

CLASS GOALS

- One of my goals is to have YOU say “I will never look at a stream the same again”
- Using the conceptual thought process, break down complex problems into manageable units, & think the problem through to a goal-based solution.
- Your job is to decide what applies to your project!!
- Daughter, Dana says “You have to have that brain thing going on.” She was talking about Cleophus finding a way to climb onto the bed, but it applies here too!!



THINKING HARD HERE!

**A great class is one where you
understand & learn 60% of
the material, & three years
later you are still thinking
about it's content &
philosophy, & would like to
take it again!!**

**If you can, let
your river be
a river!!**

**Let it breathe
& have some
freedom!**

***And rivers meander too,
these are natural river
functions***

IT'S CALLED FLOOD
PLAIN BECAUSE IT
IS PLAIN THAT IT
FLOODS!!

REMEMBER "93"

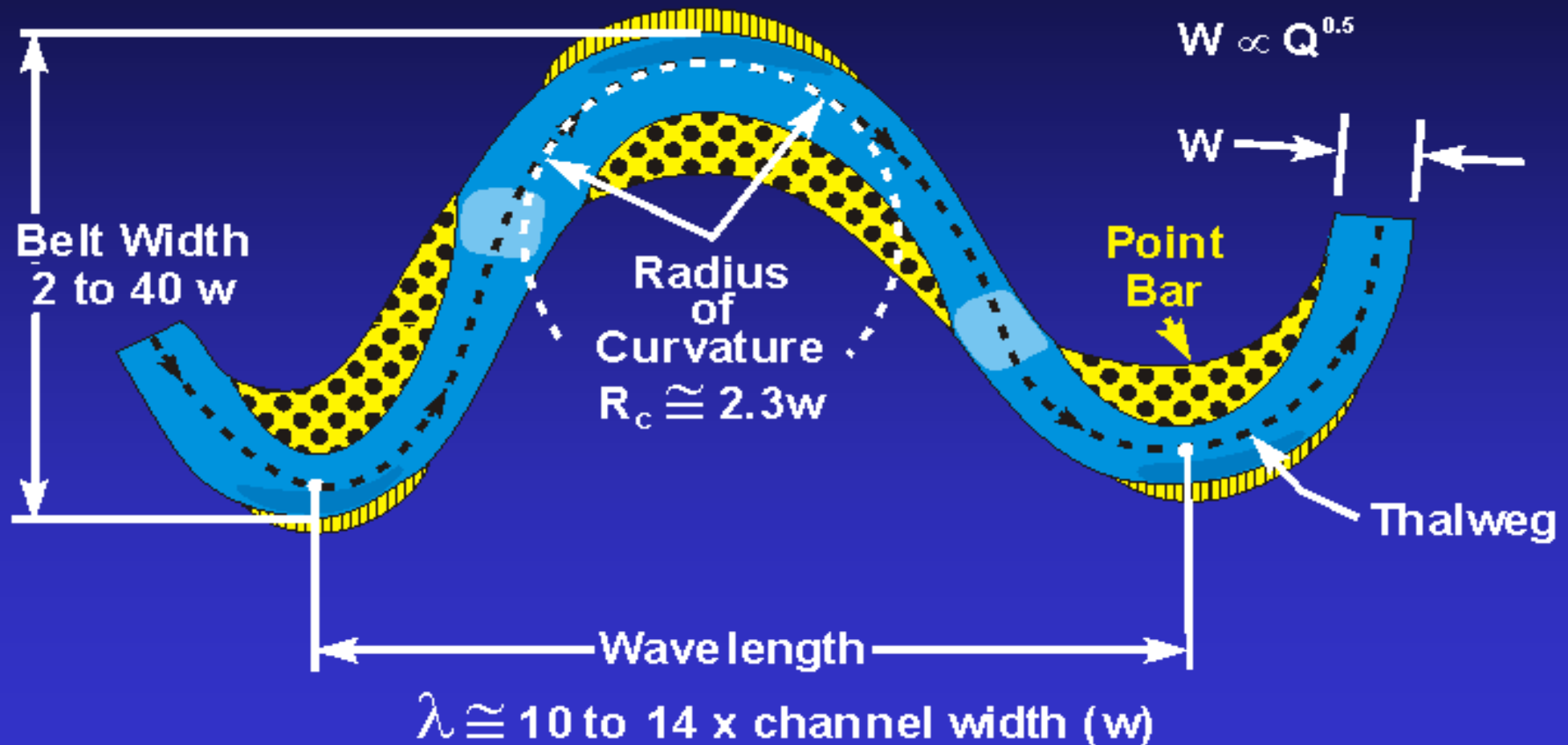
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GREAT RIVERS HABITAT ALLIANCE

**THE MORE ROOM
YOU CAN GIVE A
STREAM, THE
LESS YOUR
PROJECT COSTS !!**

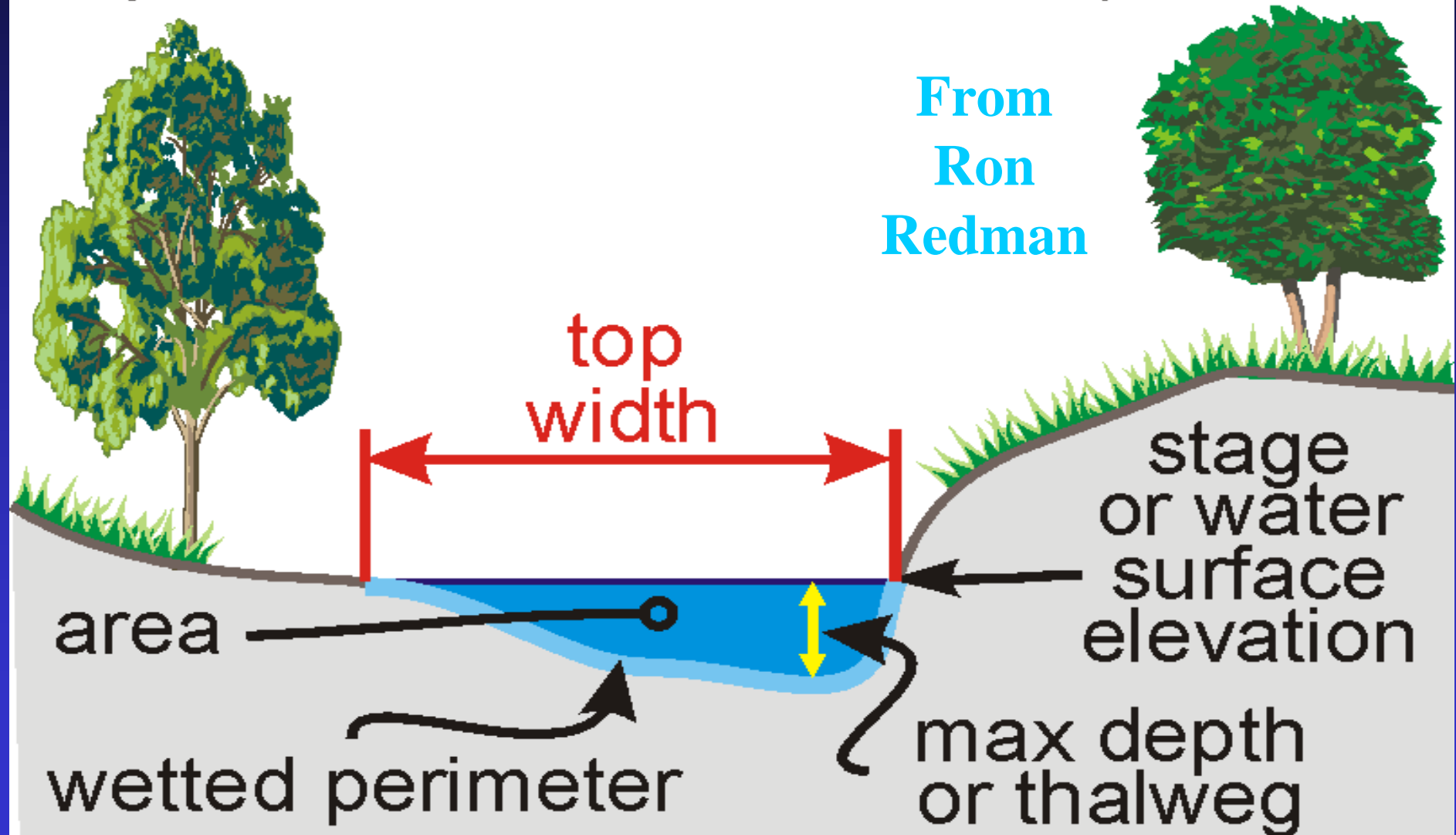
TERMS / DEFINITIONS - PLANFORM



Channel Dimensions

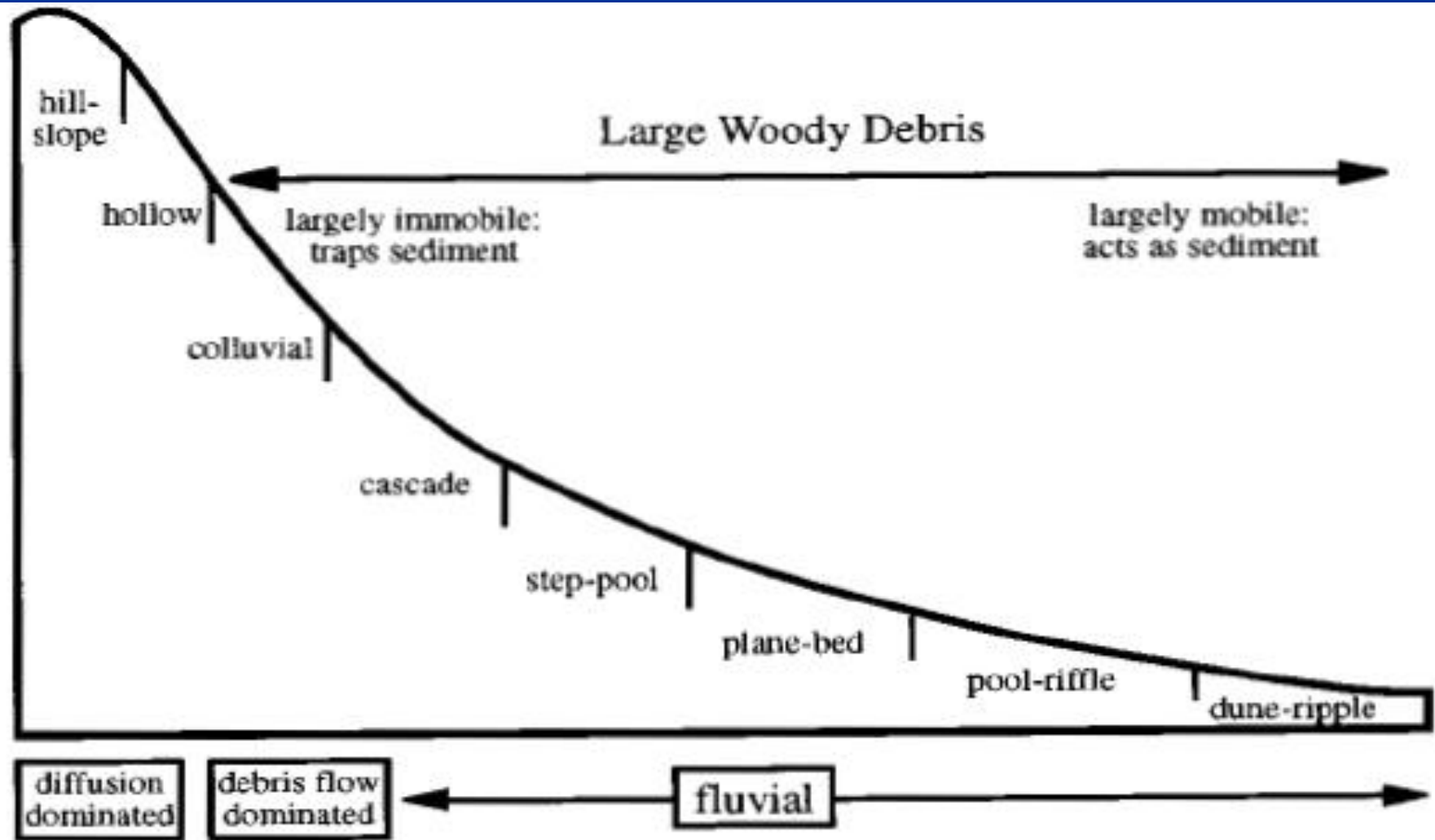
mean depth (\bar{d}) = area / top width

hydraulic radius = area / wetted perimeter



STREAM REGIMES

Montgomery & Buffington Idealized Longitudinal Profile

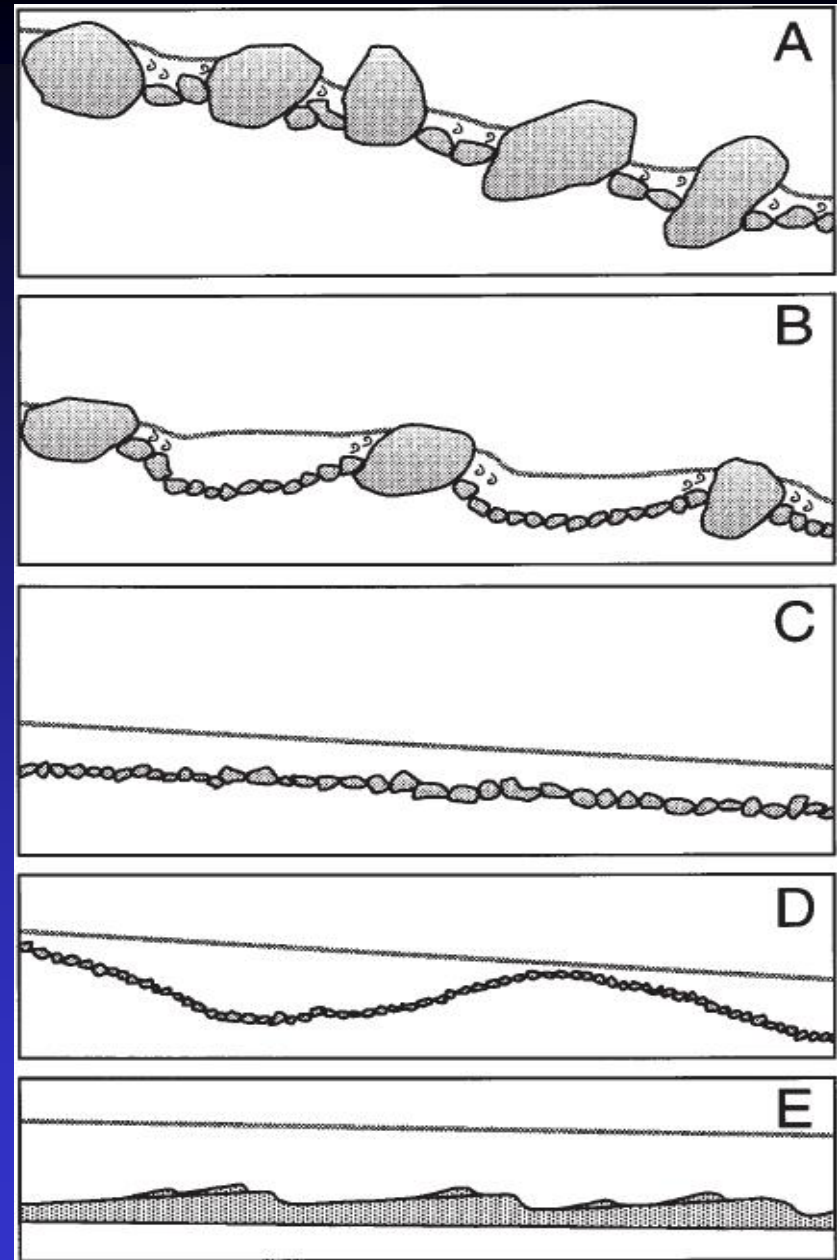


Montgomery & Buffington (1997)

Mountain Channel

Morphology for
Alluvial
Channels
developed in the
northwest
(Washington
State)

- **A – cascade**
- **B – step pool**
- **C – plane bed**
- **D – pool riffle**
- **E – dune ripple**



Cascade



A

Step Pool

T. Endreny, Ph.D.,
P.H., P.E.



B

SUNY ESF

Plane Bed

T. Endreny, Ph.D., P.H.,
P.E.



C

SUNY ESF

A very nice “S”-shaped meander bend in a wide alluvial valley

Pool - Riffle - Pool



MEADOW CREEK, LAKE TAHOE AREA, CA.-DERRICK – 5-7-2011

Dune Ripple



MEANDERING IN A POOL-RIFFILE-POOL REGIME

TERMS / DEFINITIONS

Pools and Riffles

- Both straight and sinuous channels tend to develop a characteristic undulating bed of alternating deep pools and shallow riffles.
- Pools and riffles are regularly spaced at a distance between 5 to 7 channel widths.

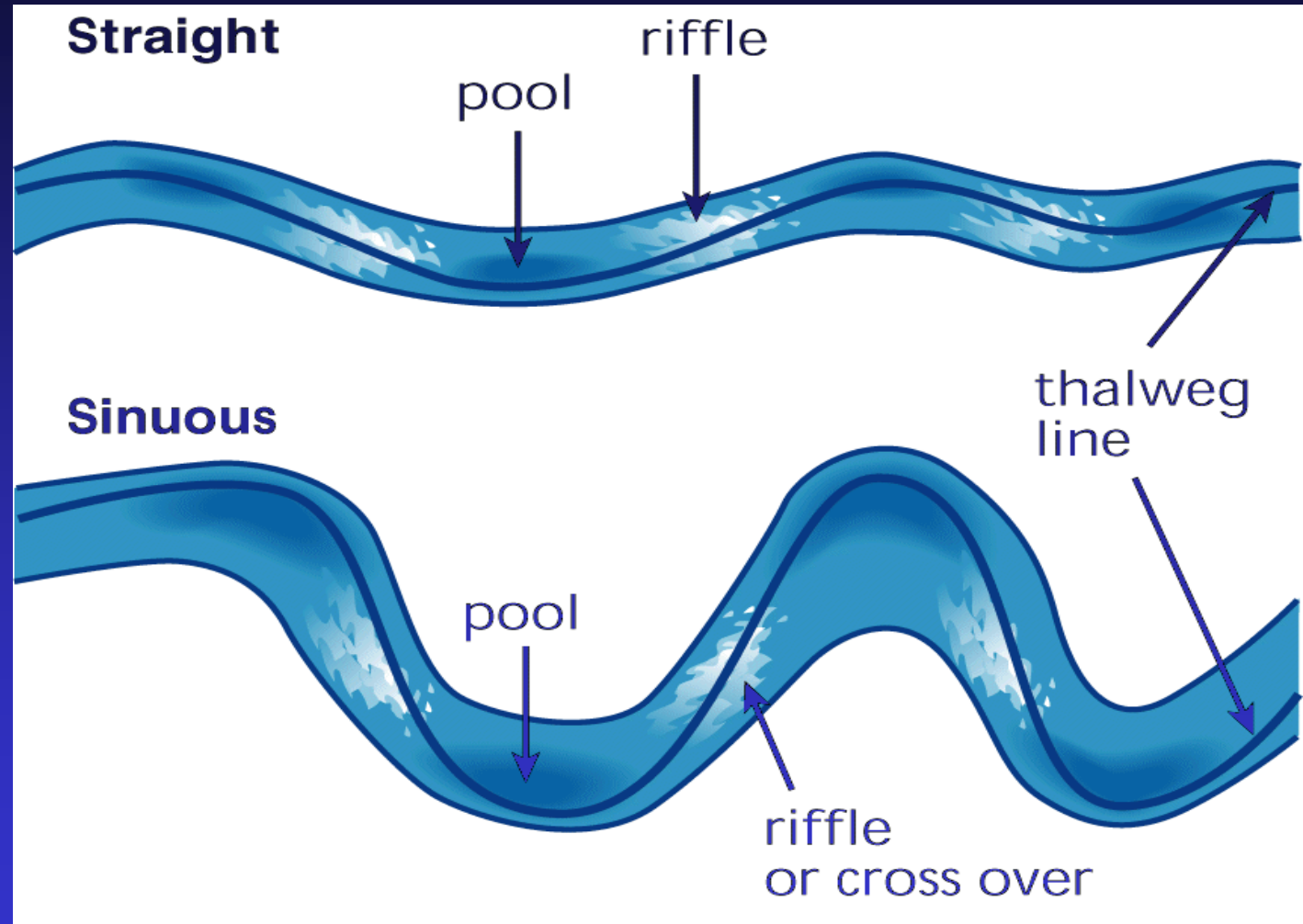


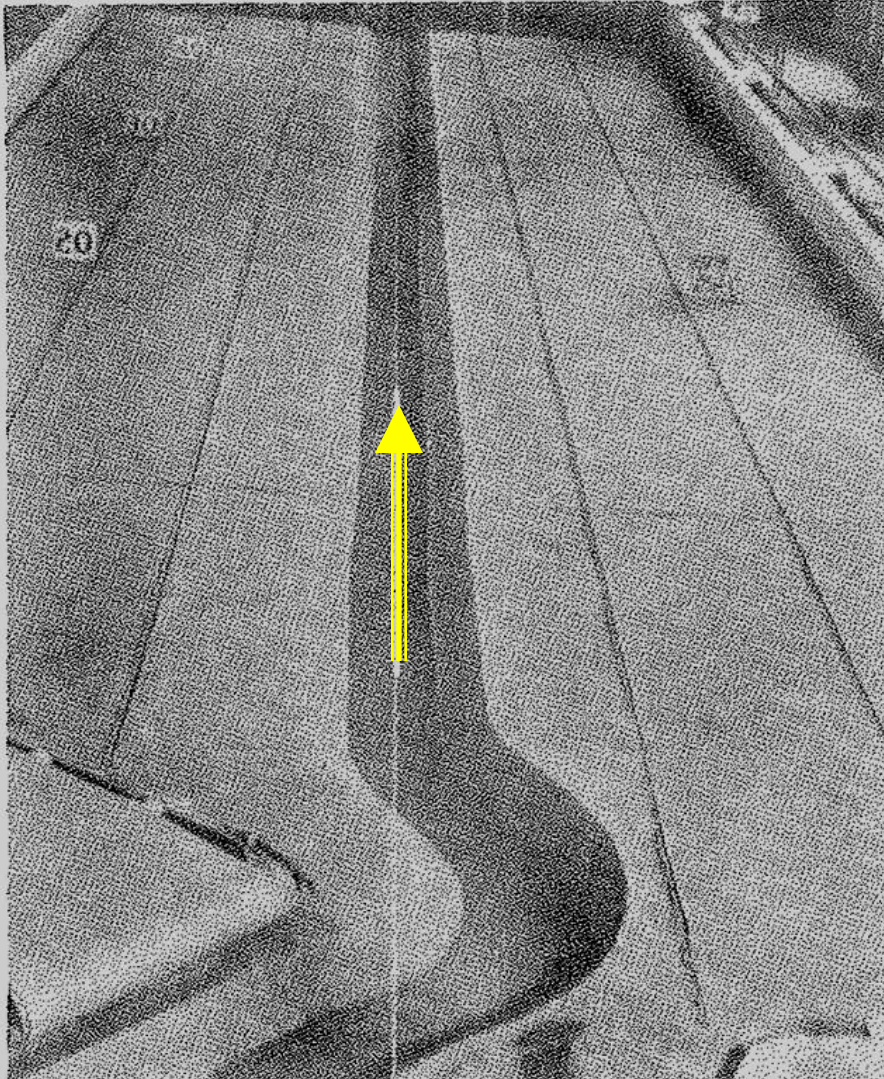
Illustration from: Stream Corridor Restoration: Principles, Processes, and Practices, 10/98, by the Federal Interagency Stream Restoration Working Group (FISRWG).

A Laboratory Study of the Meandering of Alluvial Rivers.

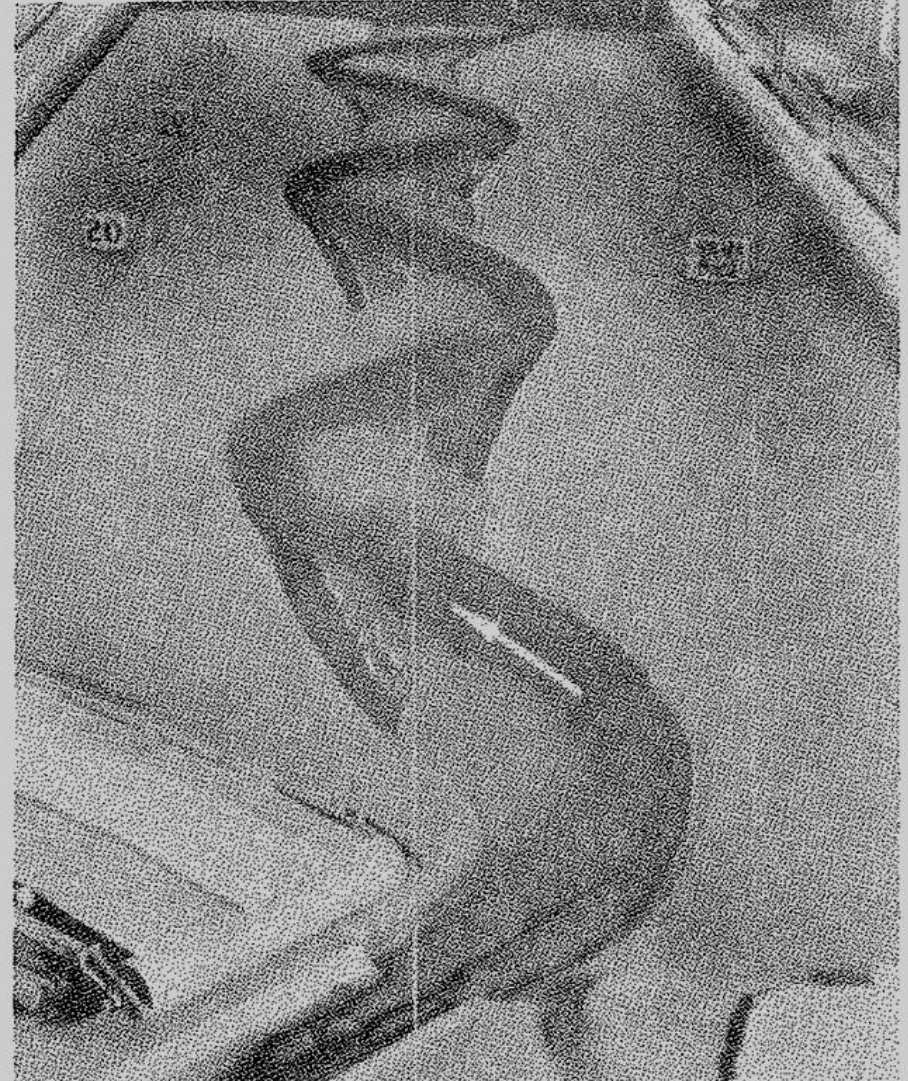
By J. F. Friedkin, Captain, Corps of Engineers - 1 May 1945

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



INITIAL CHANNEL

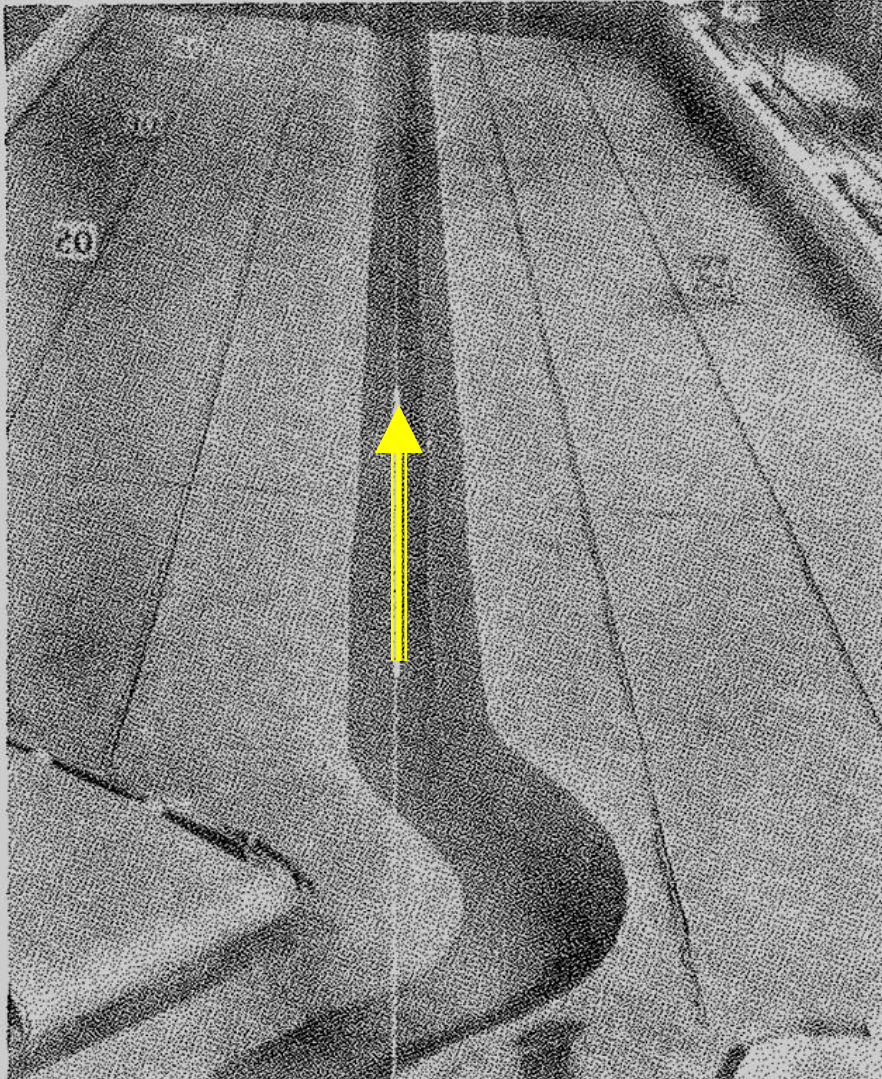


AFTER 3 HOURS

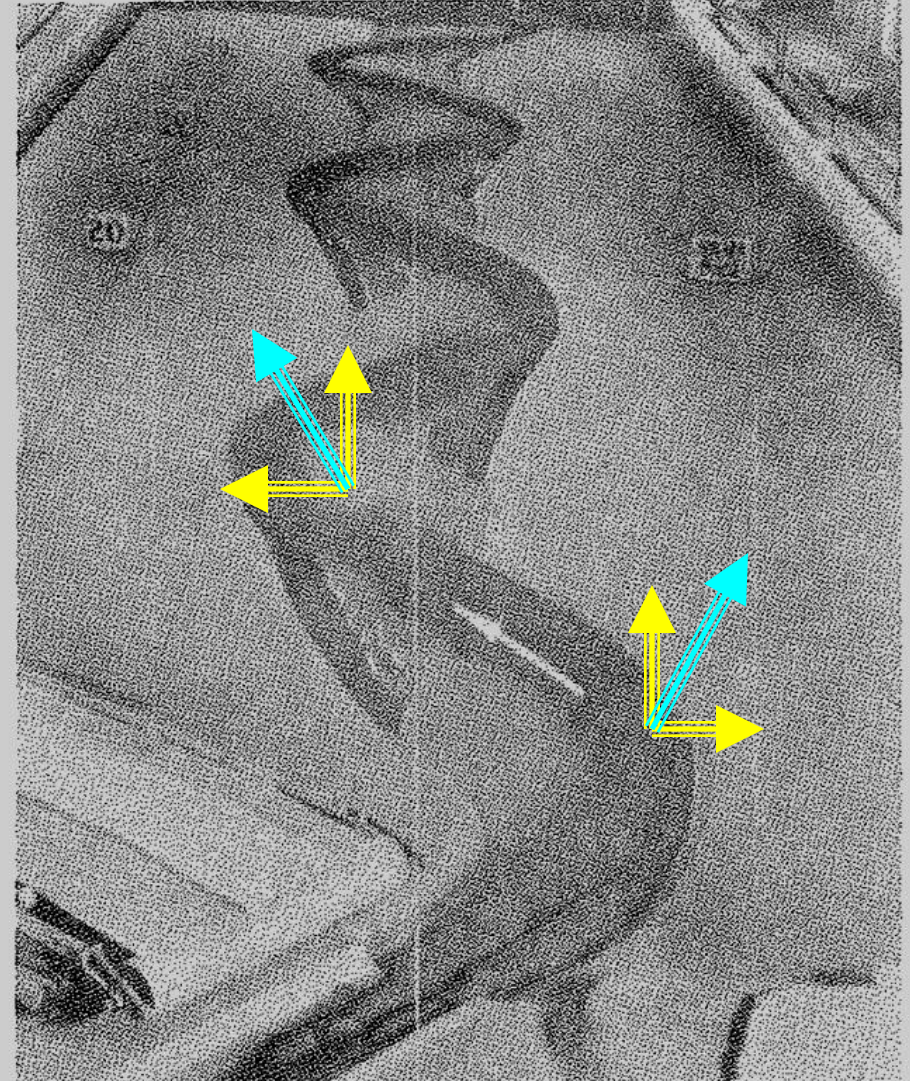
Next meanders will go **sideways (lateral movement)** & **downvalley**. Vector analysis resultants are the blue arrows

WAR DEPARTMENT

CORPS OF ENGINEERS, U.S. ARMY



INITIAL CHANNEL



AFTER 3 HOURS

**THAT WAS THEORY,
NOW HOW ABOUT A
DOSE OF REALITY!
HERE IS HOW A
STRAIGHTENED
CHANNEL RESPONDS!!!**

City of Ames, Iowa



1930'S

Skunk River



2013

2013



1950'S

Between E. Lincoln
Way & S.E. 16th St.



Straightened stream is starting to re-meander, increasing length & roughness, & decreasing slope! Black arrows are attack angles.

What is the meander belt width?

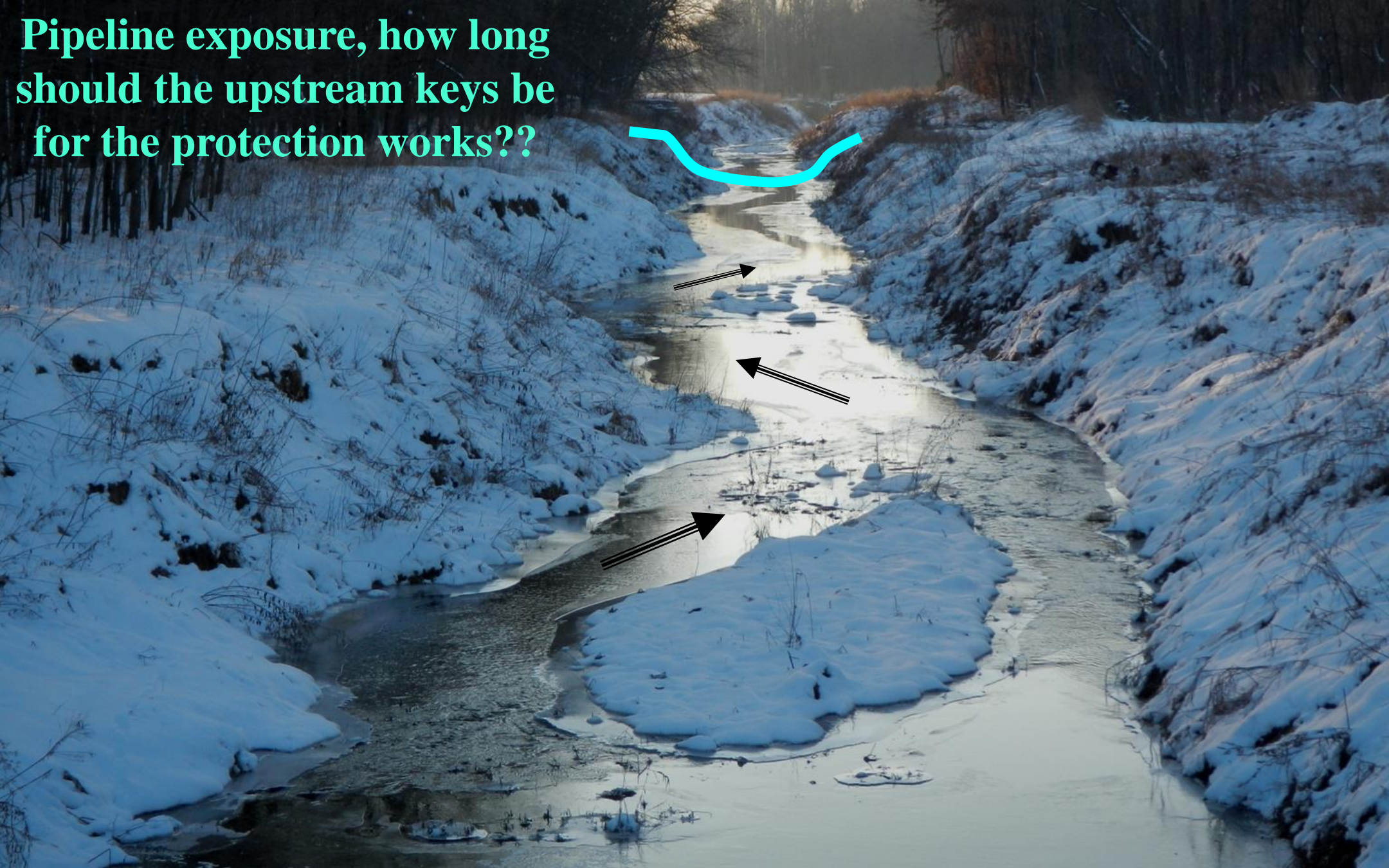
Prairie Cr. DS of Cannelburg Rd, Washington, IN. -DERRICK – 1-4-2013

**Here is the meander
belt width. It will get
wider!**



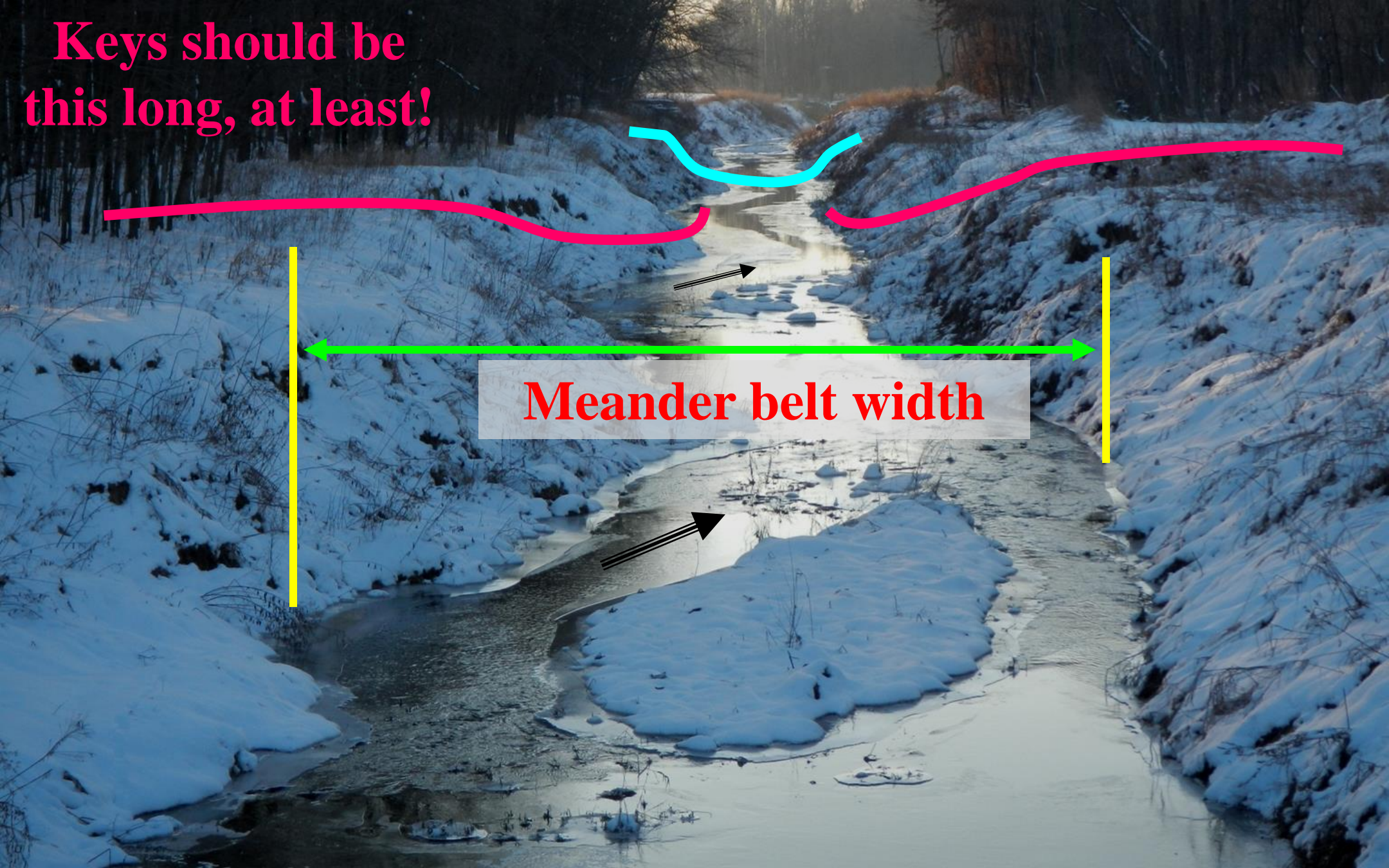
Prairie Cr. DS of Cannelburg Rd, Washington, IN. -DERRICK – 1-4-2013

**Pipeline exposure, how long
should the upstream keys be
for the protection works??**



Prairie Cr. DS of Cannelburg Rd, Washington, IN. -DERRICK 1-4-2013

**Keys should be
this long, at least!**



Prairie Cr. DS of Cannelburg Rd, Washington, IN. -DERRICK – 1-4-2013



**Big Difference in
1.5 yrs!!**

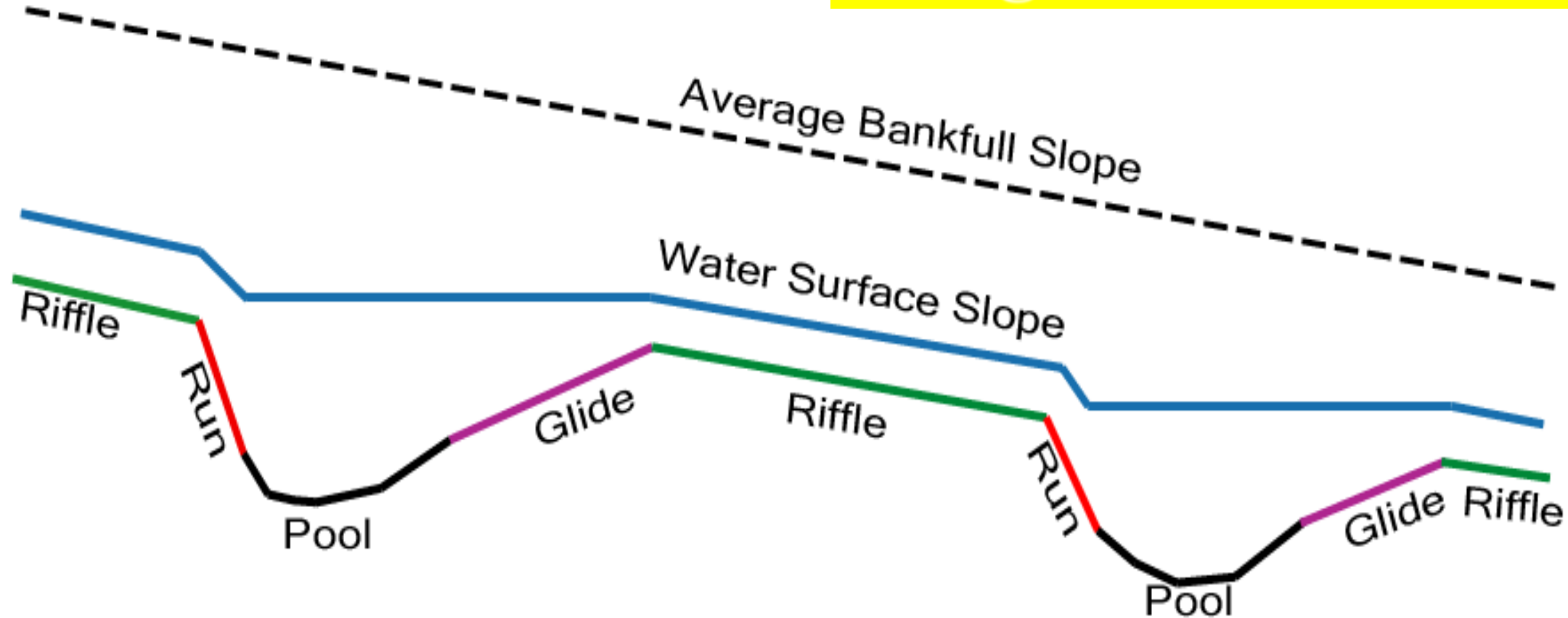
Meander belt width

HOW STREAMS NATURALLY DISSIPATE ENERGY !!

From Brad Humber

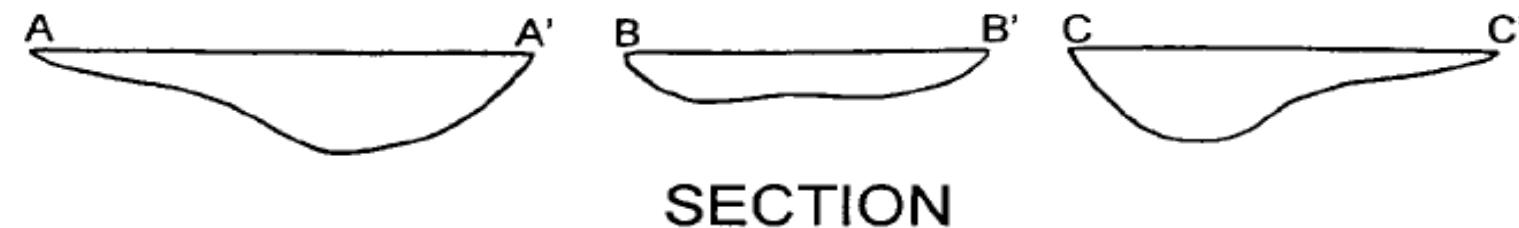
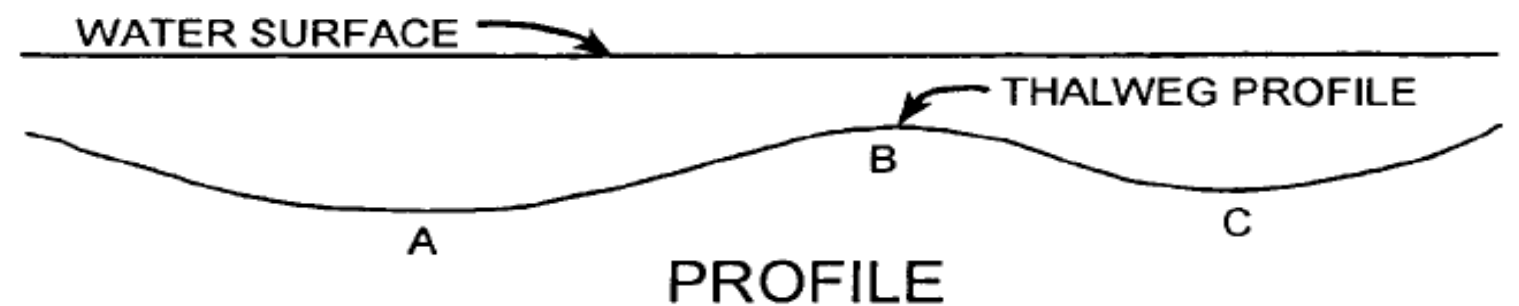
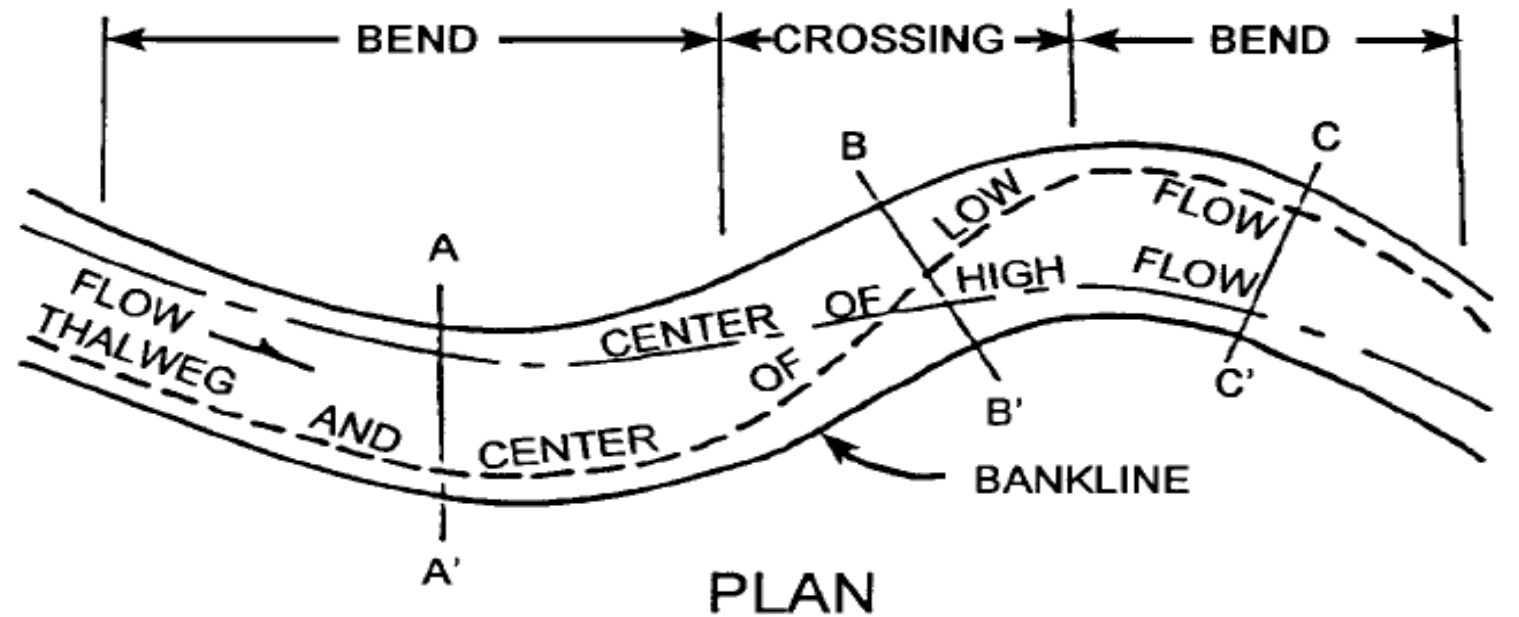
Longitudinal Profile

Flow 



Attack Angles, Thalweg Profile, & cross- sections.

Note: There
are sine
waves for both
stream
planform, &
the vertical
profile!



**HOW TO TELL
WHEN A POOL IS
WORKING
PROPERLY**

**Gravel-cobble bed, 1% slope,
rural, pool-riffle-pool**

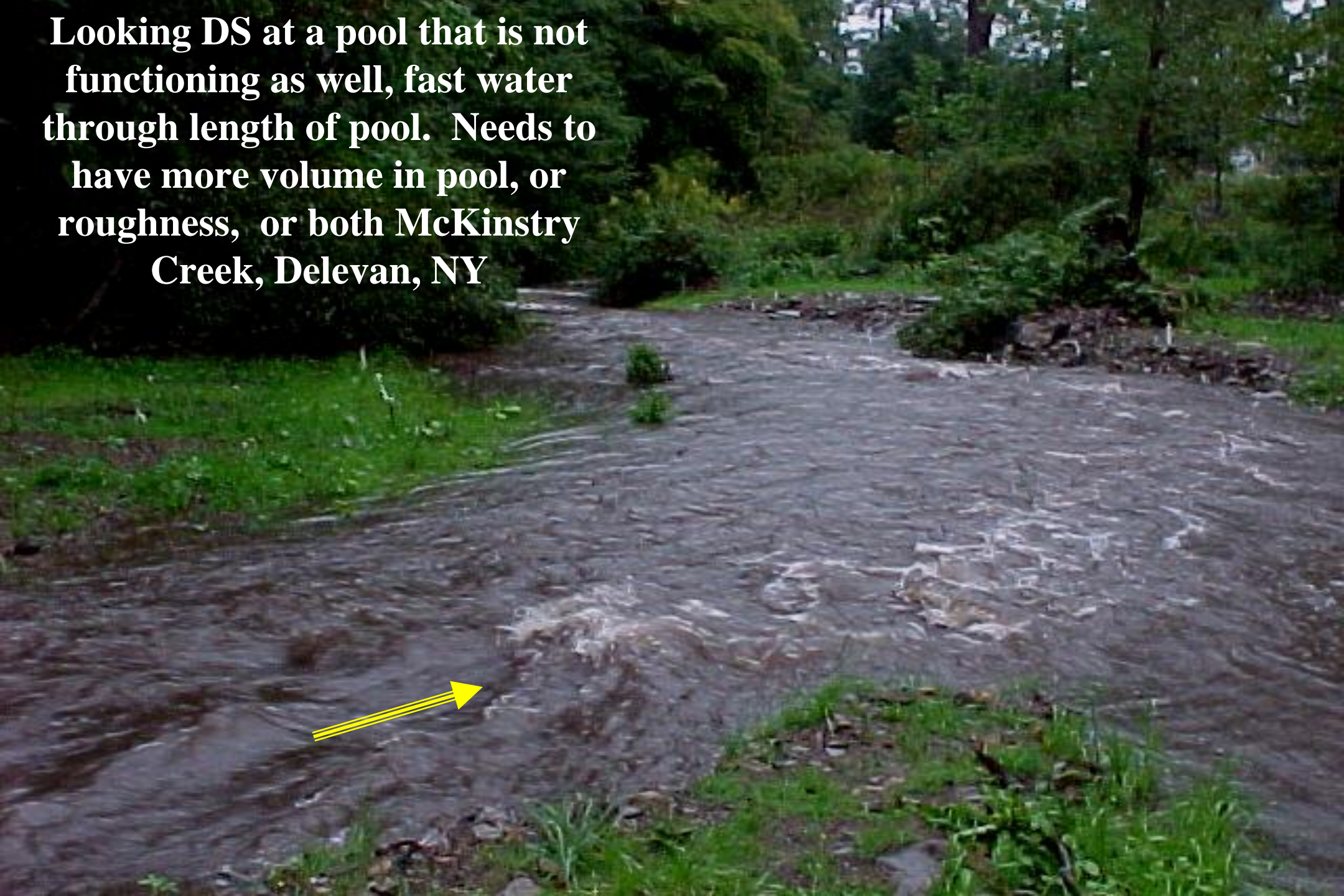
**Looking US at a
properly functioning
pool, note roostertail
dies out at DS pool
during bankfull event,
9/1/2005, McKinsty
Creek, Delevan, NY**





**Looking US at a properly
functioning pool, note
roostertail dies out at
pool during bankfull
event, 9/1/2005,
McKinstry Creek,
Delevan, NY**

**Looking DS at a pool that is not
functioning as well, fast water
through length of pool. Needs to
have more volume in pool, or
roughness, or both McKinstry
Creek, Delevan, NY**



**STUDY FLUVIAL
GEOMORPHOLOGY!**

**UNDERSTAND WHAT IS
WORKING & WHY!!**

**AND WHAT WILL
HAPPEN NEXT?**

Goal and Function- Based Design

(WHAT IN THE WORLD ARE YOU
TRYING TO ACCOMPLISH?)

**THINK MINIMUM STRUCTURE
& MAXIMUM EFFECT (FUNCTION)**
especially for urban systems

GOAL: a broad statement that reflects a desired outcome.

“The project needs shade”

OBJECTIVES: are specific statements that state GOALS in measurable terms.

“In 5 years between 45-75% of the project should be shaded”

Results of Monitoring

- Determines if project goals were accomplished
- Detects the need for maintenance or repair in a timely fashion.
- Provides a basis for designing repairs, if needed.
- Detects changes in stream characteristics.
- Provides valuable insight into stream behavior, & long-term performance and effects of stabilization works
- After appropriate analysis, design criteria for future stabilization works can be improved.

From Charlie Elliott

First Law of River Engineering:



**Complex
Problems Often
Have**

**Simple, Easy-
to-Understand**

**WRONG
ANSWERS**

**Let's straighten this stream just like Grandad did, that worked
for the last 50 years, & get that gravel for the driveway too!!!**

Second Law of River Engineering:



**Modify
what we
teach for
your
project!!**

Luxuries We Like To Have

- The “Luxury of Space”
- The “Luxury of Time” (nature strengthens the project over time)
- The “Luxury of Monitoring”
- The “Luxury of Adaptive Management”
in other words, learning by doing!!

Think conceptually regarding functions, use Derrick’s “LAW OF EXTREMES” to understand how things work. Example-ditch narrow & deep, or 10 ft wide & 1 inch deep

Third Law of River Engineering:

“Streambank Stabilization Aint Rocket Science, It Is Way More Complex Than That”, (Dr. Biedenbarn)

“With Many More Variables and Unknowns!!” (Dave Derrick)

John McCullah says “Streambank Stabilization Ain’t Brain Surgery, It Is Way More Complex Than That”



**Do U see a
shadow from
the
astronaut?
Picture
taken by me
at the
Huntsville
NASA
display**

Fourth Law of River Engineering:



**"Natural Systems
Are Complex,
And Disturbed
Systems Are Even
More Complex!!!"**

**Charlie Elliott
COE-LMVD, Retired
Bernice, LA**

Last Law of River Engineering:

When in over your head, go get help!

Dr. Biedenbarn says that at the end of this workshop, “the class participants should have a higher level of confusion, similar to the level of confusion currently experienced by the instructors”!

IF ANYONE SAYS THEY HAVE ALL OF THE ANSWERS, THEY DON'T!!!



PROJECT MANAGEMENT

***NO SURPRISES!! *NO DRAMA!!
NO BACKING UP!**





17

Teamwork is key!!
THINK
INCLUSIONARY
NOT
EXCLUSIONARY

PERMITS - get regulatory involved early!!

- First thought from regulatory
Avoidance & minimalization....
- List all alternatives – not just your best plan. Show how U have minimized already.
- Regulatory folks are 99% biologists, emphasize the effects of the project on the planet. Hint: roughness = habitat...
- Regulatory wants it done correctly, once!!

FEMME CREEK, ST. LOUIS AREA, MO.



Protection starts late & ends early, resulting in erosion at both ends of project

“Blackwater's flooding spurs scrutiny”
Washington Times - Washington, DC.
Six of the 10 worst floods on record for
the river have occurred in the past
eight years, according to the US Army
Corps of Engineers.....

THE WEATHER AINT
NORMAL ANYMORE!!!

**RIGID OBJECTS IN
DYNAMIC SYSTEMS
TEND TO FAIL
CATASTROPHICALLY,
WITHOUT WARNING,
DURING THE
CATASTROPHIC EVENT!!**

**When the concrete-lined channel breaks up it is
not pretty, Vensel Creek, Tulsa, OK**



SEVERAL LOW GRADE
CONTROL STRUCTURES
ARE BETTER THAN
ONE BIG MONSTER
GRADE CONTROL
STRUCTURE

**SELF-ADJUSTING
GRADE CONTROL
STRUCTURES WORK
WELL !!**

**Arresting an active
headcut at the
downstream end of the
Articulating Concrete
Mattress (ACM)**

Pickens, MS. ACM “tail” was laid on flat bathymetry, headcuts have migrated US and mat has adjusted and arrested the headcut



**“Hinged” ACM
grade control,
more mats can
be added if
needed**

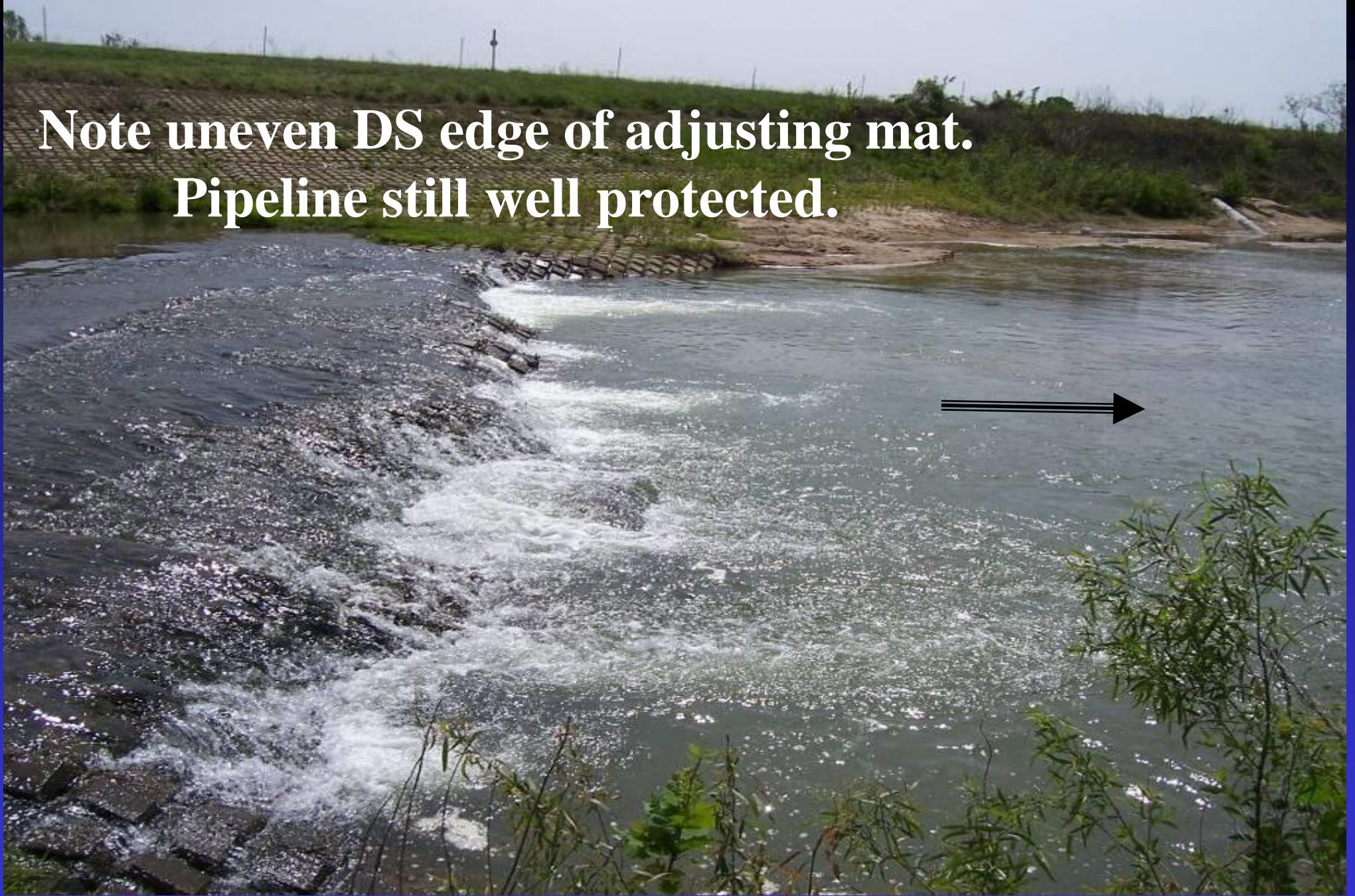
**Here is a big
headcut
arrested!!**

**Looking US 10 months after project completion, veg
looking good, note mat has arrested a small headcut**



July 2004

**Note uneven DS edge of adjusting mat.
Pipeline still well protected.**



April 2007

A more uniform adjustment of the mat to the headcut, but still approximately 14 ft until the headcut gets back to the pipeline.

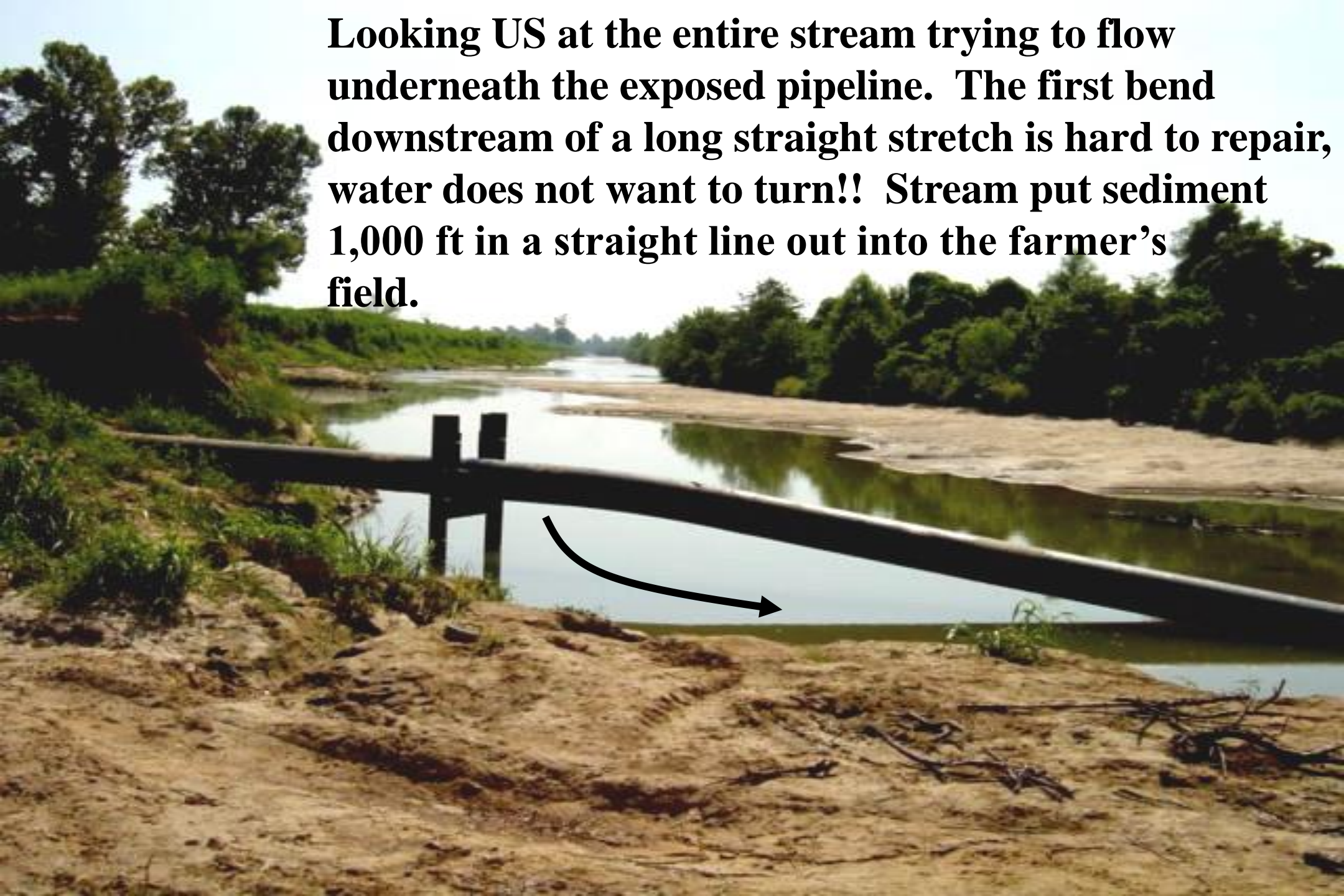


Pix by Derrick

March 18, 2009

**SELF-ADJUSTING,
SELF-HEALING BANK
STABILIZATION
METHODS ARE
BEST!!**

Looking US at the entire stream trying to flow underneath the exposed pipeline. The first bend downstream of a long straight stretch is hard to repair, water does not want to turn!! Stream put sediment 1,000 ft in a straight line out into the farmer's field.



Looking US at impinging flow impact zone. Note steep angle where LPSTP was undercut & launched (self-adjusted)



April 2006

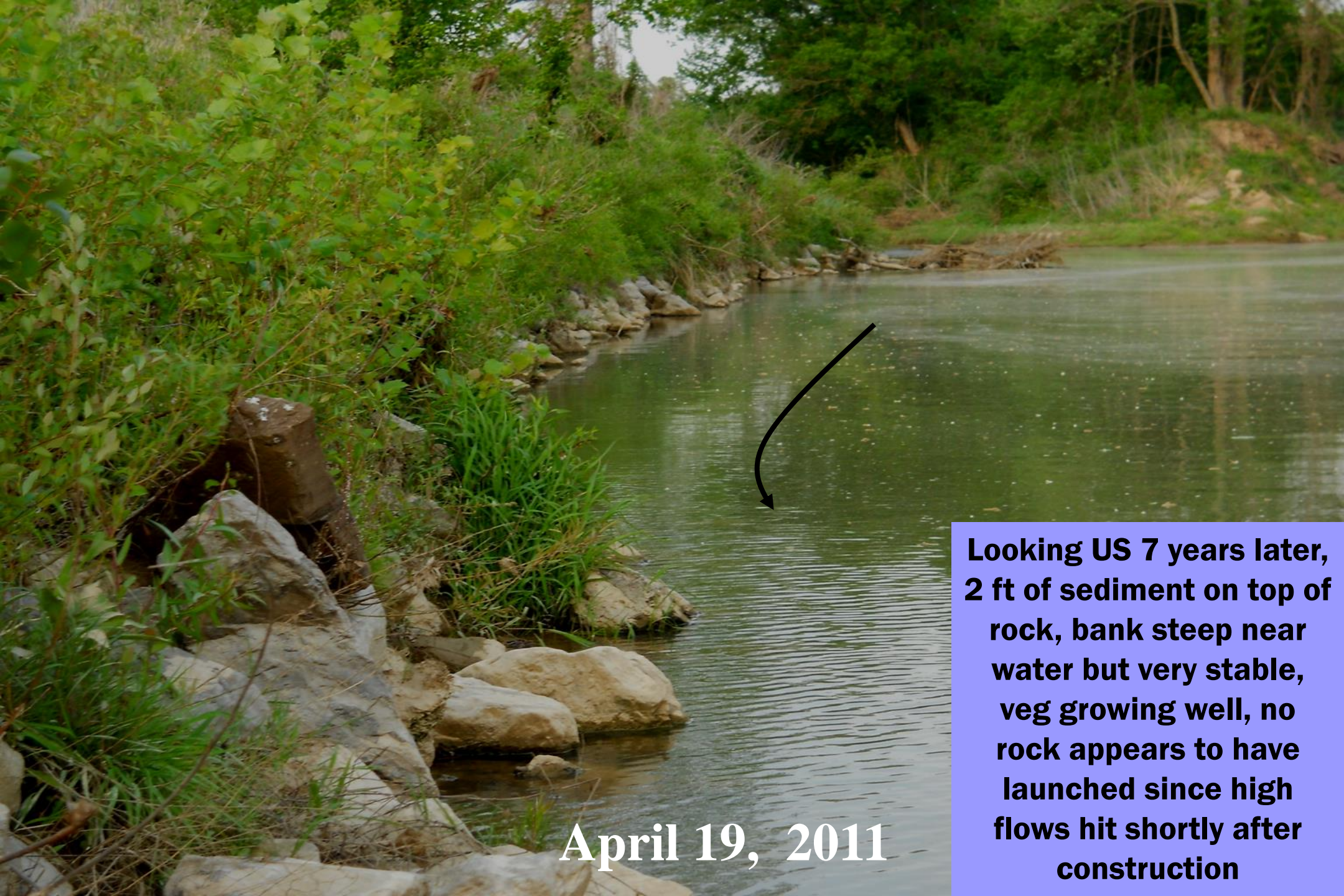
Note steep angle where LPSTP was undercut and launched (self-adjusted) as designed





**Same bank 4 years
later, veg growing
means it is very stable.**

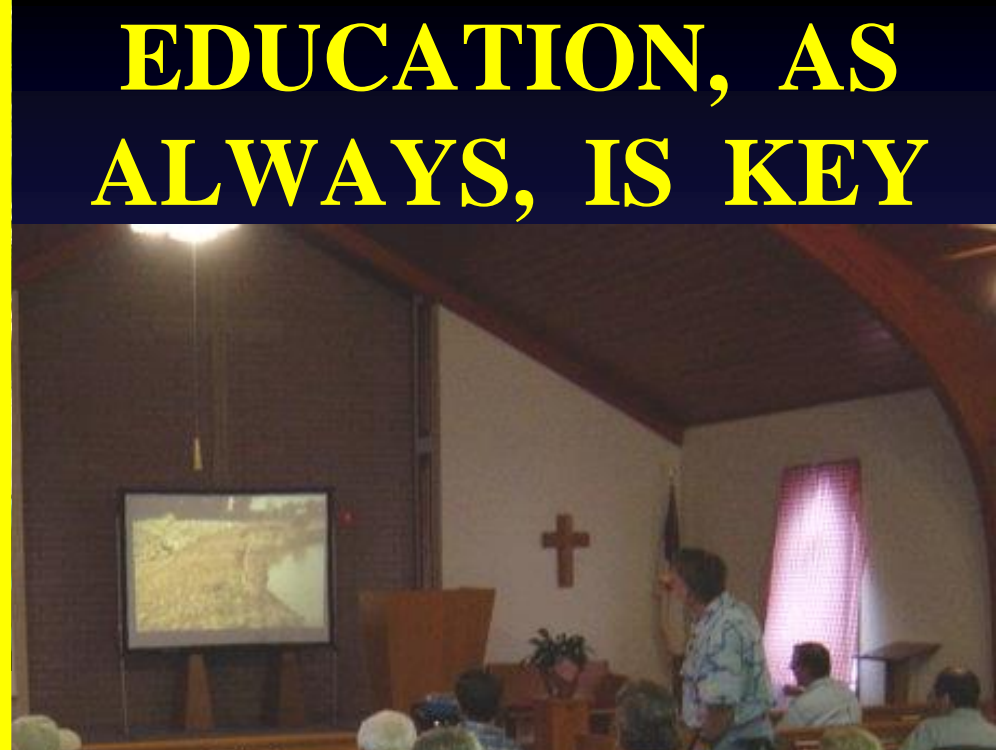
March 2007



**Looking US 7 years later,
2 ft of sediment on top of
rock, bank steep near
water but very stable,
veg growing well, no
rock appears to have
launched since high
flows hit shortly after
construction**

April 19, 2011

**EDUCATION, AS
ALWAYS, IS KEY**

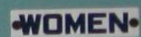
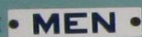


TIME FOR QUESTIONS

Remember,
We all live
down-
stream !!









DELICATESSEN
PEPSI

BUD LIGHT

LARK
ABC USED CARS
STUDEBAKER

FOUNTAIN SERVICE



ROAST BEEF 279
STEAK SANDWICH 110
SHRIMP BASKET 150
HAMBURGER 33
OR
FRIED CHICKEN 122
FISH SANDWICH 55
HAM & EGGS 89
HAM SALAD 45
CHICKEN SALAD 55



ICED Coca-Cola HERE
BUVEZ Coca-Cola GLACÉ

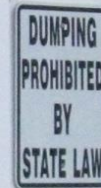


MENU
COKE 10¢
COFFEE 10¢
SANDWICHES 30¢
DONUT 5¢
CANDY 10¢
POTATO CHIPS 10¢











CALTEX
MOTOR OIL

MAGNOLIA
MOTOR OIL
GASOLINE

Mobilgas
SOCONY-VACUUM

Omar
ETHYL
GASOLINE

Enjoy
Coca-Cola
ICE COLD

Enjoy
Coca-Cola
ICE COLD

Have a
Coca-Cola
HERE

Have a
Coca-Cola
HERE

Stop here
Mobiloil



QUESTIONS? ANSWERS??

