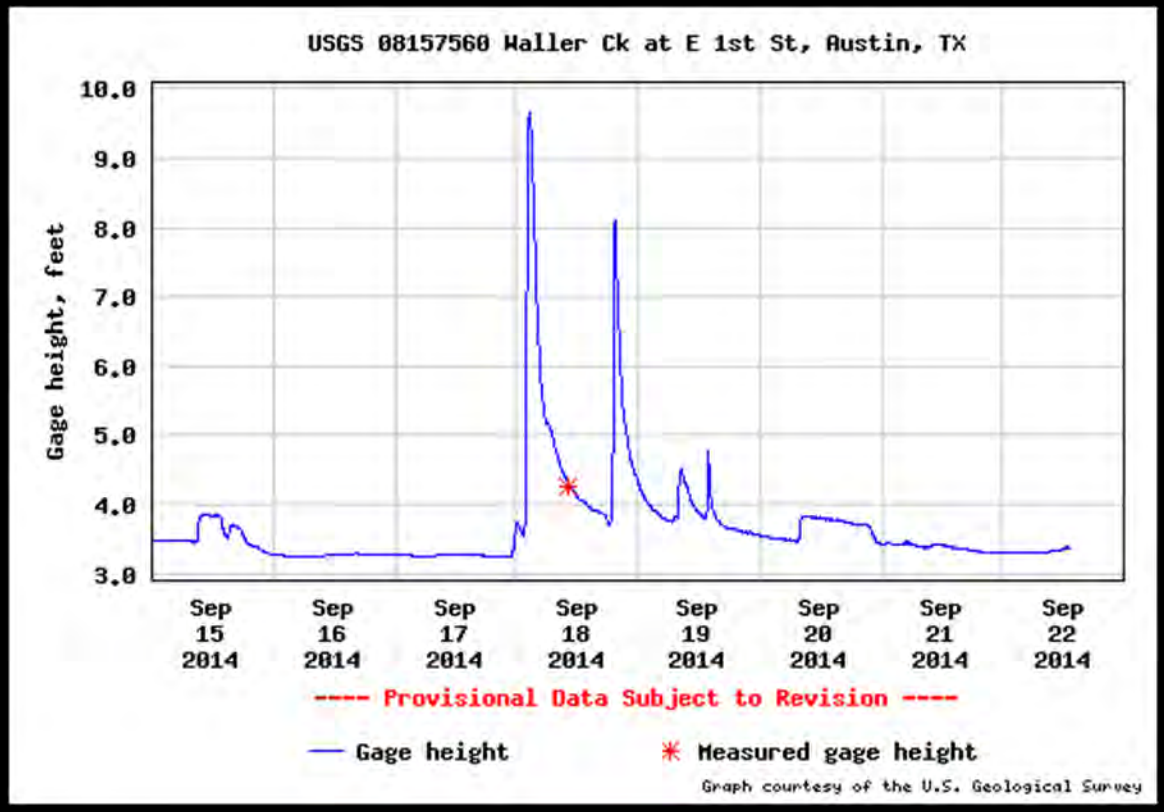


Highly Studied Hydrology

Two flow gauging stations, set up by the US Geological Survey (USGS), are located

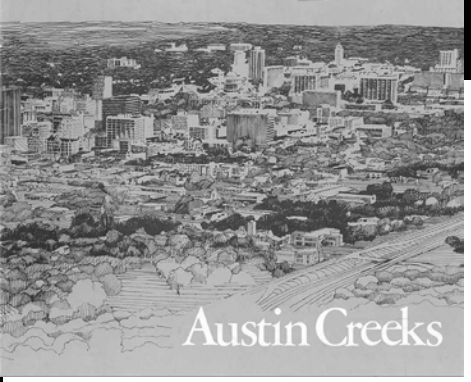
08156910 Waller Creek at Koenig Lane, Austin, TX

08157560 Waller Creek at E 1st St, Austin, TX



Hyde Park Flooding May 2025

Improving Waller Creek 1976



AMERICAN BICENTENNIAL IN AUSTIN TEXAS
1776 1976

Ninth Street to Town Lake, developmer
the Glenn Oakes Greenbelt on Boggy C
with trails and picnic tables, extensio
Stacy Park's trail to Town Lake on Bl
Creek, and beginning the redevelopmen
Waller Creek from Tenth Street to T
Lake.

WALLER CREEK

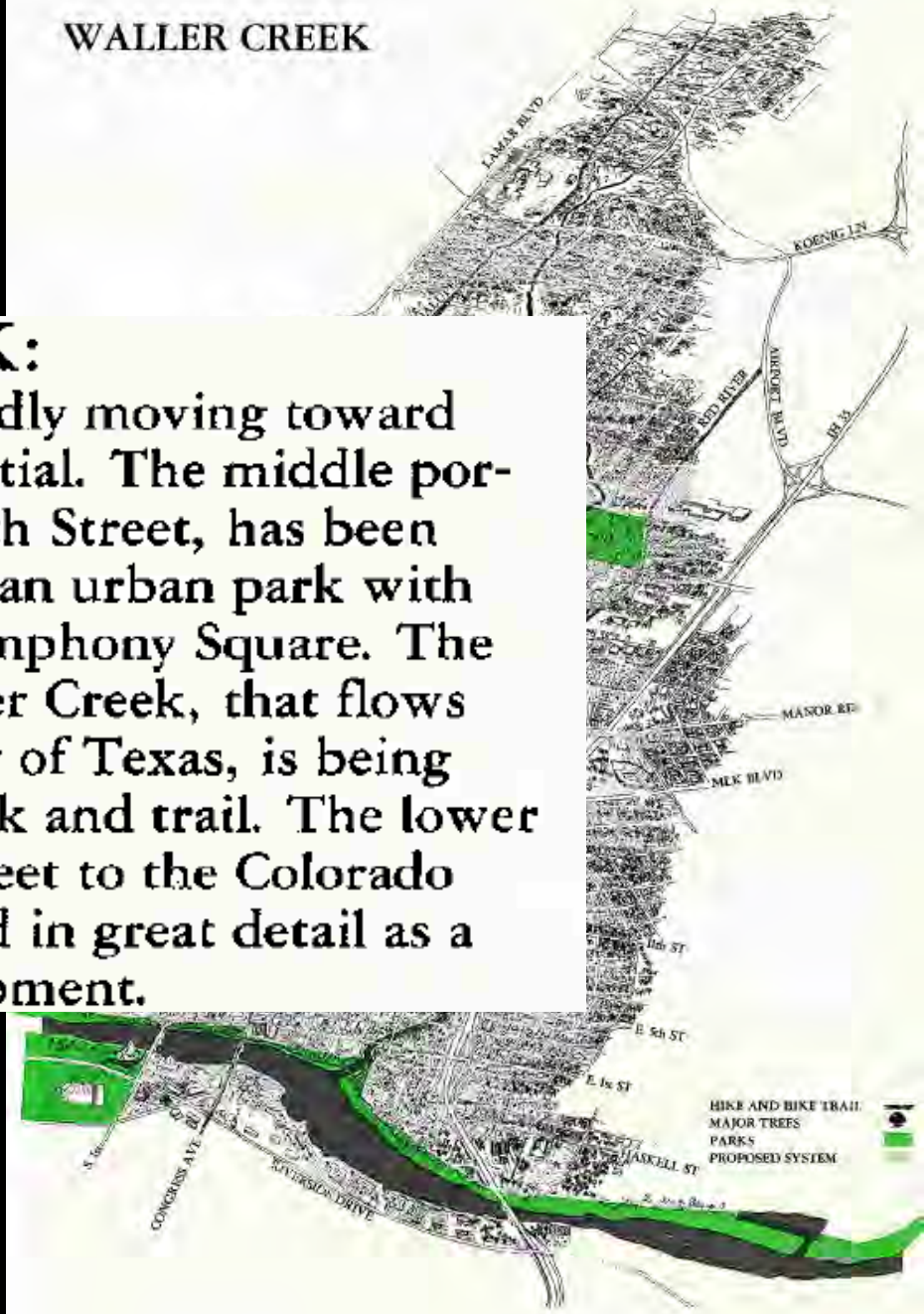
The Waller Creek project required the hi
of consultants to prepare a plan, and in
summer of 1975 several architect
firms were selected. The resulting plan
volved considerations of traffic flow,
nomic stimulations, zoning patterns, fl
ing problems, biking trails and fair wea
hiking trails, existing trees and green ar
residential possibilities and historic co
erations, among other concerns. A citiz
committee, proposed by the Bicenten
interests and selected by PARD, wo
with the consultants in the early stage
the plan. More money was requested in
December 1975 bond election, not only
ing $1.5 million to Waller Creek's deve
ment over the next several years, but
cluding nearly $8 million for creek rel
parkland acquisition and development.

Concurrent with the planning of the lo
ten blocks of Waller was the developn
of Symphony Square and Waterloo Park on
the adjacent five blocks, an area which had
been in the planning stages for several years.
Symphony Square embodies all three project
areas of the Bicentennial in its restoration of
four historic buildings on the creek, acces-
sible by trail north toward the University
and south toward downtown, and providing
the central city with cultural opportunities
previously unavailable in that area.

The University of Texas, encouraged by the
student body as well as the city's Bicenten-
nial plans on Waller, began planning for its
portion of the creek. The Student Union, the

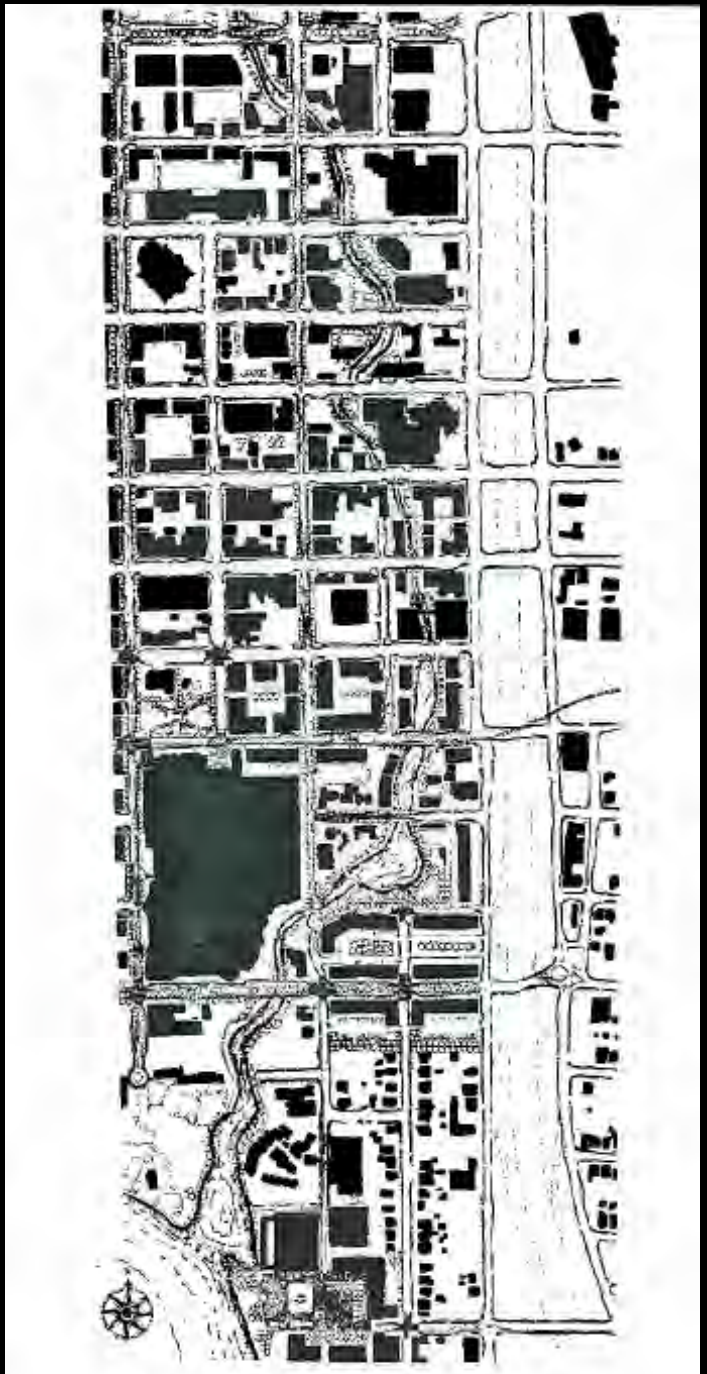
WALLER CREEK:

Waller Creek is rapidly moving toward fulfillment of its potential. The middle portion, 15th Street to 10th Street, has been virtually completed as an urban park with Waterloo Park and Symphony Square. The upper portion of Waller Creek, that flows through the University of Texas, is being planned as a linear park and trail. The lower portion, from 10th Street to the Colorado River, is being planned in great detail as a zone for urban development.



Improving Waller Creek 1998

WALLER CREEK
CHARRETTE REPORT
1998



STREETS TO BE REDESIGNED

Improving Waller Creek 2000

Waller Creek Greenway Action Plan

Austin, Texas

Action Plan Report

November 2000

Prepared for:
The Waller Creek Greenway Partnership

Prepared by:
GREENWAYS INCORPORATED
Bicycle & Pedestrian Planning
Environmental Design
Landscape Architecture

Waller Creek Characteristics

For the purposes of this Greenway study, there are three distinct characters or zones within the Waller Creek Greenway study area.

Zone 1: Lower

Town Lake to 5th street. This area consists of a fragmented natural landscape that has poor access to the lower water level. Bank erosion is prevalent due to high peak flow and poor maintenance.

Zone 2: Middle

Fifth street to 10th street. This area has a canyon effect where buildings like the Sheraton Hotel dominate the landscape. Access to the waters of Waller Creek are improved, however much of the stream channel is comprised of human structures.

Zone 3: Upper

Tenth street to Waterloo Park. This area blends the natural with the urban conditions that reflect the first two segments. Some of the best examples of good stream architecture are located in this zone (wall treatments, paving, tree wells and spatial qualities of the corridor).

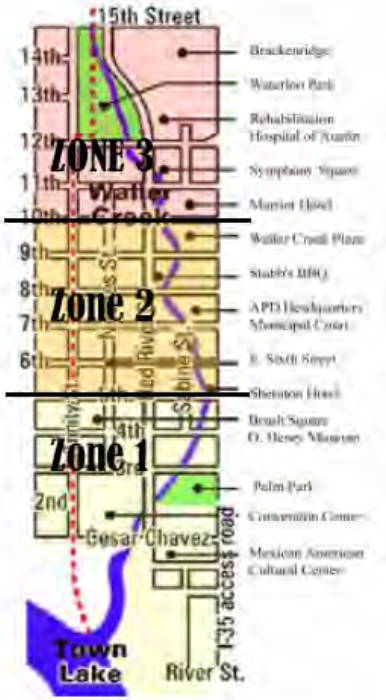
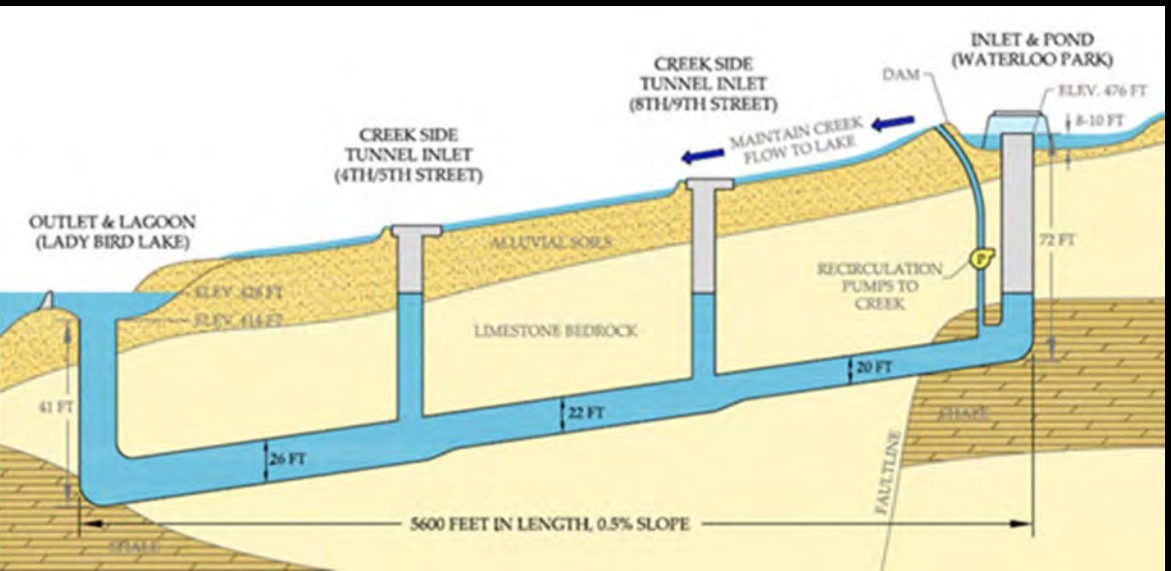


Figure 12: For the purpose of the Greenway study, the consultant has divided Waller Creek into three distinct zones. Zone 1: Lower Creek; Zone 2: Middle Creek; and Zone 3: Upper Creek.

Improving Waller Creek in the 21st Century
The Hydrological Cyborg Creek

Upper Course, Middle Course, Lower Course

RAIN
CATCHER
PILOT
PROGRAM

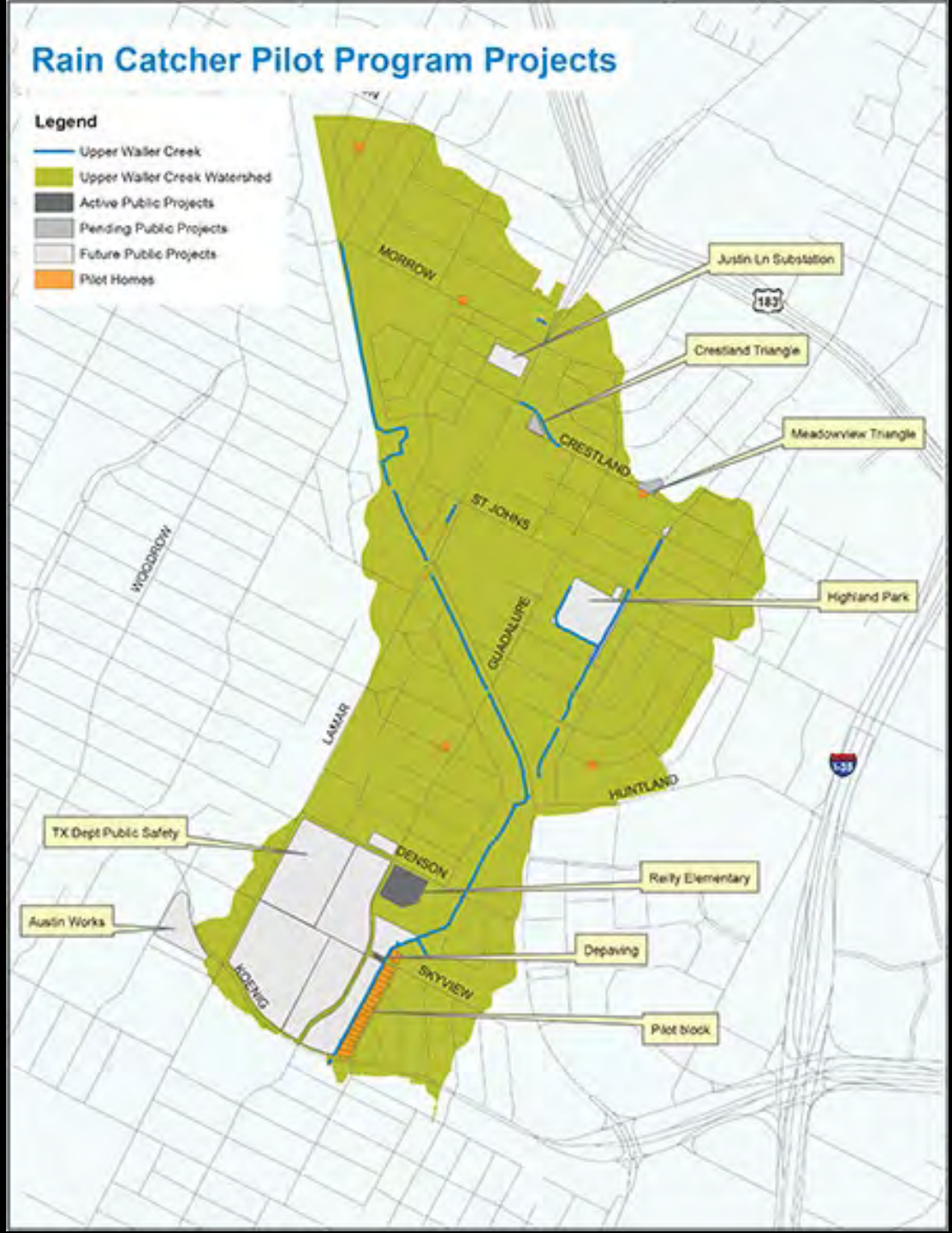


Upper Course – Headwaters

The **Rain Catcher Pilot Program** "a comprehensive effort to integrate and leverage the City's existing Green Stormwater Infrastructure (GSI) programs and resources."

This small urban area is 2.8 square kilometers (1.08 square miles) with 46% impervious cover and limited options for traditional stormwater controls.

RAIN
CATCHER
PILOT
PROGRAM



City of Austin WATERSHED PROTECTION

City of Austin Riparian Restoration

AUSTIN PARKS & RECREATION Cultural Places, Natural Spaces

Riparian Zone Restoration: Bartholomew Park

1. Persistent mowing in creek

2. Grow Zone intermediate stage

3. Grow Zone mature riparian woodland

Upper Course

Central Park Wet Pond

Constructed: 1998

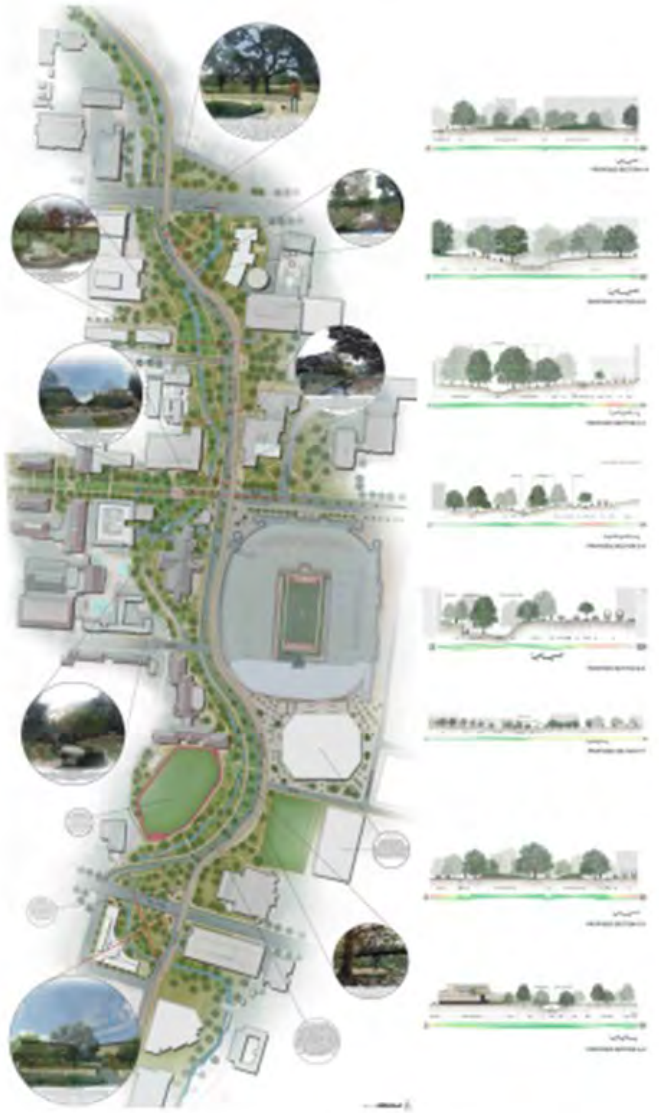
Location: Behind Central Market and the apartments at 38th Street and Lamar Avenue

Pond Watershed: 173 acres

Impervious Cover / Drainage Area: 54%

Pollutant Removal: 50,000 lbs Total Suspended Solids (TSS) removed annually

Middle Course – University of Texas



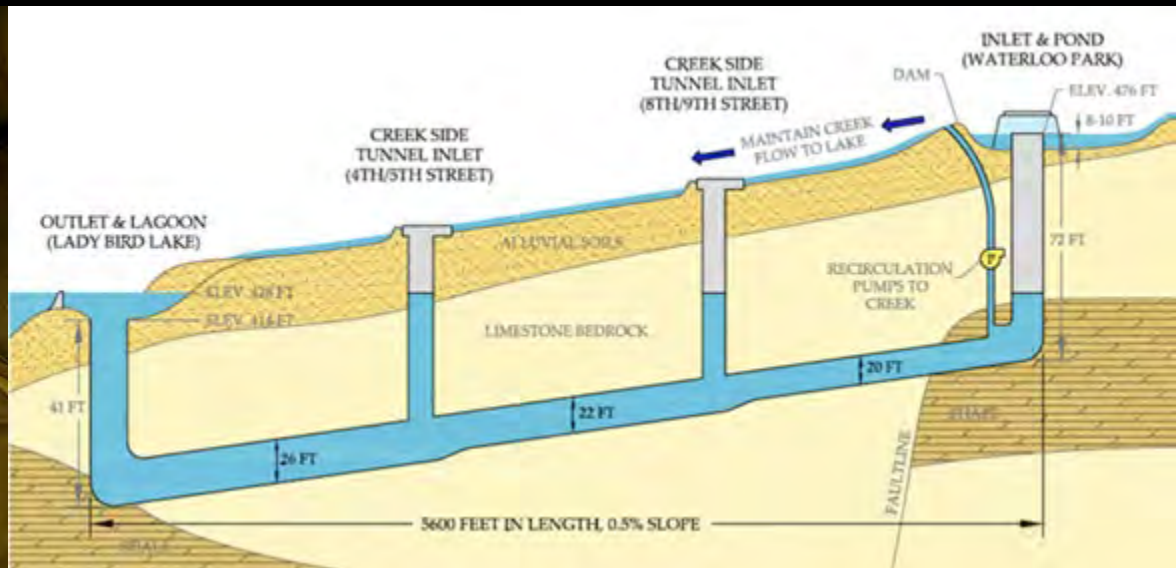
The University continues to grow and surround Waller Creek

Lower Course - 15th Street to Mouth

Lower Waller Creek

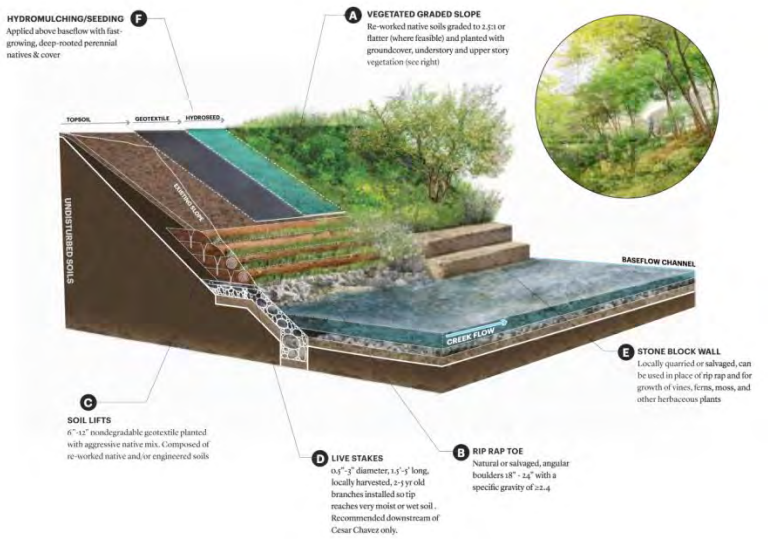
Legend

The Lower Course and The Cyborg Creek



The Cyborg Creek and Socioecological Nature

Reconstructing Failed Slopes



Socioecological Nature

Waller Creek and a Chain of Parks

Transforming Physical Geography and Cultural Geography

Waller Creek Conservancy

waterloo greenway

The Ideal Urban Creek For Humans

waterloo greenway

CREEK SHOW 2023

Inhabiting The Ideal Urban Creek

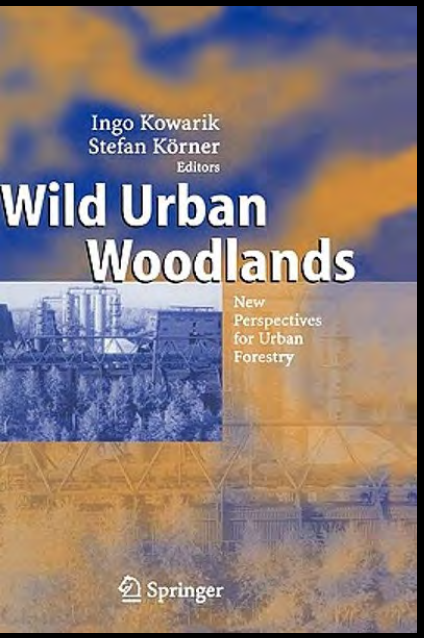
Humans – The Subjects

Nonhumans – The Objects

waterloo greenway

Nonhumans as Subjects

The Problem of Wild Urban Woodlands – Waller Creek 7th Steet Bridge



2024

2005

2009

2012

2017

Nonhuman Agency

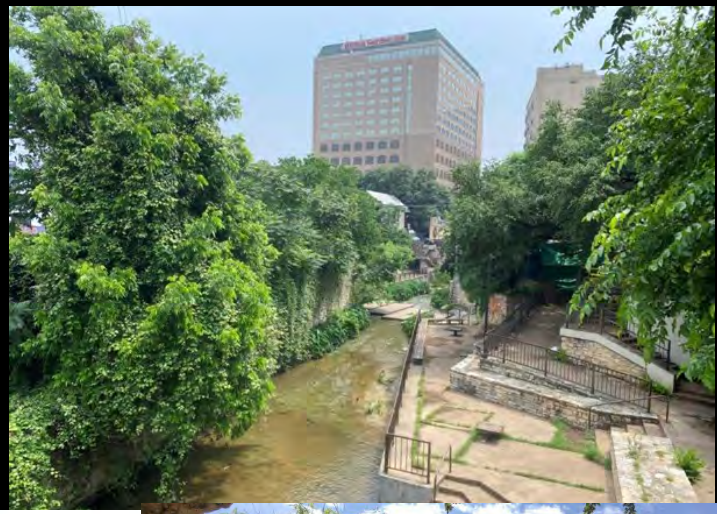
Unauthorized Grow Zone – Waller Creek 7th Steet Bridge

The Wild Urban Woodlands of Waller Creek

Socioecological Nature

- Dynamic
- Self Organizing
- Tolerant of Disturbance
- New Combination of Species

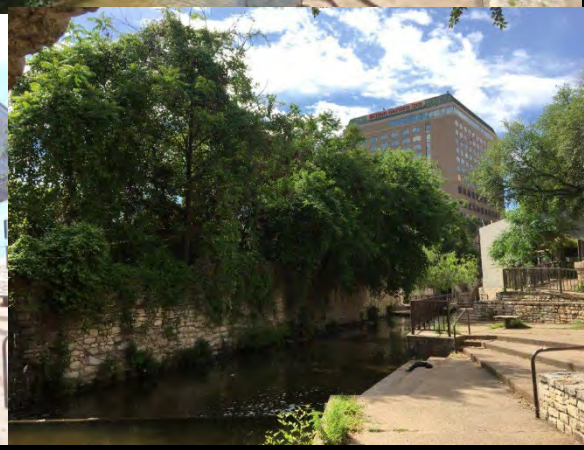
2024



2005

2009

2012



2017

At Home on Waller Creek

Dr. Travis LaDuc, Curator of Herpetology for the Texas Biodiversity Center

Since 2006, LaDuc and others have been capturing and radio-tagging the snakes in Waller Creek to better understand their biology in our urban ecosystem.

Blotched watersnakes are the most common large snakes in the Waller Creek. The only other large species of snake seen in the creek is the non-venomous Texas ratsnakes.

Small species of snakes seen (infrequently) include the Texas Brown Snake and the Texas Blindsnake.

In the intensive surveys, they have never encountered any venomous snakes in the creek, and going back through museum records since 1947, there have been no venomous snakes collected anywhere along Waller Creek.

There is probably one snake every 30 feet of the creek

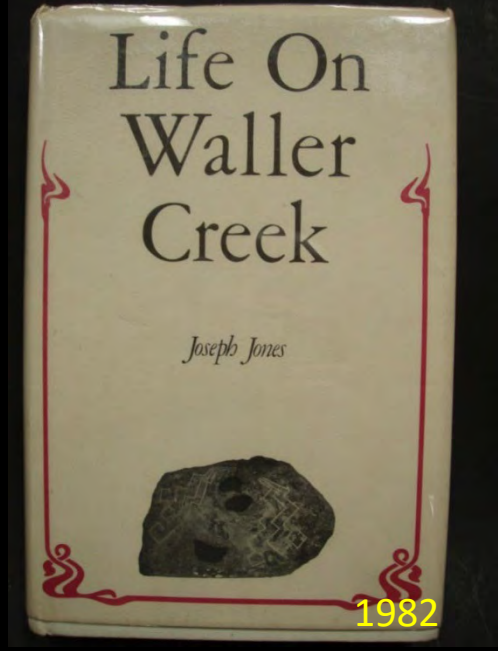
Life on a Cyborg Creek

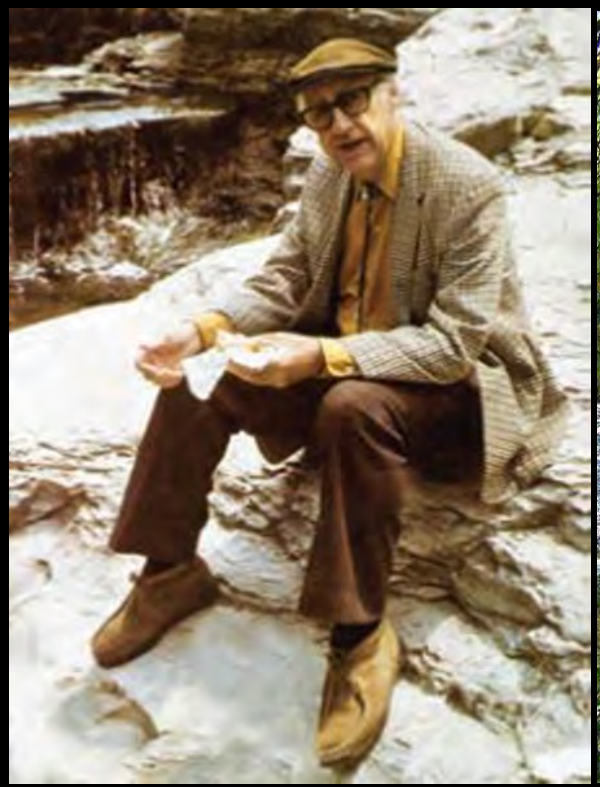
"The Creek is an ever-visible manifestation of continuity, of life…

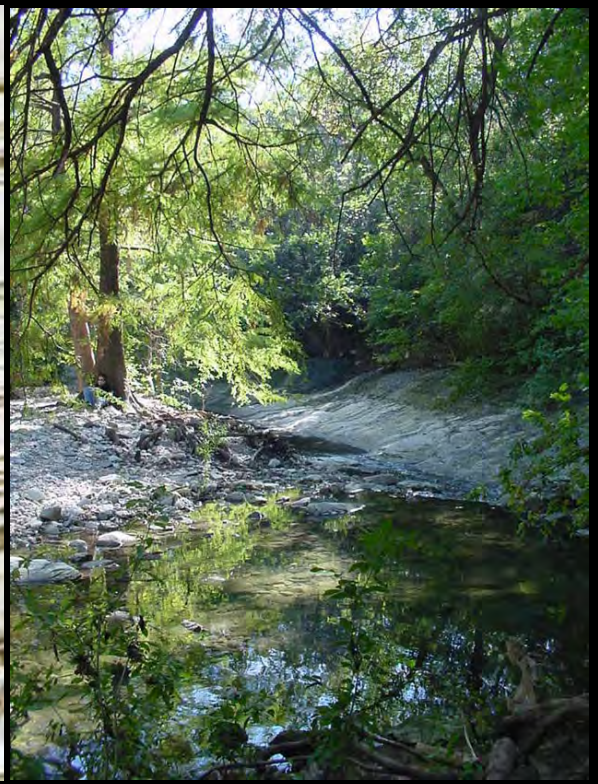
it is the sum total of many processes, an intricately integrated process in itself…

The fact that it has been interfered with by man, and continues to be interfered with, must be accepted as part of such total process, whatever opinion may be held as to the merits of the interferences."

Joseph Jones 1908-1999







"I would hope also that the reader, if he should tire of being reminded overmuch of what an efficient trash-receiver (up to a point) the Creek has become in our day, will exercise the reader's privilege of imagining what counterparts to an inventory of the 1970s-80s were almost certainly to be found in Waller Creek pretty steadily after 1839 and indeed even before.

But let him first accept himself as part of the continuum and become his own short-term archeologist: such fugitive creek-things as I will be cataloguing here, when carried and buried, might be thought of as archeology going somewhere to happen.

Thus, for example:

Plastic beer cups (Brand X with blue map of Texas) in addition to the ever-ongoing deposit of beer cans…

A grackle's reflection as he flies low over a still pool…

After a flood, young willows keep reminding us, for many days, "It went that-a-way,"…

Waller Creek - The Perennial Weed

"Waller Creek is that kind of a natural organism, very pertinacious, luckily almost impossible to kill – a perennial weed, so to speak."

Joseph Jones, *Life on Waller Creek*