

The Honolulu Advertiser

MONDAY | November 5, 2007 HAWAII'S NEWSPAPER

BREAKING NEWS 24/7 AT HONOLULUADVERTISER.COM

INSIDE TODAY

Patriots rally to beat Colts

Battle of unbeatens goes to New England

SPORTS | D1

UH drops in BCS ranking

But big bowls lining up to check out Warriors

SPORTS | D1

Shabby ship, high-tech role

Pearl vessel helps test missile defense shield

MILITARY BRIEFING | B4

THE ADVERTISER'S SPORTS BLOGS

Warrior Beat

Prep Talk

Fantasy R&R

HONOLULUADVERTISER.COM

A wet mess on O'ahu

Sewage spills, wayward boulders — and still more rain to come

Firefighters push a pump through the floodwater to drain driveways of homes on Kalihiwai Avenue in Kailua. Red Cross workers were also in the area to help out.

DEBORAH BOOKER

Kailua folks act to avert flood, blame city officials

South shores could get surf up to 15 feet through tonight

AFFECTED AREAS

See where the boulders hit and which areas got the most rain | A2

THE ADVERTISER'S VIDEO REPORTS

• Watch a video and see more photos of the surf

• Or view more pictures of the floods in Kailua at

HONOLULUADVERTISER.COM



JAMM AQUINO / JAQUINO@STARBULLETIN.COM

What causes the most damage on Oahu?

A) Surface water
B) Groundwater
C) Big surf
D) Tsunami

Surface Water

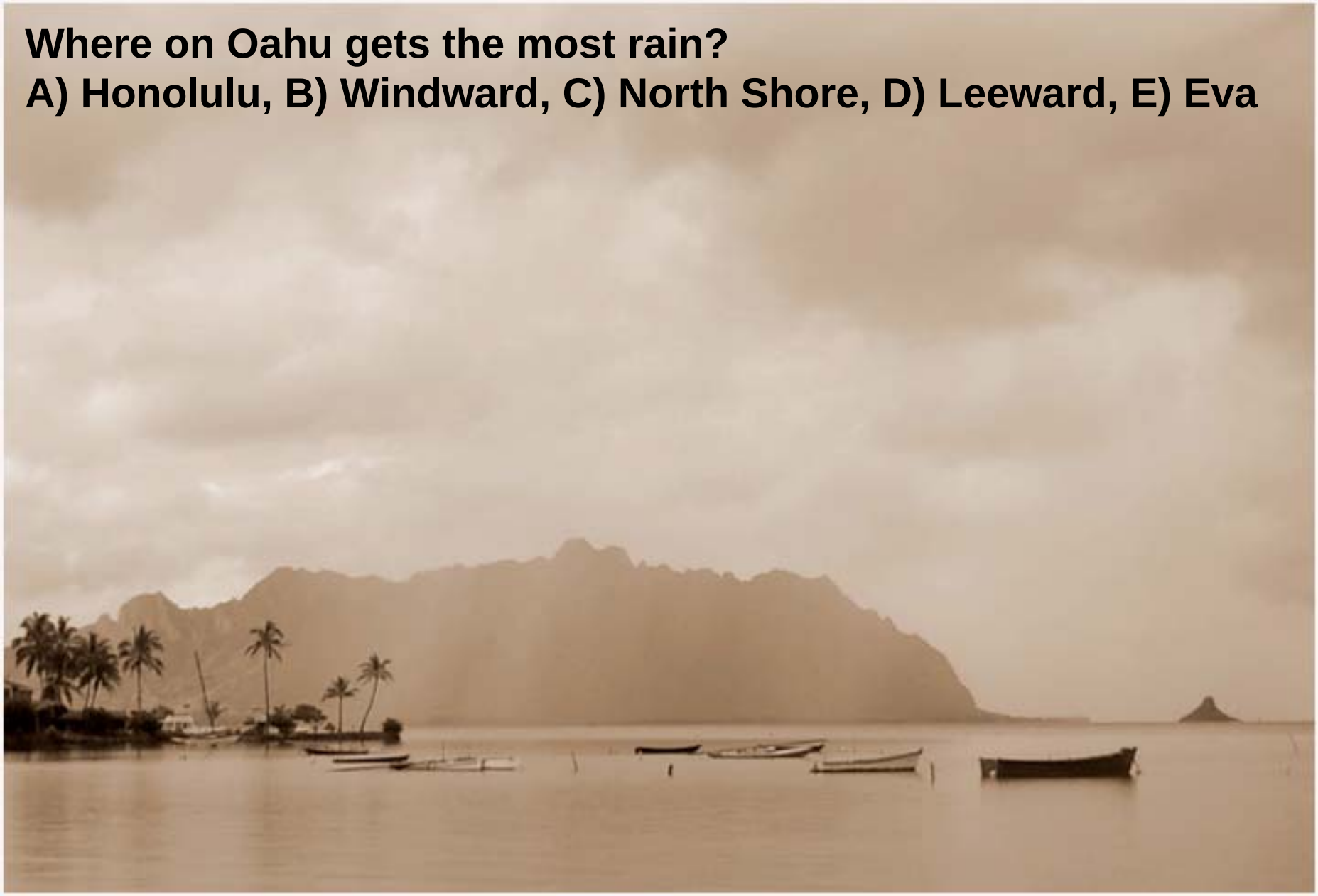






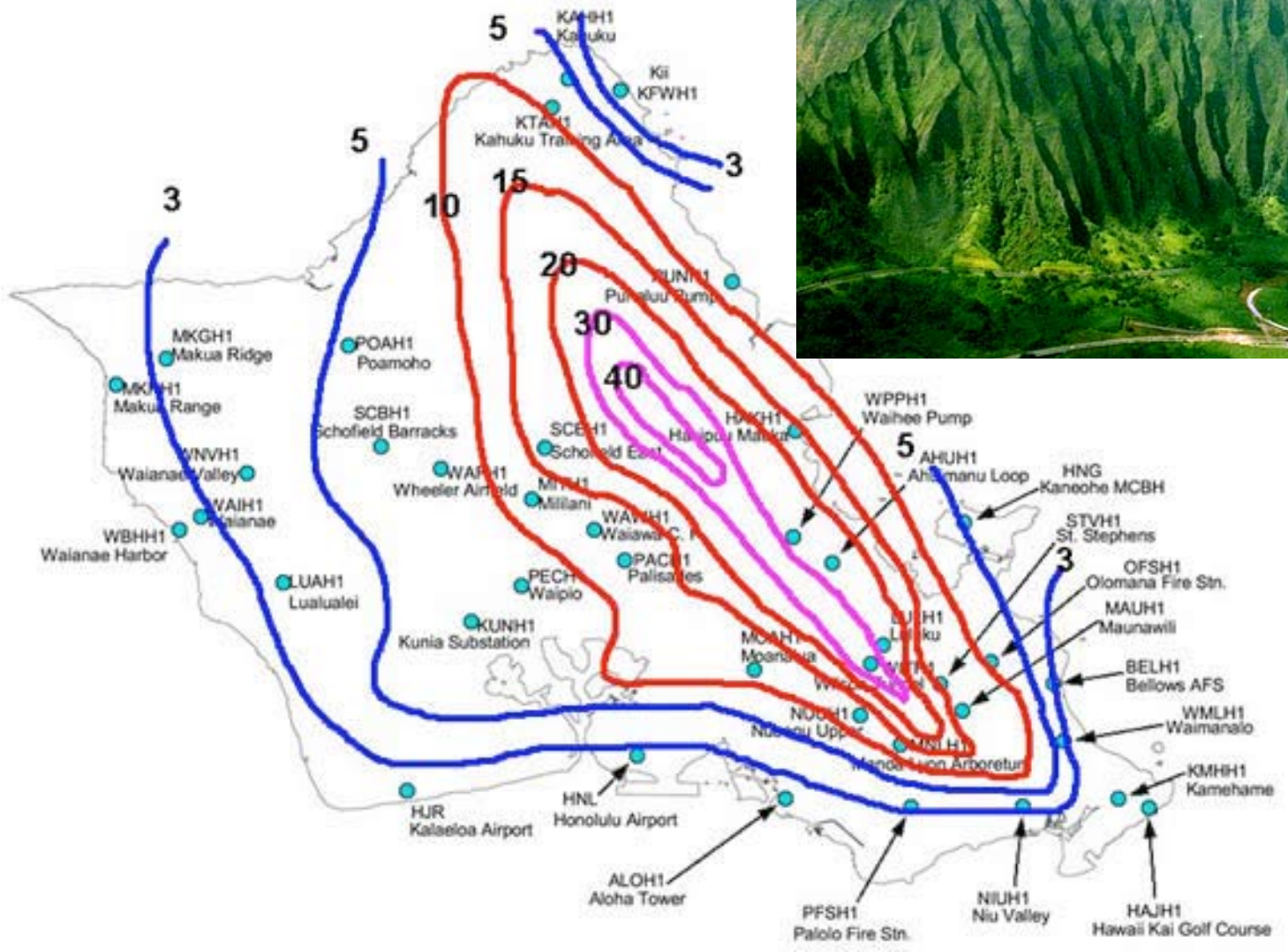


Where on Oahu gets the most rain?
A) Honolulu, B) Windward, C) North Shore, D) Leeward, E) Eva



One week's rainfall (inches) on Oahu





What are the sources of Oahu's water?

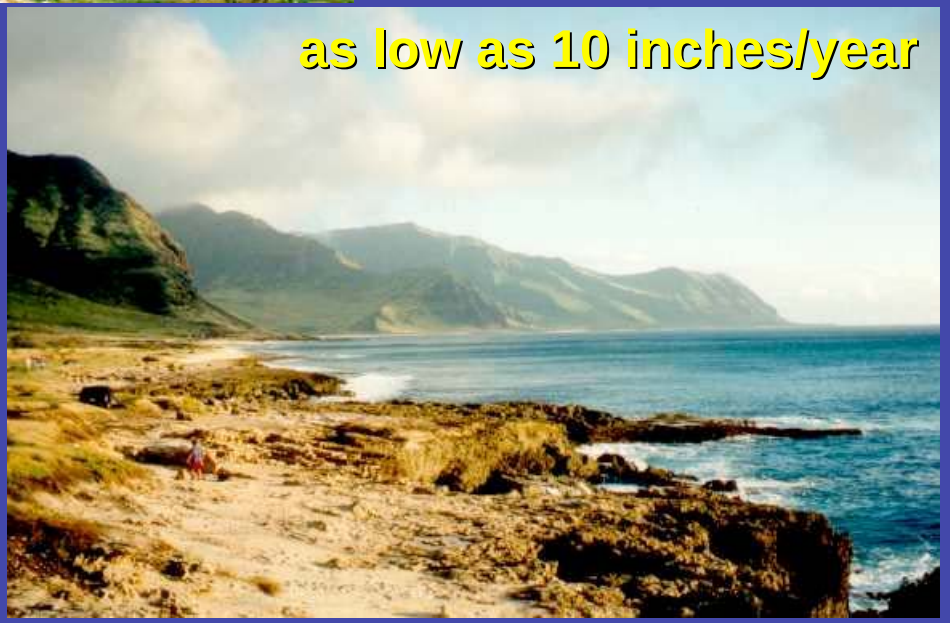


1) Tradewinds

and…

2) "Orographic Effect"

control rainfall distribution in Hawaii

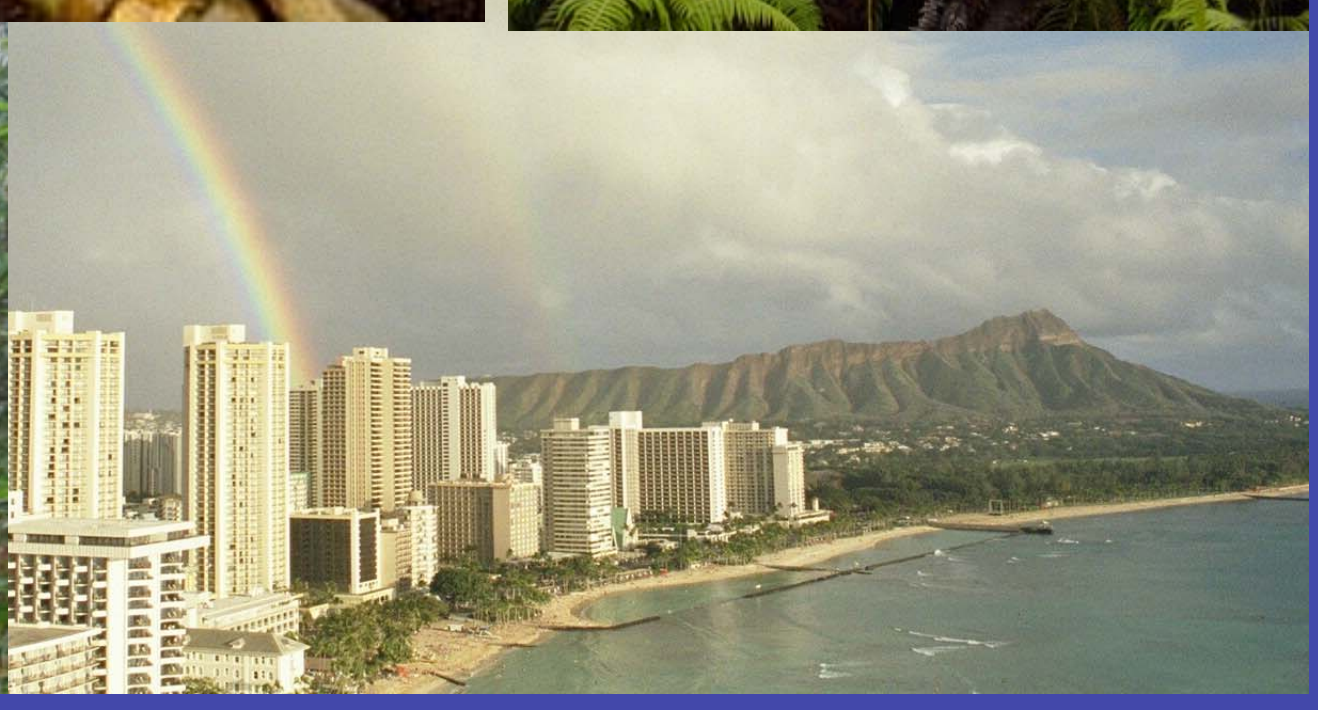


What are other sources of Oahu's water?





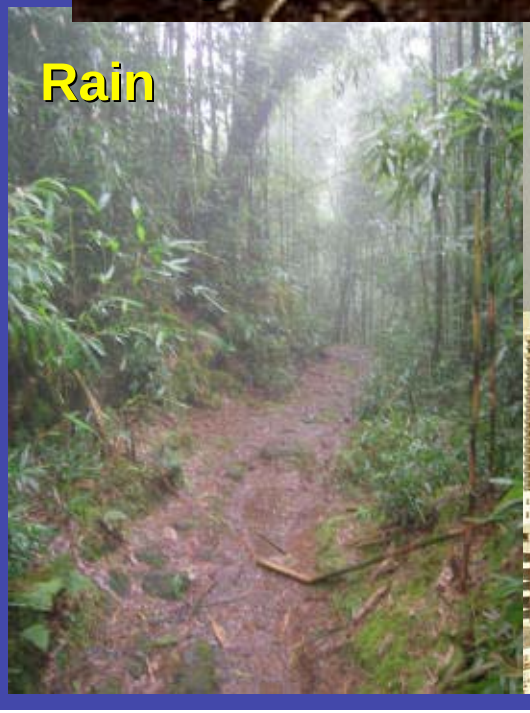




What are other sources of Oahu's water?









How much water flows across the surface?





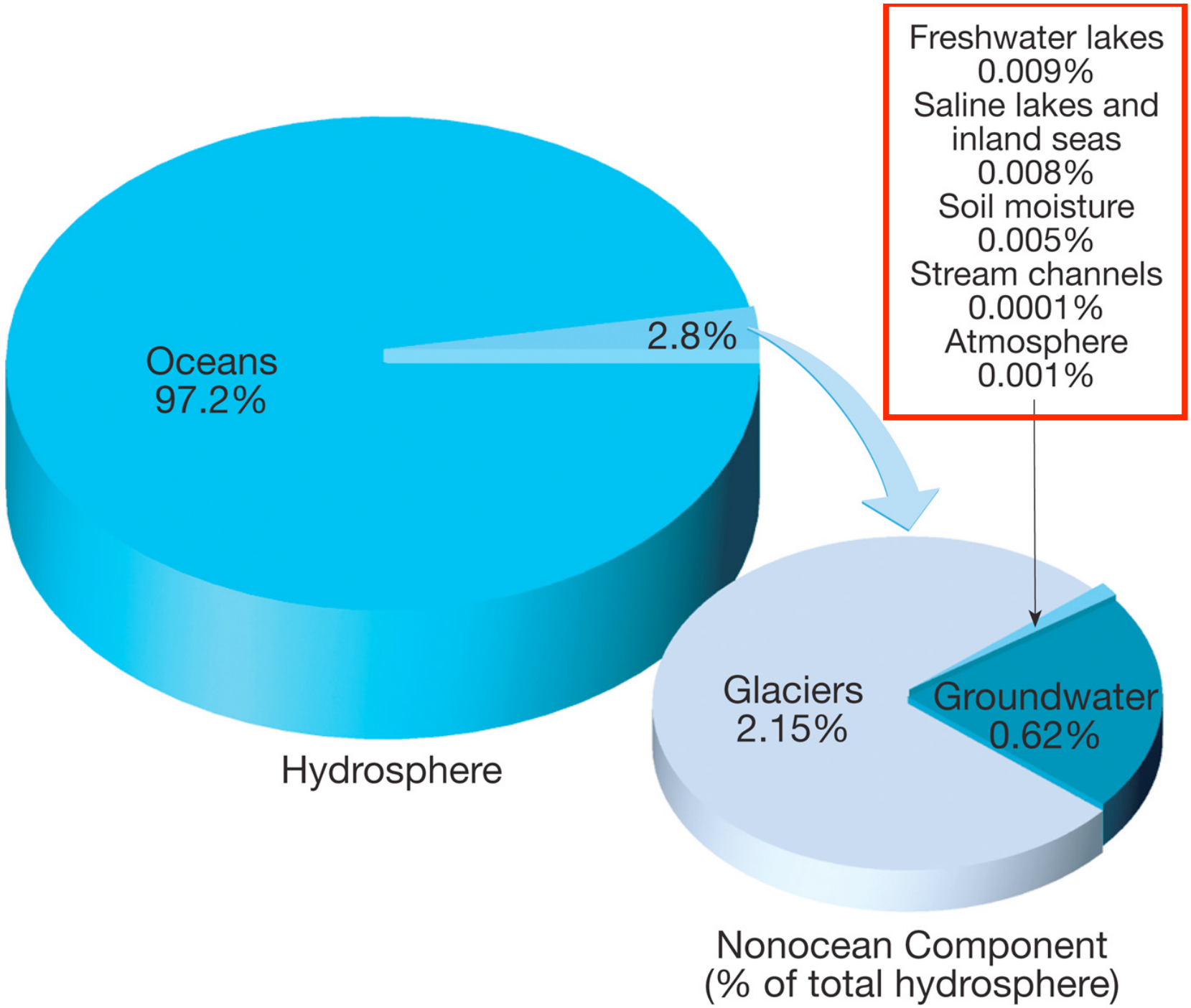
How much water flows across the surface?





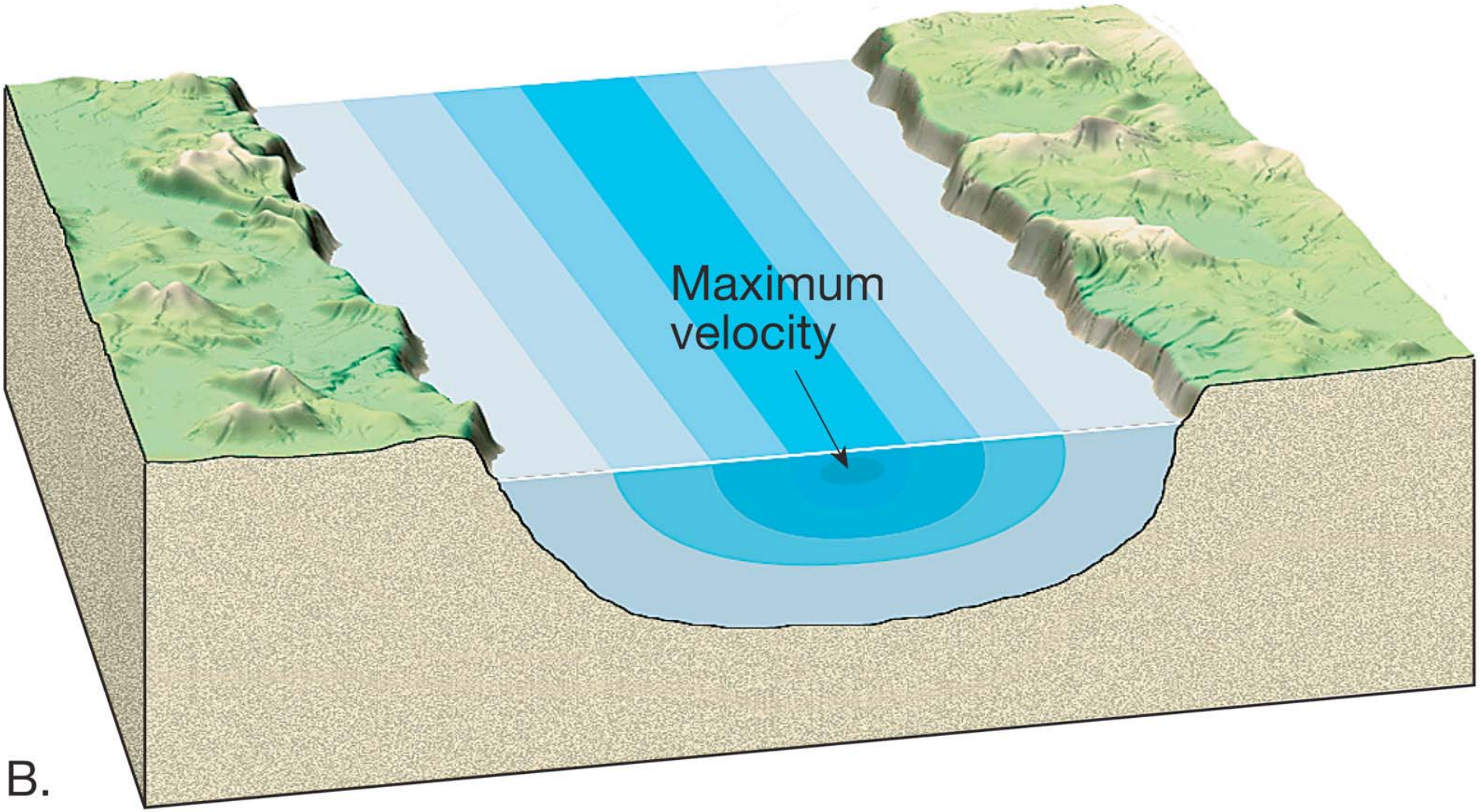
Oahu RUNOFF = 50-90% of rainfall, fog drip, irrigation



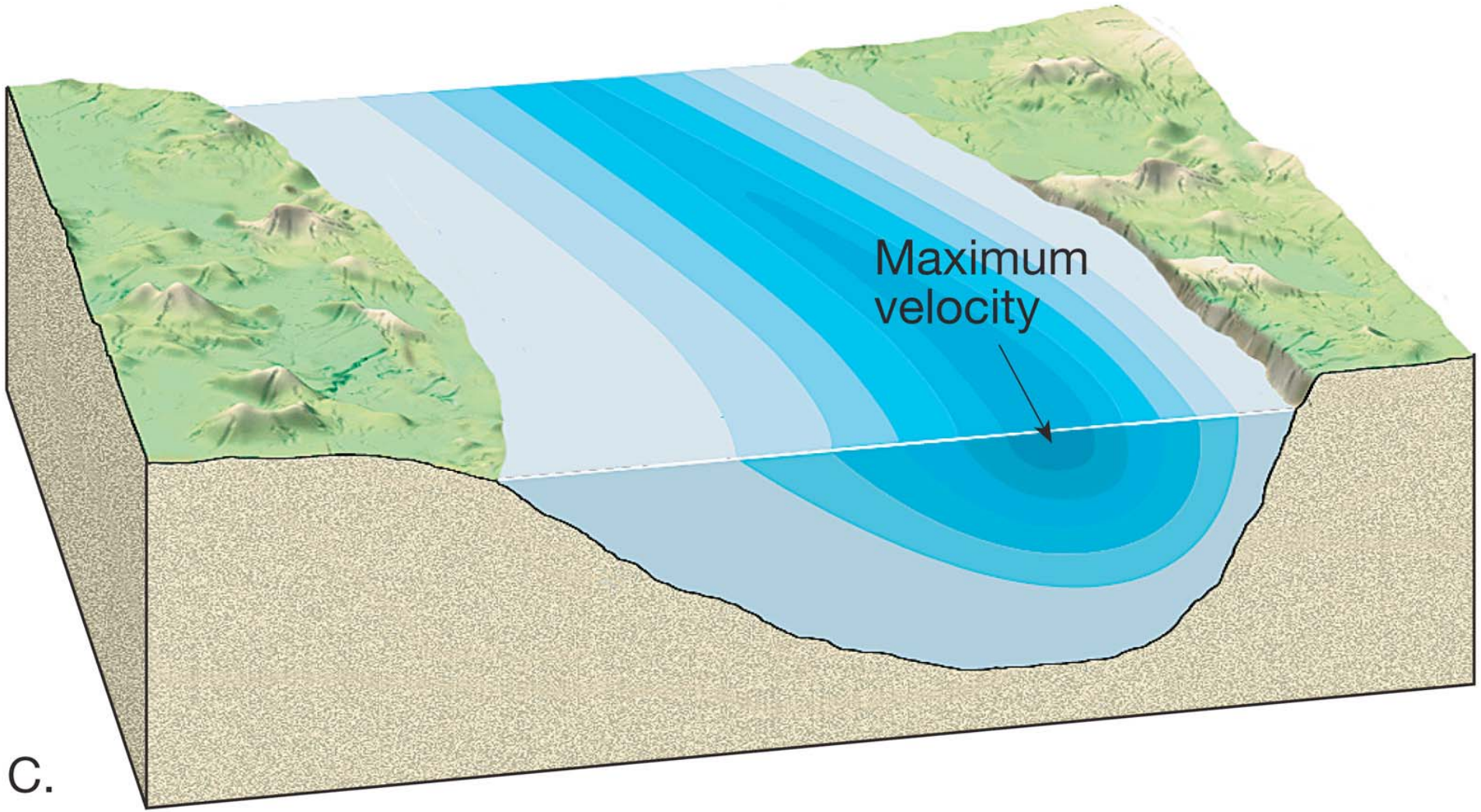

Freshwater lakes
0.009%
Saline lakes and
inland seas
0.008%
Soil moisture
0.005%
Stream channels
0.0001%
Atmosphere
0.001%
Oceans
97.2%
2.8%
Glaciers
2.15%
Groundwater
0.62%
Hydrosphere
Nonocean Component
(% of total hydrosphere)

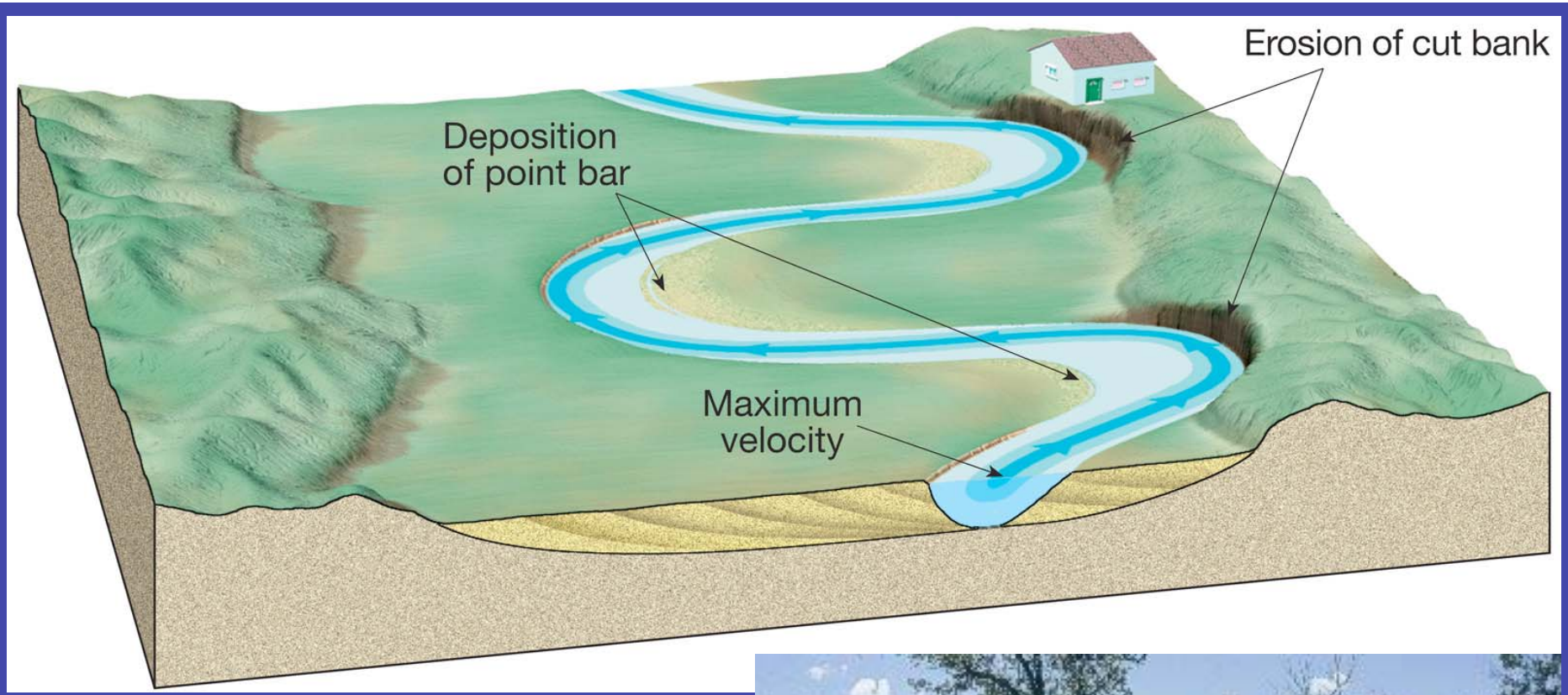

Where is the fastest flowing water?
A) Right
B) Left
C) Center
D) Top
E) Bottom

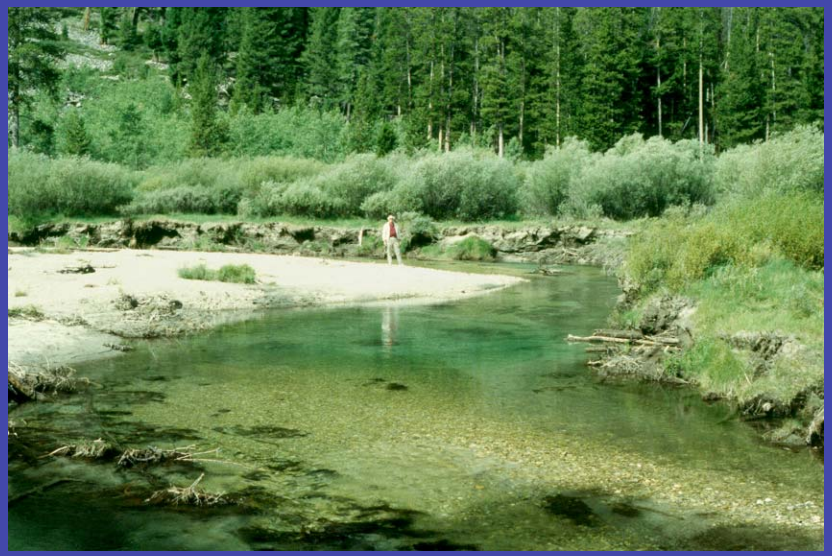
Maximum velocity where friction is lowest



Centrifugal force shifts max velocity to outer edges of bend

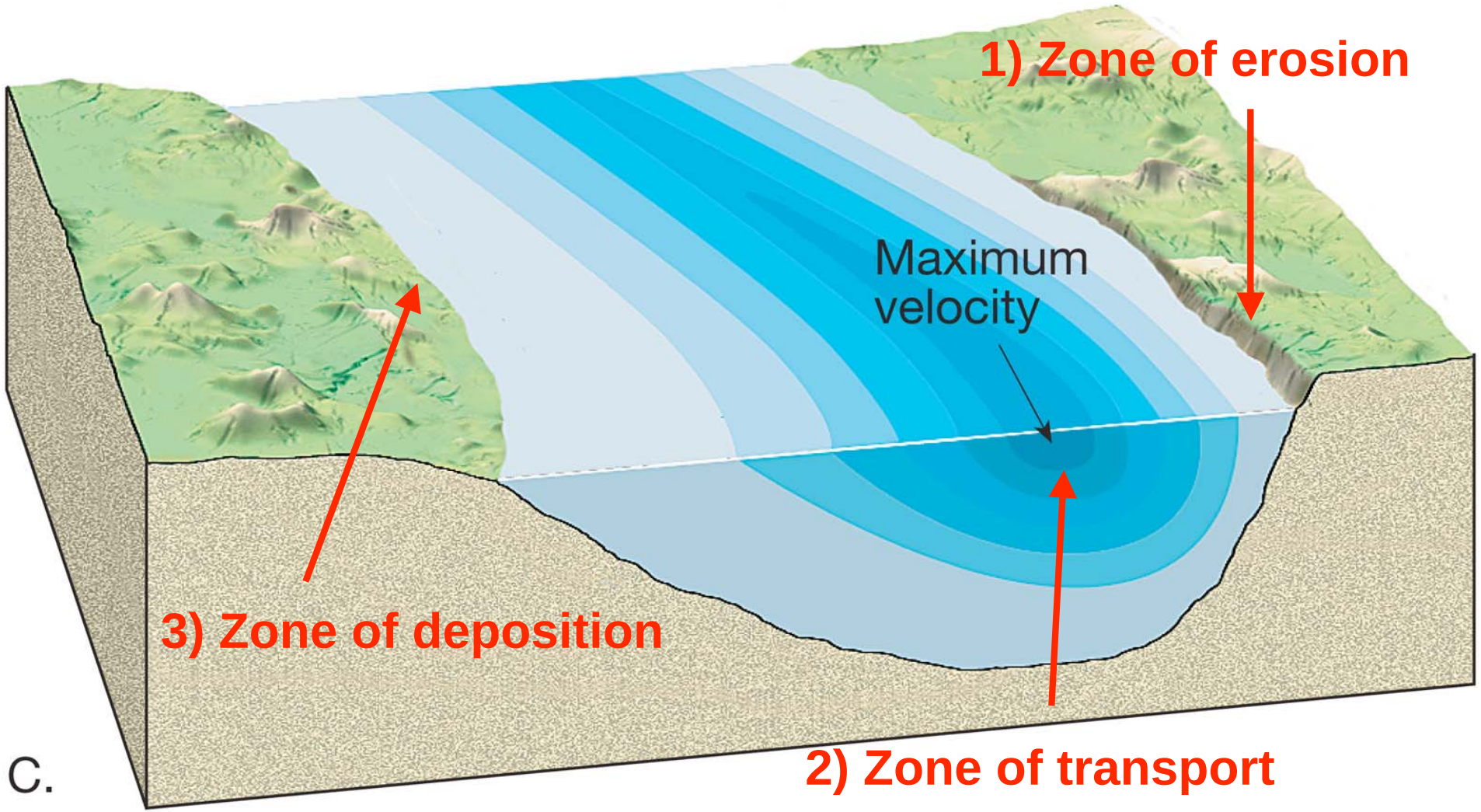



Erosion of cut bank
Deposition
of point bar
Maximum
velocity

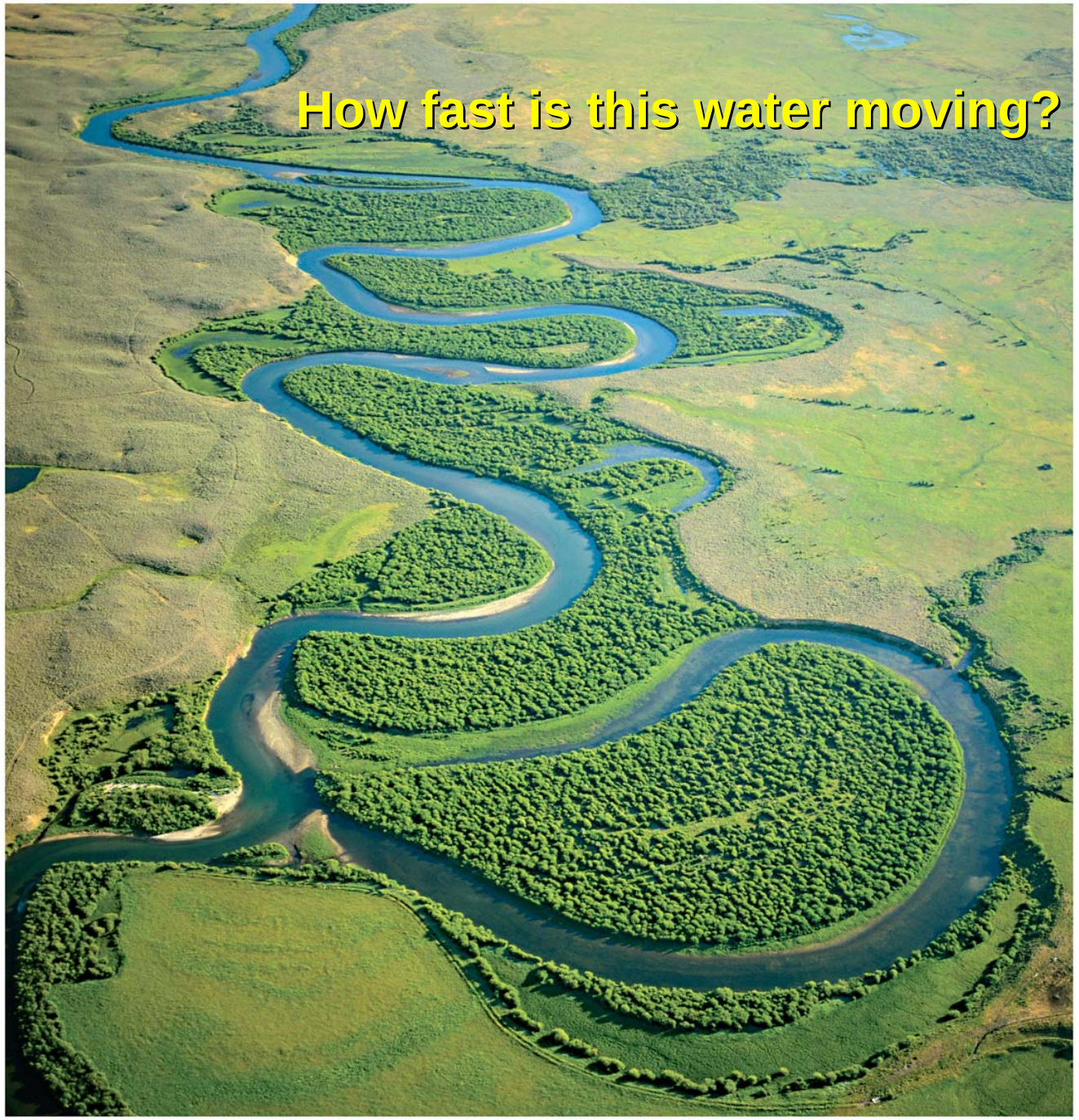




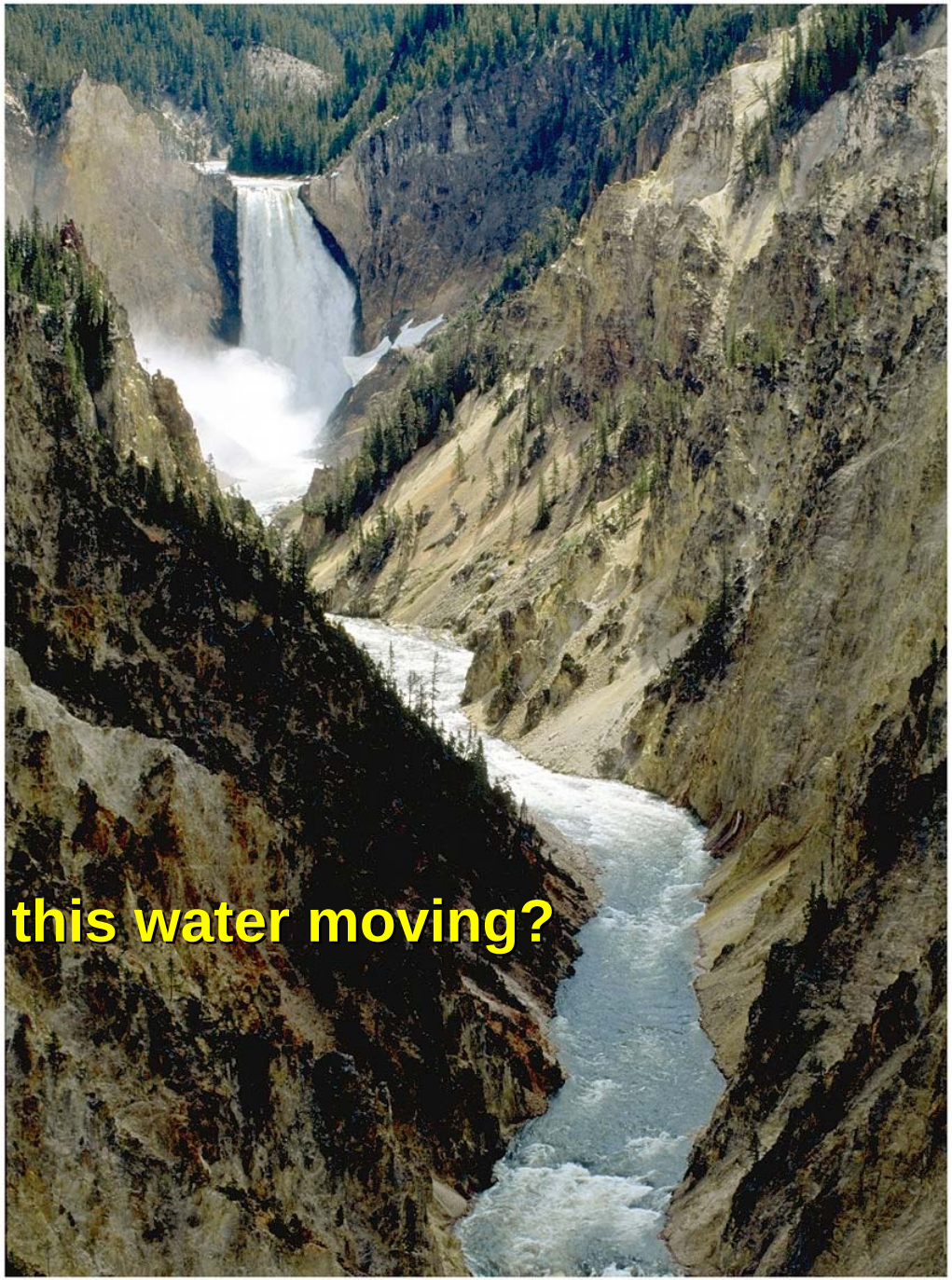
Running water most important agent sculpting Earth's surface



3 zones common to all river systems

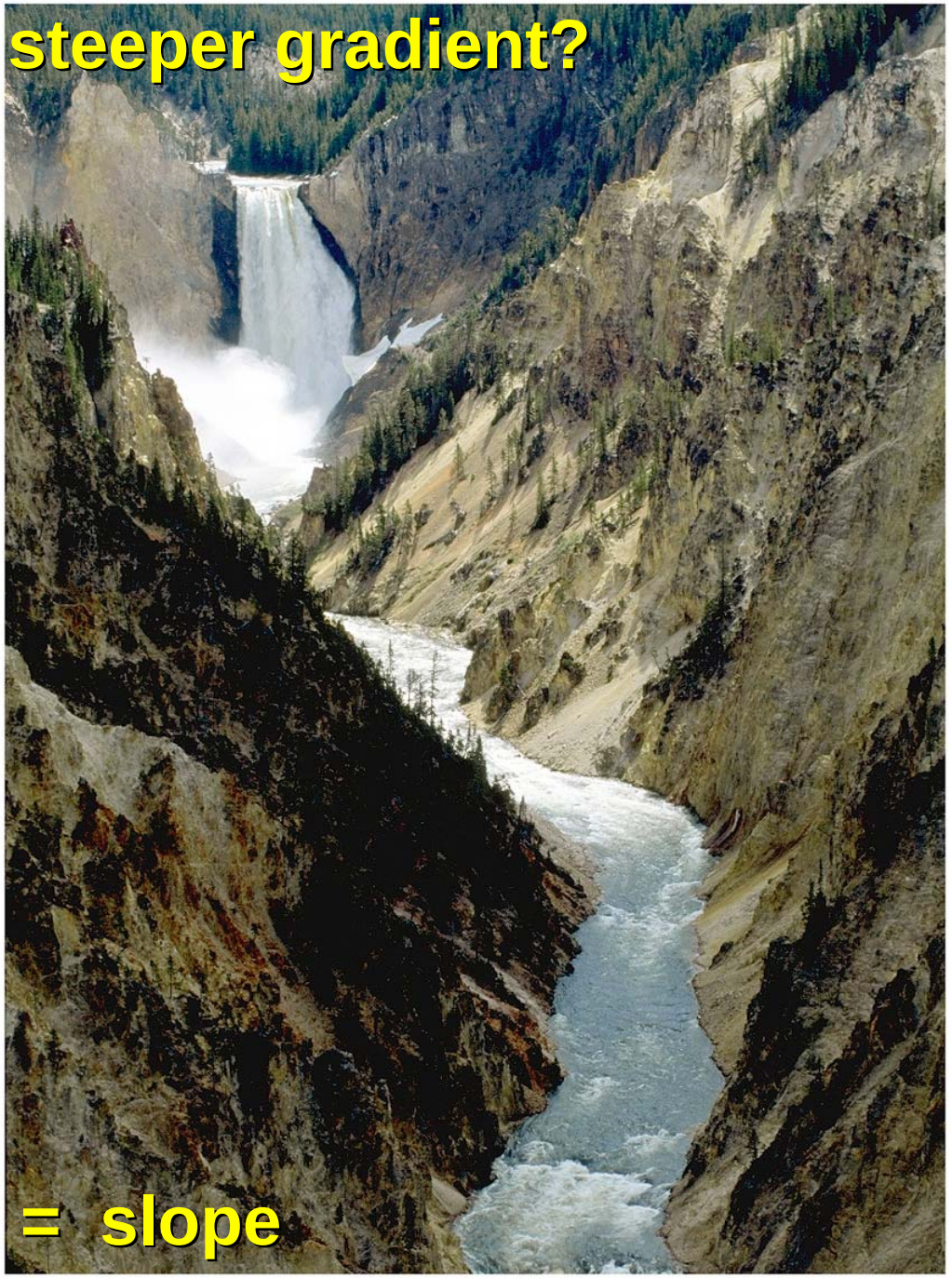

How fast is this water moving?

How fast is this water moving?



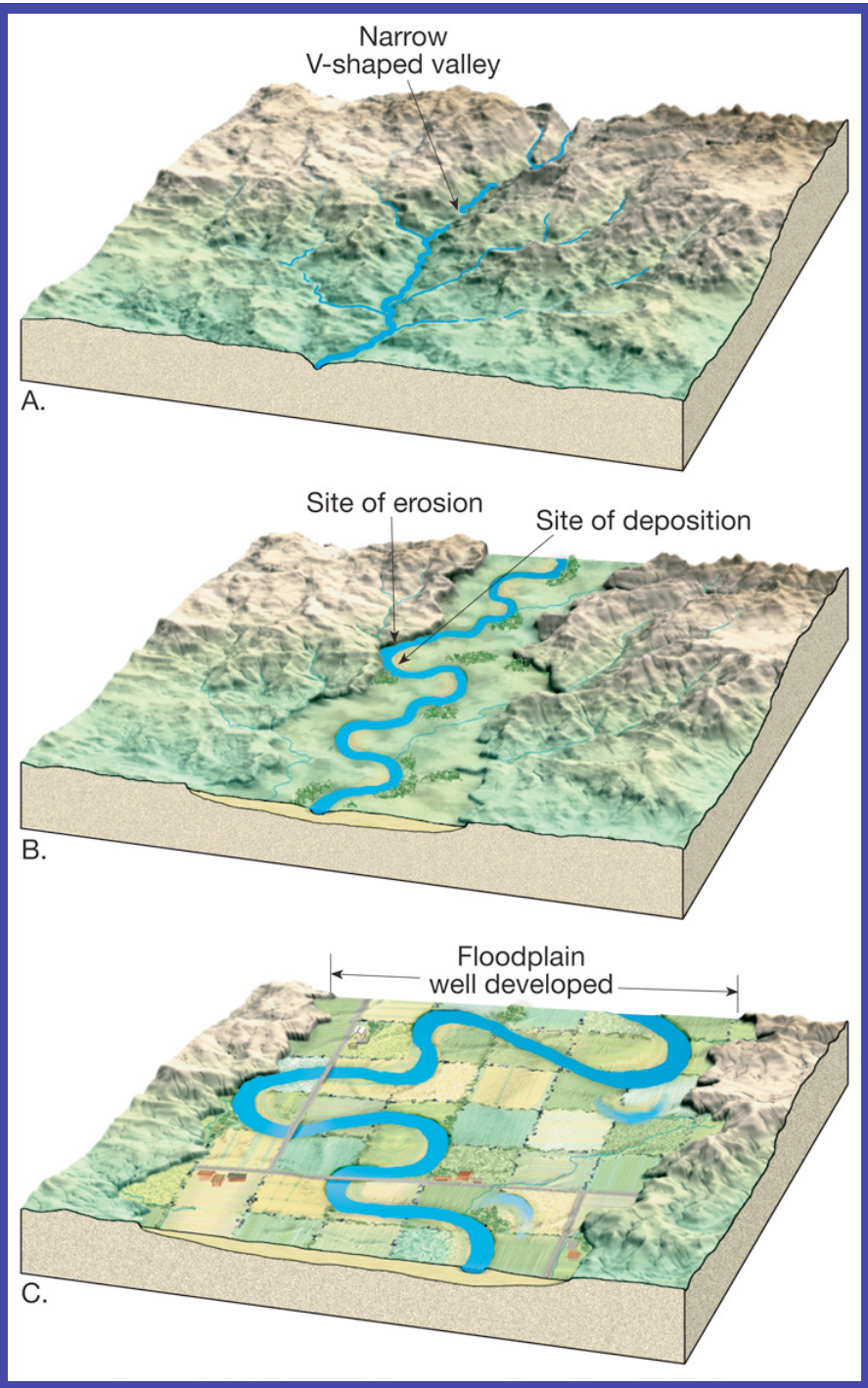
Which has the steeper gradient?



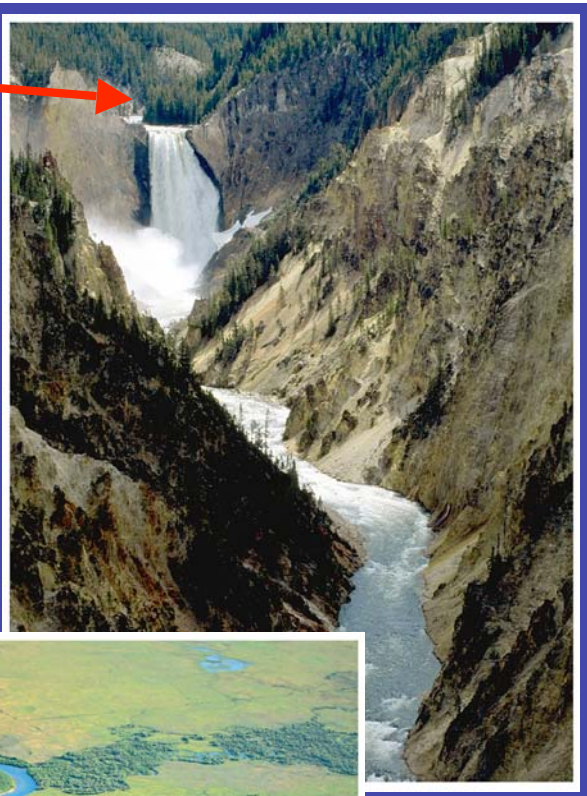


Gradient = slope

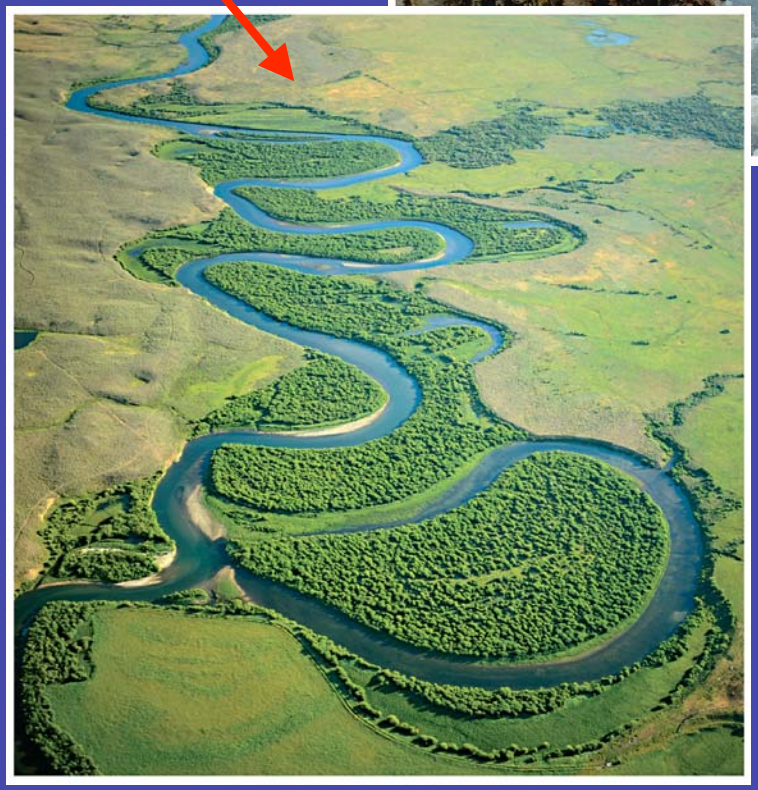
Floodplain Development

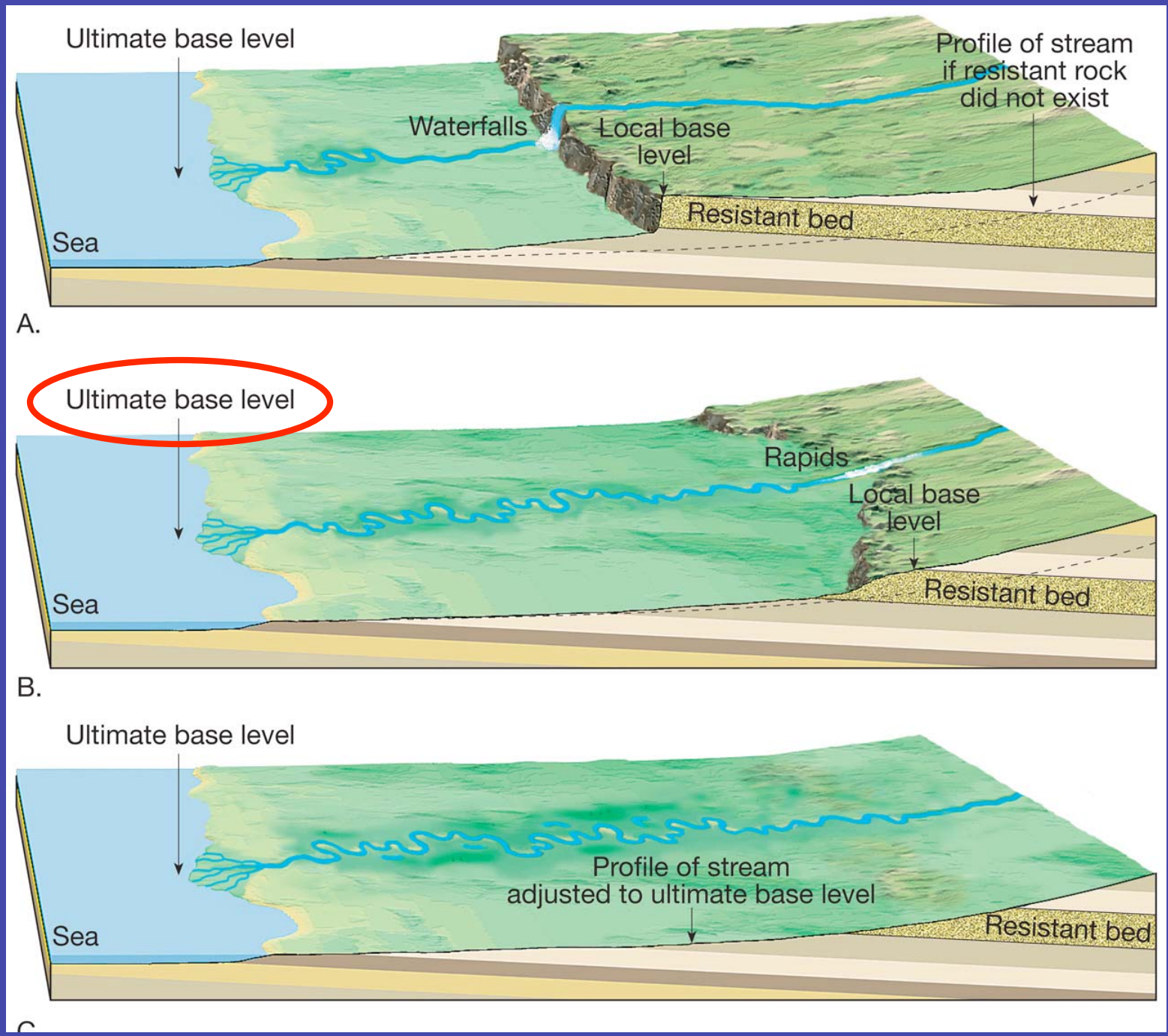


Immature



Mature




Ultimate base level
Profile of stream
if resistant rock
did not exist
Waterfalls
Local base
level
Resistant bed
Sea
A.
Ultimate base level
Rapids
Local base
level
Resistant bed
Sea
B.
Ultimate base level
Profile of stream
adjusted to ultimate base level
Resistant bed
Sea
C

Young

Old

Where are the boundaries…



…of this river?


Floodplain
River



Floodplains:

1) Good for agriculture

2) Bad place to build your house!



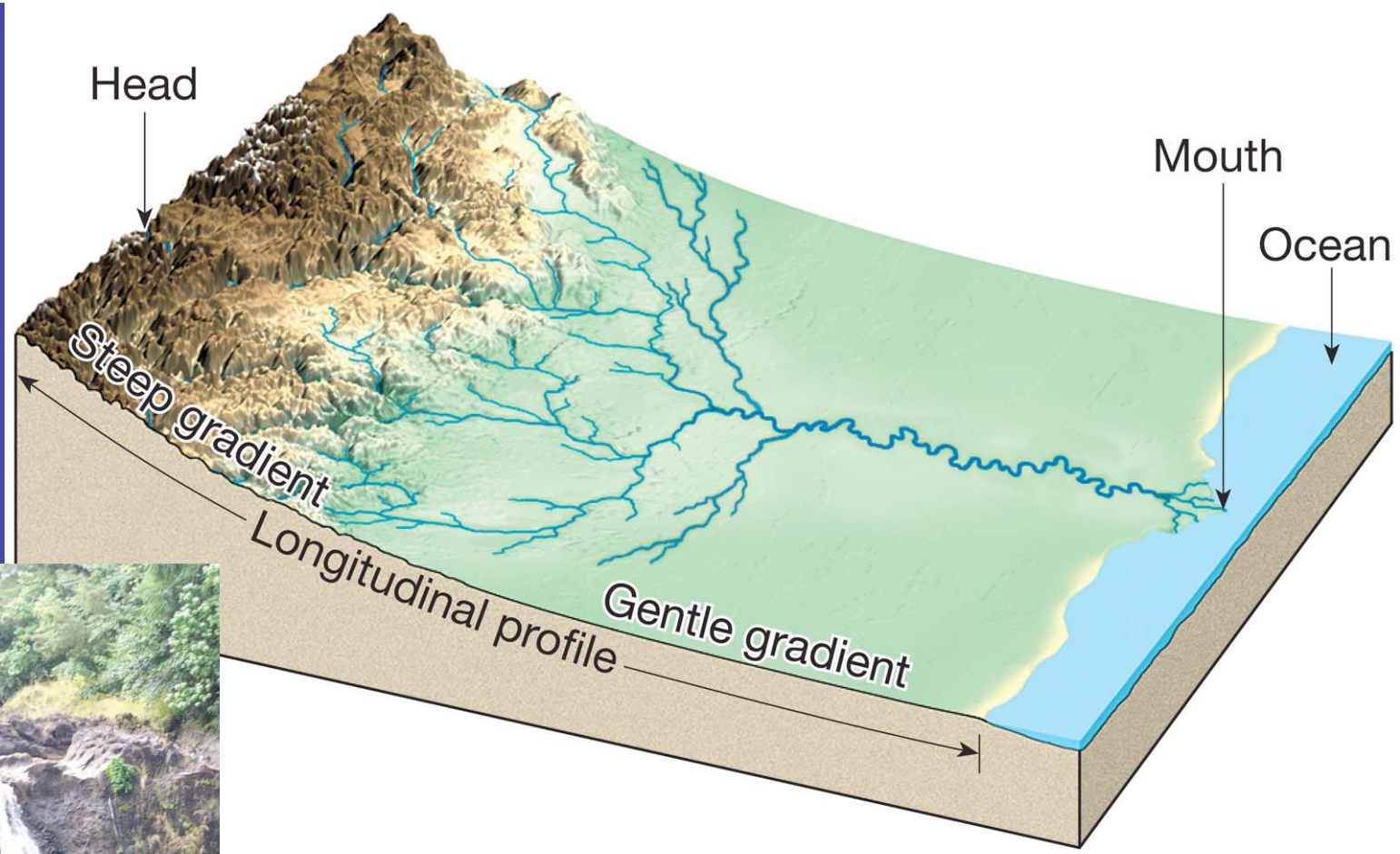
Immature river systems:

V-shaped valleys
Steep gradients
Straight channels

Mature river systems:

Broad floodplains
Low gradients
Sinuous channels

Discharge flow volume per unit time





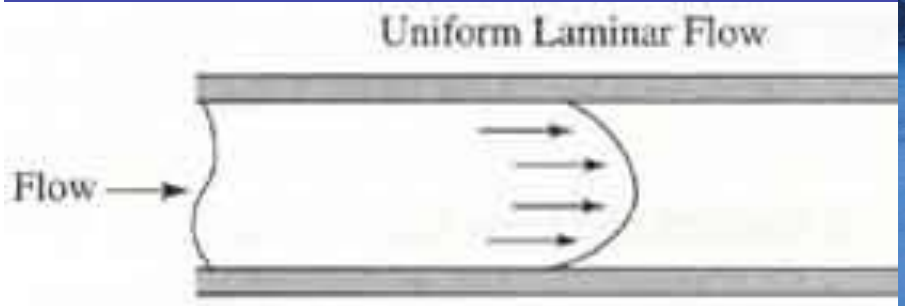
Discharge varies with -

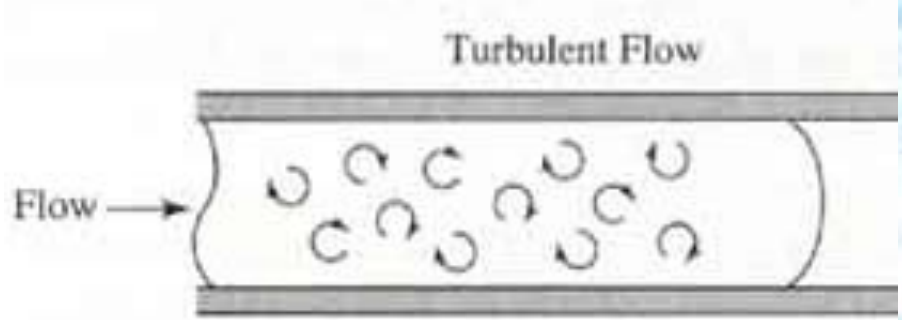
1) location relative to stream profile

2) seasonally

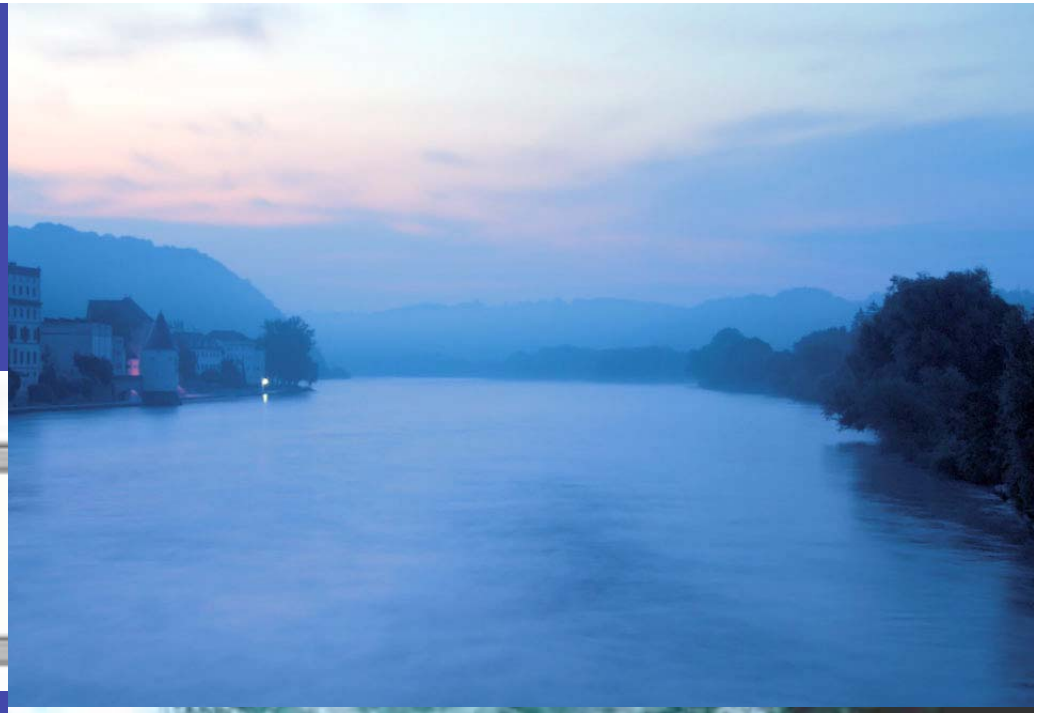

Antelope Canyon, Arizona

Which flow regime leads to erosion?





Which water is moving faster?





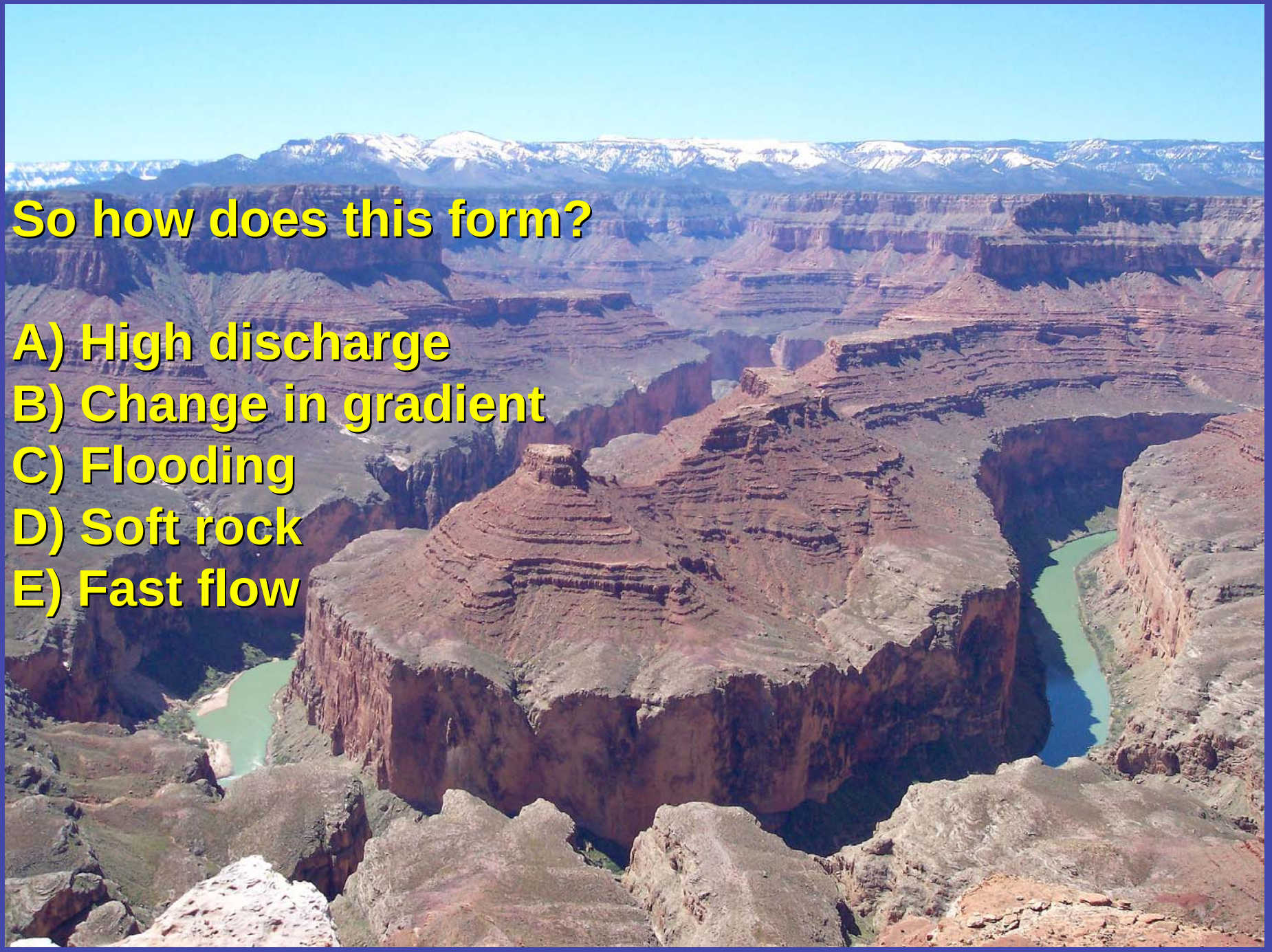
Factors contributing to erosion/downcutting:

1) Location of maximum velocity

2) Turbulent vs. laminar flow

3) Stream gradient (which is a function of height above base level)

4) Discharge volume


So how does this form?
A) High discharge
B) Change in gradient
C) Flooding
D) Soft rock
E) Fast flow

Why do we care about river dynamics?



Why do we care about river dynamics?



Himalayan-sourced rivers supply drinking water to one BILLION people





RECREATION



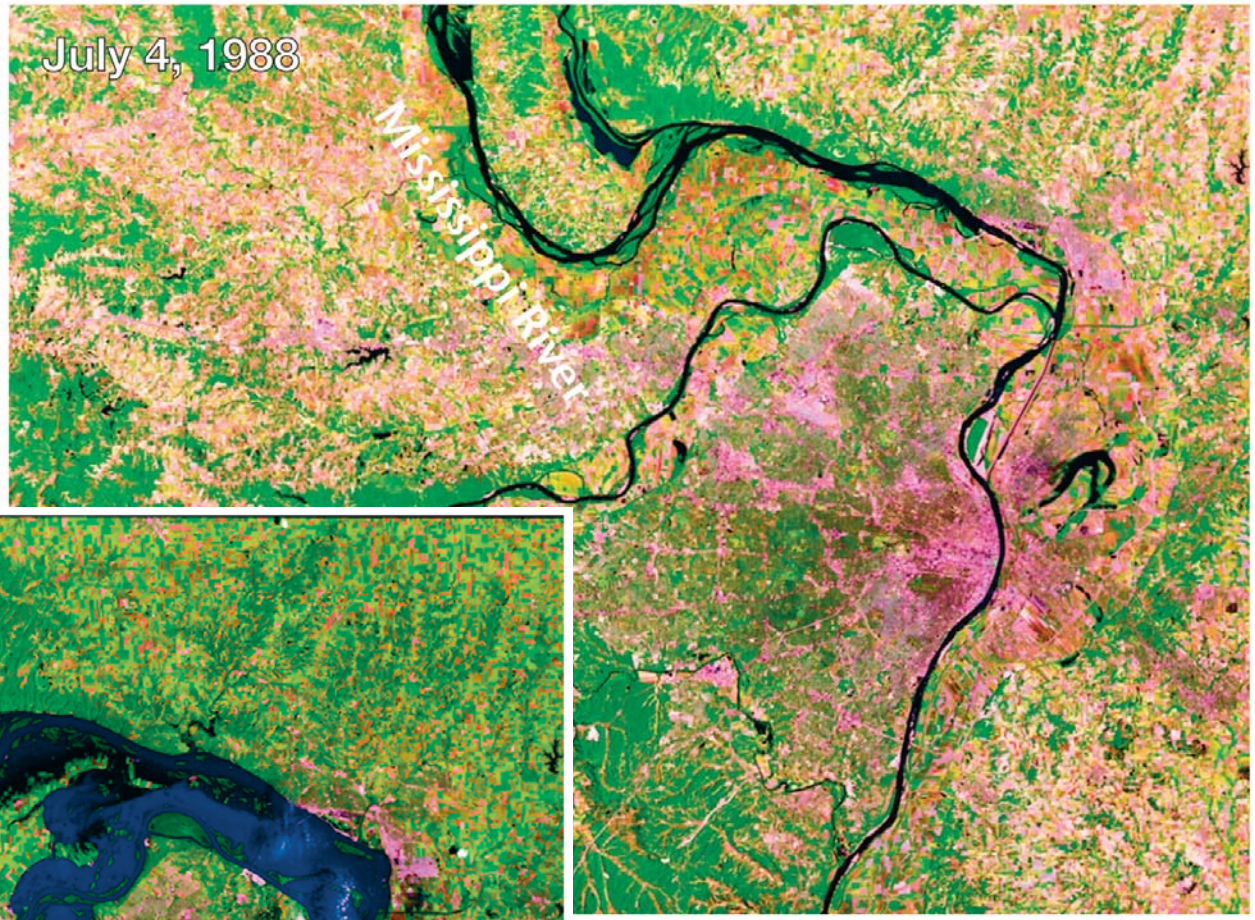


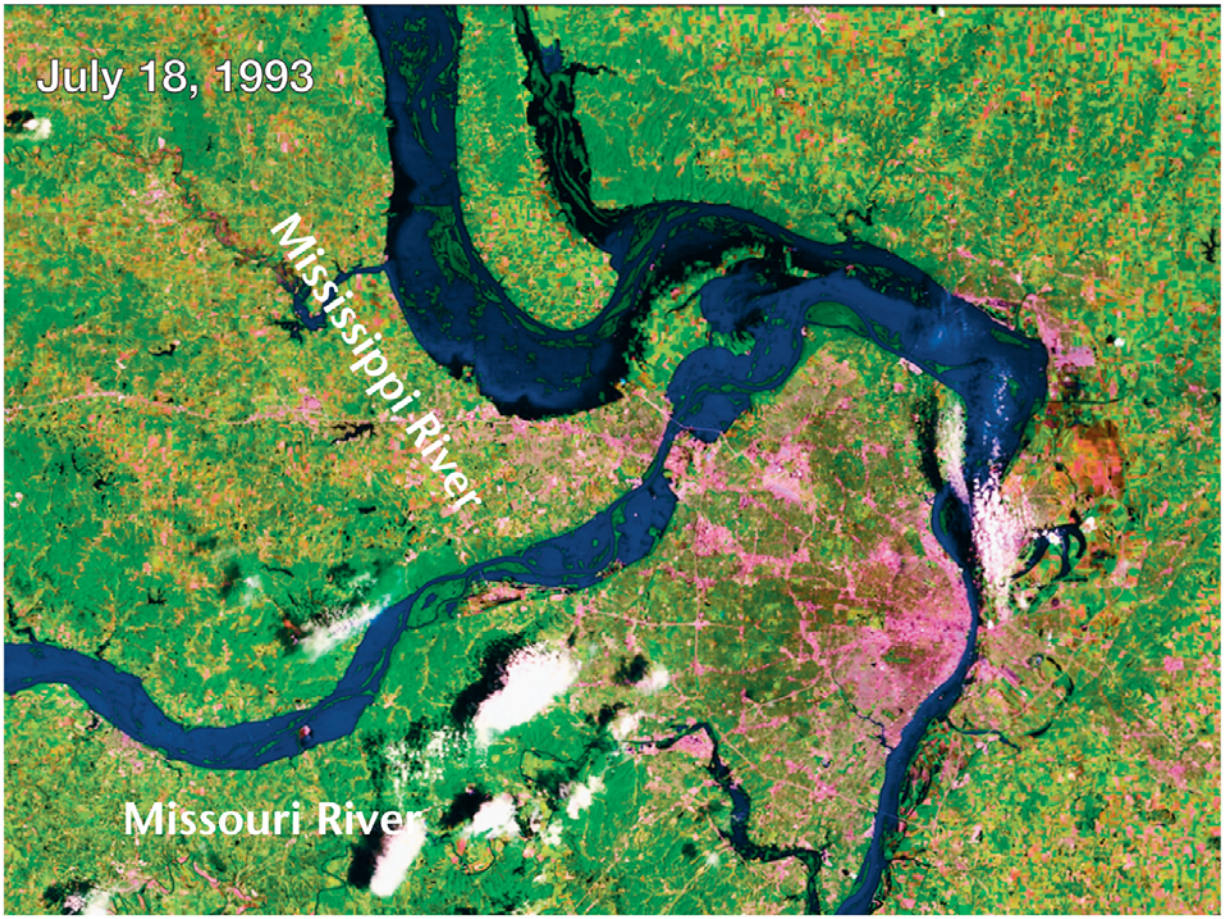
AGRICULTURE, INDUSTRY

Flood Control! - floods most destructive geologic hazard



Missouri / Mississippi floods of 1993



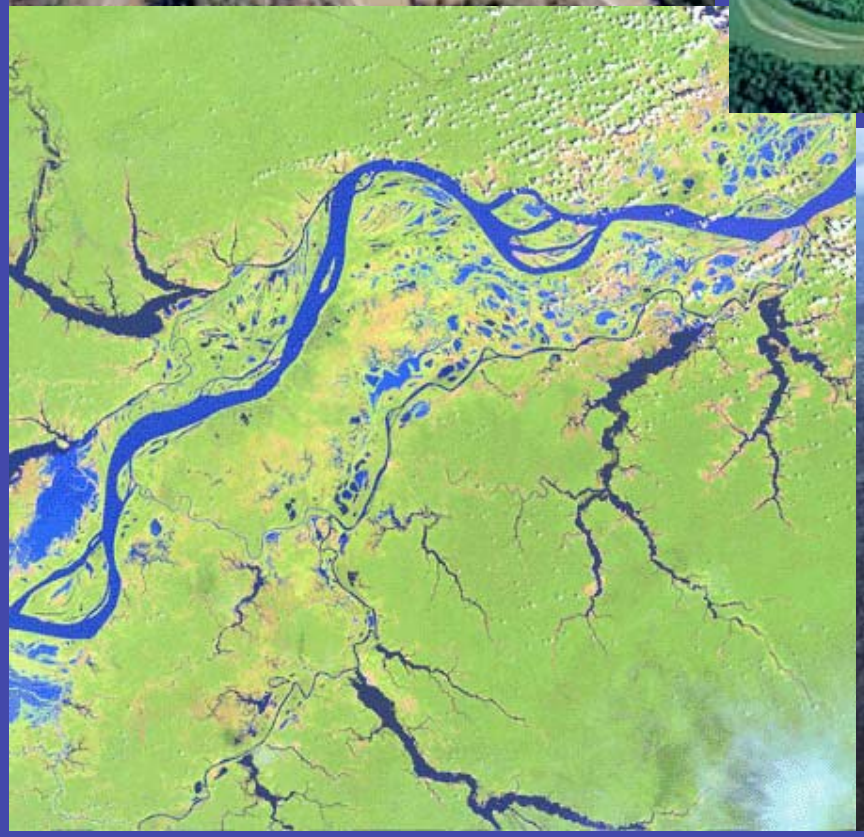


14 million acres Inundated

50,000 people displaced









Is this river…

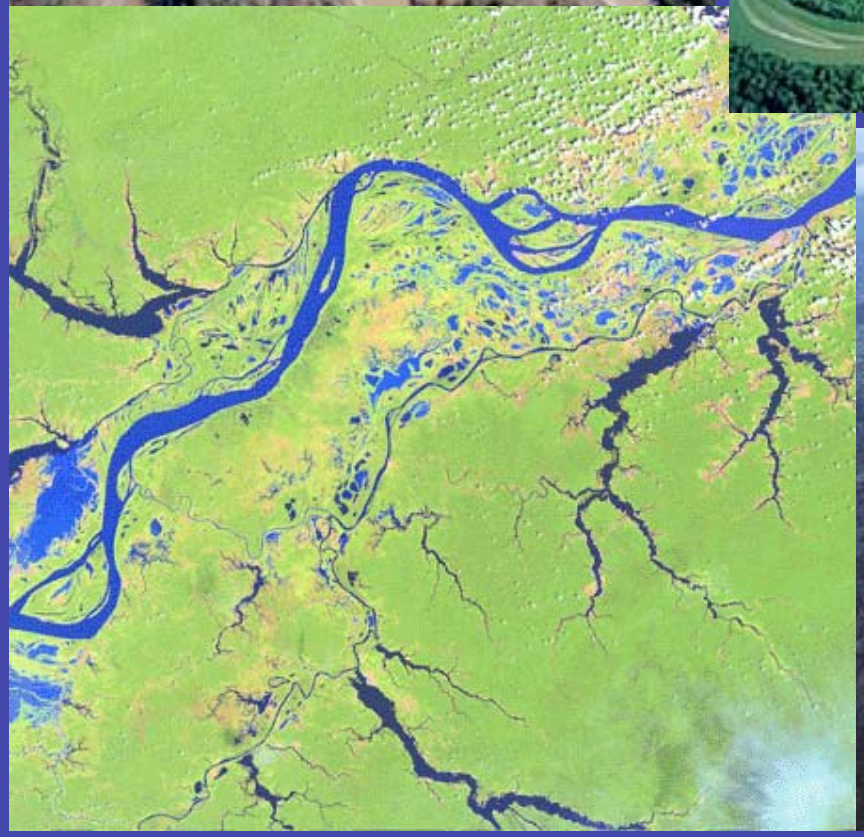
A) Mature
B) Immature



Amazon River - 10x flow volume of all world's other rivers *combined*



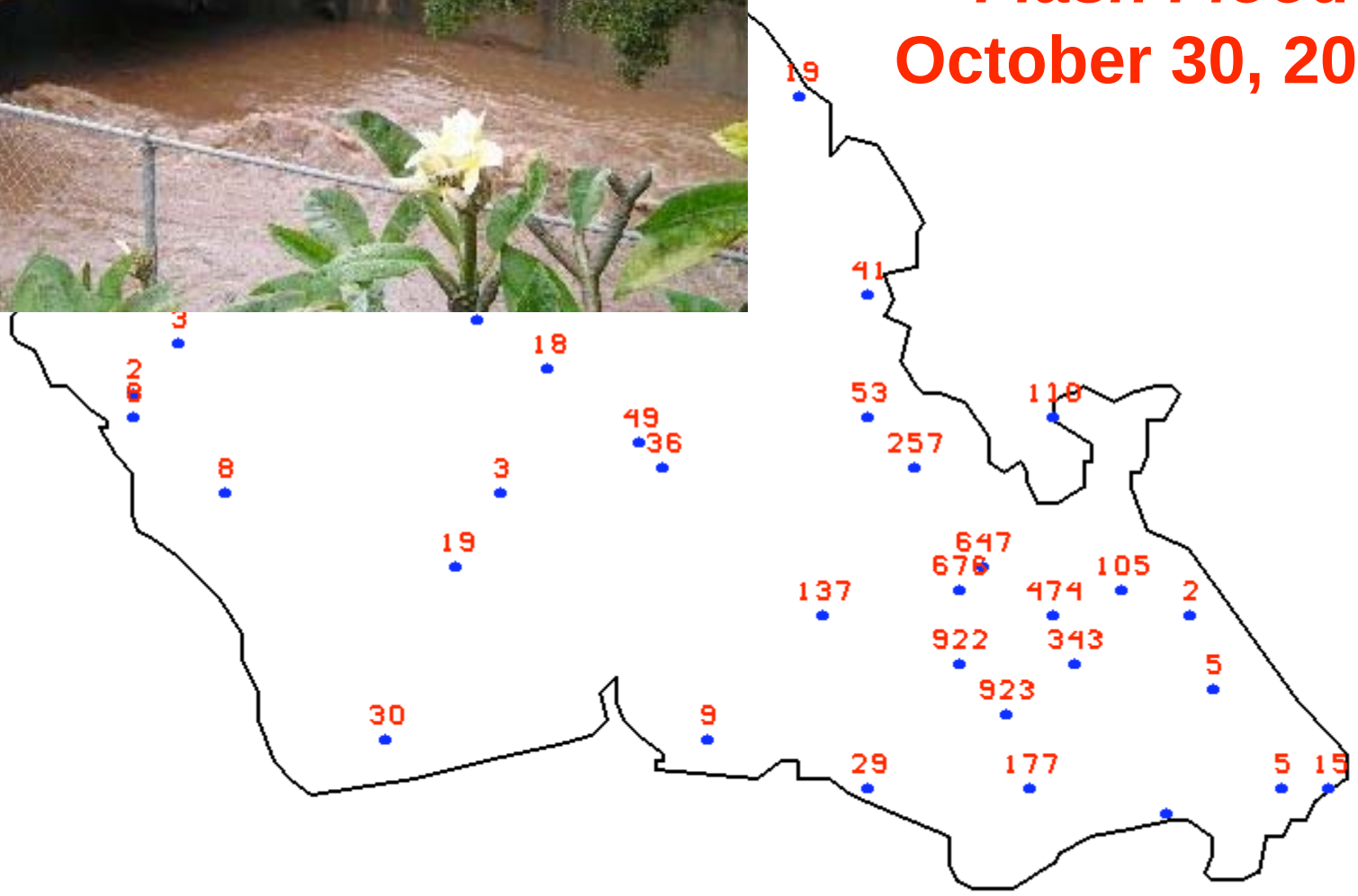
65 Mya flowed West





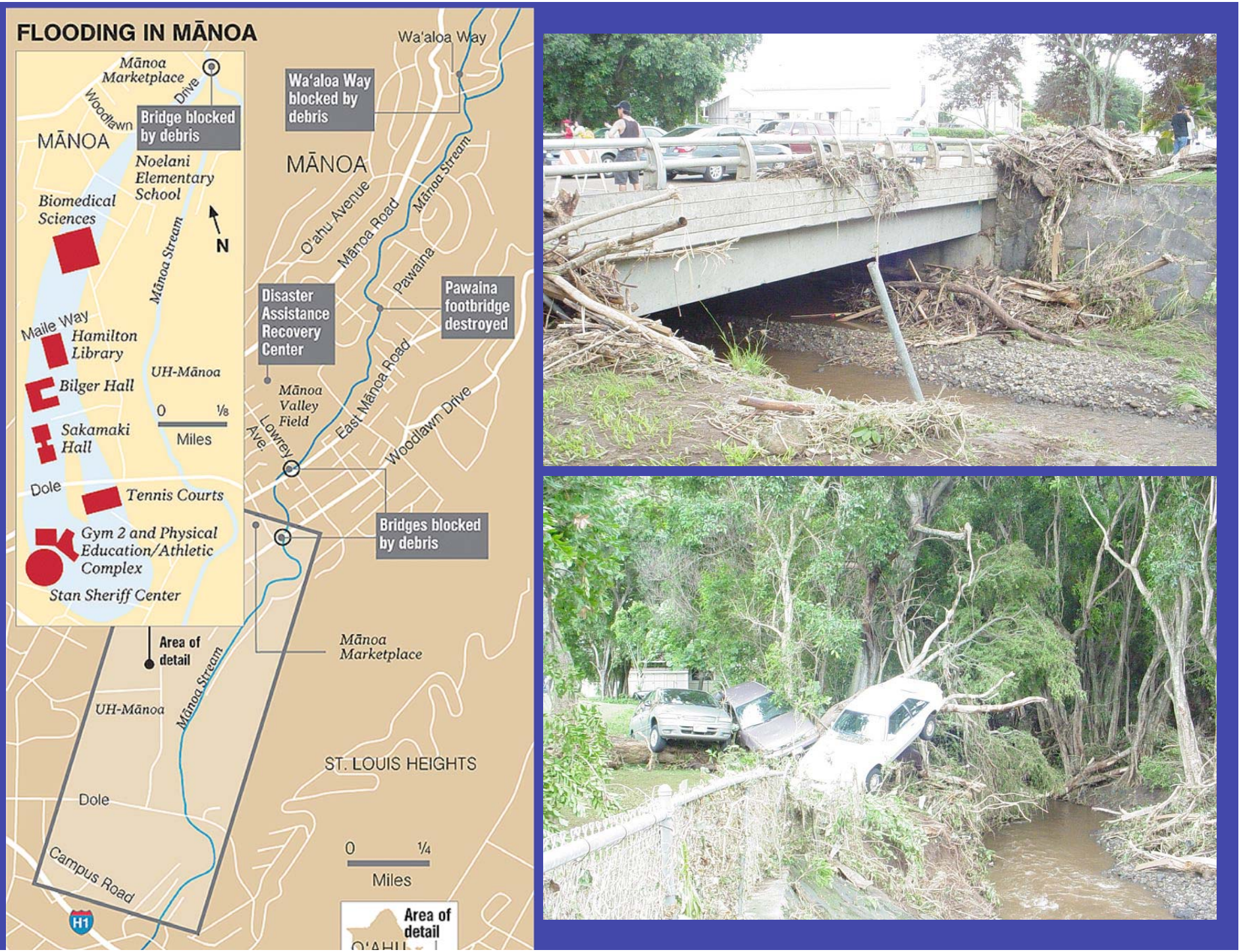
Manoa Stream (?)
Flash Flood
October 30, 2004







What about Manoa's topography makes flooding likely?


FLOODING IN MĀNOA
Mānoa Marketplace
Drive
Woodlawn
Bridge blocked by debris
MĀNOA
Noelani Elementary School
Biomedical Sciences
Mānoa Stream
N
Maile Way
Hamilton Library
UH-Mānoa
Bilger Hall
0
1/8
Miles
Sakamaki Hall
Dole
Tennis Courts
Gym 2 and Physical Education/Athletic Complex
Stan Sheriff Center
Area of detail
UH-Mānoa
Mānoa Stream
Campus Road
H1
Dole
ST. LOUIS HEIGHTS
0
1/4
Miles
Area of detail
Wa'aloa Way
Wa'aloa Way blocked by debris
MĀNOA
O'ahu Avenue
Mānoa Road
Mānoa Stream
Pawaina
Pawaina footbridge destroyed
Disaster Assistance Recovery Center
Mānoa Valley Field
Lowrey Ave
East Mānoa Road
Woodlawn Drive
Bridges blocked by debris
Mānoa Marketplace



Flood hits first in Woodlawn area of Manoa



UH Biomedical Building









UH Hamilton Library







Sakamaki Hall, Krauss Annex

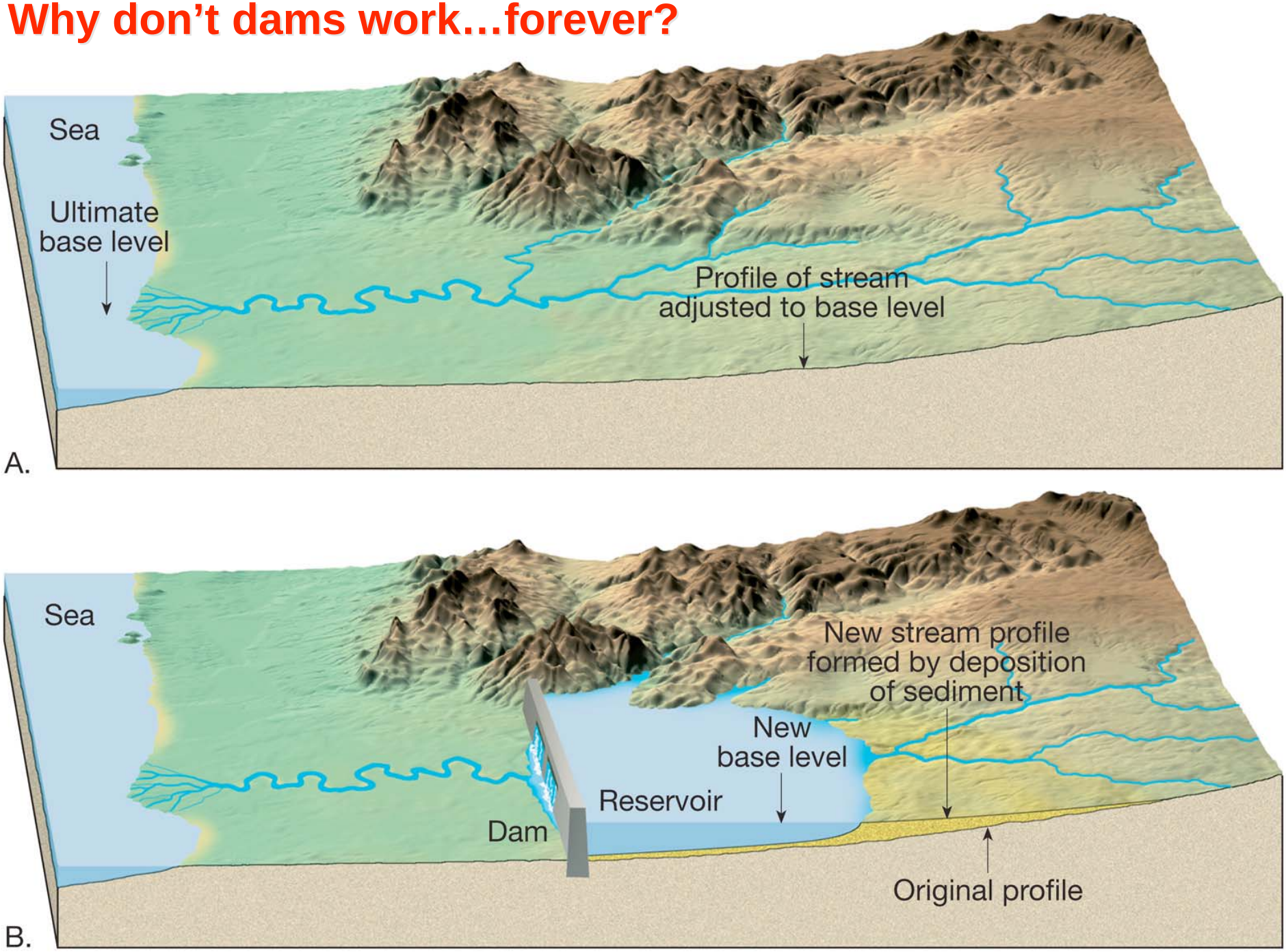
Flash flooding:

1. Intense rainfall
2. Steep topography
3. Paved surfaces



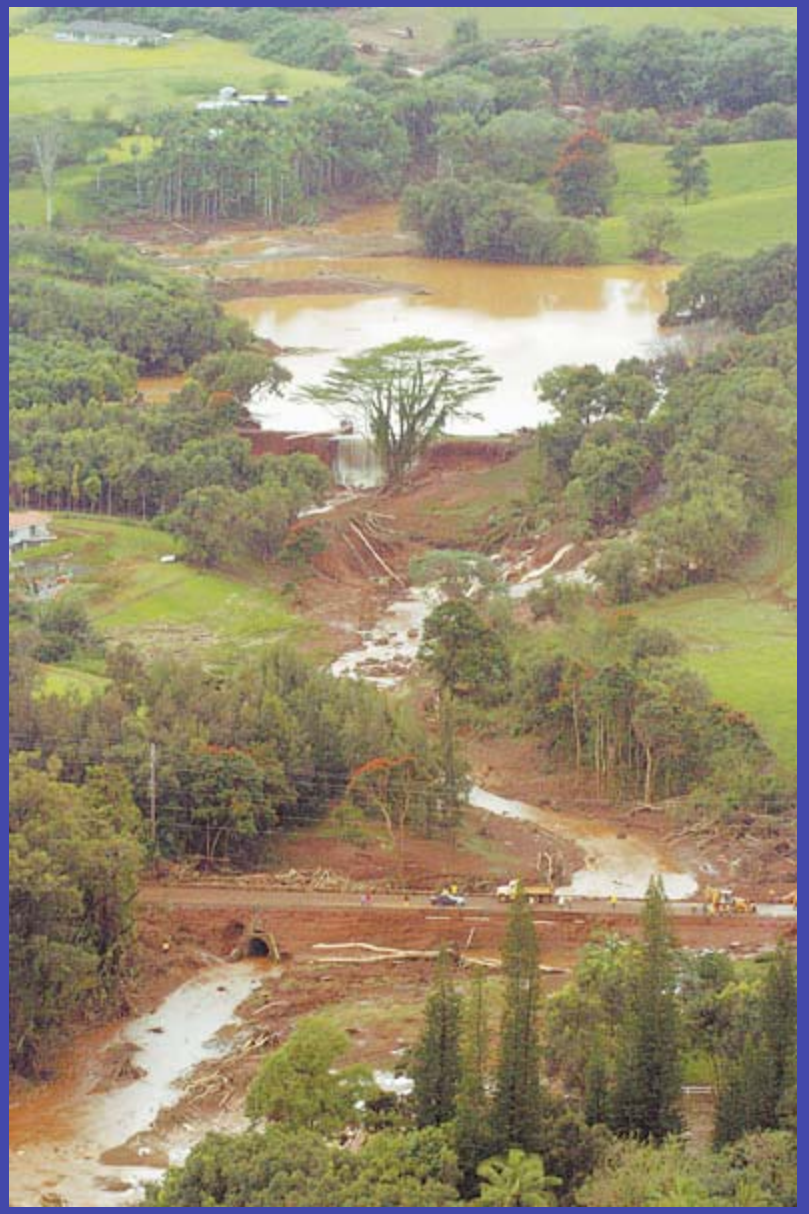
4. Rapid rise in flow levels
5. Dangerous flow velocities

Why don’t dams work…forever?



300 million gallons





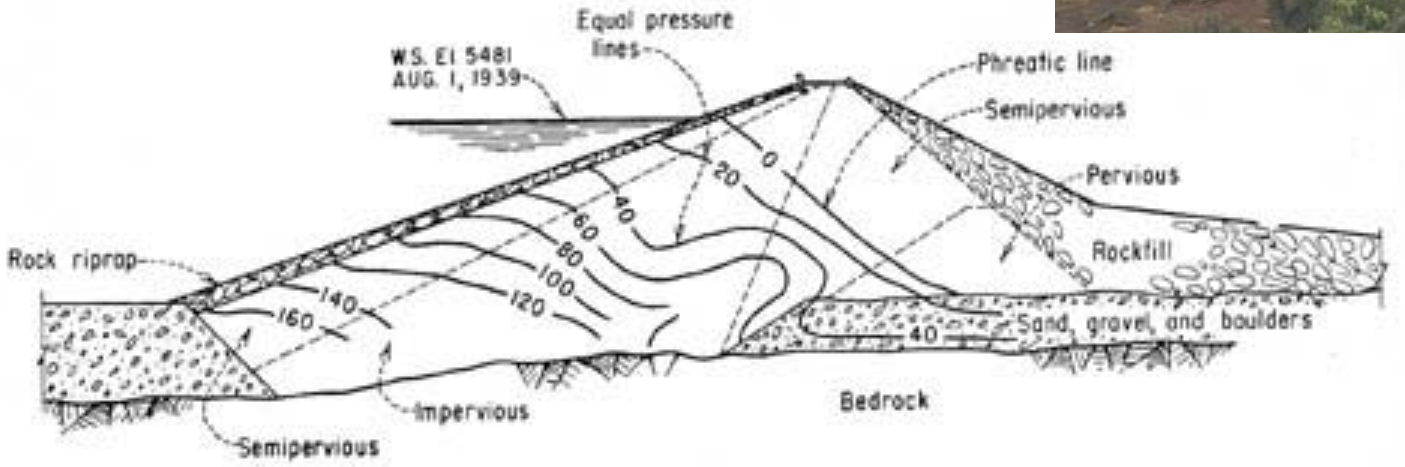


Ka Loko Reservoir Dam Break, 2005

Rising waters increased pressure on earthen dam

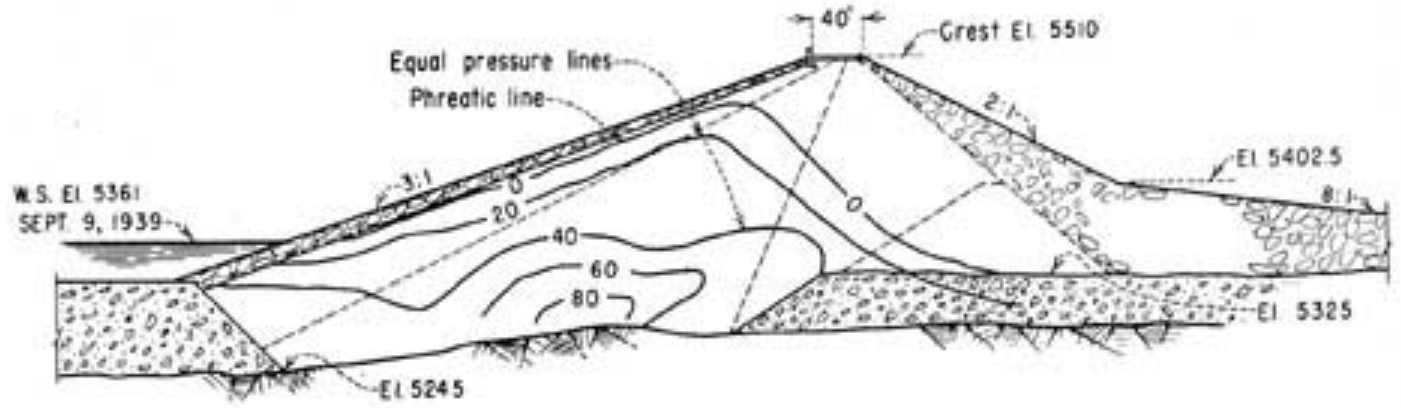


256



Note: Pressures measured in feet of water

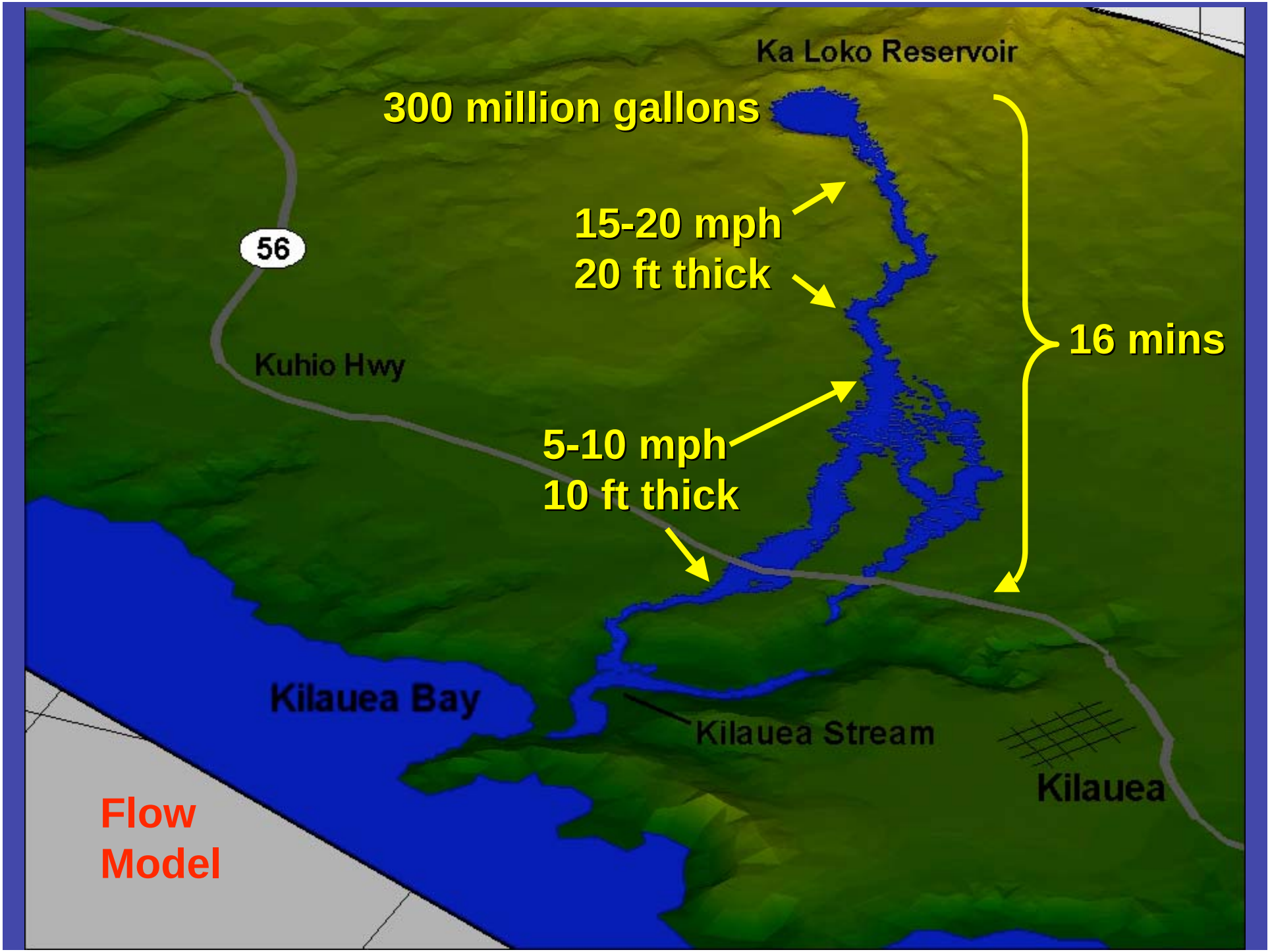
(A) STEADY STATE CONDITION



High water

increasing stress

Normal water


Ka Loko Reservoir
300 million gallons
15-20 mph
20 ft thick
56
Kuhio Hwy
16 mins
5-10 mph
10 ft thick
Kilauea Bay
Kilauea Stream
Kilauea
Flow
Model



Floodwaters destroyed property

Killed 7 plus unborn infant





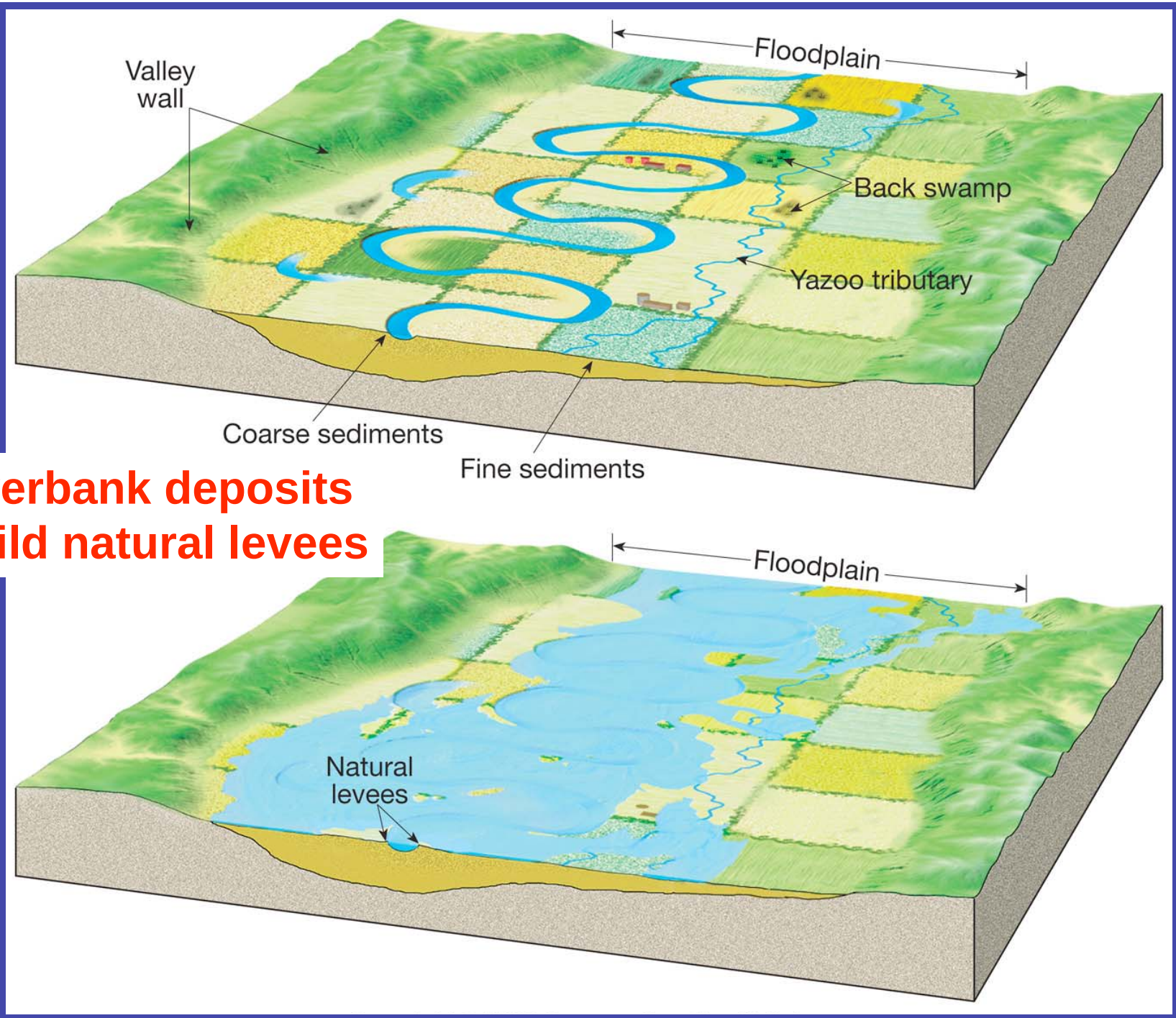
Dam break flooding:

1. High rainfall
2. Increased water pressure
3. Dam structure inadequate



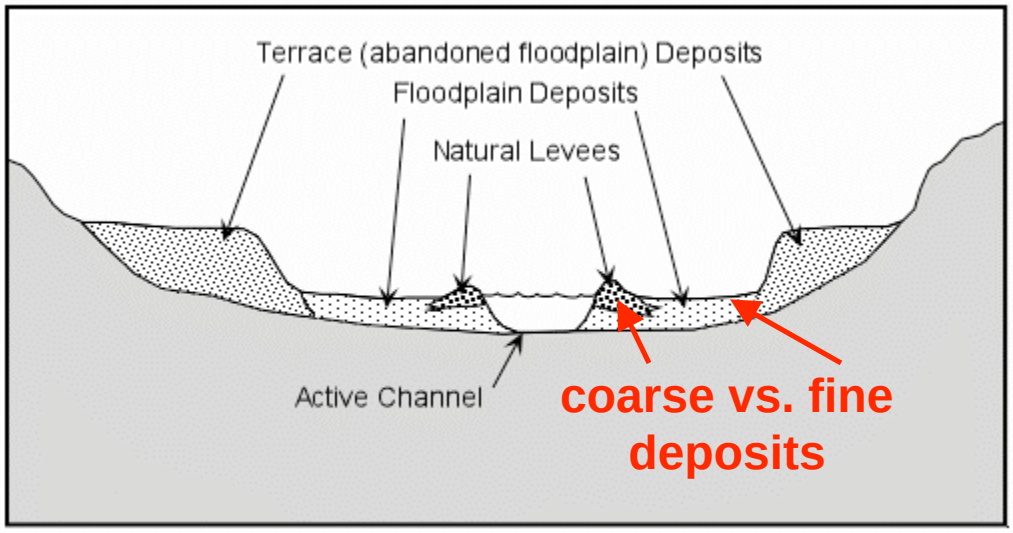
4. Dam overtopped/undermined
5. Rapid erosion/destruction of dam
6. Dangerous flow volumes/velocities


How did these alluvial fans form?



Overbank deposits build natural levees

Natural levees



(natural/man-made) Levee breaks cause floods



What's the biggest river in the U.S.?

A) Columbia, B) Ohio, C) Mississippi, D) Hudson, E) Missouri

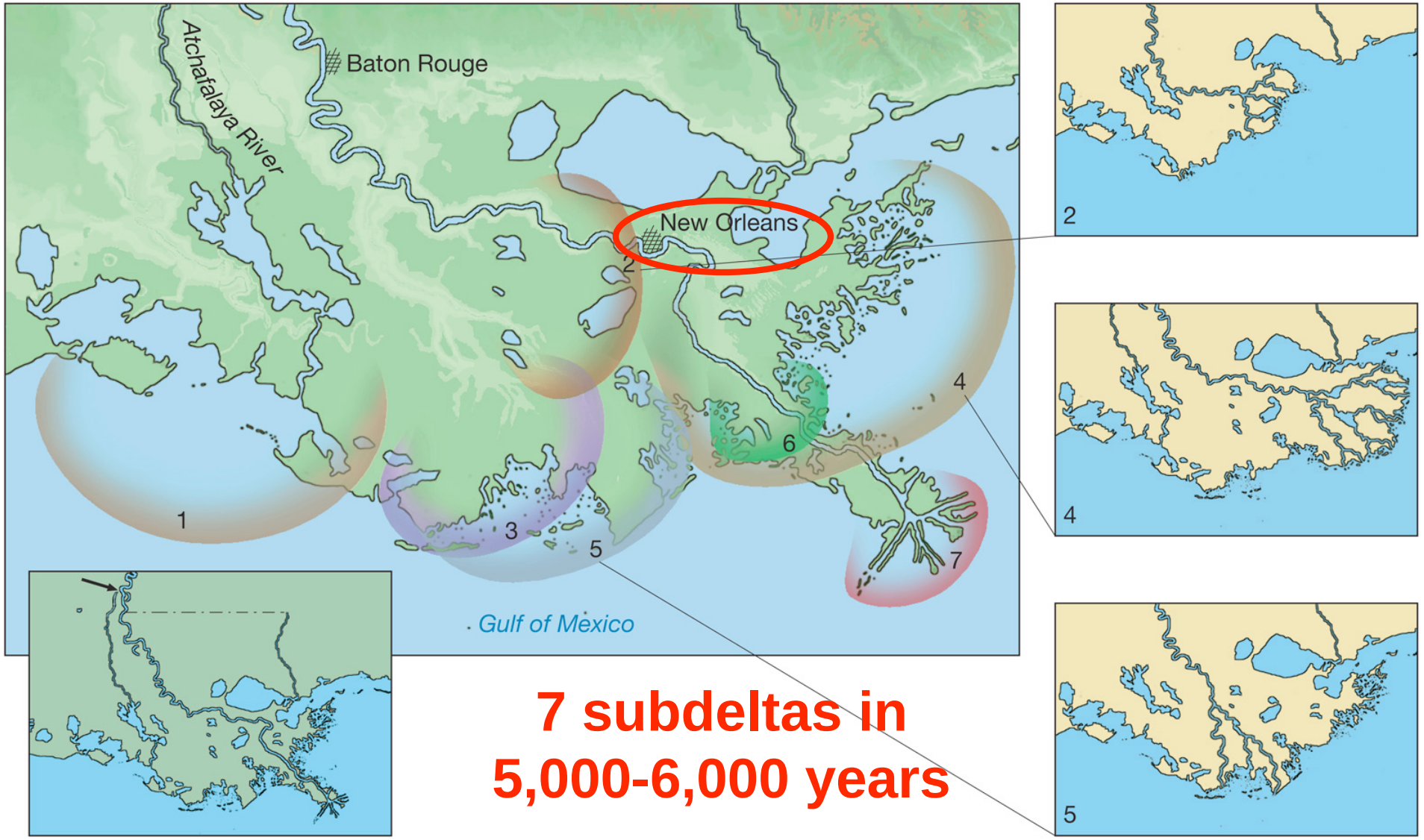


Mississippi drainage covers 3 million square kilometers



This means lots of floodplains!


Where is the original coastline?



7 subdeltas in 5,000-6,000 years

What is the shortest (i.e. steepest) route to the sea?



Old River control structure built 1950s

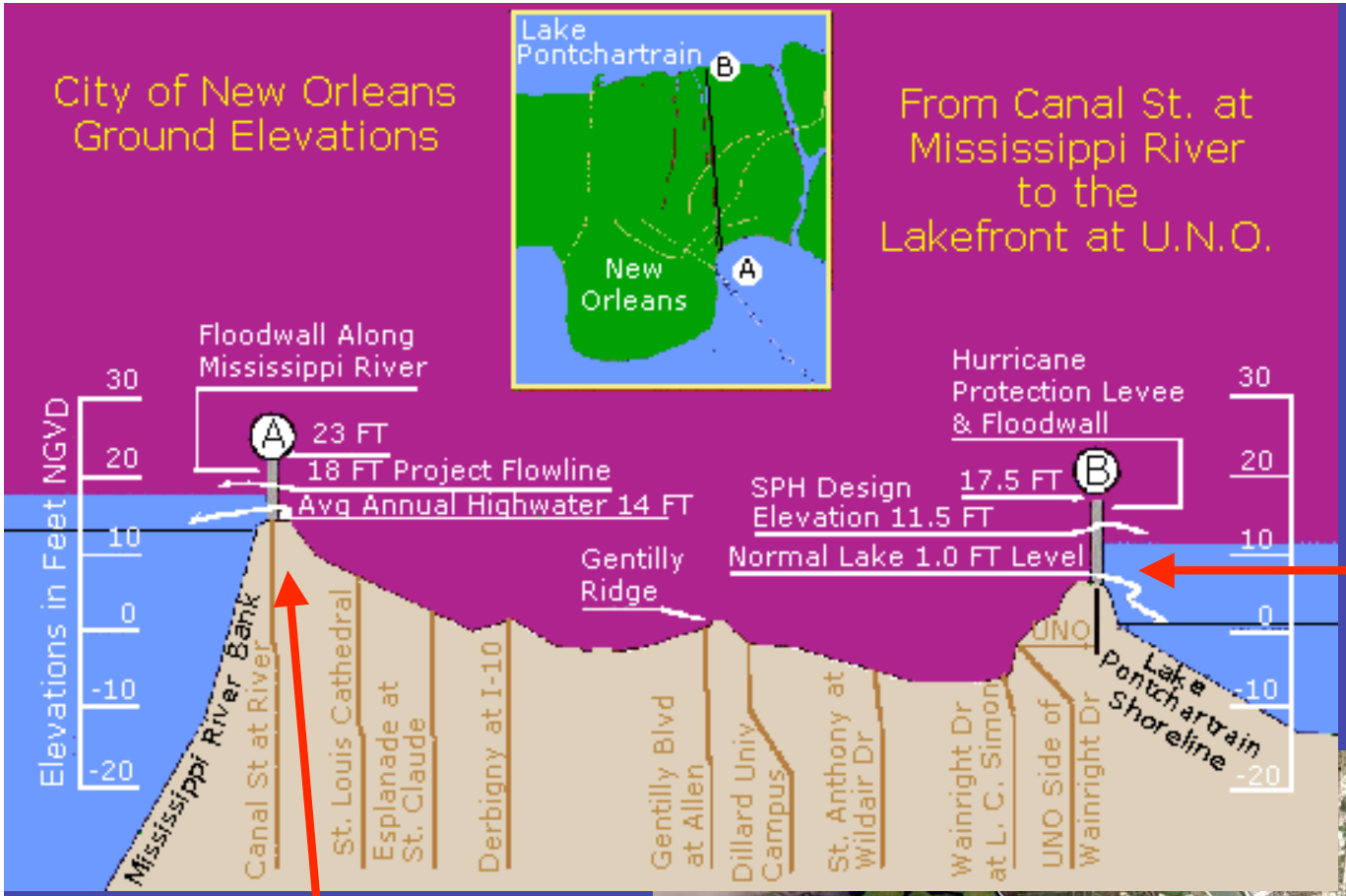
Prevents Mississippi shifting to Atchafalaya

Total cost > $1 billion



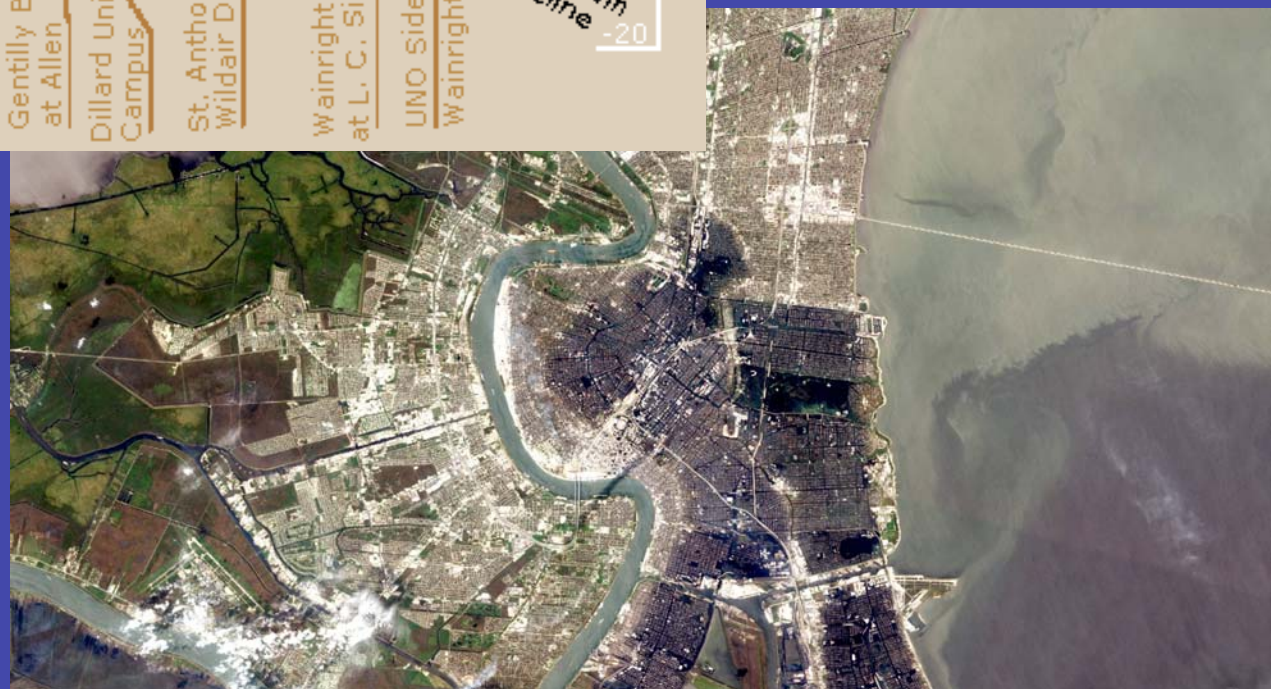


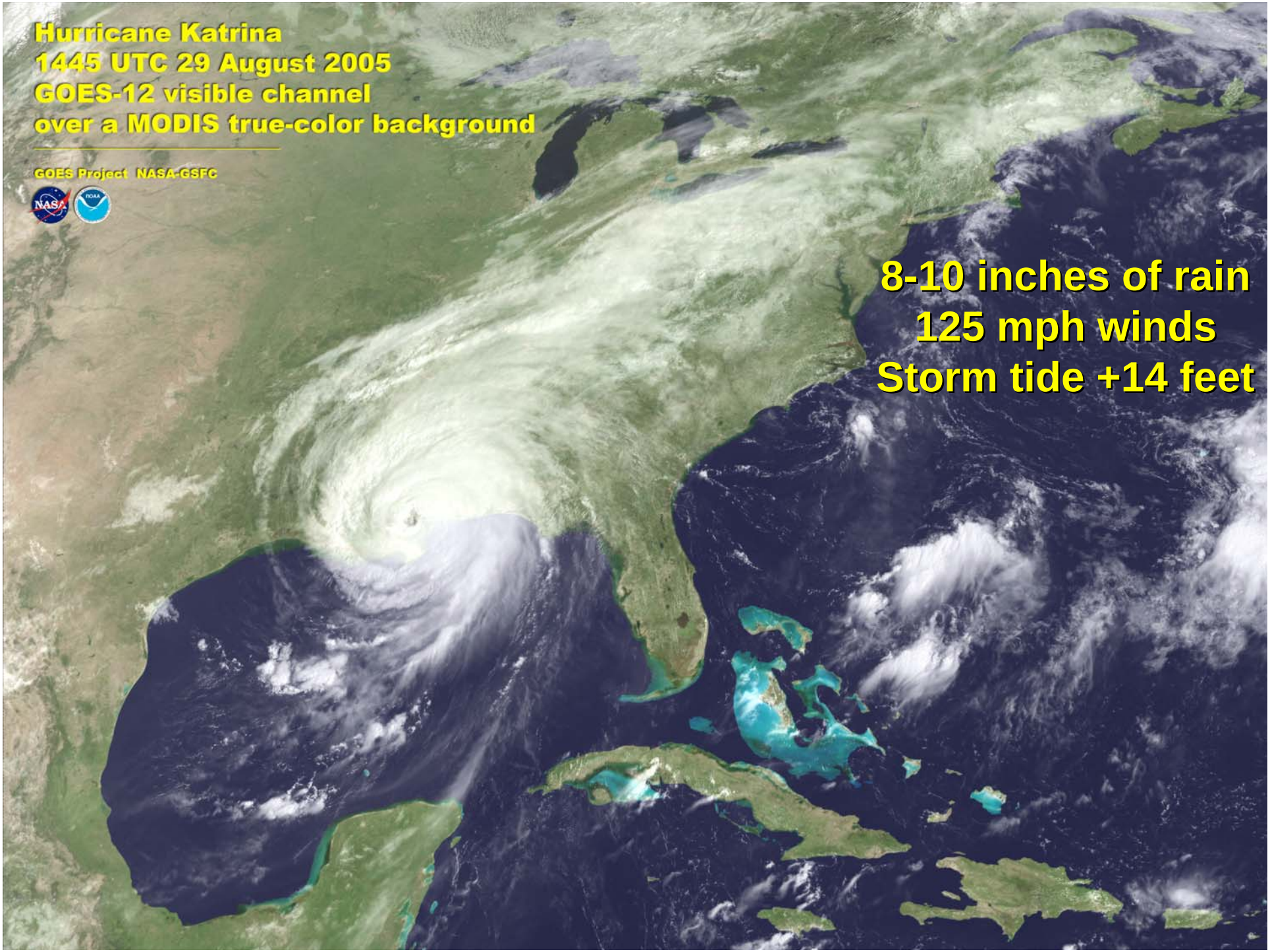
NEW ORLEANS TOPOGRAPHY



Lake Pontarchtrain Levee

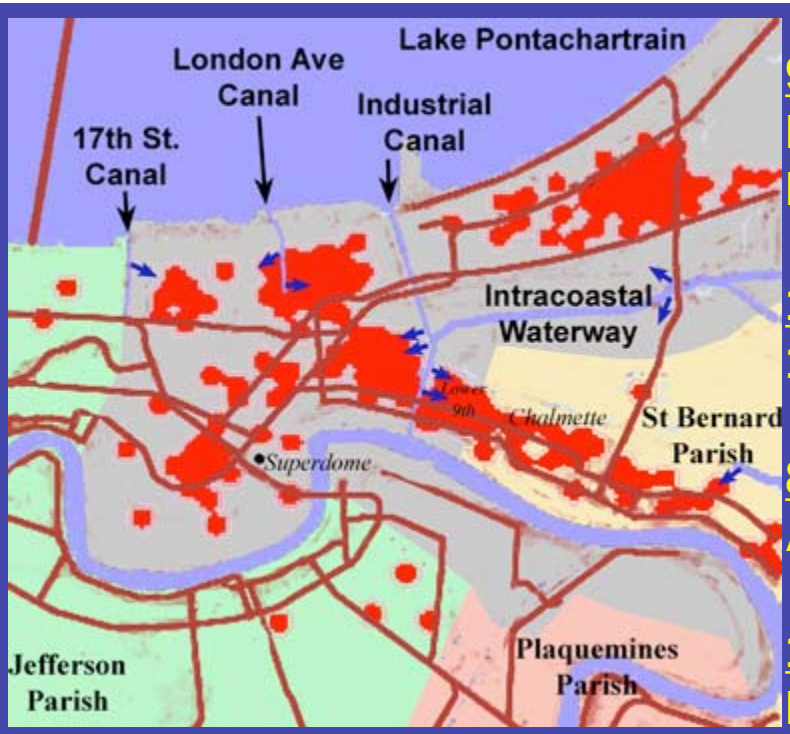
Mississippi River Levee




Hurricane Katrina
1445 UTC 29 August 2005
GOES-12 visible channel
over a MODIS true-color background
GOES Project NASA-GSFC
8-10 inches of rain
125 mph winds
Storm tide +14 feet



Levee Failures



9:00am
Industrial Canal
First pump

12:00pm
17th Street Canal

8:30pm
All pumps

12:00am
London Ave Canal



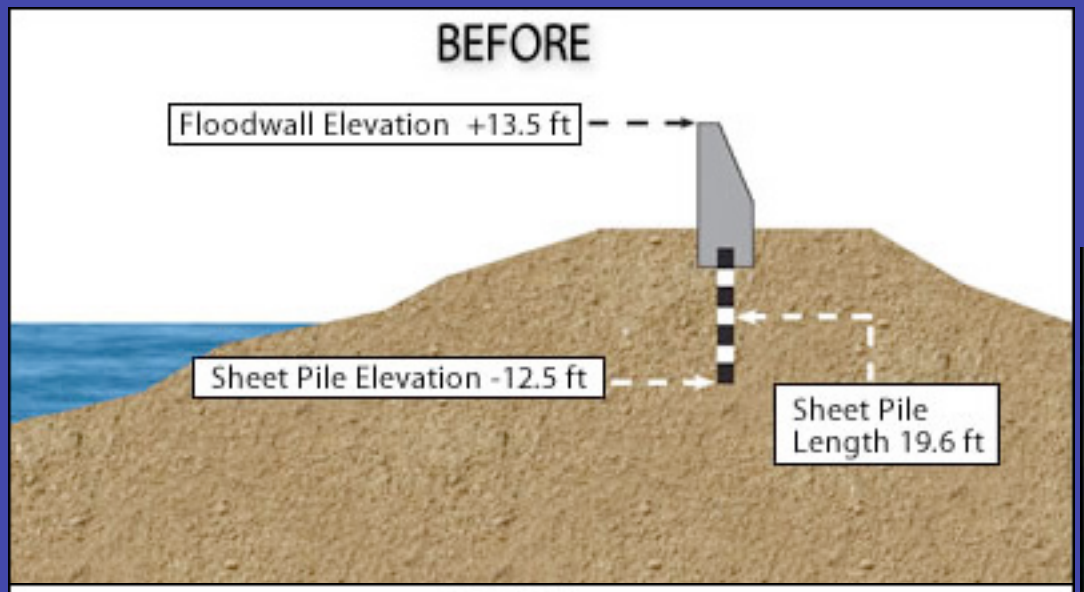


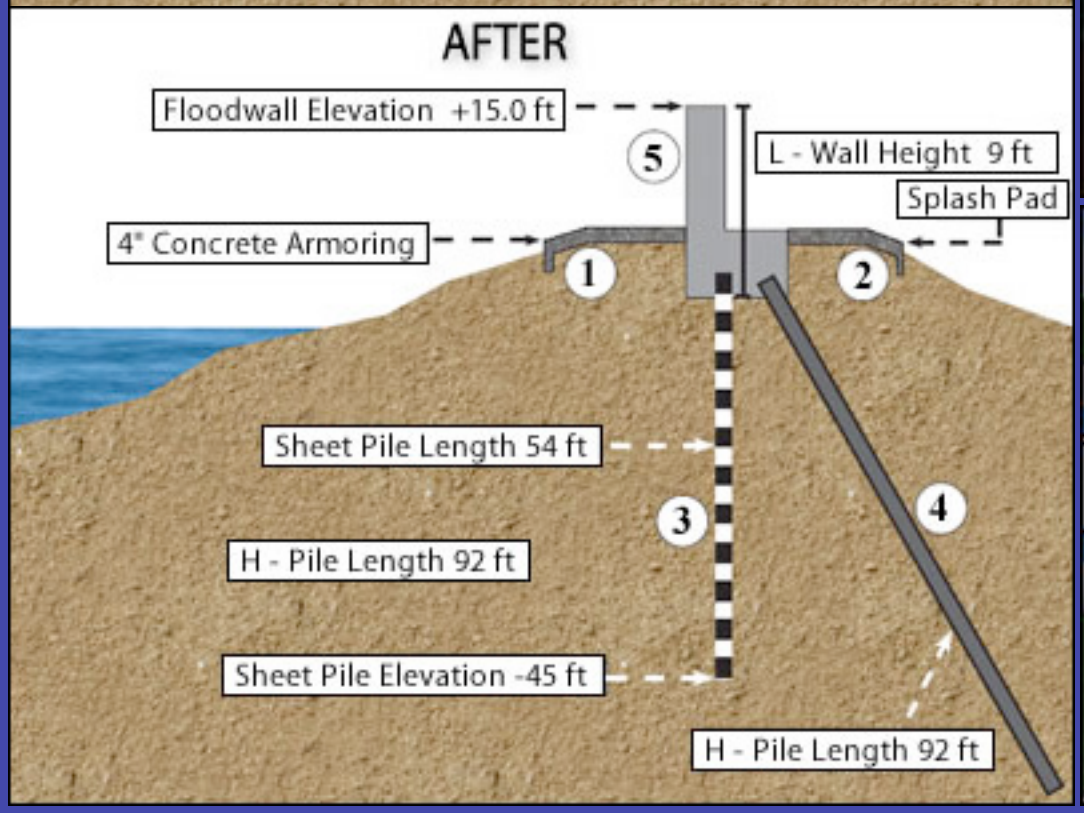


Aftermath

1,836 killed, 705 missing
$86 billion in damage
30 oil platforms destroyed
9 refineries closed
Massive environmental damage







Would you move back to New Orleans…?
A) Yes, B) No



