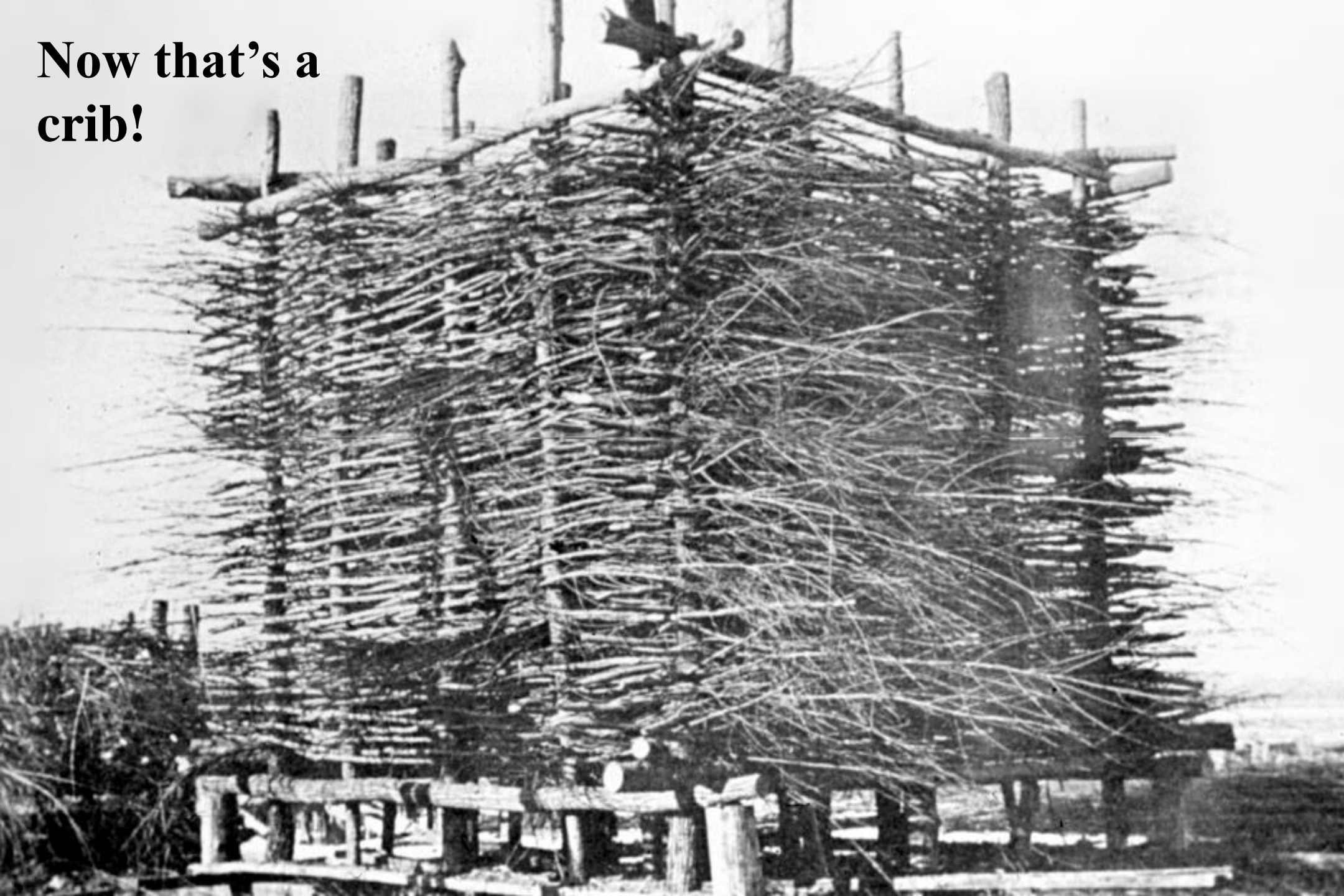


**PLANTING
ADVENTITIOUS
ROOTING PLANTS
BY MACHINE AND
HAND
(PROSPECT CLASS)**

**Now that's a
crib!**



**U.S ARMY CORPS OF ENGINEERS - Woven willow mattress,
Missouri River, circa 1925-30, note brush layering up bank**



**BIOENGINEERING IS
YOU GIVING
MOTHER NATURE A
JUMP START ON
STABILIZING YOUR
PROJECT!!**

BIOENGINEERING

WHAT ARE YOU TRYING TO DO?-FUNCTION-BASED DESIGN!

- **PROBLEMS:** For rills & gullies from overland flow, strong & dense rooted ground covers or grasses might function well.
- Use pioneer species that will stabilize the bank & evolve into a climax forest?
- Plant specific plants for use by specific fauna? Plants for insect production?
- Do you need an understory, mid-story & overstory? Will the overstory shade out the understory?
- Do you need no mid-story for woodpecker flyways?
- Vegetative roughness or living dikes to reduce flow velocities & catch sediment?
- Do you need shade & canopy over the stream? Microhabitats?
- Tall veg & canopy to keep cool moist air over the stream?
- Flood concerns? Use herbaceous plants!?!?

**VEGETATION
CAN
HOLD YOUR
WORLD
TOGETHER !!!**



**Conceptually, LIST PLANT CHARACTERISTICS
NEEDED (not a specific plant) to satisfy performance goals**



What's the effective root depth??

Bioengineering Planting Considerations

- First look up, then look down, (up to analyze for amount of light and overhead power lines, down for suitable soil & pipeline right-of-ways), then look around for exotic plant competition, and where (or if) the plants of choice are growing naturally. Plants on opposite banks might grow in different elevation bands. If plants are not found naturally, why?
- Plant materials can be obtained through commercial growers, NRCS plant material centers, grown in-house, or harvested from the wild.
- Harden-off rooted-stock plants (place outside greenhouse) before planting.
- Harvested cuttings should be kept moist and out of direct sunlight.
- Some cuttings benefit from soaking (up to 31 days for Black Willow). Water that plants are soaked in should be fresh.
- Very important to have good soil-to-stem contact, this must be carefully specified in contracts
- Plantings need to be closely monitored for insect infestation and mortality, some replanting can be expected during the second growing season.
- Is irrigation needed? Weed control? Browsing control?

**Consider
the effects
of canopy
and shade**

Picture from Dave Derrick



How Vegetative Treatments Stabilize Banks

- Foliage slows floodwaters on and near the eroding bank.
- Root network helps to bind soil together.
- Trunks and stems can trap debris and upslope failed material.
- Vegetation removes soil moisture through transpiration.
- Larger branches/trunks planted deep can sometimes mechanically stabilize soil, and could possibly pin shallow failure faults.
- Can induce sedimentation.
- Most importantly, the resulting stable bank allows for the establishment of volunteer plant growth and subsequent vegetative succession.

Cottonwood 4
Weed 88

EMERGENCY
PARKING
ONLY



Adventitious Rooting Material Planting Considerations

- **Should be harvested & planted when dormant**
- **IF PLANTED DURING THE NON-DORMANT**
- **Or refrigerated at 28 degrees (wrapped in plastic so material will not dry out and boxed in waxed cardboard boxes) and kept frozen until planted**
- **Or soaked for 10 days if harvested & planted when not dormant (expect about 25% to live)**

**Harvesting Pole-
sized Adventitious
Rooting Material**

Matt Horvat with safety glasses & ear plugs cutting willows with chainsaw



Teen volunteers cutting branches & leaves from poles



CONSTRUCTION-TOLEDO OHIO PROJECTS. PIX BY KRIS PATTERSON 8-2008

Use stout twine to bind a set number of poles into a manageable bundle. Twine should be looped & tied at one end, then looped & tied at the opposite end, thus providing a carrying handle



CONSTRUCTION-TOLEDO OHIO PROJECTS. PIX BY KRIS PATTERSON 8-2008

Soaking willow, half out of water, half of the pole should be submerged with butt ends underwater. Research by Dr. Doug Shields showed that soaking Black Willow 10 days will increase root production by 2,600%, 100% flushed out, & twice as many survived. Fence is to protect from beaver browse.



Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007

TWO-STAGE SLIT TRENCH TECHNIQUE

**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

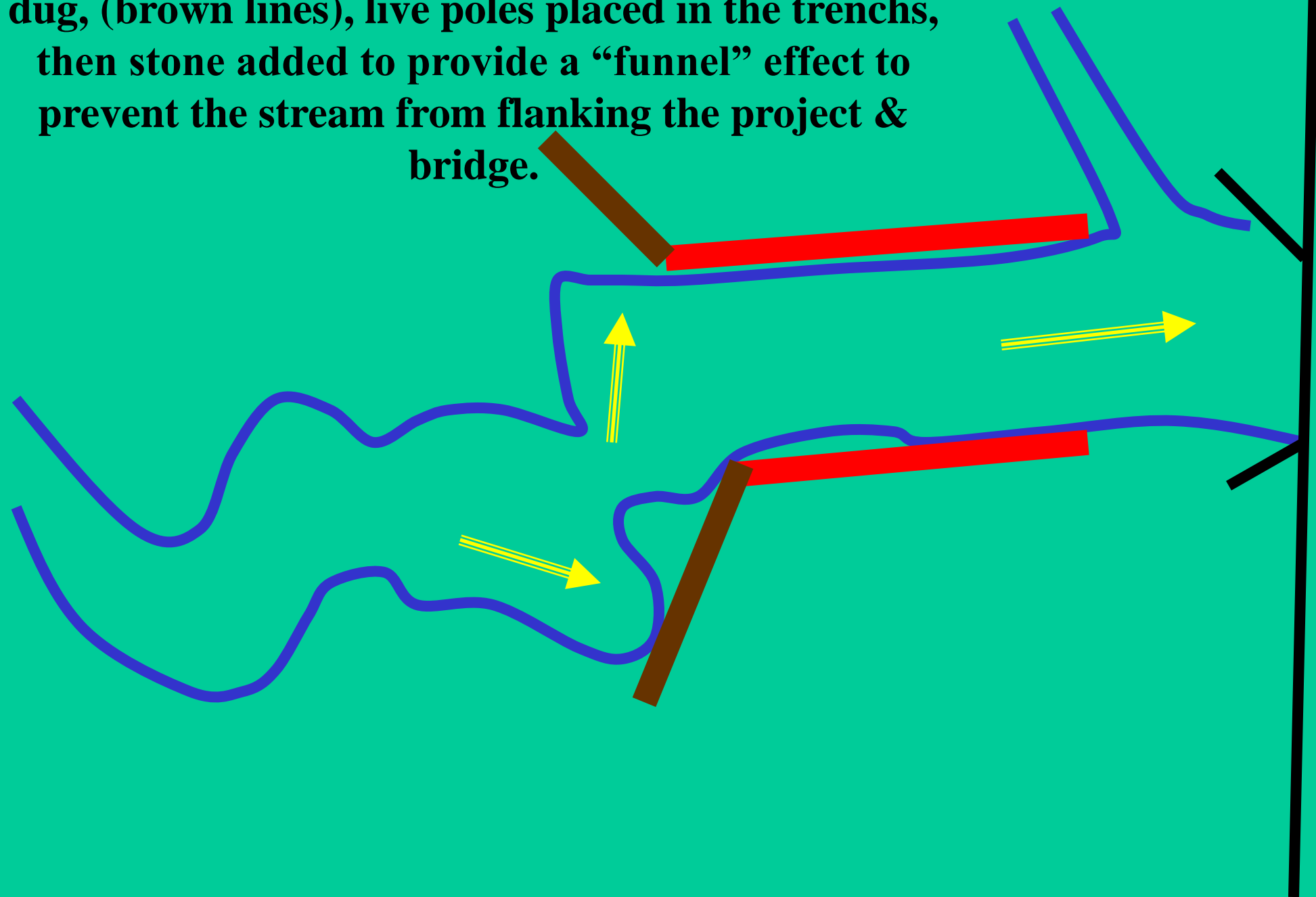
**Looking US at right
bank. Pix by Derrick**



**Stream was straightened &
stacked stone walls built along the
red lines, all without a permit!!**



Some stone was removed from the walls, then trenches dug, (brown lines), live poles placed in the trenches, then stone added to provide a “funnel” effect to prevent the stream from flanking the project & bridge.



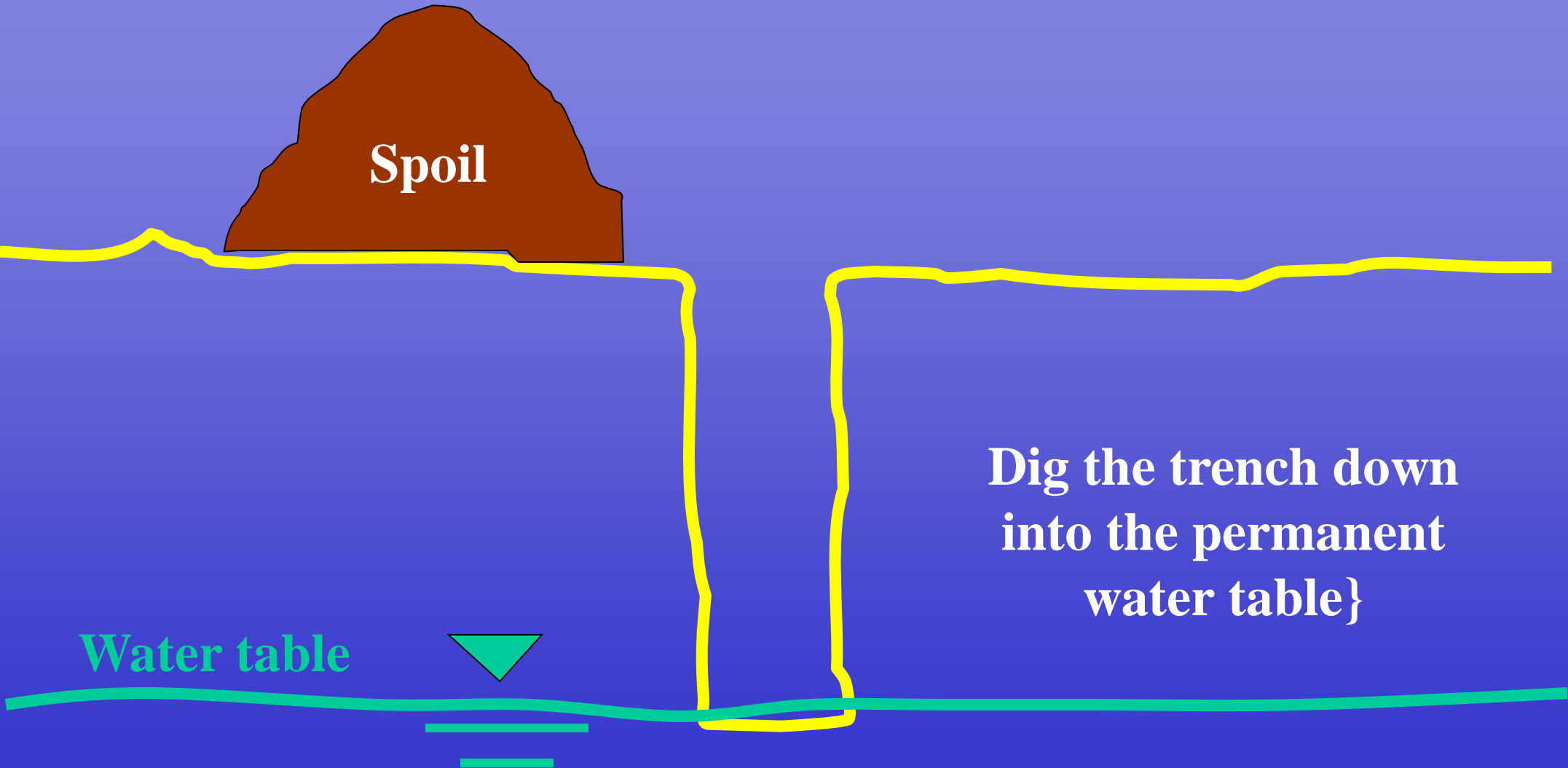
**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**



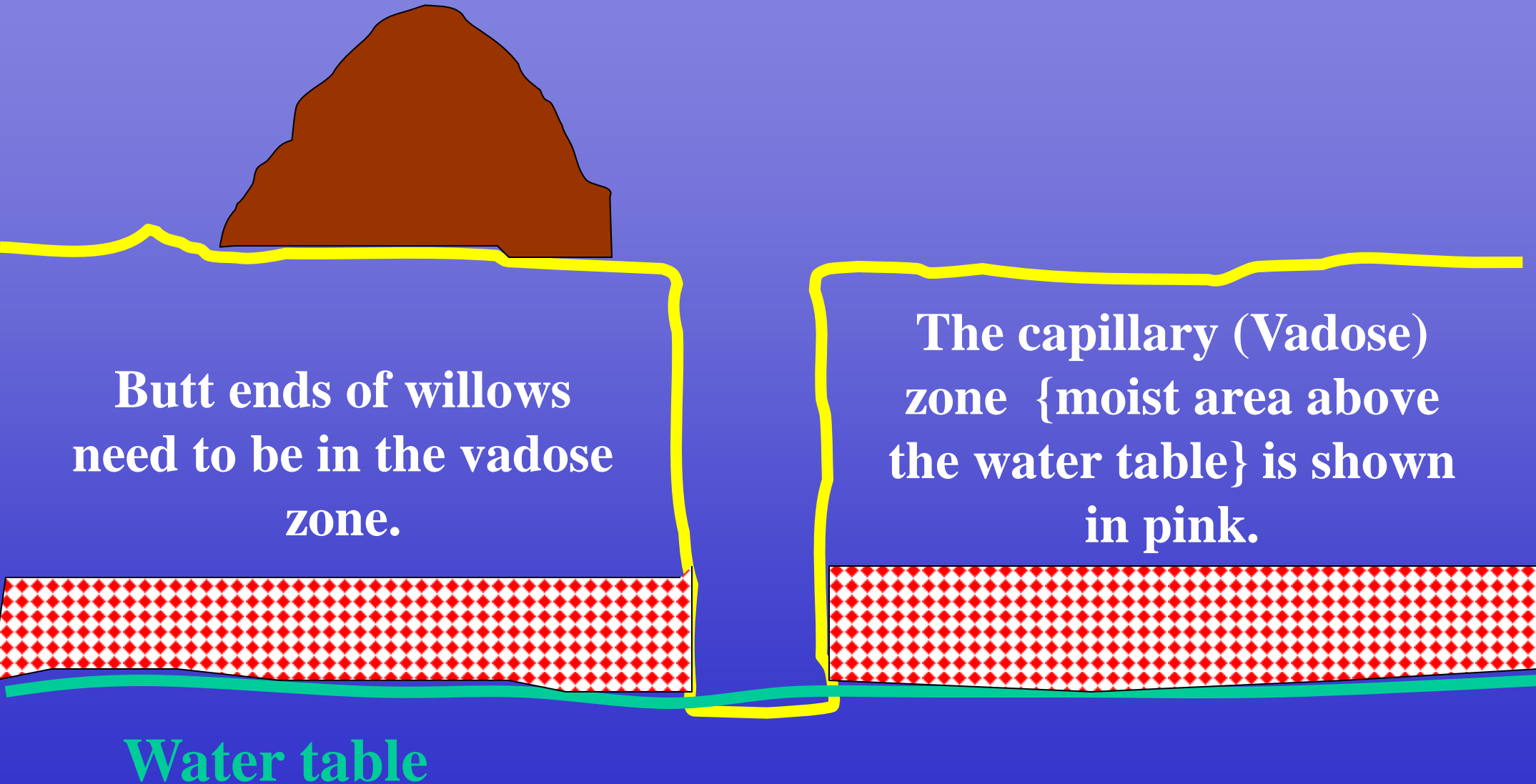
**Rubber tired
backhoe digs
4-5 ft deep
trench with a
narrow
bucket.**

**Pix by Bill
Frederick**

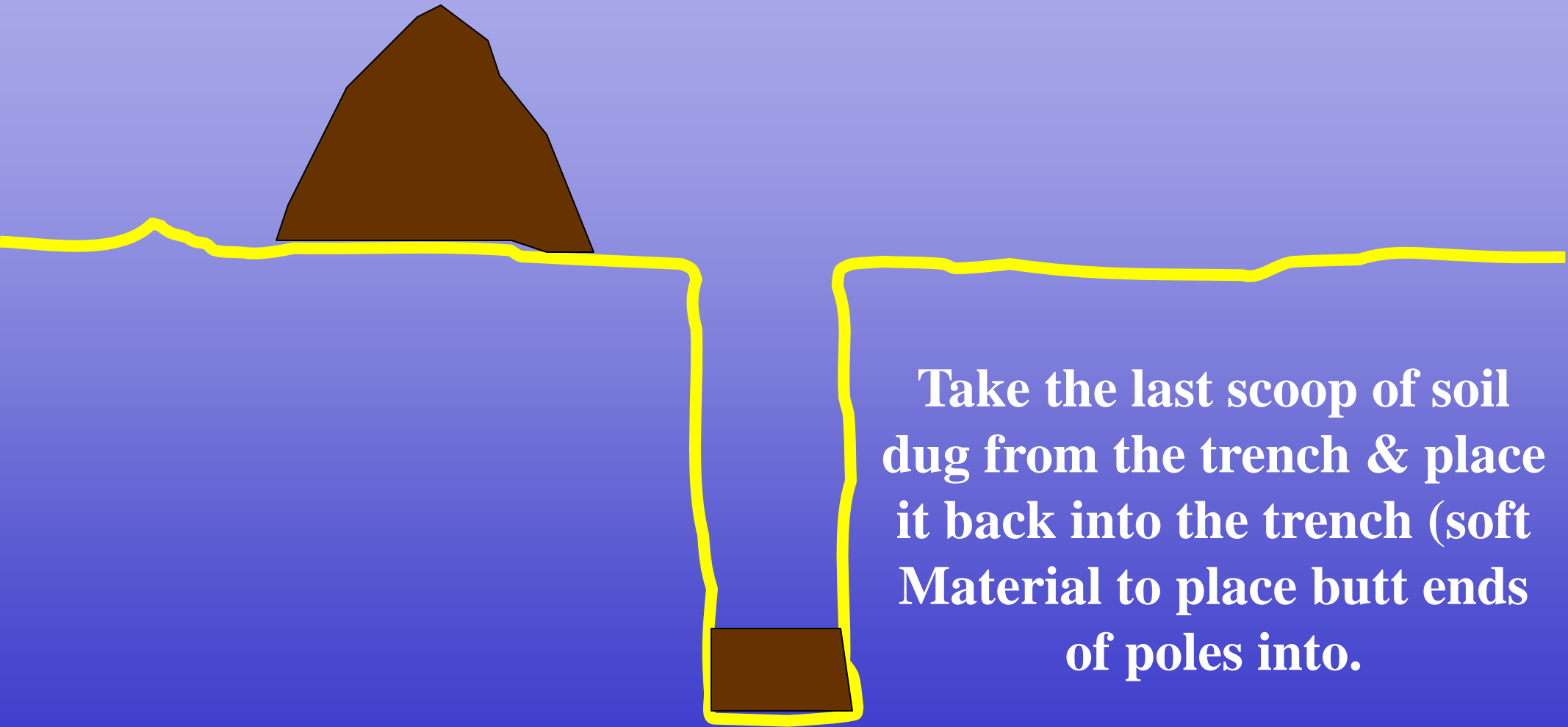
TWO-STAGE SLIT TRENCH TECHNIQUE



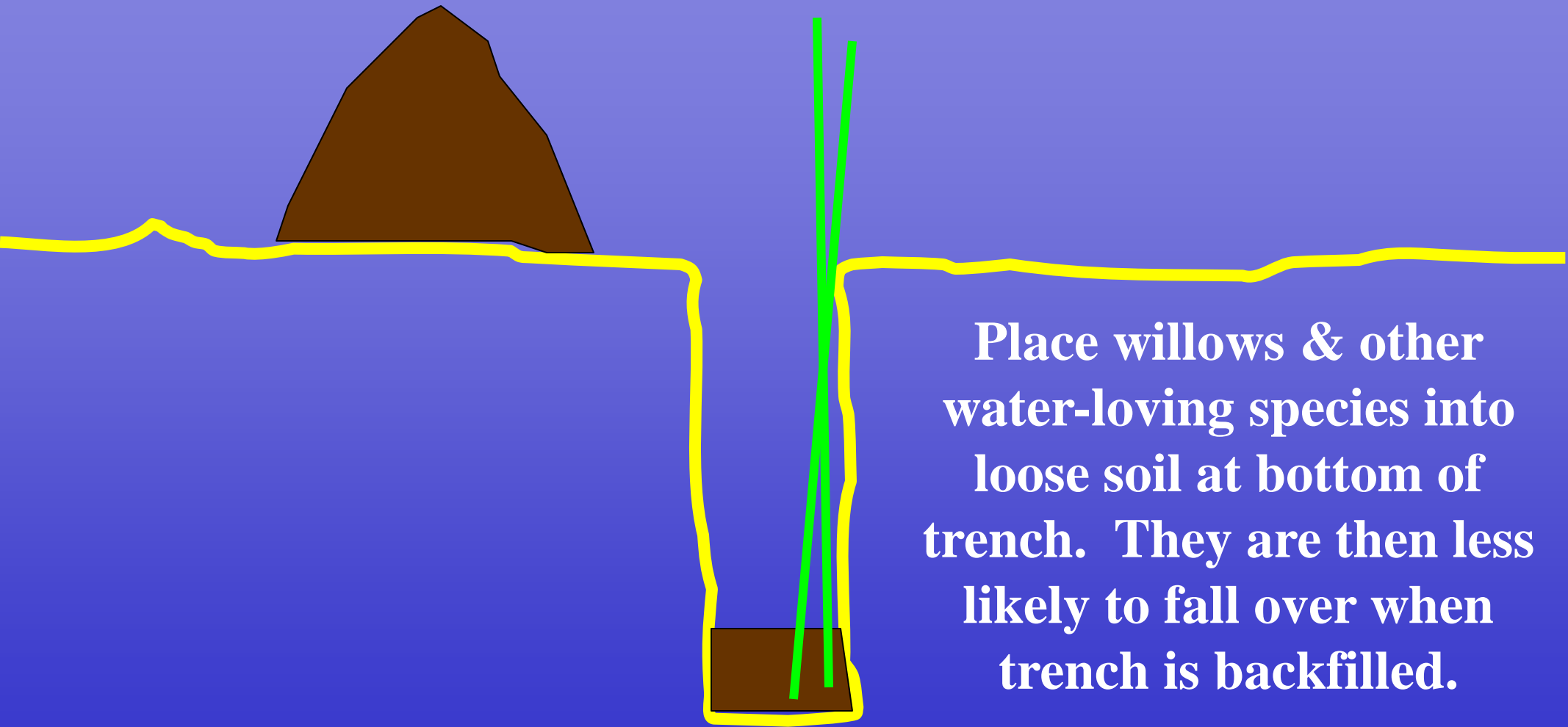
TWO-STAGE SLIT TRENCH TECHNIQUE



TWO-STAGE SLIT TRENCH TECHNIQUE



TWO-STAGE SLIT TRENCH TECHNIQUE

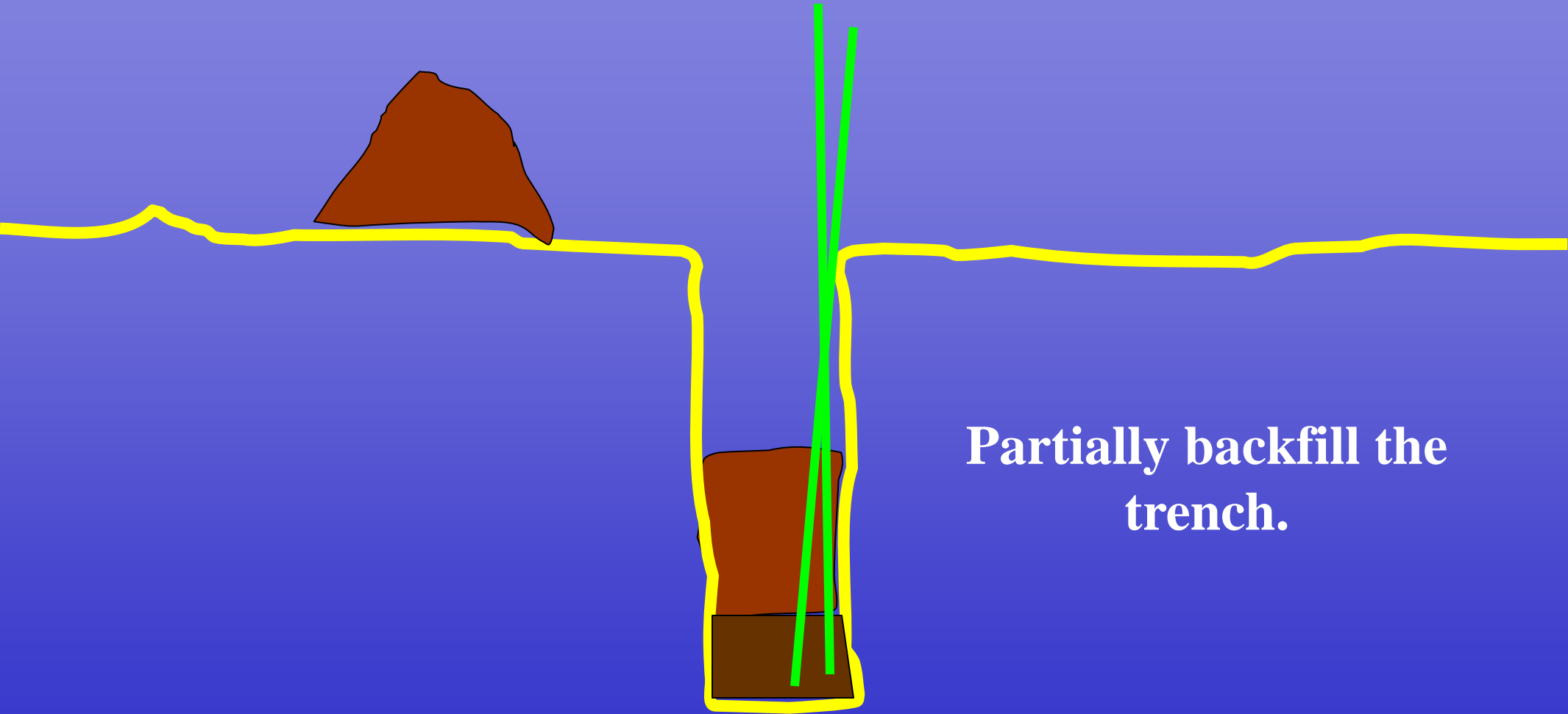


**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

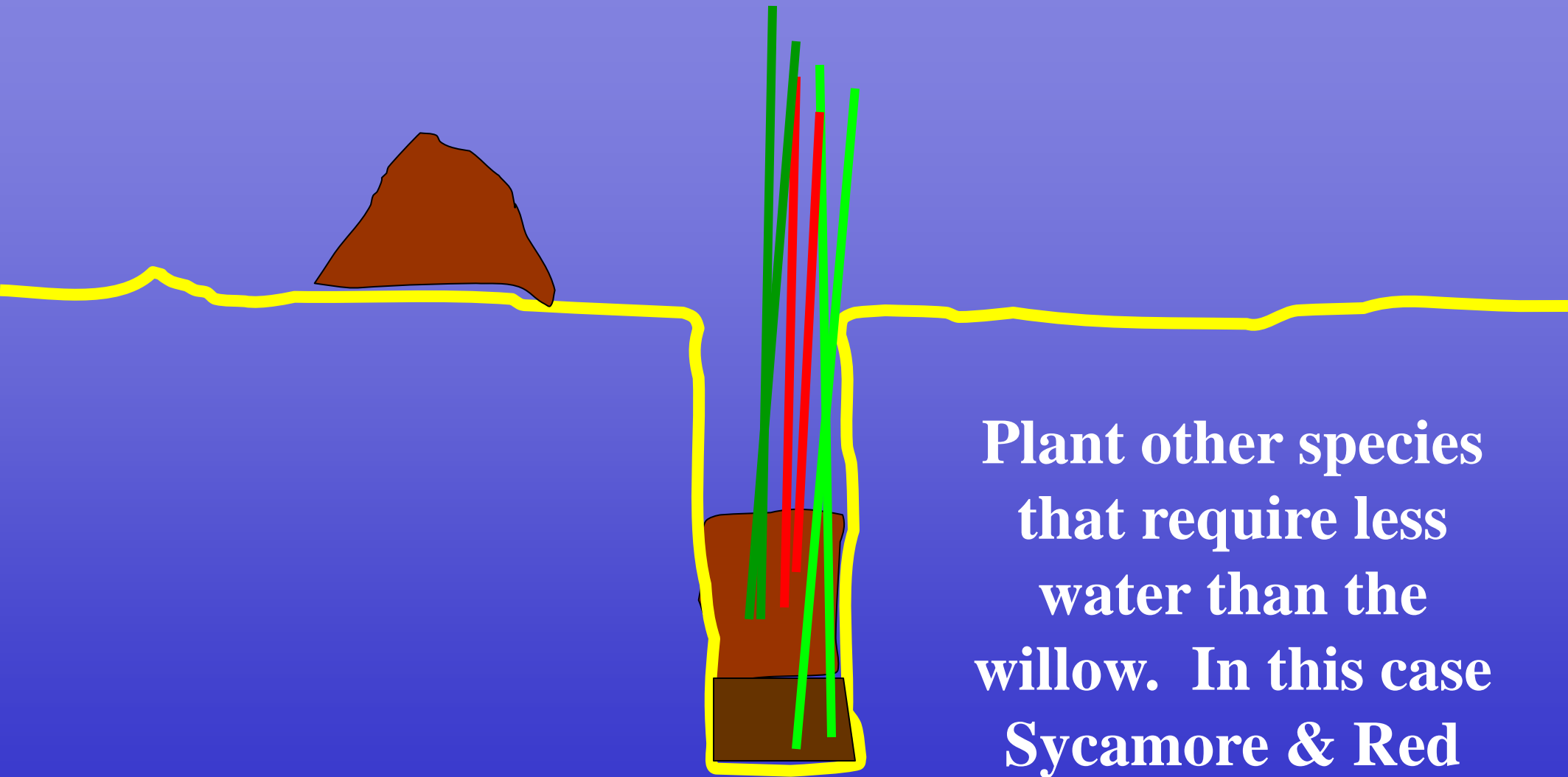


**Many hands get things
done quickly, 2,740
plants planted in about 6
hours. Pix by Derrick**

TWO-STAGE SLIT TRENCH TECHNIQUE



TWO-STAGE SLIT TRENCH TECHNIQUE



Plant other species
that require less
water than the
willow. In this case
Sycamore & Red
Osier Dogwood

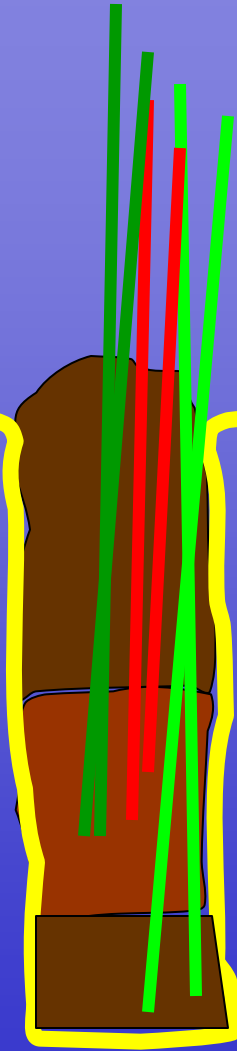


**Partially
backfill, then
plant species
that require less
water (Red
Osier Dogwood
& Sycamore).
Pix by Derrick**

**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

TWO-STAGE SLIT TRENCH TECHNIQUE

DONE



Completely
backfill trench &
water plants in



**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

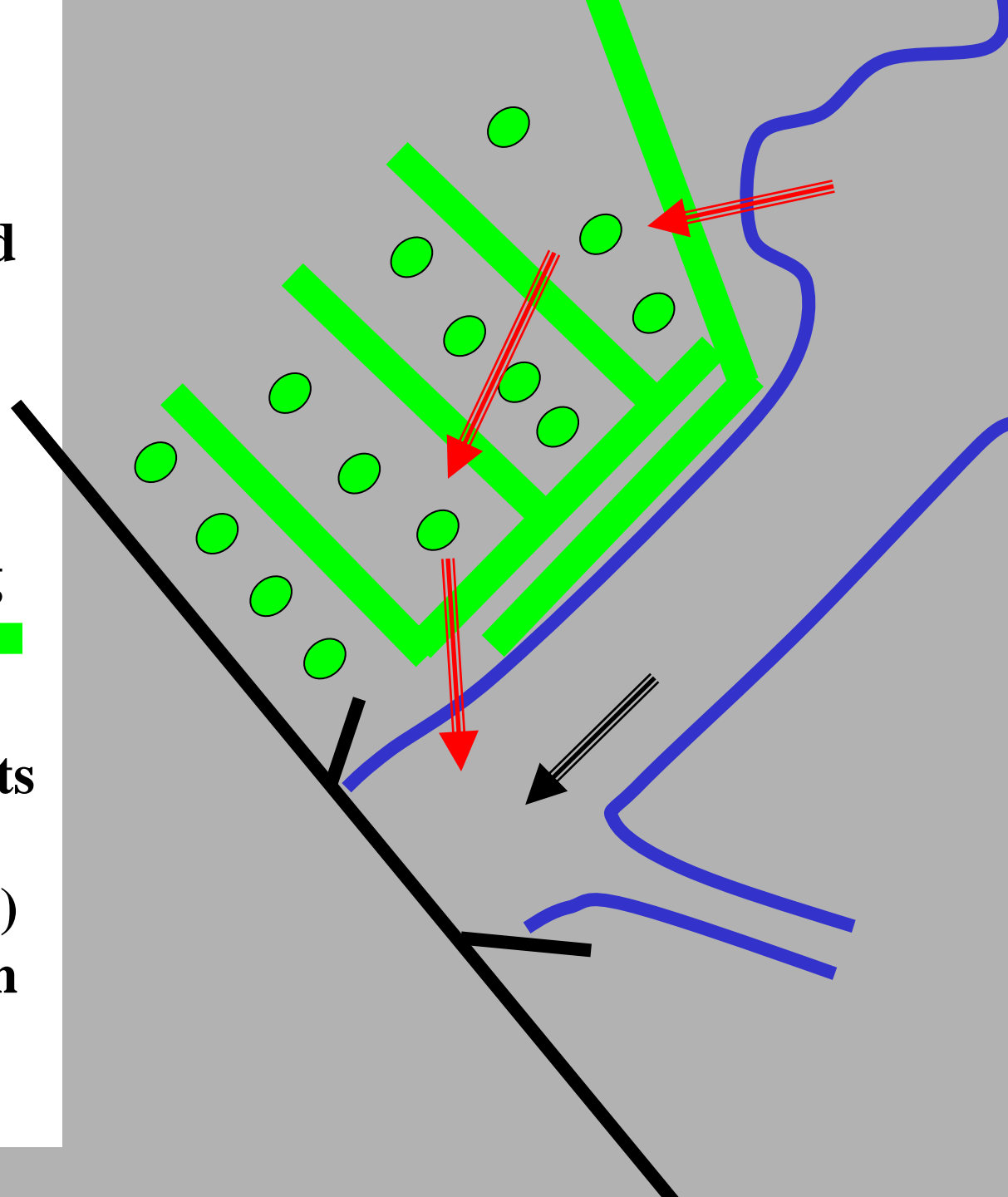
Backfill using either the bulldozer or hoe. Pix by Derrick



PLANT PLANTS ON A GRID

**(PERPENDICULAR &
PARALLEL TO THE DIRECTION
OF HIGH FLOW)**

**Black Willow,
Streamco
Willow, Red
Osier Dogwood
& Sycamore
were planted
using the Slit
Trench
bioengineering
method. 
40 RPM
container plants
(7 species of
trees & shrubs)
were planted in
the green oval
areas. **



**Plantings
form a grid
to flow. **No
matter how
water flows
through the
project, it
encounters
rows of
vegetation
(Living
Dikes)****

**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

**Slit Trenches on the grid
pattern. Pix by Derrick**



**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

**LET'S SEE
HOW IT
GROWS**

**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

**BEFORE 5-15-2007
8:00am. Pix by Derrick**



**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

**AFTER 5-15-2007 Noon.
Pix by Derrick**



**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**



**Aug 3, 2007 Less than 3 months after installation.
Looking US at right bank floodplain. Pix by Mark Schaub**

**July 10, 2008. {middle of second growing season} Looking at Slit
Brush Layering (left bank). Pix by Derrick**

Onondaga Creek-Year 2



**July 10, 2008. {middle of second growing season} Right overbank
lush growth, average height is 7 to 9 ft tall. Pix by Derrick**

Onondaga Creek-Year 2



**2 YEARS & 1 MONTH
LATER-Mark with 10-14
ft tall willow.**



2 YEARS & 1 MONTH LATER-Onondaga Cr.@ Nichol Rd Bridge-DERRICK 6-18-09

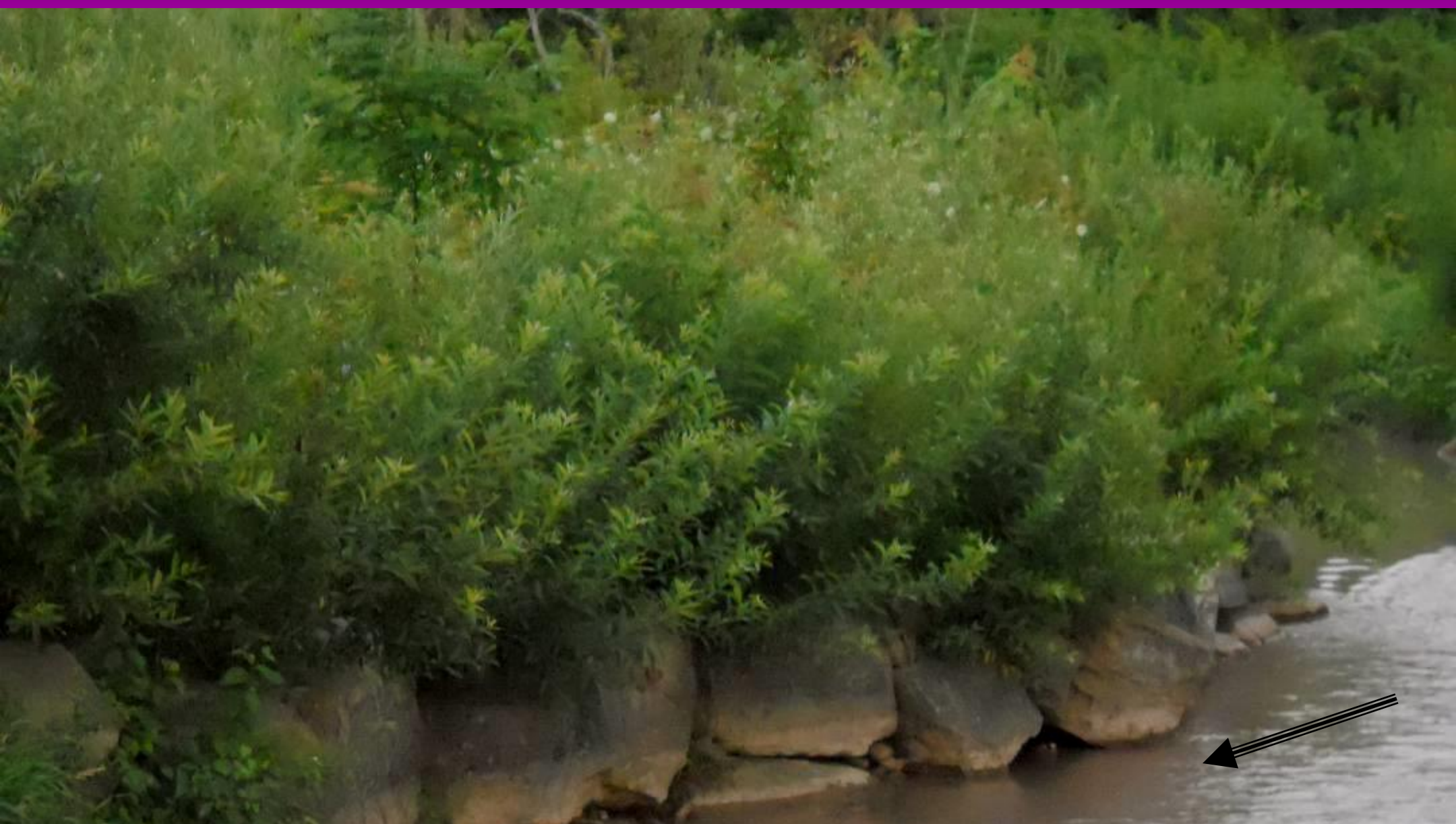
**3 YEARS AFTER
PROJECT
COMPLETION
Photos by Derrick
JULY 21, 2010**

3 YEARS LATER-Looking US @ robust floodplain bench growth



3 YEARS LATER-Onondaga Cr.@ Nichol Rd Bridge-DERRICK 7-21-2010

3 YEARS LATER-Robust streamside growth!!!



3 YEARS LATER-Onondaga Cr.@ Nichol Rd Bridge-DERRICK 7-21-2010

WHY WILLOW??

Willows, dogwoods, alders, & cottonwoods (early pioneer species) hold the bank together & provide roughness until other slower growing species or the seed bank kicks in.

Willows will not be long-term dominants, they are short-term aggressors that stabilize banks quickly post-construction.

Paraphrased from Paul Fuhrmann, Ecology & Environment

Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007

TWO LAYERS OF “SLIT” BRUSH LAYERING

**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

**Two rows of Slit Brush
Layering located along
black lines. Pix by Derrick**





Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007

This is almost a Live Siltation retrofit. Pix by James Bennett



**Slit Brush Layering the
Streamco Willow close to water
surface. Pix by Kathy Blaisure**

**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**

**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**



**Looking US at
both layers of
completed Slit
Brush Layering.
Pix by Bill
Frederick**

MAY 15 2007

**Onondaga Creek @ Nichol Road Bridge,
LaFayette, NY – project planted 5-15-2007**



**Looking US at both
layers of Slit Brush
Layering. Pix by
Bill Frederick**

July 10, 2008. Looking at Slit Brush Layering. Pix by Derrick

Onondaga Creek-Year 2



July 10, 2008. Looking at Slit Brush Layering. Pix by Derrick

Onondaga Creek-Year 2



**2 YEARS & 1
MONTH AFTER
PROJECT
COMPLETION**

Photos by Derrick

JUNE 18, 2009

2 YEARS & 1 MONTH LATER-Looking @ left bank Slit Brush Layering. Vegetation is robust & lush & fully functioning. Red Osier Dogwood is dominating the Slit Brush Layering on the bank



2 YEARS & 1 MONTH LATER-Onondaga Cr.@ Nichol Rd Bridge-DERRICK 6-18-09

2 YEARS & 1 MONTH LATER-Looking US @ 2 rows of Slit Brush Layering.



2 YEARS & 1 MONTH LATER-Onondaga Cr.@ Nichol Rd Bridge-DERRICK 6-18-09



**Tree eaters can
cause problems,
but usually of a
cyclic nature**

Beaver damage



30" diameter tree



Rocky the Dog damage

**Clear Creek,
Bovina, MS.
Another
shot of
beaver-
browsed
willow
resprouting**



**Beware invasive exotics, 7 million acres of
Kudzu down south (small patch shown here)**



Adventitious Rooting Plants

(when trunk or branches are in contact with soil the plant will sprout roots)

- Banker's Willow- *Salix x cottetii*, Streamco Willow- *Salix purpurea*, Black Willow- *Salix nigra*, Pussy Willow- *Salix discolor*, & Crack, Autumn etc.
- Red Osier Dogwood- *Cornus stolonifera*
- Silky Dogwood- *Cornus amomum*
- Buttonbush- *Cephalanthus occidentalis*
- Sycamore- *Platanus occidentalis*
- Cottonwood- *Populus deltoides*
- Box Elder- *Acer negundo*
- Speckled Elder-(bark was scarred)- *Alnus rugosa*
- Elderberry- *Sambucus Canadensis*
- Elm- *Ulmus Americana*
- Bois d'arc, Mock Orange, Bow Wood, Hedge Apple, Horse Apple, Osage Orange- *all are Maclura pomifera*.
- River Birch- (*Betula nigra*)
- Black Locust- (*Robinia pseudoacacia*)
- Northern Catalpa- (*Catalpa speciosa*)
- Mulefat- (*Baccharis salicifolia*)

Anyone know of
any others???

**ADVENTITIOUS ROOTING
PLANTS NEED TO BE
PLANTED WHEN THE
PLANTS ARE DORMANT
{AFTER THE LEAVES
HAVE DROPPED & BEFORE
THE LEAF BUDS APPEAR
IN THE SPRING}**

TRANSPLANT

A BIG

CLUMP OF

STUFF

**TRANSPLANTED LIVING WILLOW
RETARDS
MONKEY RUN STREAM REALIGNMENT
PROJECT, ARCADE, NY**

- **THINK BIG!!!! THINK INSTANT!!!**
- Transplanting an entire big clump of willows (roots and all) a track hoe bucket (4 ft wide) at a time
- Multi-function, used to weigh down bank protection and provide bank protection, shade, cover, insect habitat, etc



**Looking US at Pool
#1, log revetment in
place and anchored
with duckbill anchors**

**Grab a scoop
of willows**



Mini case study: 2 of 4



**More
willows**

Mini case study: 3 of 4

Looking US at Living Willow Retard two growing seasons after planting Aug 24, 2006



Pix by Derrick

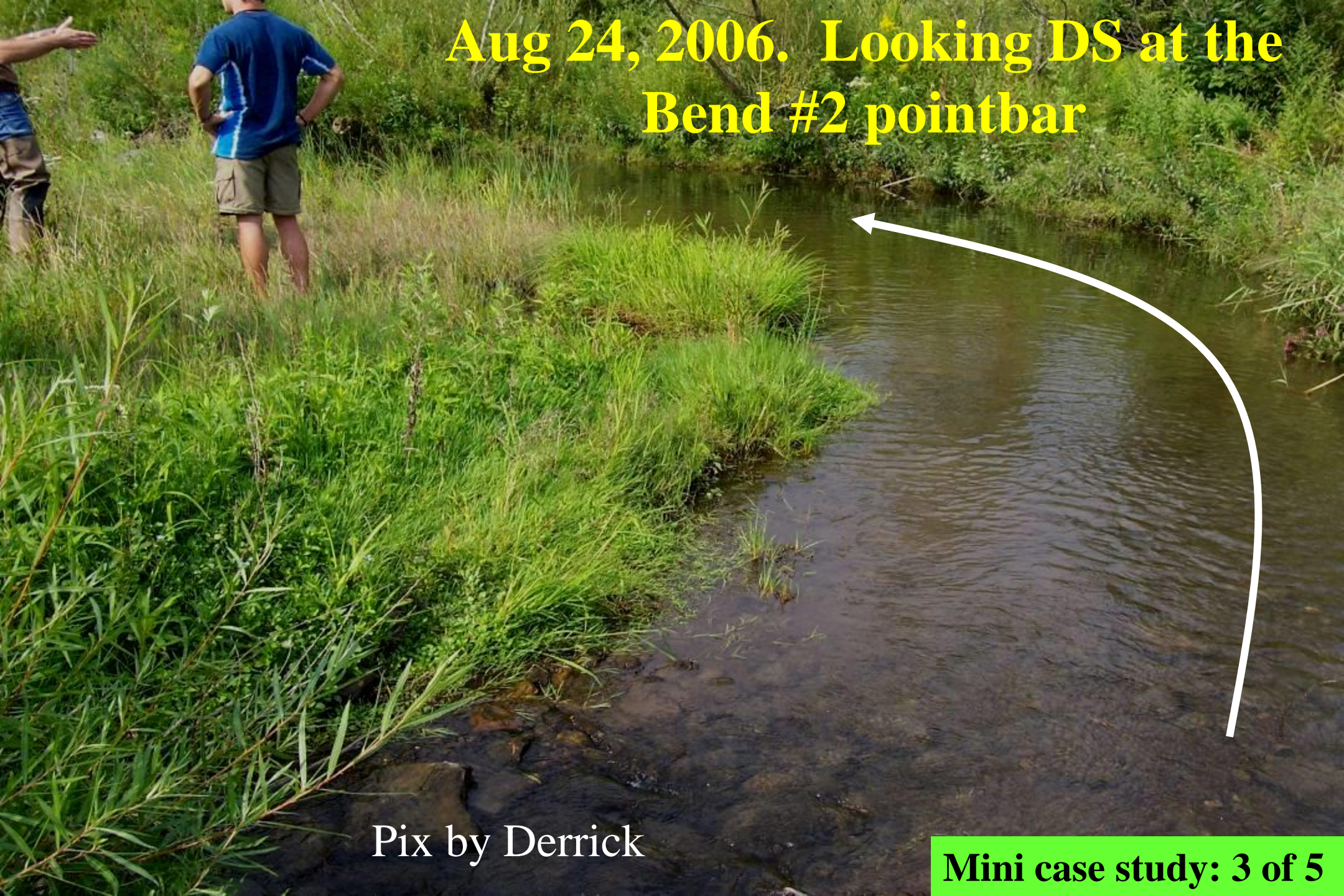
**TRANSPLANT A
LITTLE BITTY
CLUMP OF STUFF
MONKEY RUN,
ARCADE, NY**

**Looking DS. Creeping bent grass
sod transplantation to define
channel width-Nov 5, 2006**



Mini case study: 2 of 5

**Aug 24, 2006. Looking DS at the
Bend #2 pointbar**



Pix by Derrick

Mini case study: 3 of 5

Watercress, mint, creeping bentgrass, etc


Plants that occupy that **occupy**
edge between terra firma &
water with much mass in the
water, good refugia for bugs, and
juvenile & young-of-year fishes

**Aug 24, 2006. Great diversity & shallow areas
on the pointbar. Almost a hemi-wetland!!!!**



Pix by Derrick

Mini case study: 4 of 5

A photograph of a river bend. The right bank is covered in dense, green vegetation, including tall grasses and shrubs. The water is dark and reflects the sky. A white arrow points from the text on the right towards a pointbar in the water. The foreground shows some rocks in the water.

**Aug 24, 2006.
Looking DS at
Bend #2, note
nice growth on
pointbar**

Pix by Derrick

Mini case study: 5 of 5

Half-Drowned

Bushes with

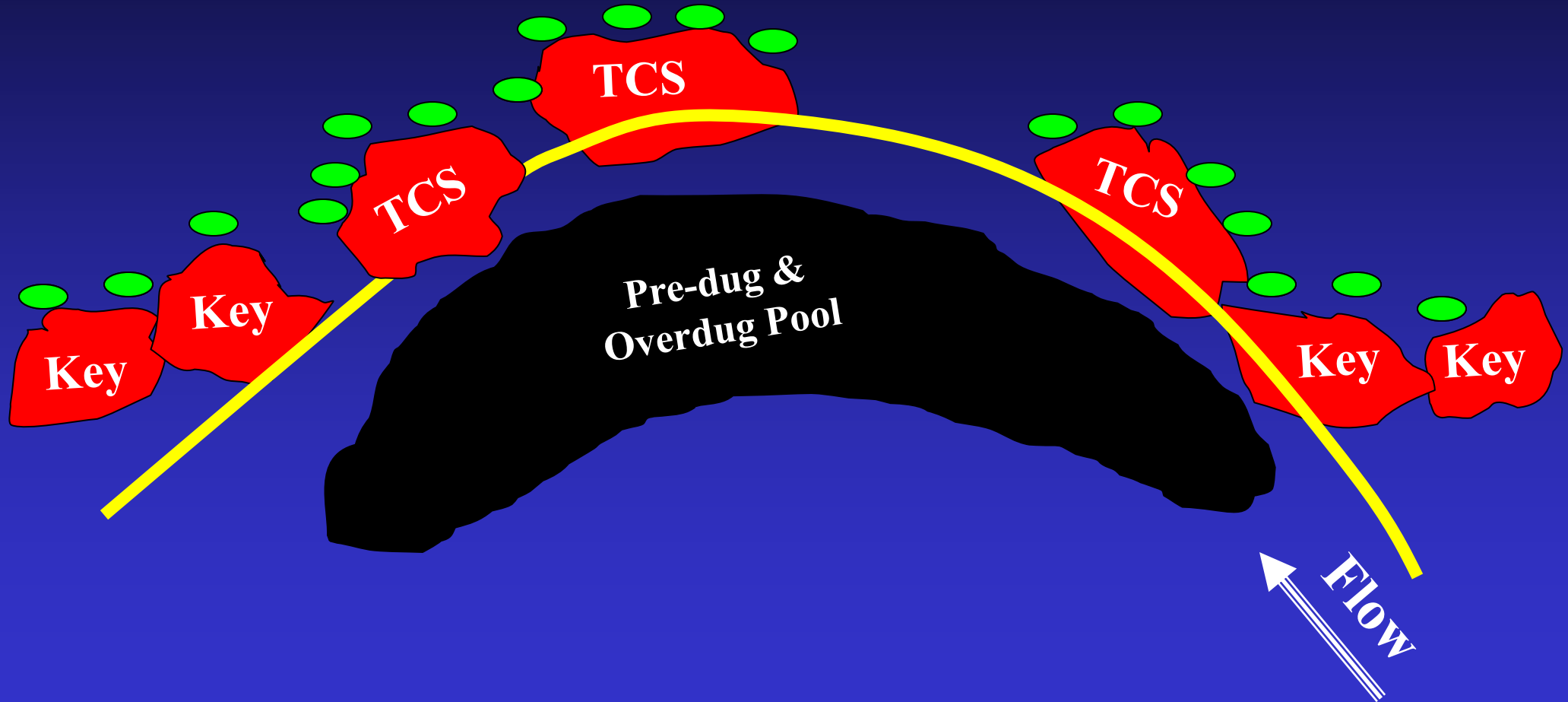
**Traffic Control Stones
& additional plantings.**

Half-Drowned Bush with Traffic Control Stones



Pre-dig and Over-dig pool.

Half-Drowned Bush with Traffic Control Stones



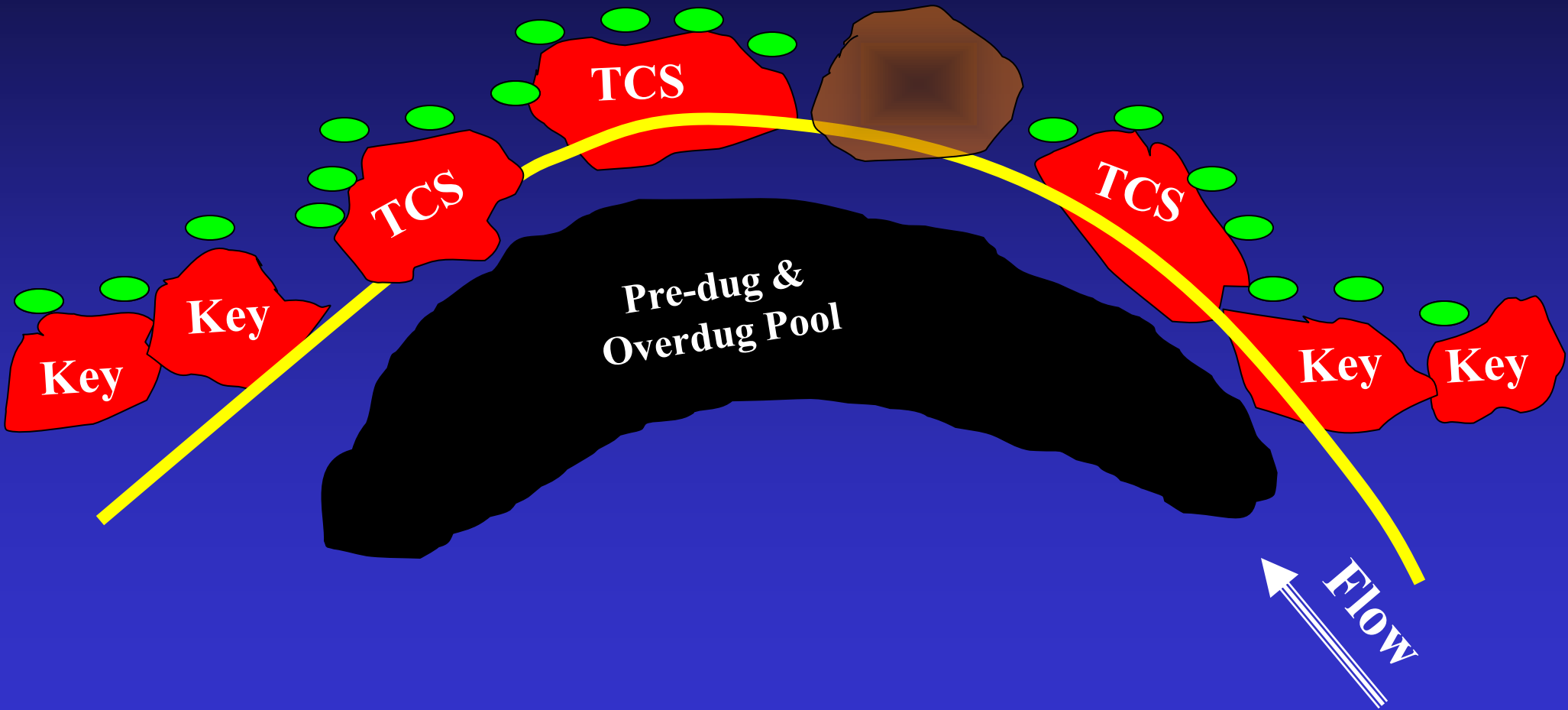
Dig holes for Traffic Control Stones, place live poles against bank, set TCS's.

Dig hole for Traffic Control Stone (TCS), place willow against bank, push TCS into position, backfill.



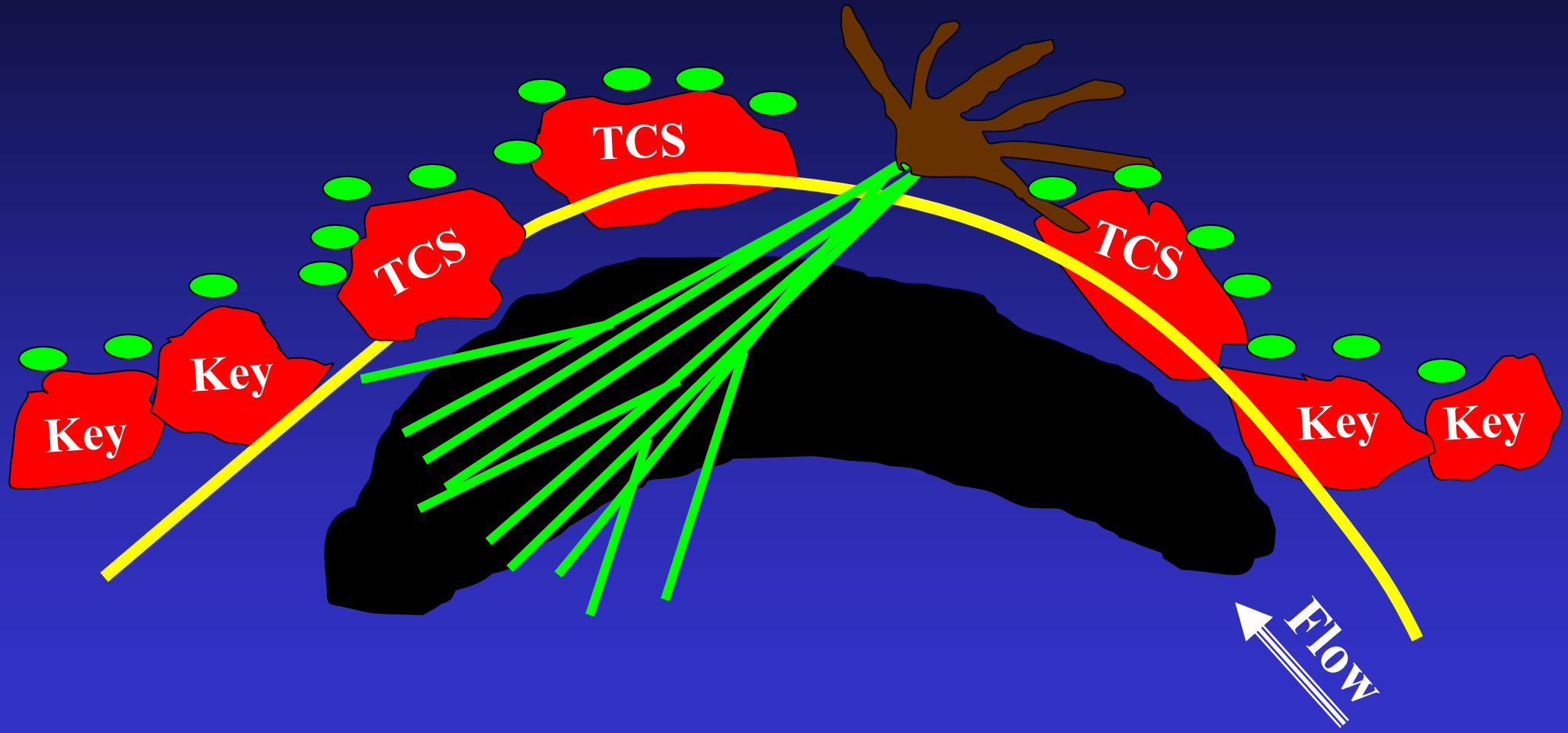
McKINSTRY CR. DOT MITIGATION – 7/10/2007 - PIX BY JOE GALATI

Half-Drowned Bush with Traffic Control Stones



Dig hole for Half Drowned Bush.

Half-Drowned Bush with Traffic Control Stones



Place Half-Drowned Bush. Roots should be at proper level relative to needs of plant. Bushes should be angled downstream & partially in water.

Track hoe carrying the Half-Drowned Bush.



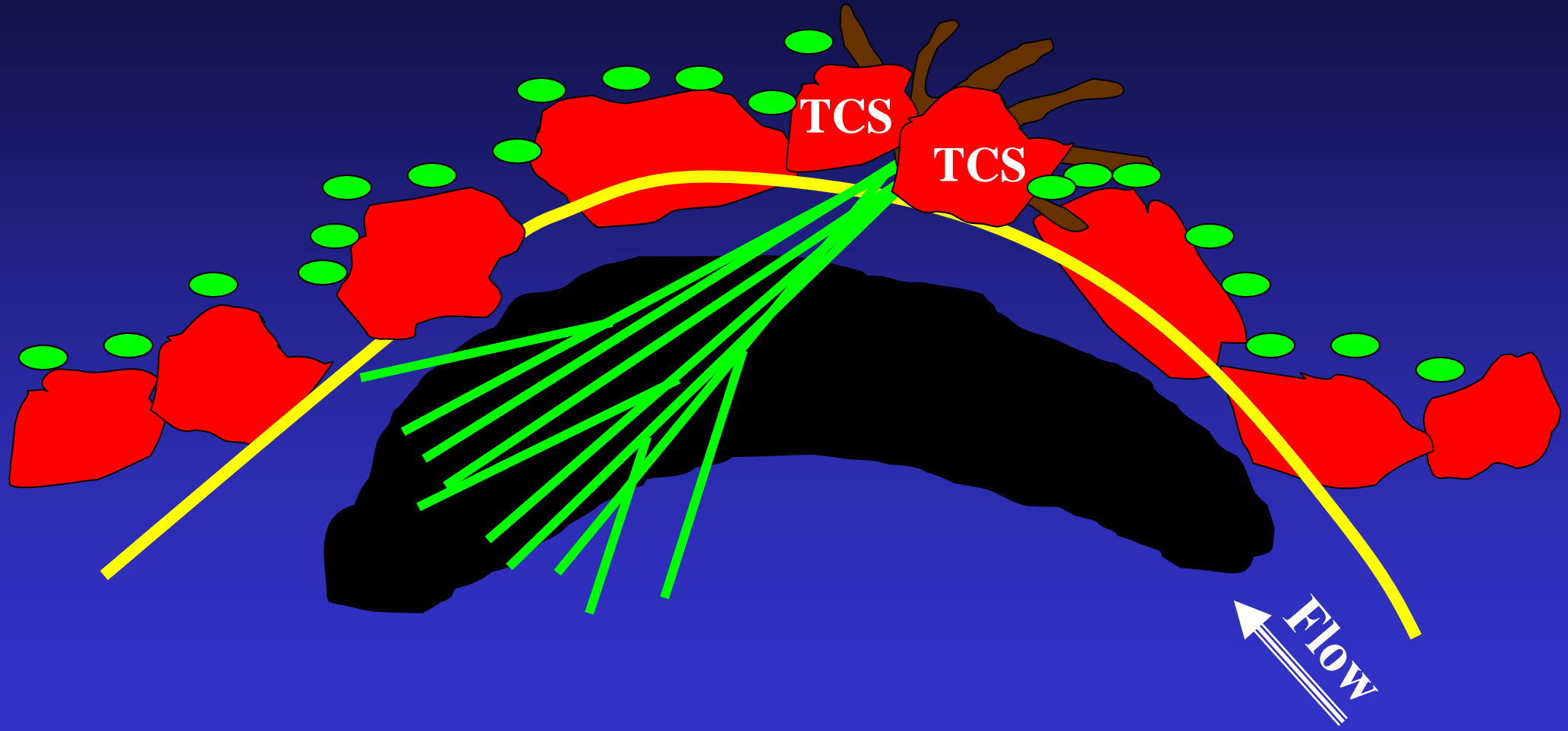
McKINSTRY CR. DOT MITIGATION – 7/10/2007 - PIX BY DERRICK

Hole was dug in bank, then Half-Drowned Bush is planted deep.



McKINSTRY CR. DOT MITIGATION – 7/10/2007 - PIX BY JOE GALATI

Half-Drowned Bush with Traffic Control Stones



If needed, stabilize Half-Drowned Bush & roots with additional stones.

Looking @ the transplanted Half-Drowned Willow Bush, never lost its leaves even though it was transplanted in summer (92 degrees)!



McKINSTRY CR. DOT MITIGATION – 7/10/2007 - PIX BY JOE GALATI

2 Years later. Looking DS @ Half-Drowned Bush. Note shade, cover, & branches dragging in water.



McKINSTRY CR. NY. DOT MITIGATION – 6/6/2009 - PIX BY DERRICK

2 years later. Looking DS @ Half-Drowned Bush



McKINSTRY CR. NY. DOT MITIGATION – 6/6/2009 - PIX BY DERRICK

2 years later. Looking US @ Half-Drowned Bush



McKINSTRY CR. NY. DOT MITIGATION – 6/6/2009 - PIX BY DERRICK

4 YEARS LATER-Half-Drowned Bush & Lesta Ammon's head



4 YEARS LATER-McKINSTRY CR. NYS-DOT MITIGATION - DERRICK – 7/11/2012

VINES – THE OVERLOOKED RESTORATION TECHNIQUE

**Use to shade stone &
improve aesthetics**

1 YEAR LATER-Looking DS @ planted Virginia Creeper vines on stacked stone wall. Great vine growth for first year



1 YEAR LATER-BUSHKILL CR-SITE 2-A - DERRICK 9-12-2010

BIOENGINEERING INFO SOURCES

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Stream Corridor Restoration: Principles, Processes, and Practices.
National Technical Information Service, U.S. Department of
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Bioengineering Slope Stabilization: A Practical Guide for Erosion
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- **Schiechtl, Hugo, (1980)** Bioengineering For Land Reclamation &
Conservation. The University of Alberta Press
- **Schiechtl, Hugo M., & Stern, R. (1996)** Water Bioengineering
Techniques for Watercourse Bank and Shoreline Protection. Blackwell
Science, Inc.
- **GOOGLE: F. Douglas Shields; Donald Roseboom; Andrew Leiser;
Robin Sotir; John McCullah; Phillip Balch; S.R.Pezeshki**

**This PowerPoint presentation was
developed & built by Dave Derrick.**

**Any questions or comments, call my
personal cell @ 601-218-7717, or
email @ d_derrick@r2d-eng.com**

Enjoy the information!!



**Clean
Fun
in AR**