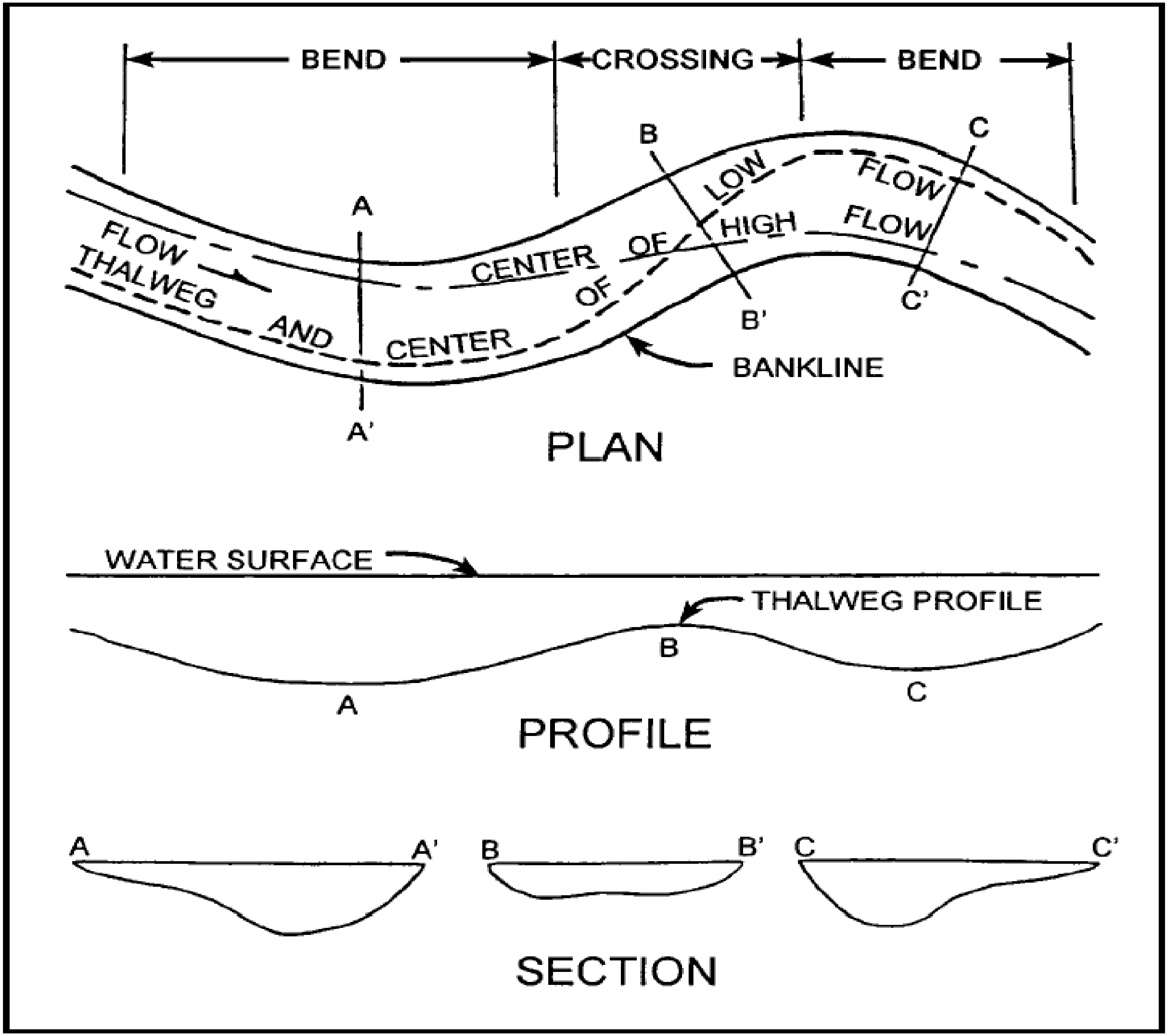
HOW STREAMS WORK & ENVIRONMENTALLY SENSITIVE GRADE CONTROL

Attack Angles, Thalweg Profile, & cross-sections.

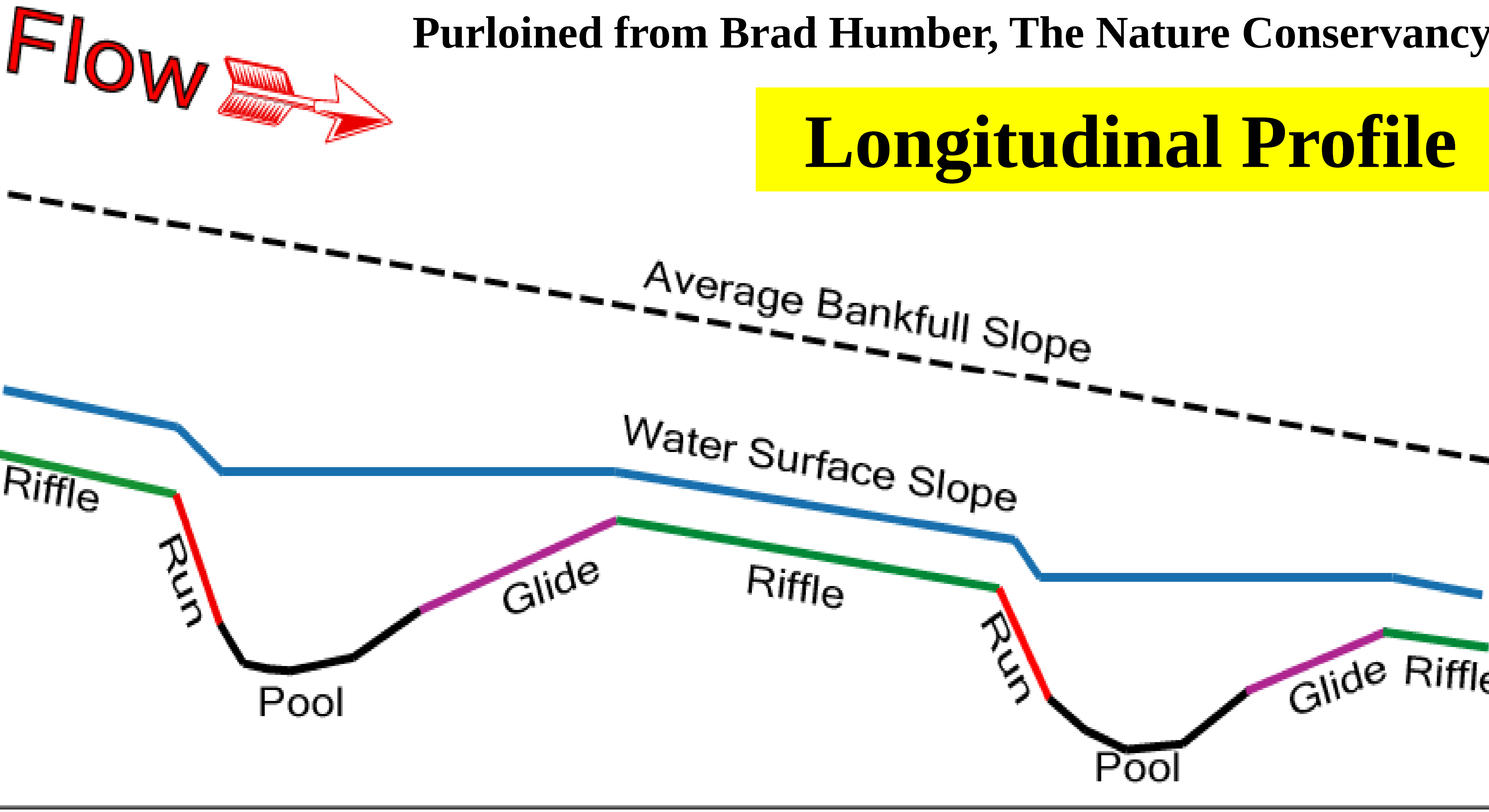
Note: There are sine waves for both stream planform, & the vertical profile!



HOW STREAMS NATURALLY DISSIPATE ENERGY !!

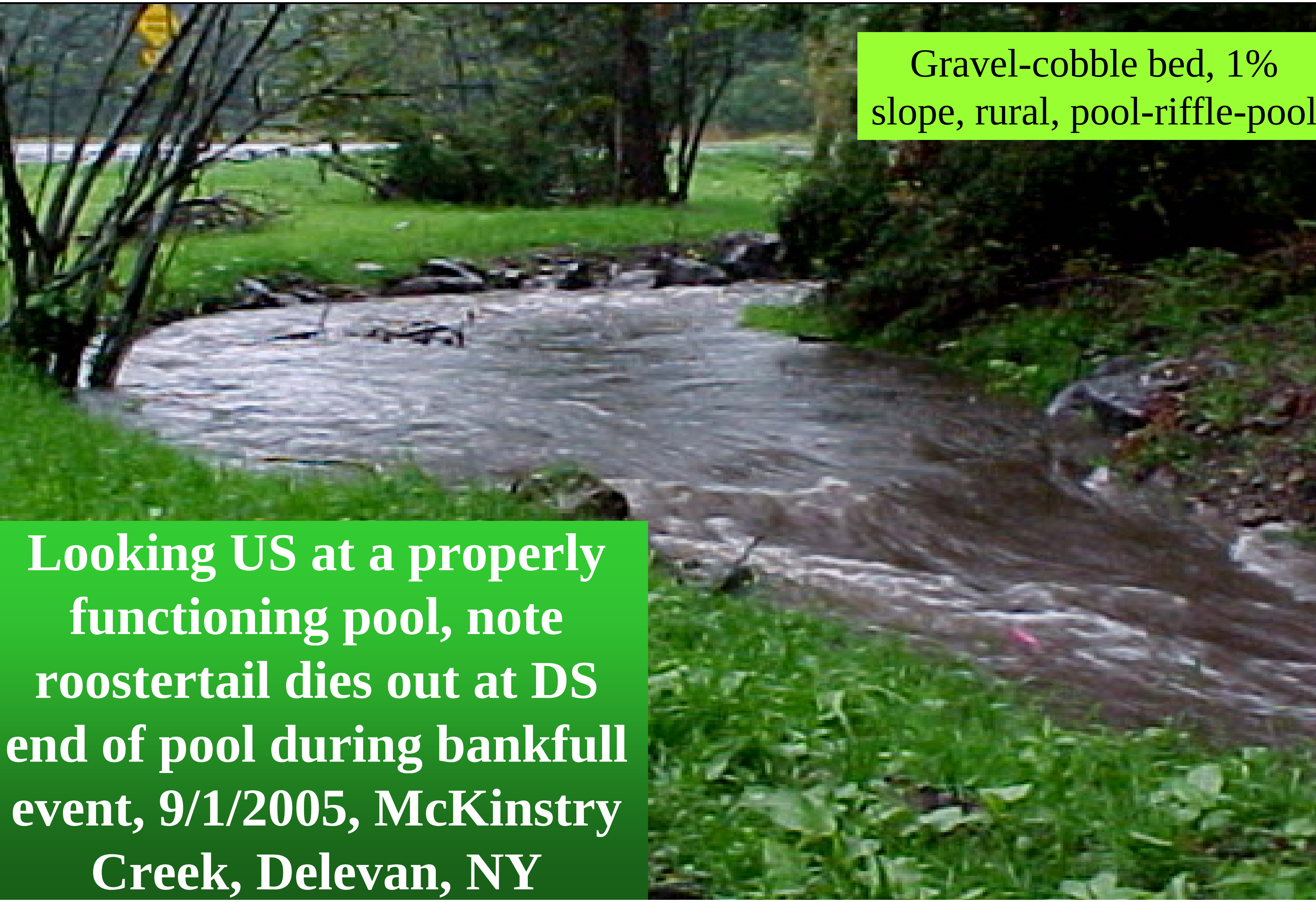
Purloined from Brad Humber, The Nature Conservancy

Longitudinal Profile



HOW TO TELL WHEN A POOL IS WORKING PROPERLY, McKINSTRY CREEK, DELEVAN, NY {rural, gravel-cobble, 1% slope, pool-riffle-pool, re-meandered}

Mini case study: 1 of 4



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

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

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

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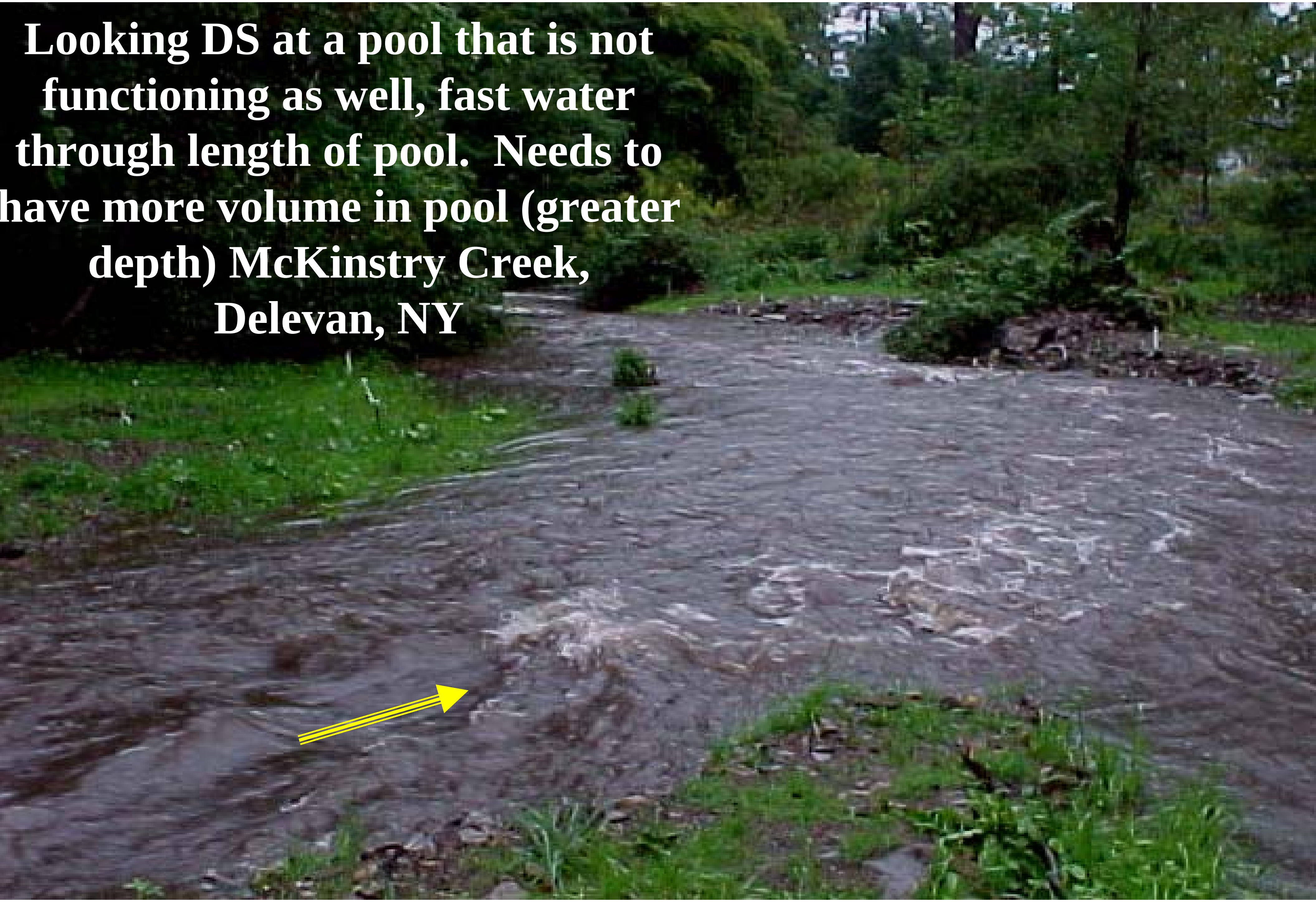

Looking DS at a pool that is not functioning as well, fast water through length of pool. Needs to have more volume in pool (greater depth) McKinstry Creek, Delevan, NY

GRADE CONTROL

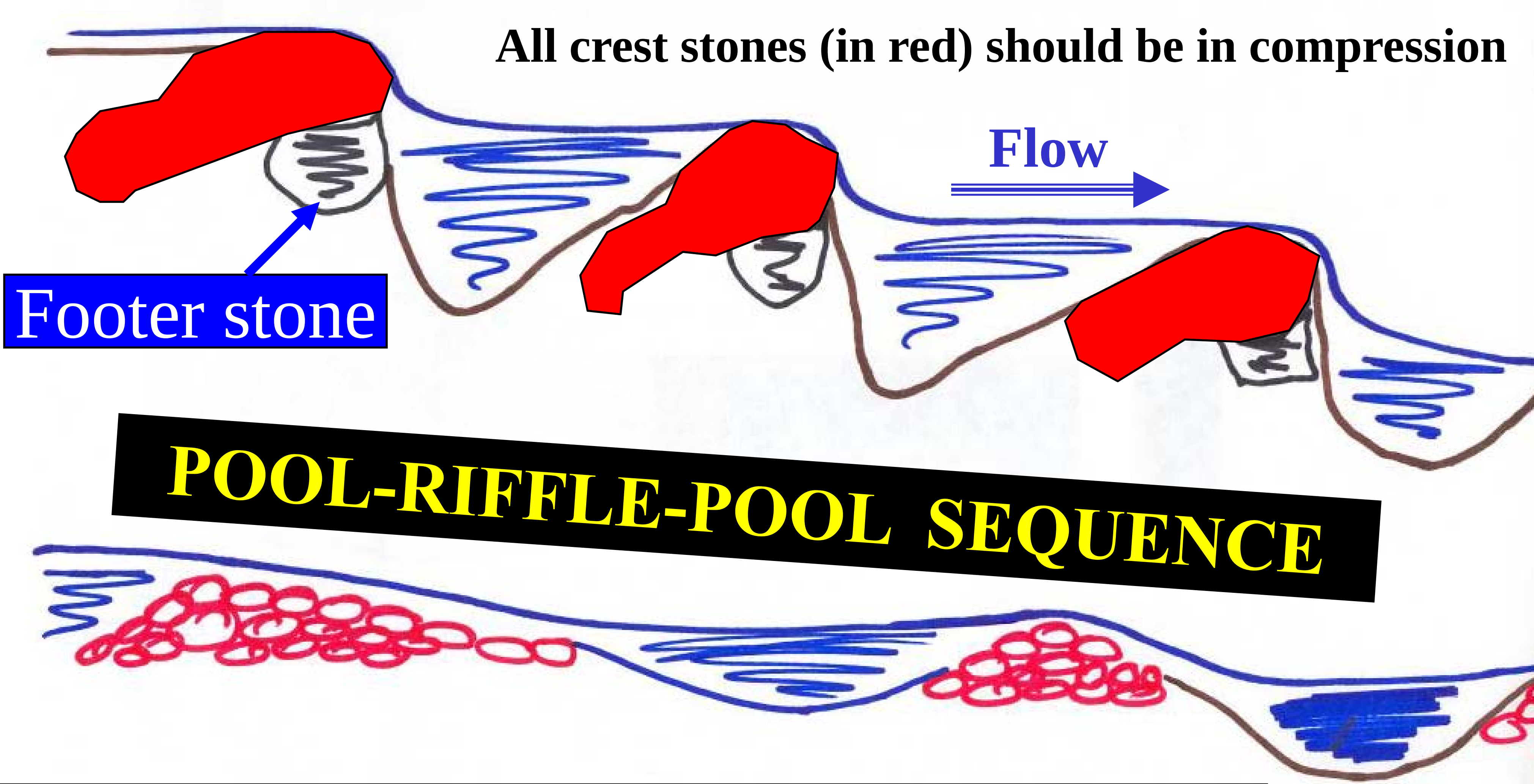
- GRADE CONTROL STRUCTURE-Placed across a stream channel bed & keyed into both banks for the purpose of controlling the stream slope & preventing bed degradation.
- The crest of the GC structure needs to be oriented perpendicular to THE DIRECTION THAT THE FLOW NEEDS TO BE AIMED downstream of the GC structure.
- It is not a bad idea to consider a grade control at the upstream end of a project so that changes in the project do not migrate upstream) & at the DS end (to protect from any downstream instability moving US

STEP-POOL-STEP
VS.
POOL-RIFFLE-POOL

Richey Run, PA, pix by Bruce Dickson. {step–pool sequence}

If your stream has vertical drops in it, maybe that is what you should imitate, OR NOT, back in history was the stream always down to bedrock????

STEP-POOL-STEP SEQUENCE



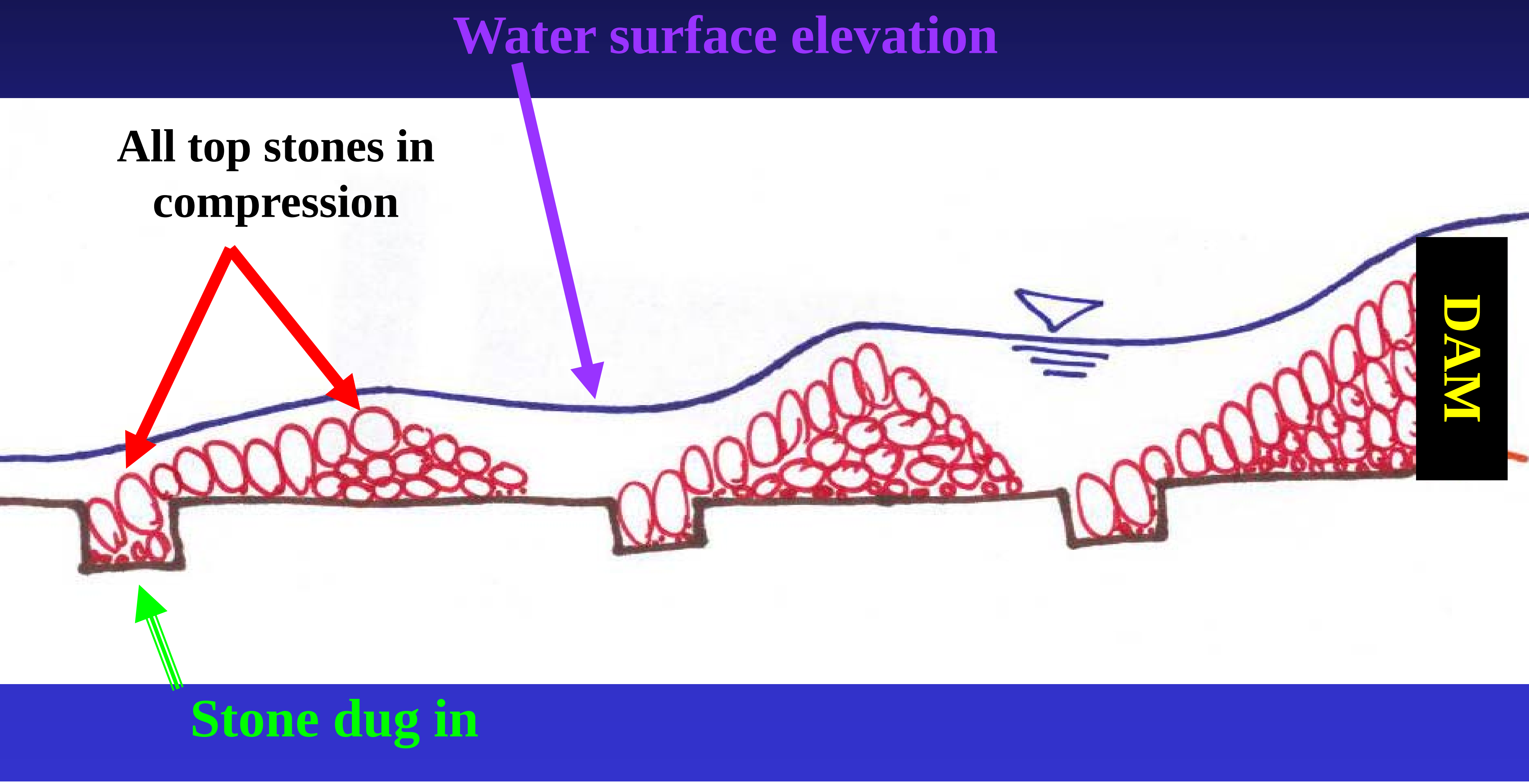
RIFFLES AND RUNS SET THE DIMENSIONS OF THE POOLS.
A FLATTER RUN RESULTS IN A LONGER, SHALLOWER POOL.
A STEEP RUN RESULTS IN A SHORTER, DEEPER POOL.

Grade Stabilization Structures

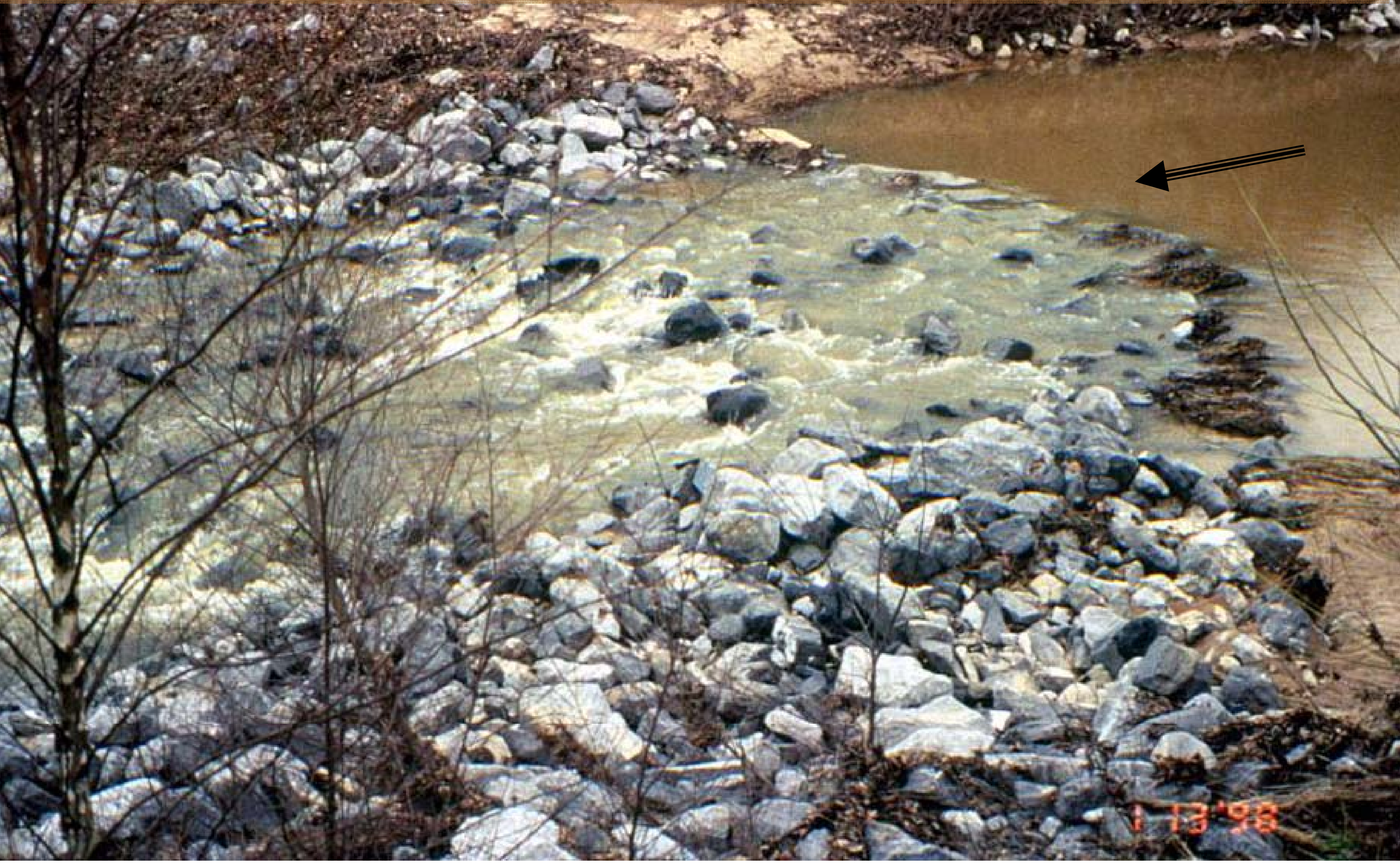
- Natural Controls (rock outcroppings, massive clays)
- Exposed Pipeline Crossings
- Bridges, culverts, and low-water crossings
- Dams
- Soil Cement Structures
- High-Drop Structures
- Drop Pipes and overbank drainage problems
- Low-Drop Structures
- Upstream and Downstream Angled Chevrons
- Vortex Weirs & Cross Vanes
- Engineered Rocked Riffles
- At-Grade Grade Control Structures (including two-stage extended Bendway Weirs)
- Gabion Structures
- Articulating Concrete Mats

Engineered Rocked Riffles (ERR) in series used to mitigate the vertical drop over the concrete dam at Highland Park Dam on Swan Creek

Constructed pool-riffle-pool configuration



Loose stone engineered rocked riffle



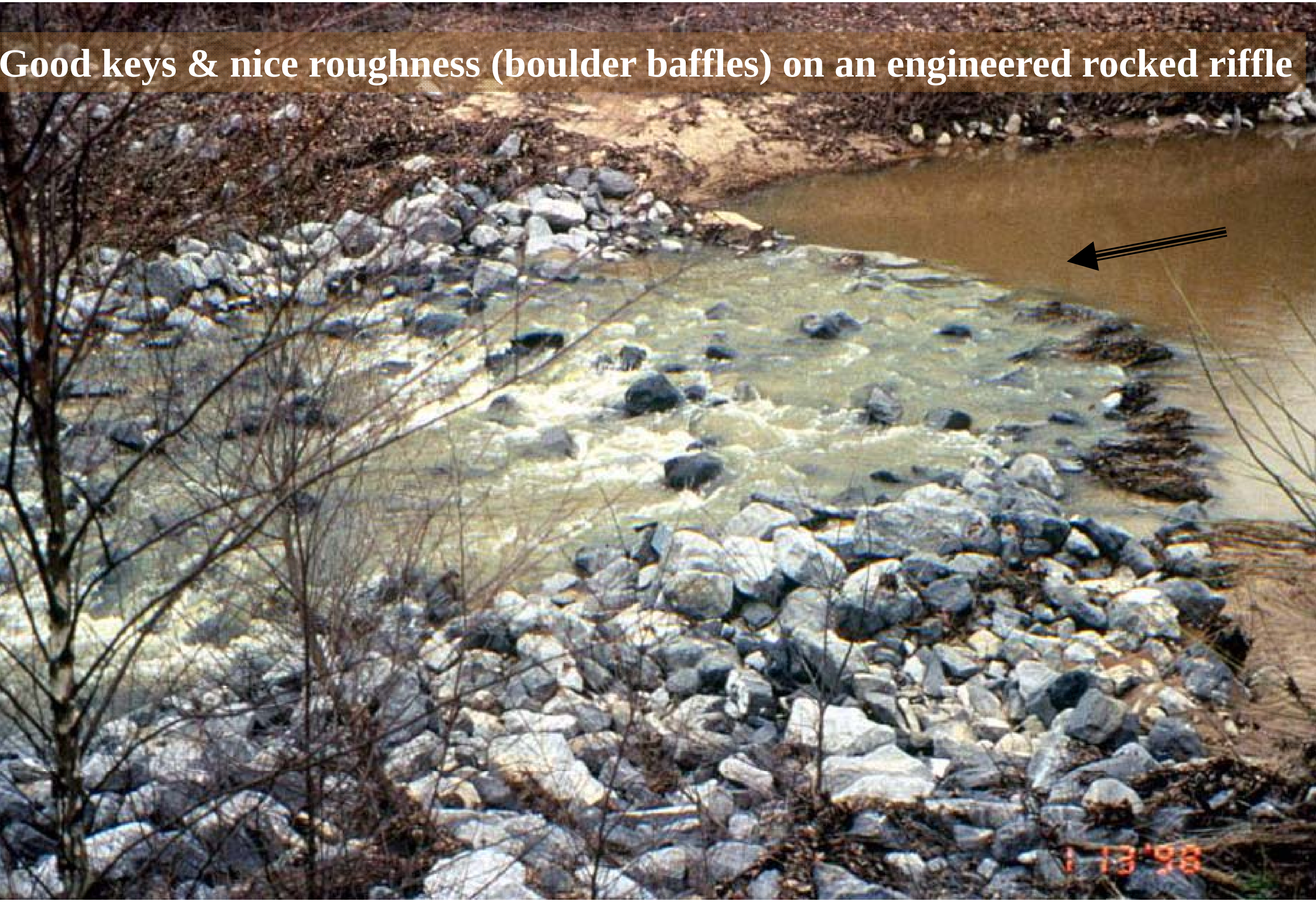
ENGINEERED ROCK RIFFLES,

ERR-stones not in compression

ERR with all stones in compression with an integrated fishway!

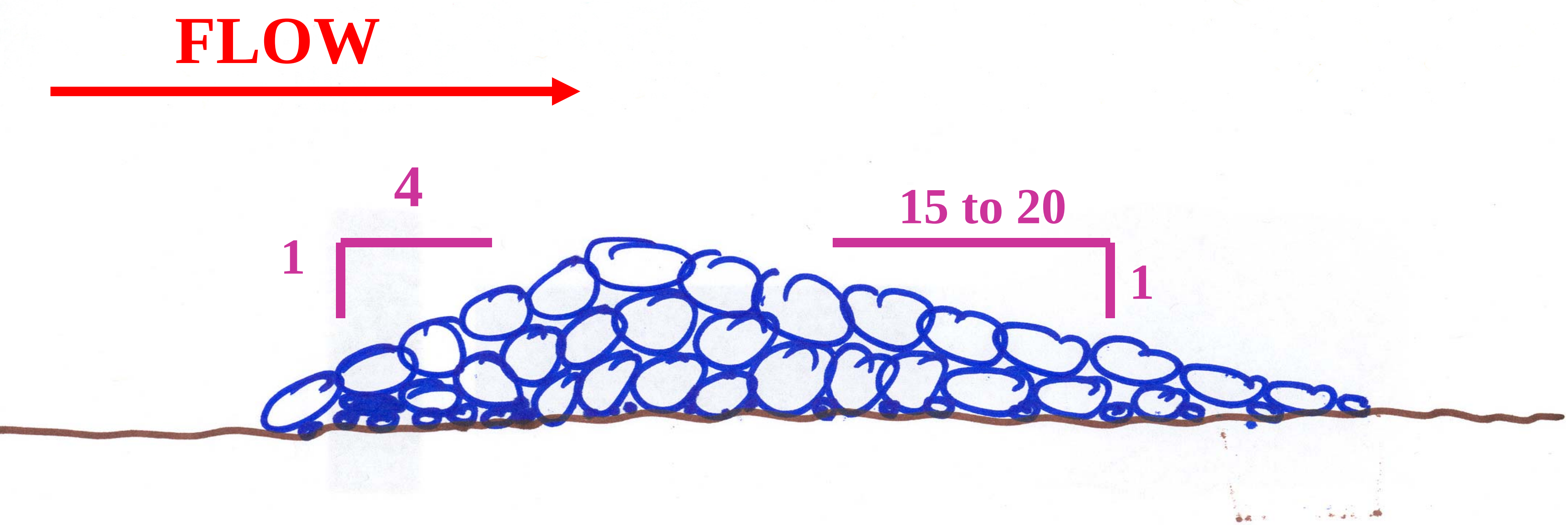
LOOSE STONE ENGINEERED ROCK RIFFLES

Good keys & nice roughness (boulder baffles) on an engineered rocked riffle



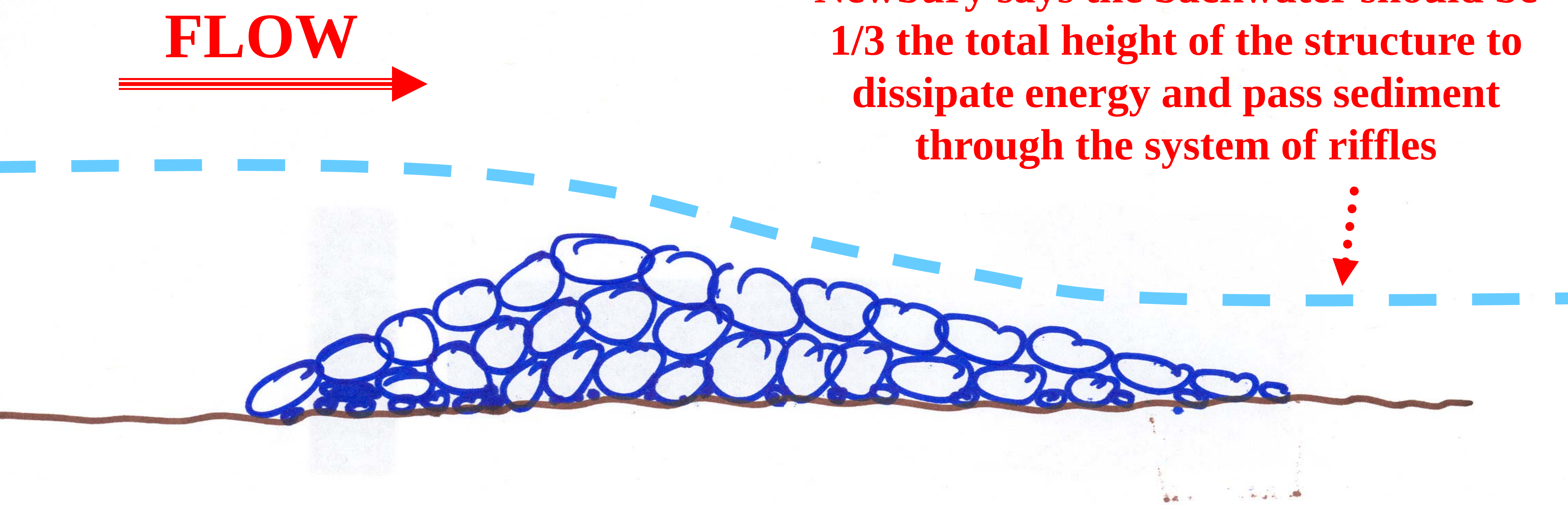
Site “M”, the first rocked riffle in IL, note boulder baffles

AN ENGINEERED ROCKED RIFFLE



Largest stones are placed at crest and on downstream face, upstream face is in compression due to water flow

AN ENGINEERED ROCKED RIFFLE



Largest stones are placed at crest and on downstream face.


Newbury-style engineered
rock riffle, Quincy, IL

WAYNE KINNEY'S REALLY TALL ENGINEERED ROCKED RIFFLES CASE STUDY: ERR #12, WHICH IS A 5.2 FT TALL STRUCTURE


A 5.2 ft tall ERR, Big Creek, Union County, IL. {rural, sand-gravel, pool-riffle-pool, meandering, incised} Designed by Wayne Kinney
Mini case study: 2 of 10
Looking DS at the 5.2 ft tall Engineered Rocked Riffle in the proper location between two bends
Photo by Derrick 2/7/2007


A 5.2 ft tall ERR, Big Creek, Union County, IL. Designed by Wayne Kinney
Mini case study: 3 of 10
Looking at the key, flow right to left. US slope is angle of repose, DS slope is 20 to 1.
Photo by Derrick
2/7/2007

A 5.2 ft tall ERR, Big Creek, Union County, IL. Designed by Wayne Kinney

Key is dug 3 ft deep into substrate & 10 ft into each bank. Stone is RR4-well-graded stone with a top size of 500 pounds.

Photo by Derrick 2/7/2007

A 5.2 ft tall ERR, Big Creek, Union County, IL. Designed by Wayne Kinney

Mini case study: 5 of 10

Looking DS. Uniform 20 to 1 slope, has enough roughness for good fish passage.

Photo by Derrick 2/7/2007


A 5.2 ft tall ERR, Big Creek, Union County, IL. Designed by Wayne Kinney
Mini case study: 6 of 10
Looking US
Photo by Derrick
2/7/2007

A 5.2 ft tall ERR, Big Creek, Union County, IL. Designed by Wayne Kinney

Looking US at the 5.2 ft tall Engineered Rocked Riffle

Photo by Derrick
2/7/2007

A 5.2 ft tall ERR, Big Creek, Union County, IL. Designed by Wayne Kinney

Photo by Derrick 2/7/2007


A 5.2 ft tall ERR, Big Creek, Union County, IL. Designed by Wayne Kinney
Mini case study: 9 of 10
Looking US. A thing of beauty!!
Photo by Derrick
2/7/2007

A 5.2 ft tall ERR, Big Creek, Union County, IL. Designed by Wayne Kinney

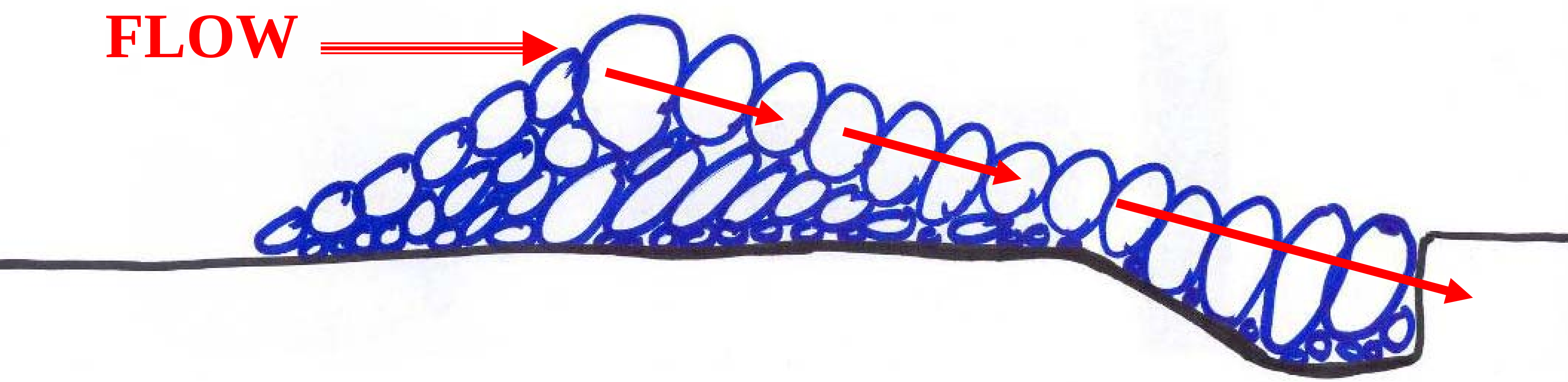
Looking US, note riprap bank protection.

Photo by Derrick 2/7/2007

ENGINEERED ROCK RIFFLES WITH ALL STONES IN COMPRESSION

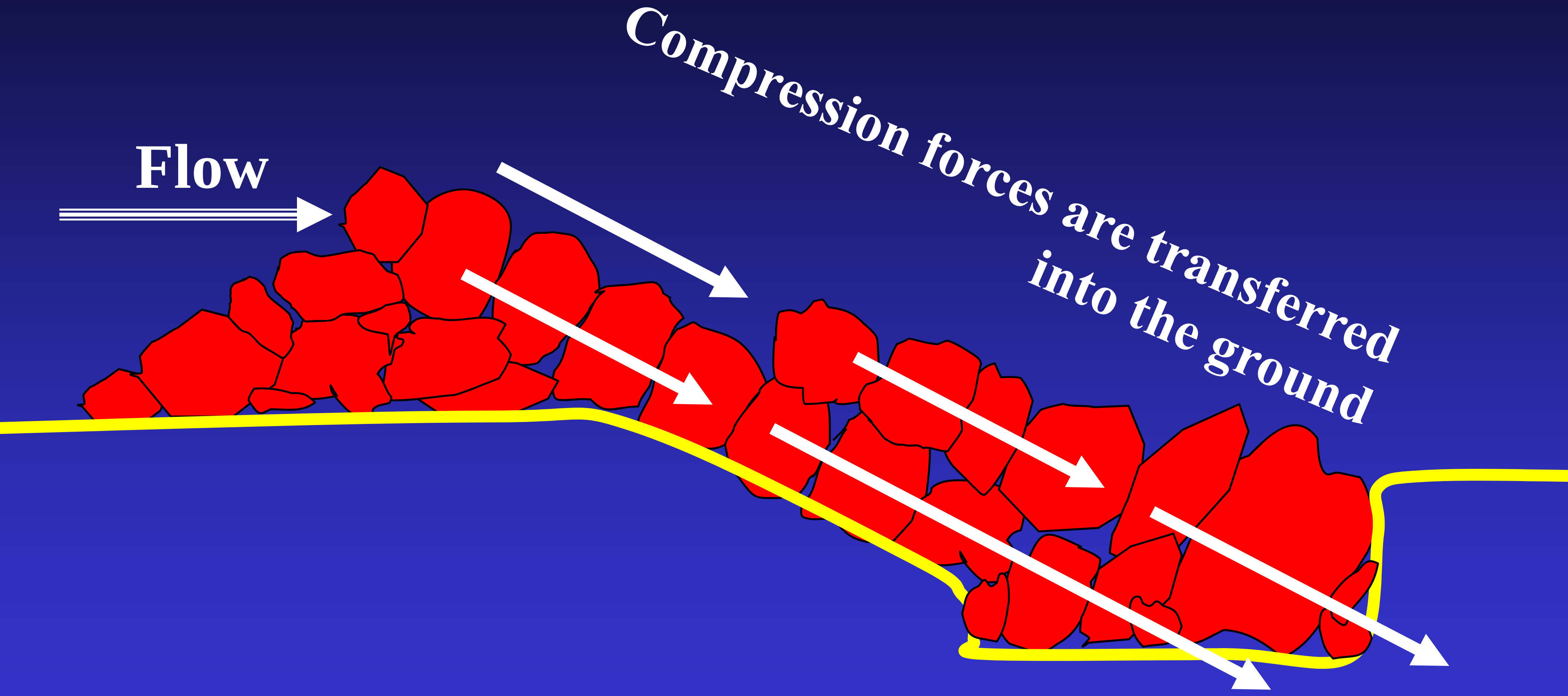
AN ENGINEERED ROCKED RIFFLE WITH WEIGHTED TOE

Stones on crest, the downstream face, & toe all set in compression



Weighted toe can designed to help stop the headward migration of a DS knickpoint {headcut}

AN ENGINEERED ROCKED RIFFLE WITH INTEGRATED FISH LADDER



NYSDOT ROAD PROTECTION FOR ROUTE 248 – CHENUNDA CREEK, {suburban, gravel-cobble, pool-riffle-pool, meandering} SOUTH OF WELLSVILLE, NY CONSTRUCTED SEPTEMBER 2006. An ERR with integrated fish ladder !!

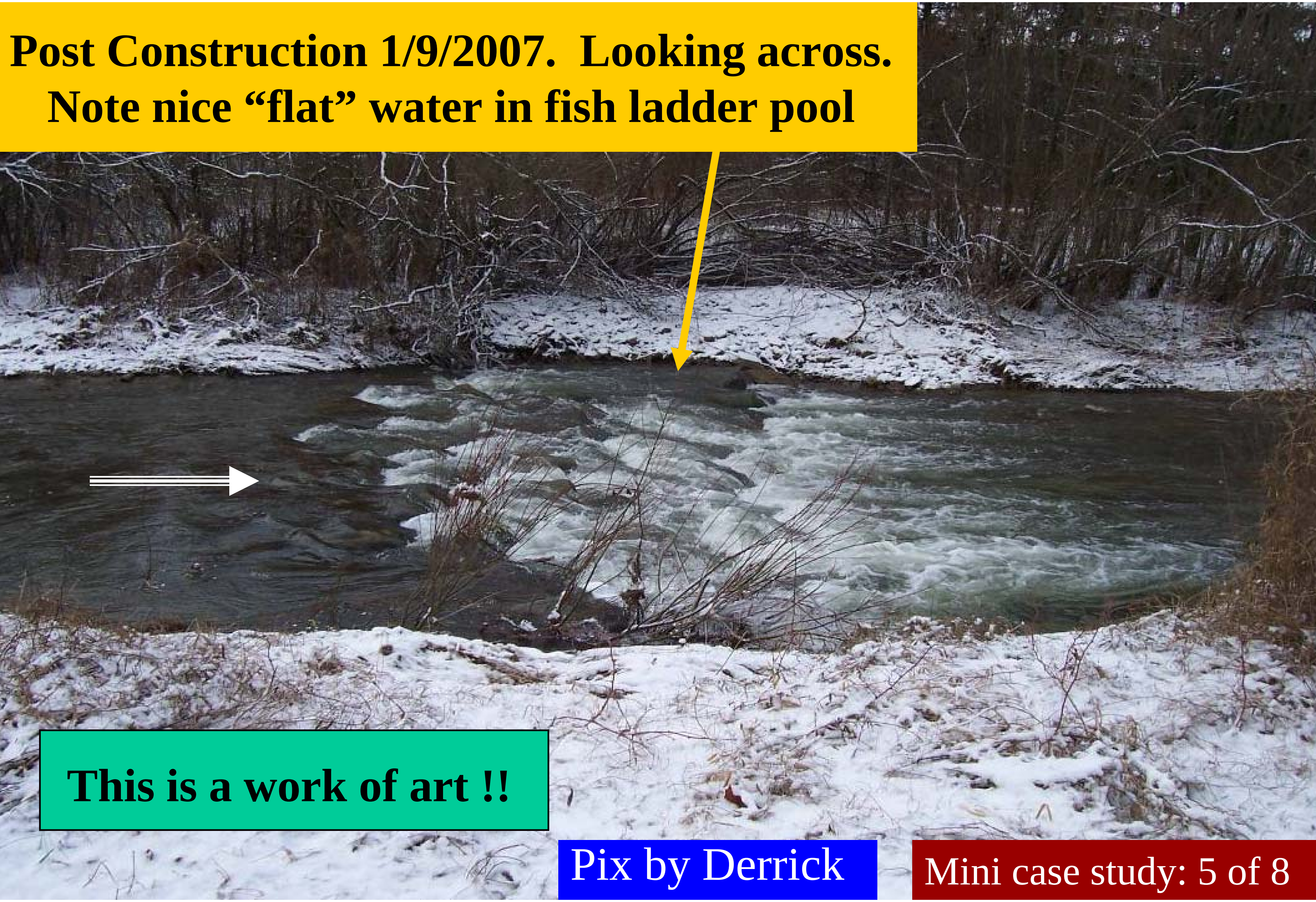
Chenunda Creek, Willing, NY. Post construction 1/9/2007. Looking across at a 2-ft tall steep-sloped Engineered Rocked Riffle {ERR} with integrated fish passage ladder (ladder on far side of stream). ERR constructed of DOT Heavy {4,500 lb, max weight} stone, all stones set in compression.

Pix By Derrick

Post Construction 1/9/2007. Looking US at the ERR. Nice pool for fish passage along left bank

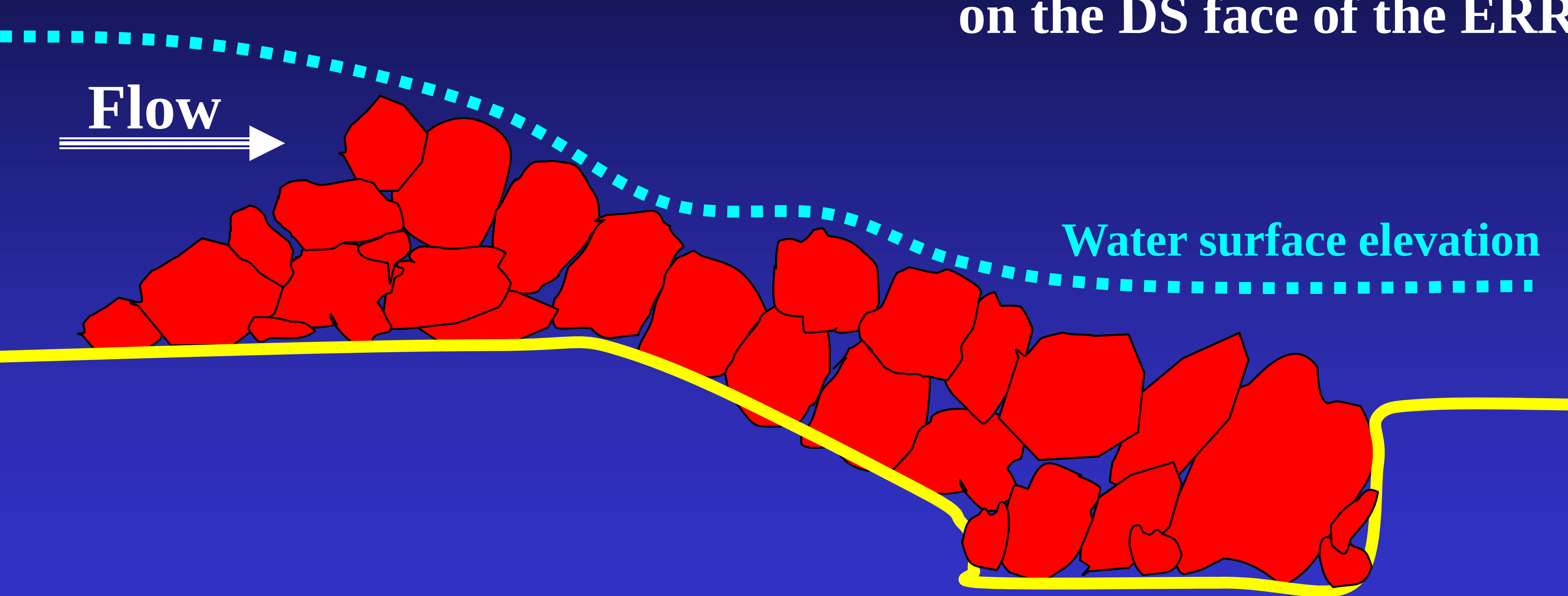
Pix by Derrick


Post Construction 1/9/2007. Looking US & across, close up of the fish ladder pool
Pix by Derrick
Mini case study: 4 of 8


Post Construction 1/9/2007. Looking across.
Note nice “flat” water in fish ladder pool
This is a work of art !!
Pix by Derrick
Mini case study: 5 of 8

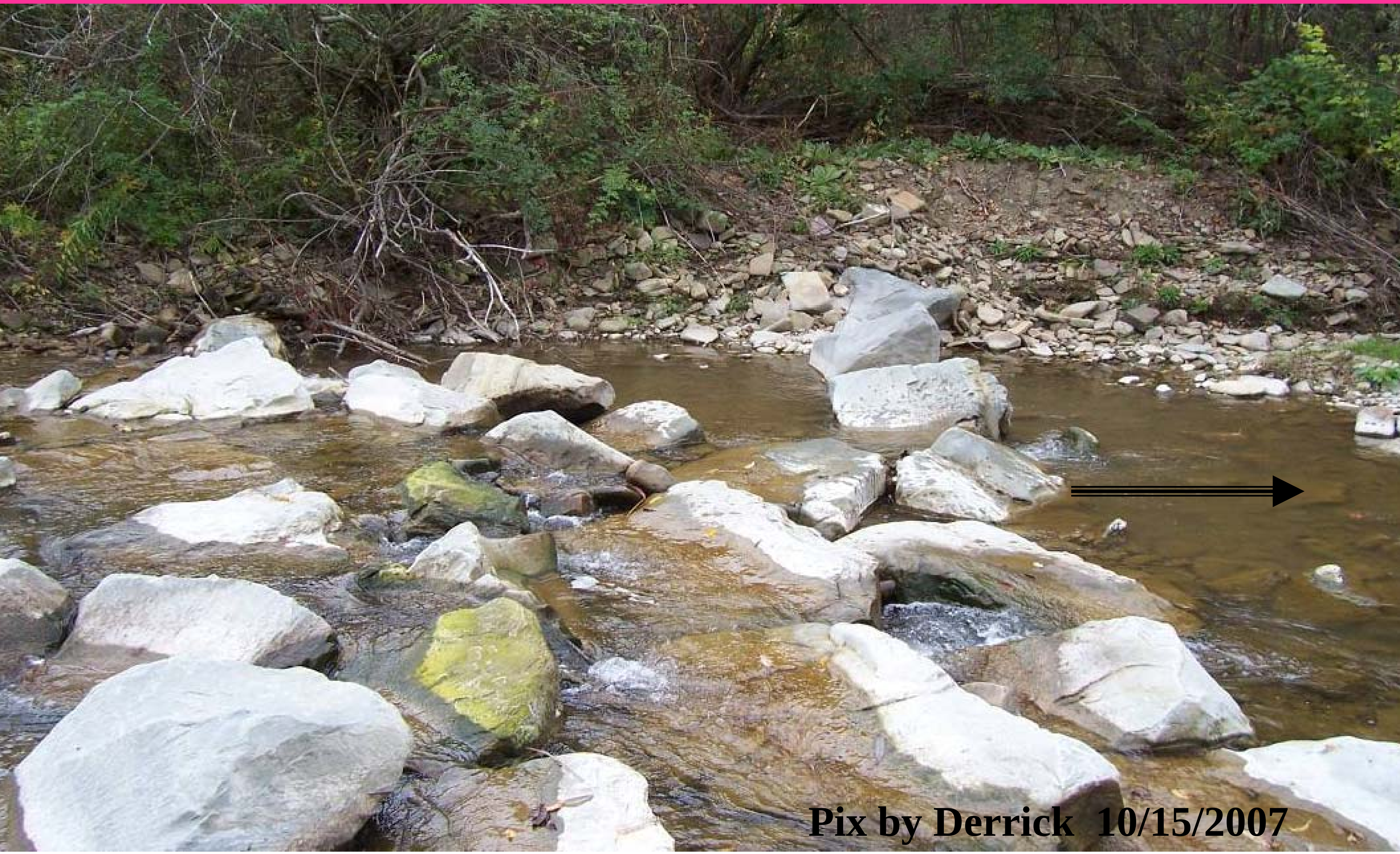
AN ENGINEERED ROCKED RIFFLE WITH INTEGRATED FISH LADDER

At least two layers of stones are set in compression to form pools on the DS face of the ERR



LOW LOW LOW LOW FLOW
13 MONTHS AFTER CONSTRUCTION
Photos by Dave Derrick
OCTOBER 15, 2007

13 Months LATER-low flow. Looking across @ fish ladder.

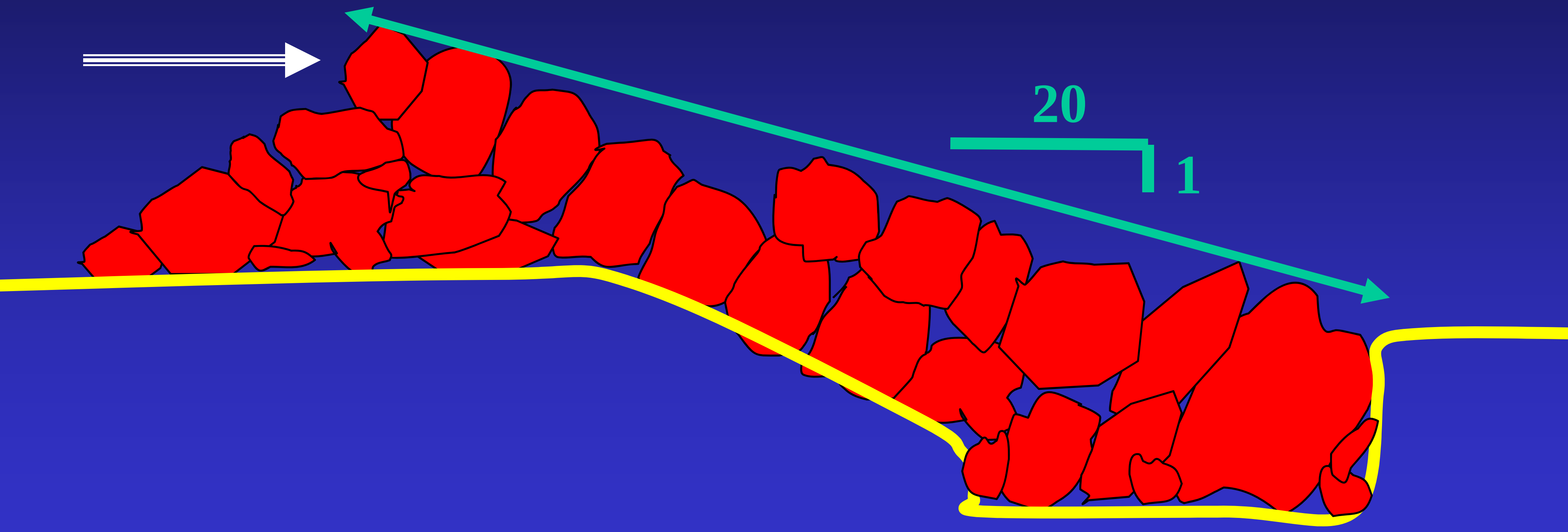


Pix by Derrick 10/15/2007

13 Months LATER-low flow. Looking across @ ERR & fish ladder.

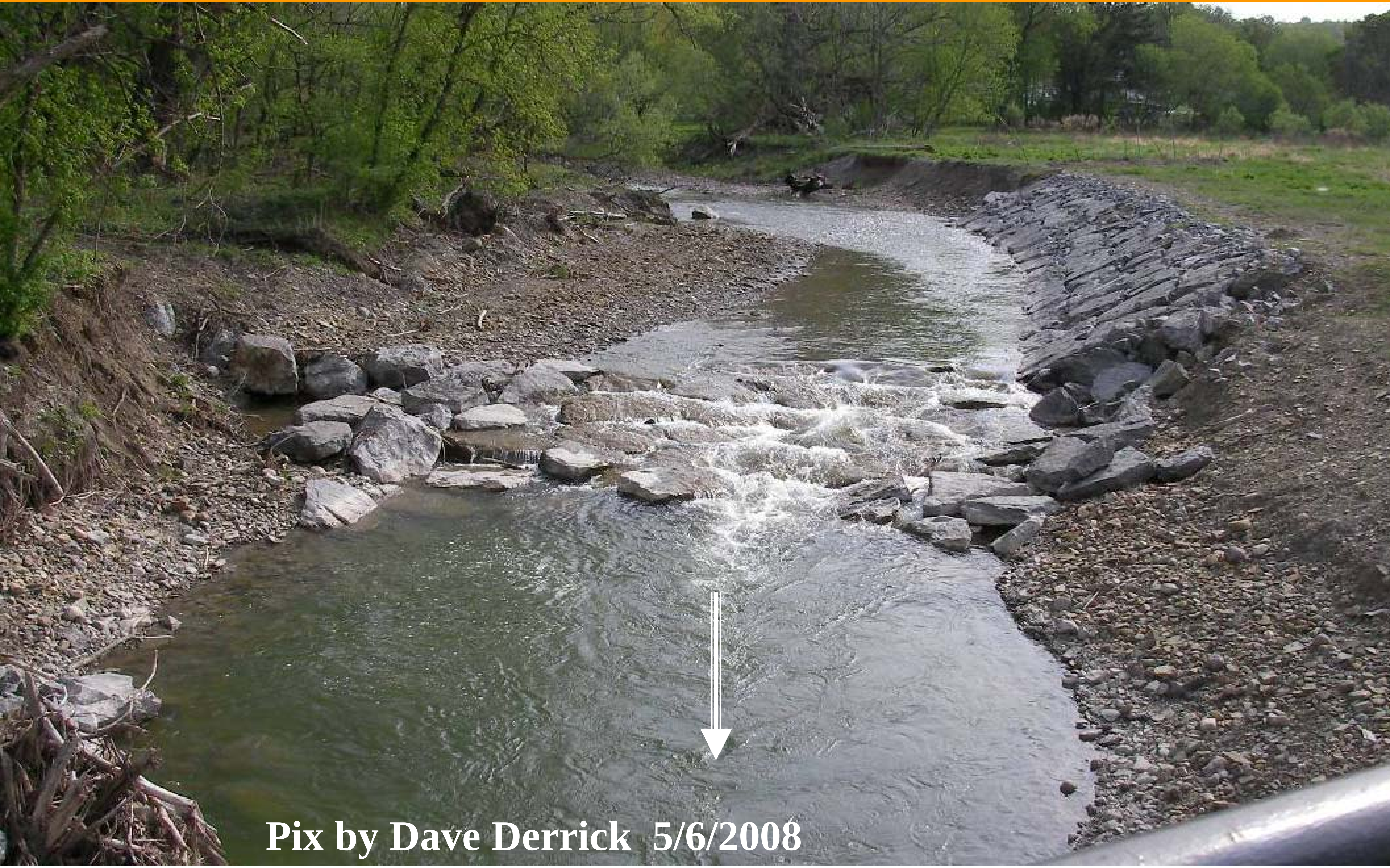
AN ENGINEERED ROCKED RIFFLE WITH INTEGRATED FISH LADDER

An overall slope of 20 to 1 can still be maintained

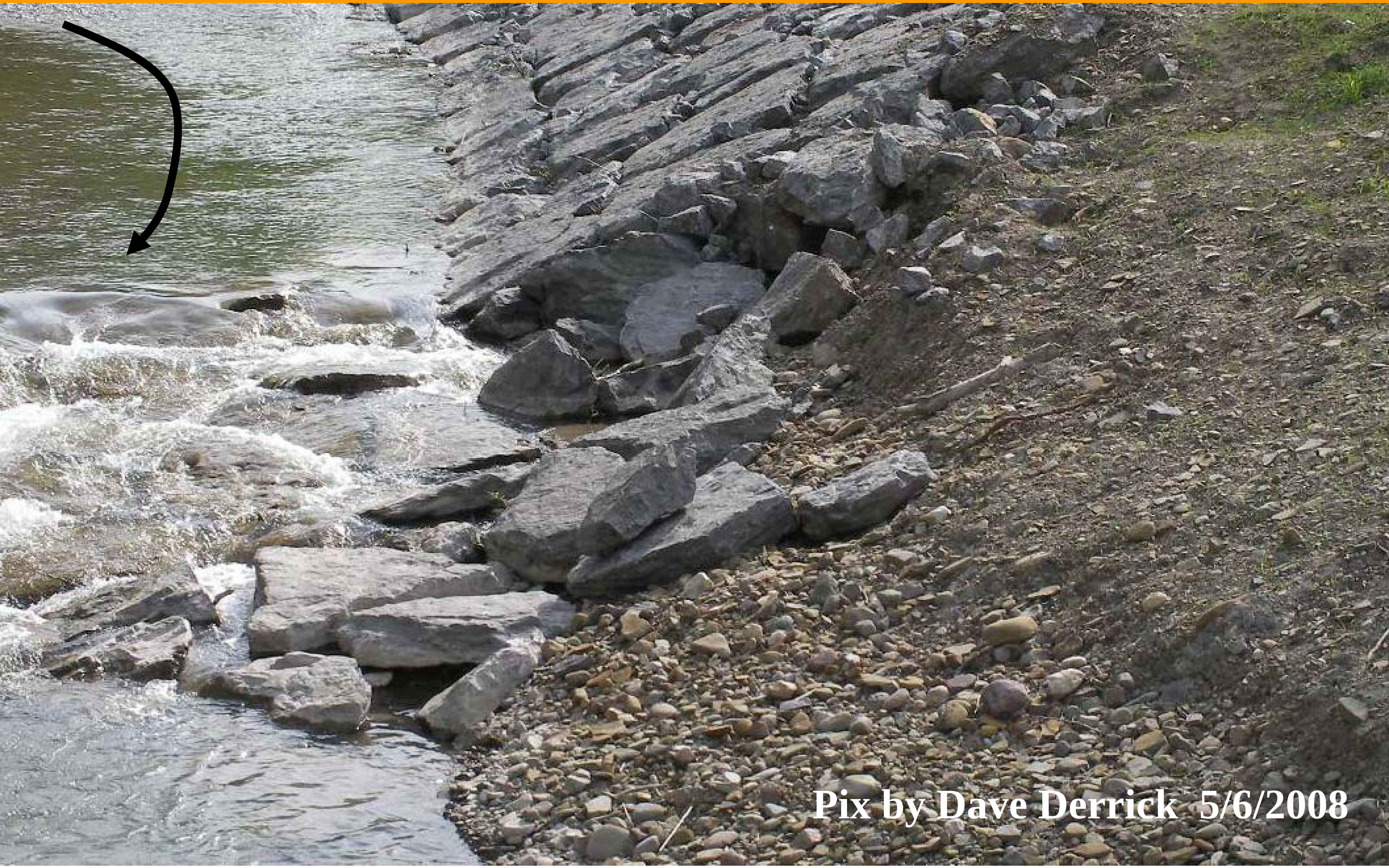


GRADE CONTROL STRUCTURES ALWAYS ALWAYS NEED BANK PROTECTION AND KEYS

Looking US @ Oatka Cr., both banks failing at ERR.



Looking US @ ERR, inadequate bank protection, Oatka Cr.



Looking US @ bank failing @ ERR on Oatka Cr., NY.

Pool Construction for All Bends

- Pools should be pre-dug and overdug for all bends except for Bend 1 (already tight and narrow)
- Over-digging allows the stream to set the final bed depth
- Over-digging allows for toe-in of bank protection materials.

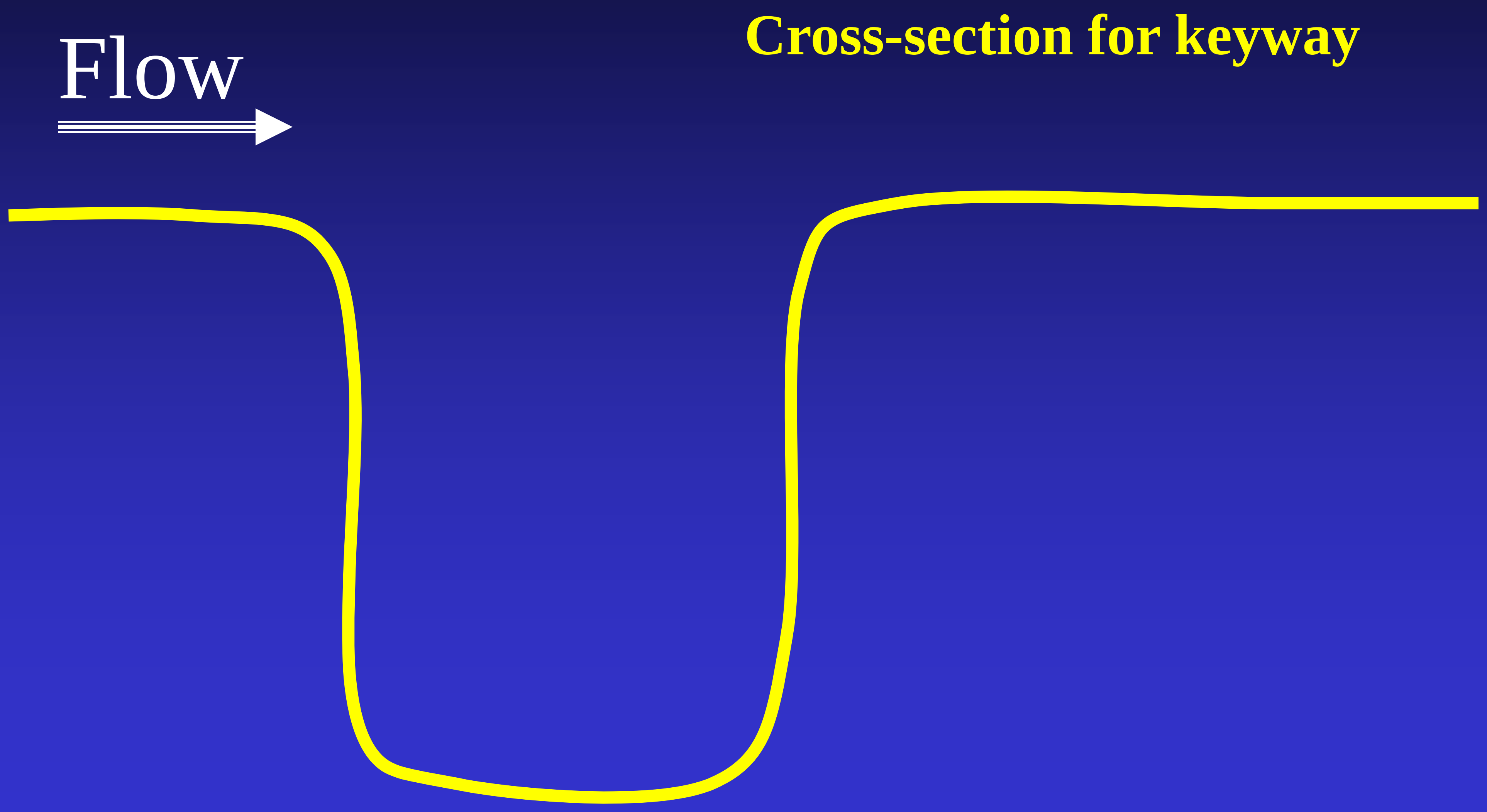
A KEY HAS ONE MAIN JOB, TO CONNECT THE RIVER TRAINING STRUCTURE TO THE REST OF THE WORLD (DON'T LET THE STREAM GET BEHIND {FLANK} RIVER TRAINING STRUCTURES)

MID-PROJECT TIE-BACKS & KEYS

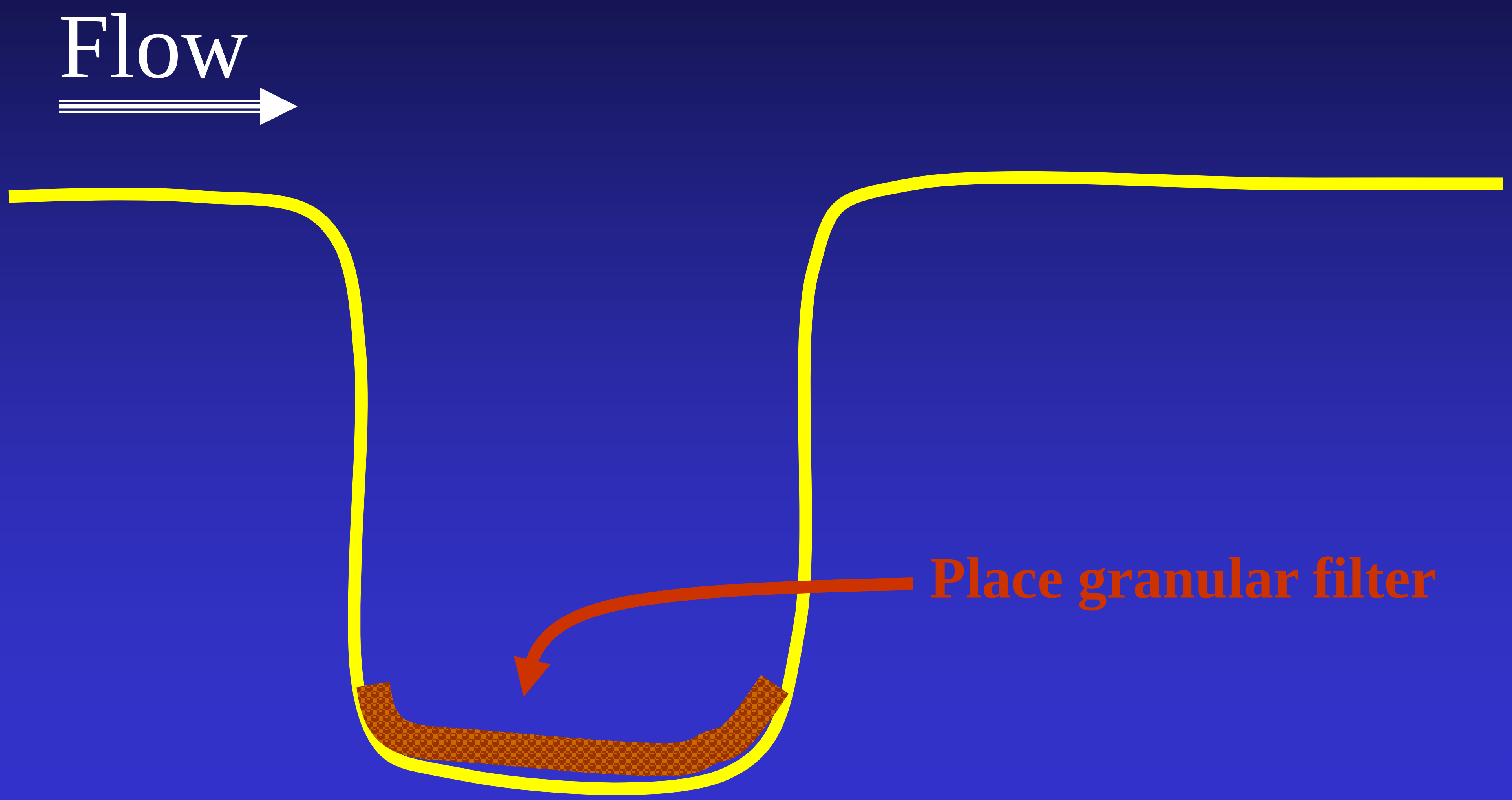
Dig straight trench perpendicular to high flow path, place willow, ?? & dogwood poles on US side (so that plants will be in compression against the stone during high flow events), backfill with graded stone, water in, backfill (&overfill for settling) with soil, water in again, then seed & compost or Hydroseed

ERR KEYWAY DETAIL

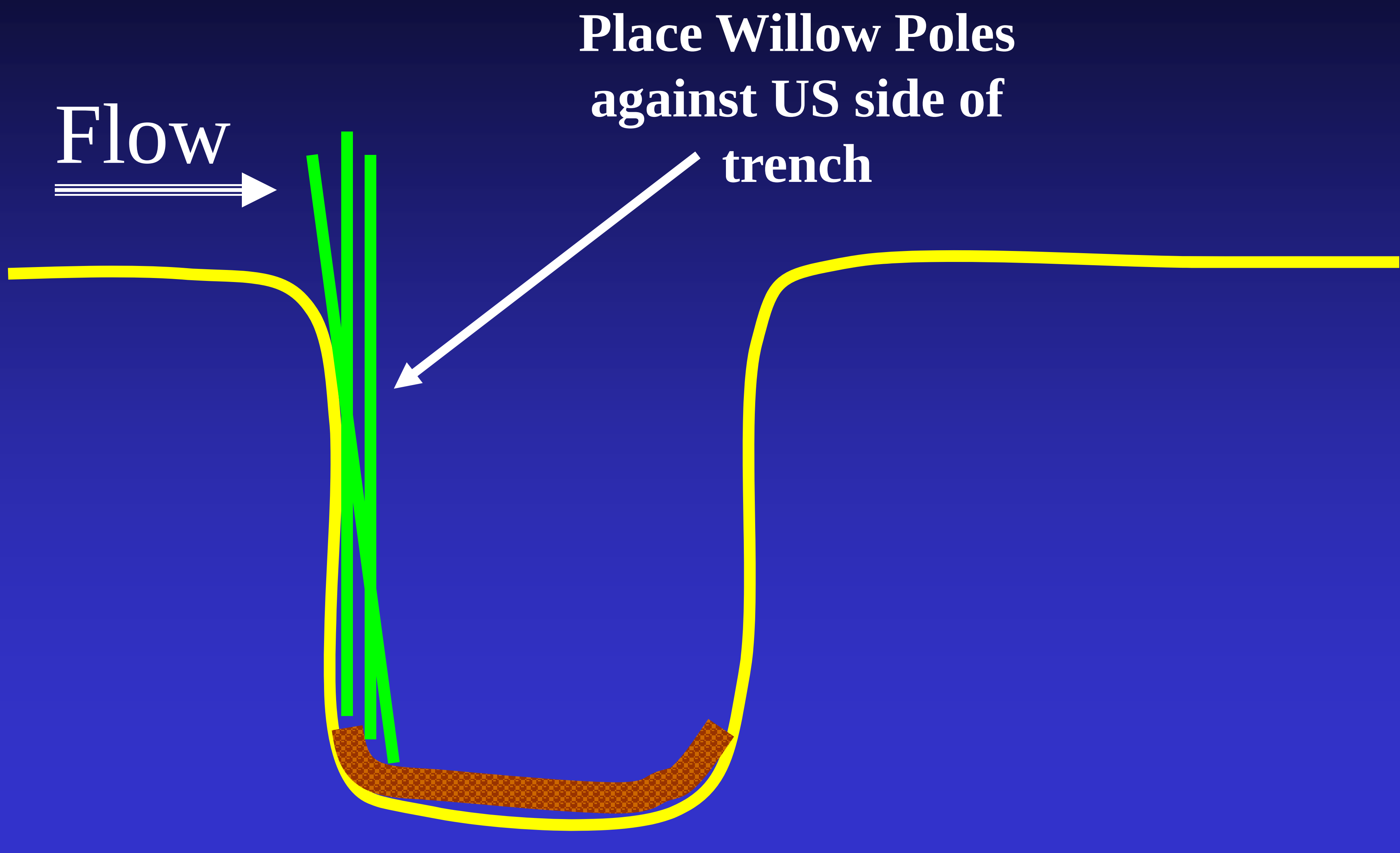
Detail for key



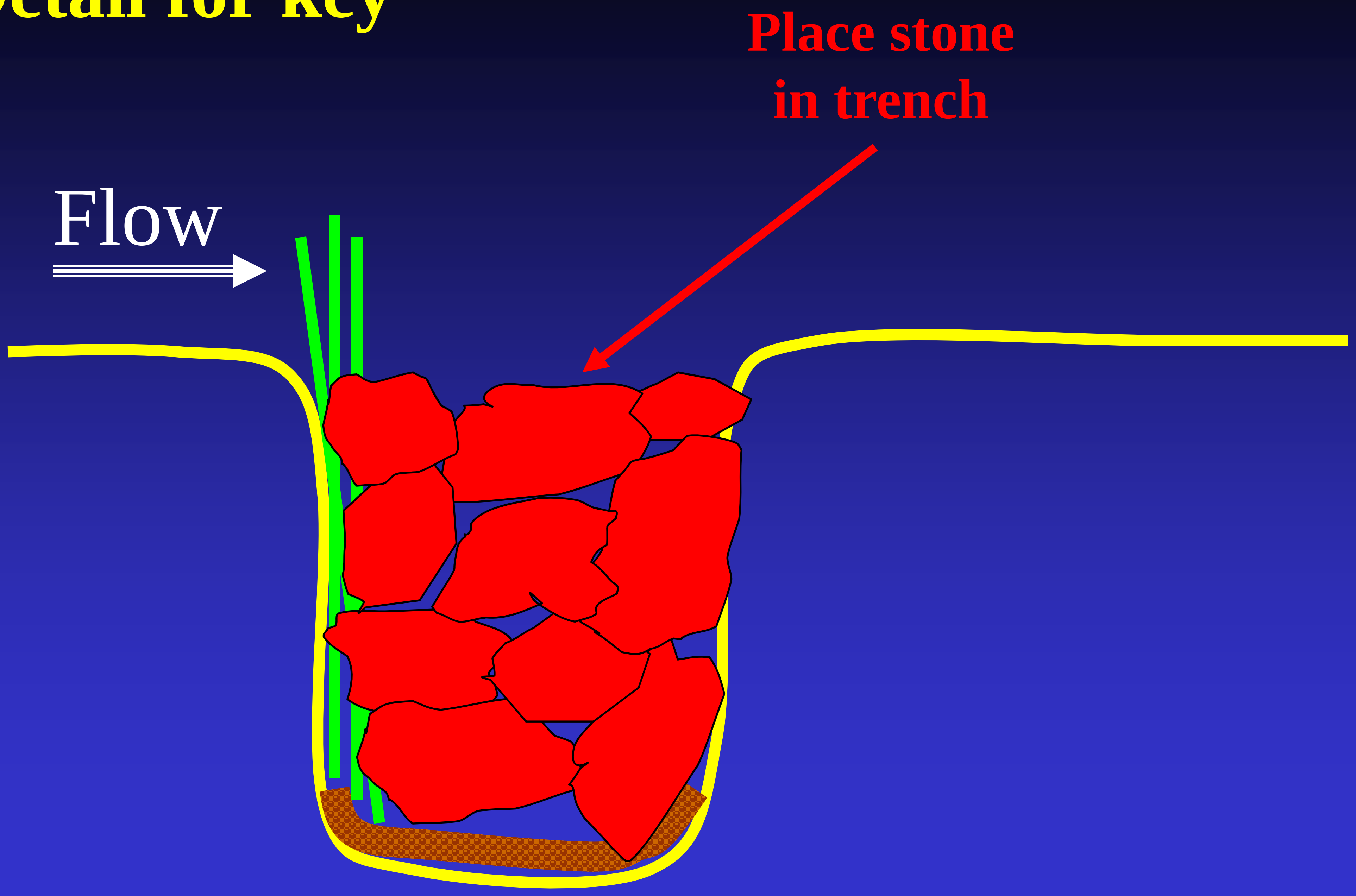
Detail for key



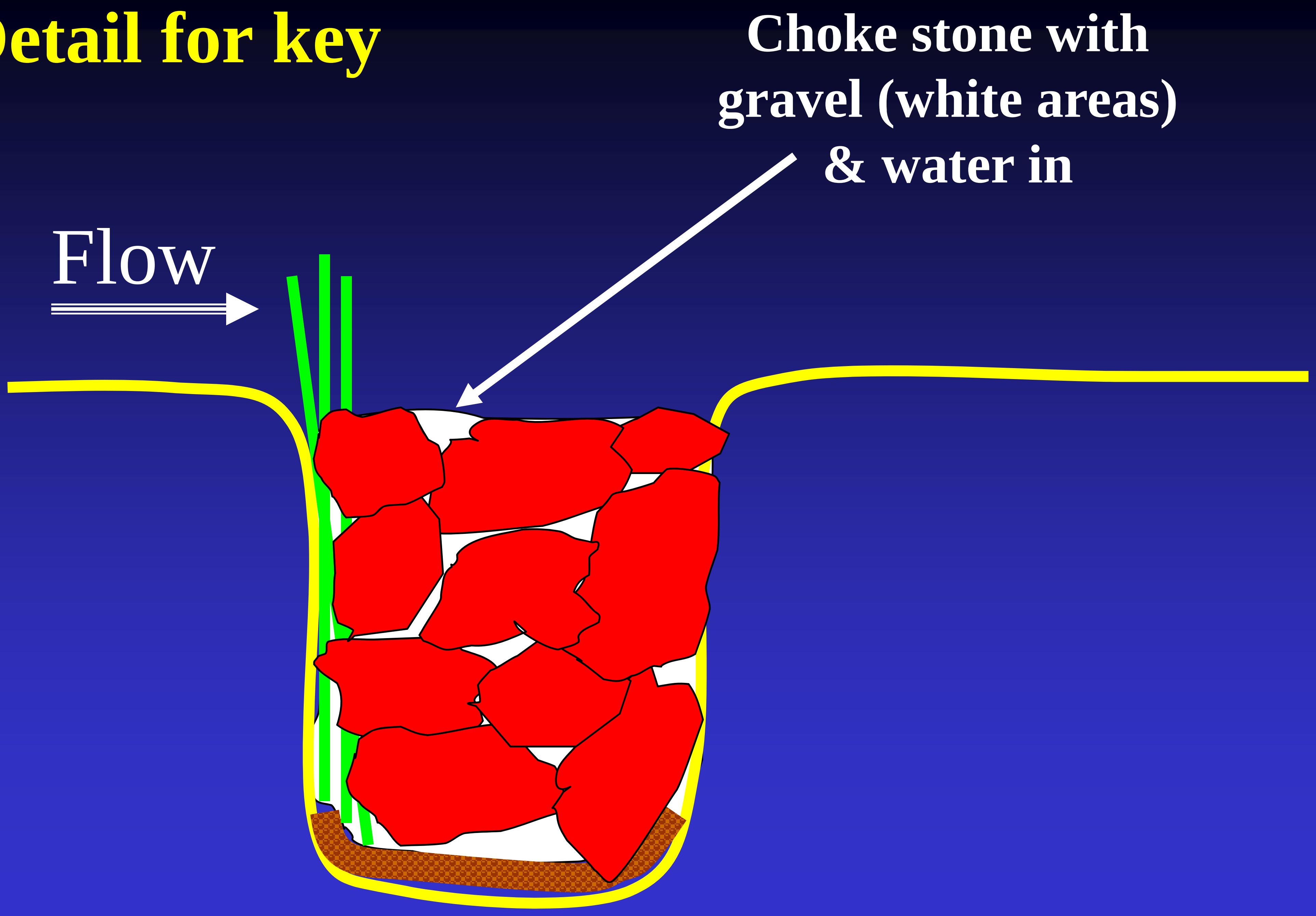
Detail for key



Detail for key

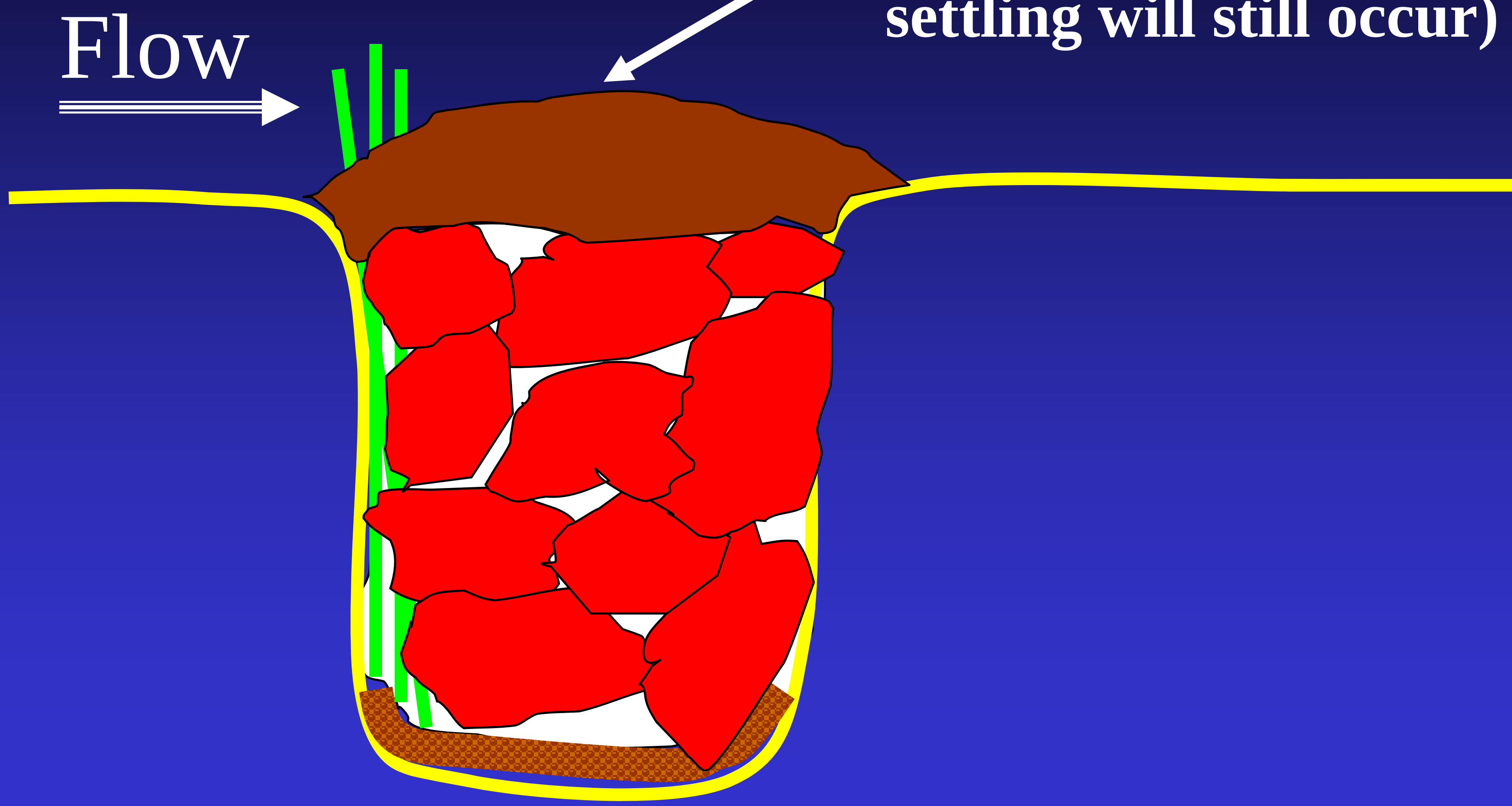


Detail for key

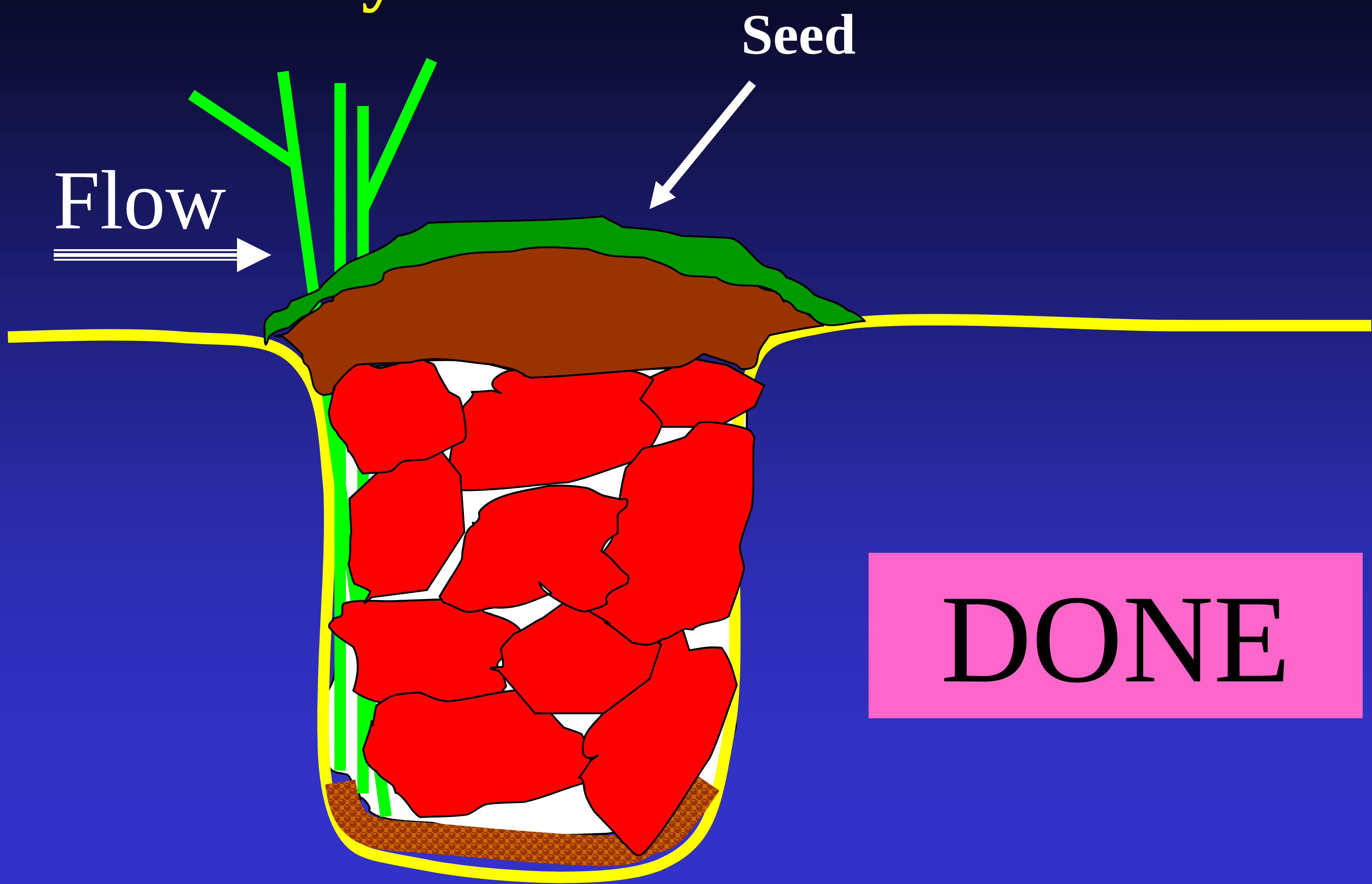


Detail for key

Backfill and overfill with native soils, then compact (some settling will still occur)



Detail for key



There is great info available on Newbury Rocked Riffles

- **TAKE A BOB NEWBURY CLASS!!!**
- **http://ouc.collegestoreonline.com/**
- http://www.newbury-hydraulics.com/workshops.htm
- **Bob Newbury's out-of-print "Stream Analysis & Fish Habitat Design Manual" is available at** ftp://ftp.lgl.com/pub/ **under 'Stream Analysis.pdf'**

When constructing a series of Newbury RR Bob always puts a NRR "at grade" (buried) at the DS end of the project to protect against DS headcuts, max height of a NRR is 1.5 ft, and Bob always puts a tailwater of 1/3 the total height of the upstream NRR on the upstream NRR. This provides energy dissipation into the tailwater pool, but also provides sediment continuity (sediment does not deposit between NRR's and the stream does not meander and flank the DS NRR)

STUDY NATURE!!!

Looking US where the stream has randomly placed a double row of boulders. This resulted in a “loose” riffle and a DS pool. Sunday Creek, Seattle, WA

AGRADATION CAN BE AGGRAVATING


STOP
'96 11 9