The Toe Wood Structure

by Dave Rosgen

Objectives:

- Enhance fish habitat/food chains
- Stabilize streambanks
- Maintain a low width/depth ratio
- Provide a more natural appearance & improve visual values
- Be compatible with geomorphic settings
- Eliminate the need for toe rock
- Be cost effective with a lower risk

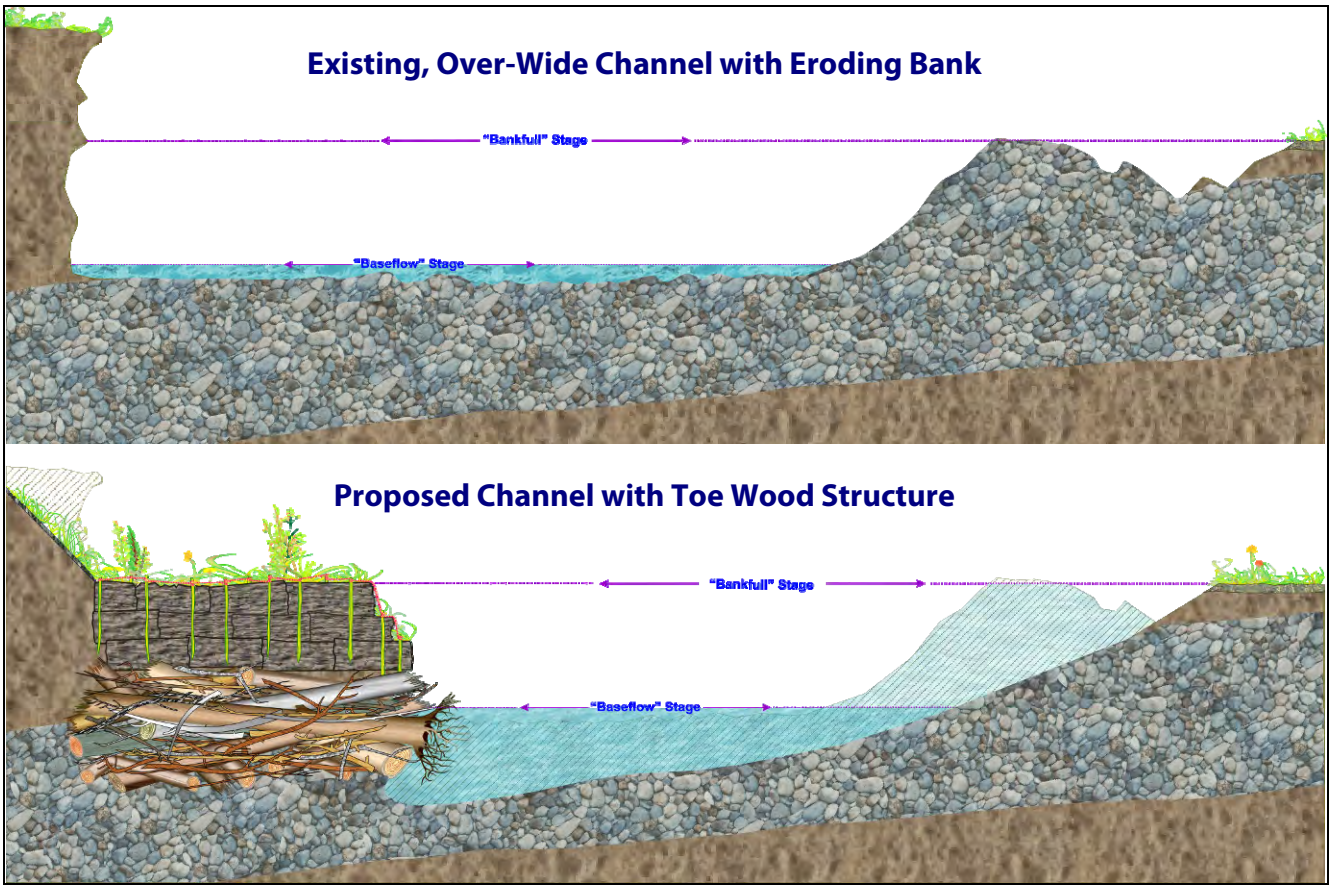
The Toe Wood Structure:

- Incorporates native woody material into a submerged undercut bank to replicate natural streambanks
- Toe wood is positioned on the lower 1/3 to 1/2 of bank to ensure it is submerged year round to prevent wood deterioration
- Cuttings with sod and live staking or woody transplants cover the toe wood and are installed up to the bankfull stage

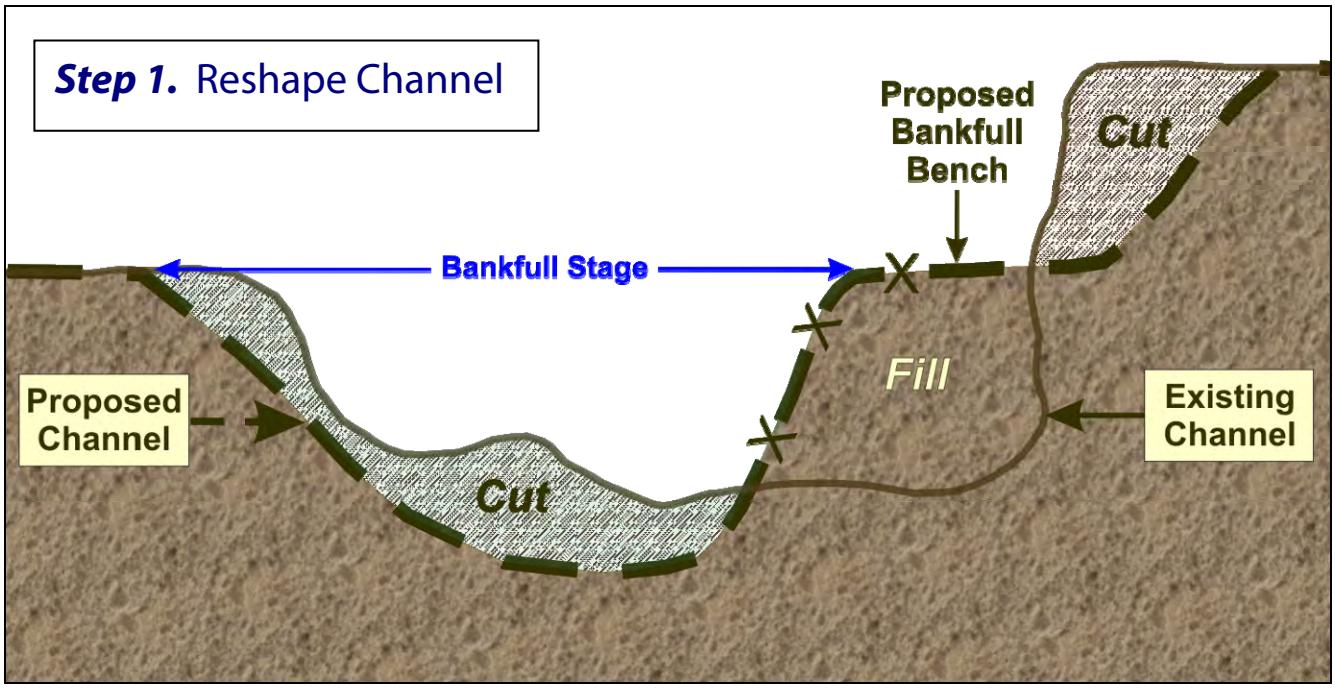
Variations in the Toe Wood Structure:

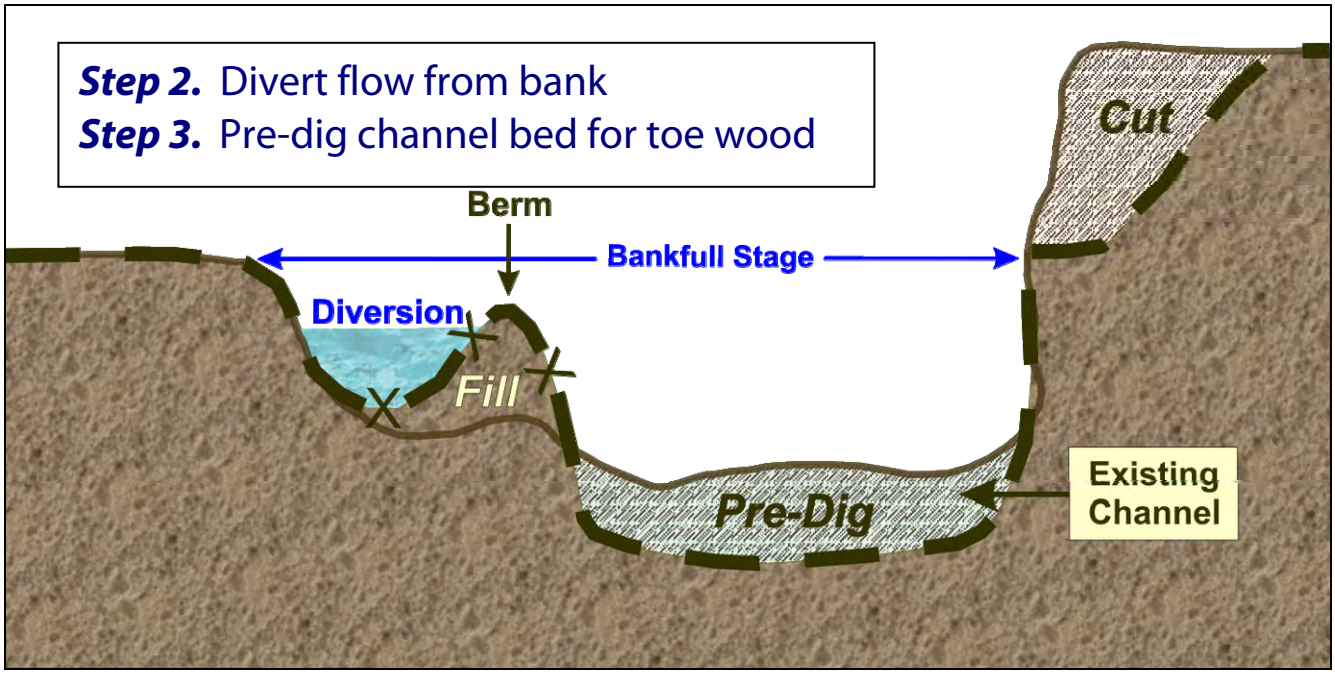
- ***Option 1*** – Use cuttings and sod mats that are staked and held down by interweaving shroud line
- ***Option 2*** – Instead of cuttings and sod mats, use woody transplants, such as willow, alder, cottonwood or dogwood
- ***Option 3*** – where sod mats and woody transplants are unavailable, use cuttings with "burrito" soil lifts

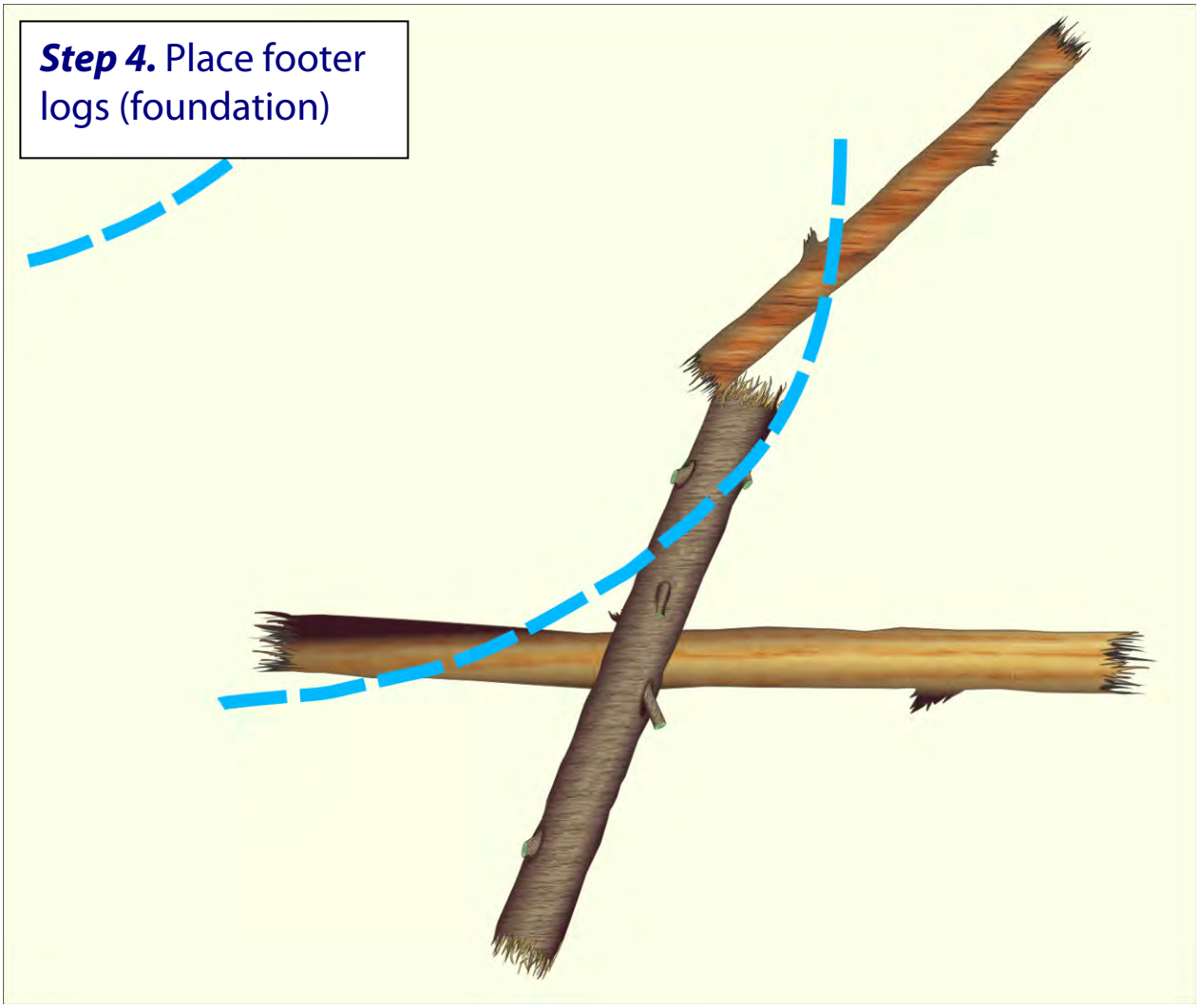
General Concept

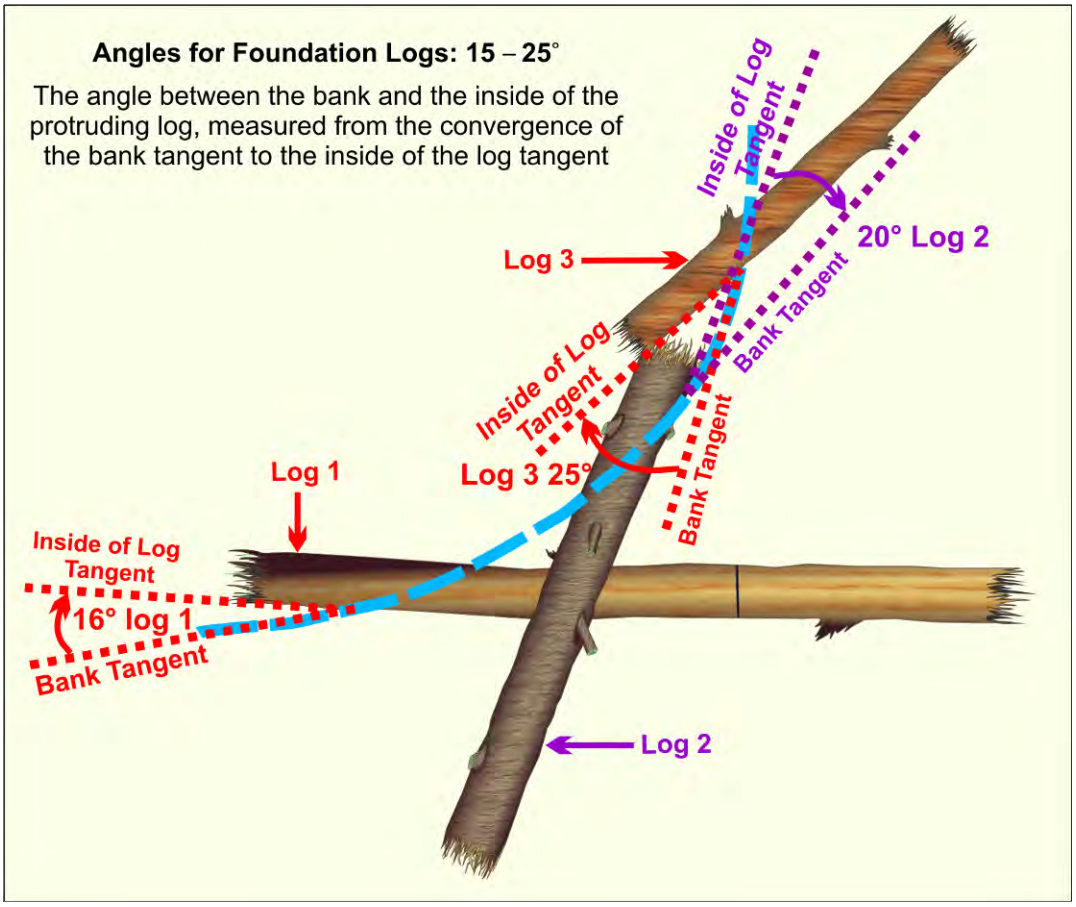


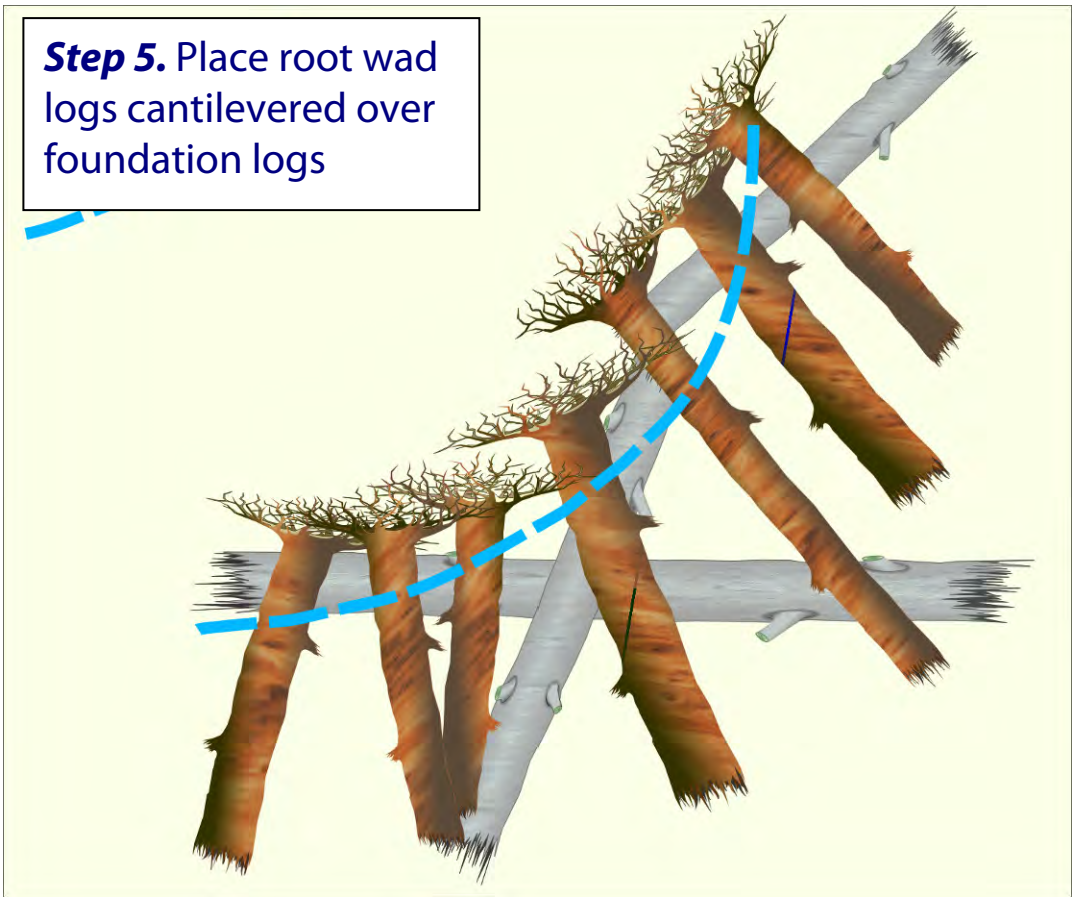
Installation Sequence for Option 1 –
Use Cuttings & Sod Mats with Staking

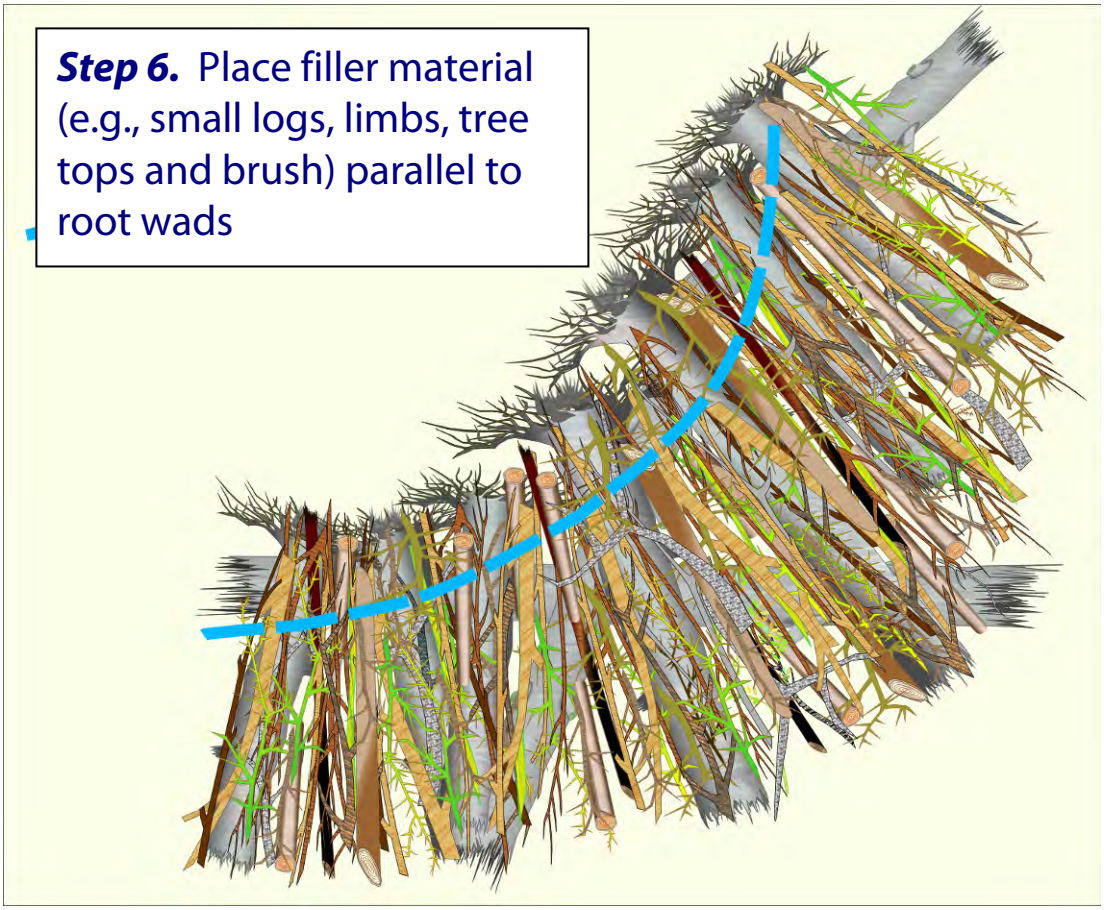


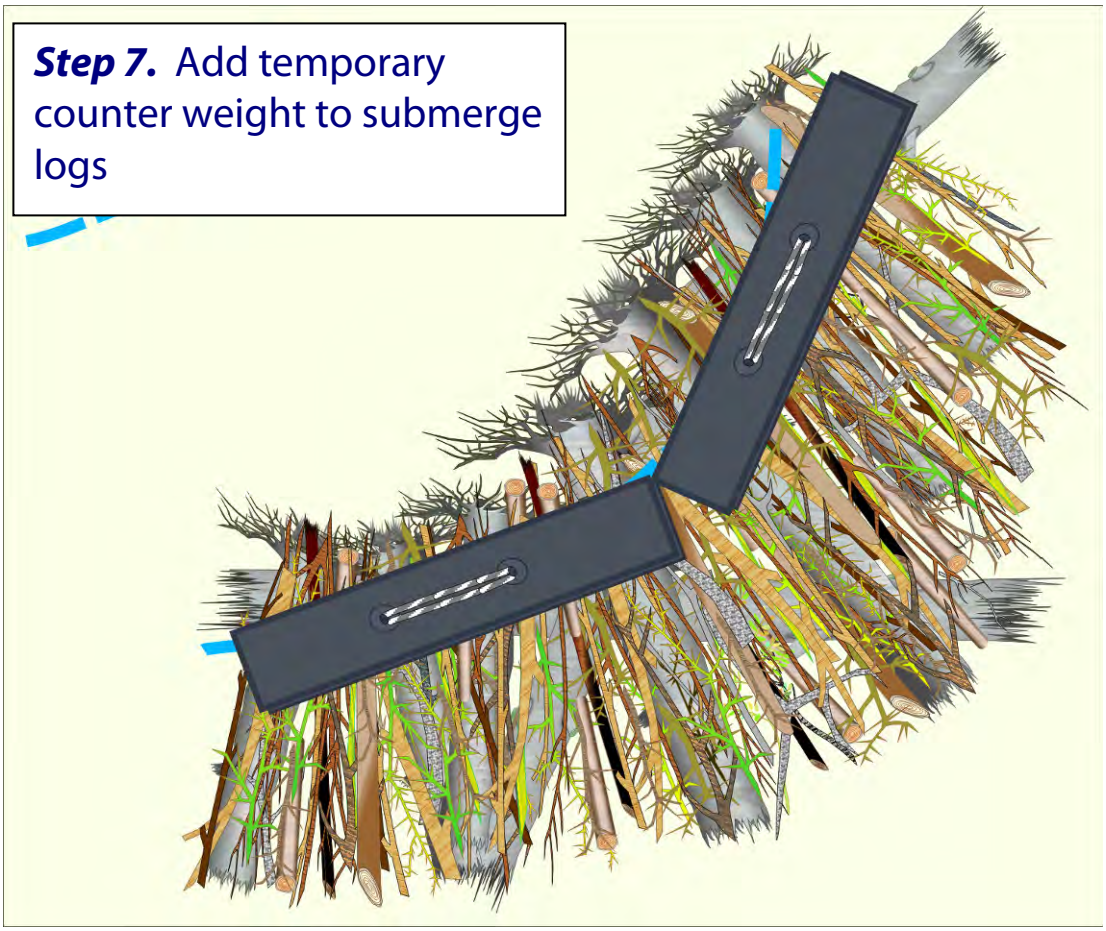

Step 2. Divert flow from bank
Step 3. Pre-dig channel bed for toe wood
Berm
Bankfull Stage
Cut
Diversion
Fill
Pre-Dig
Existing Channel

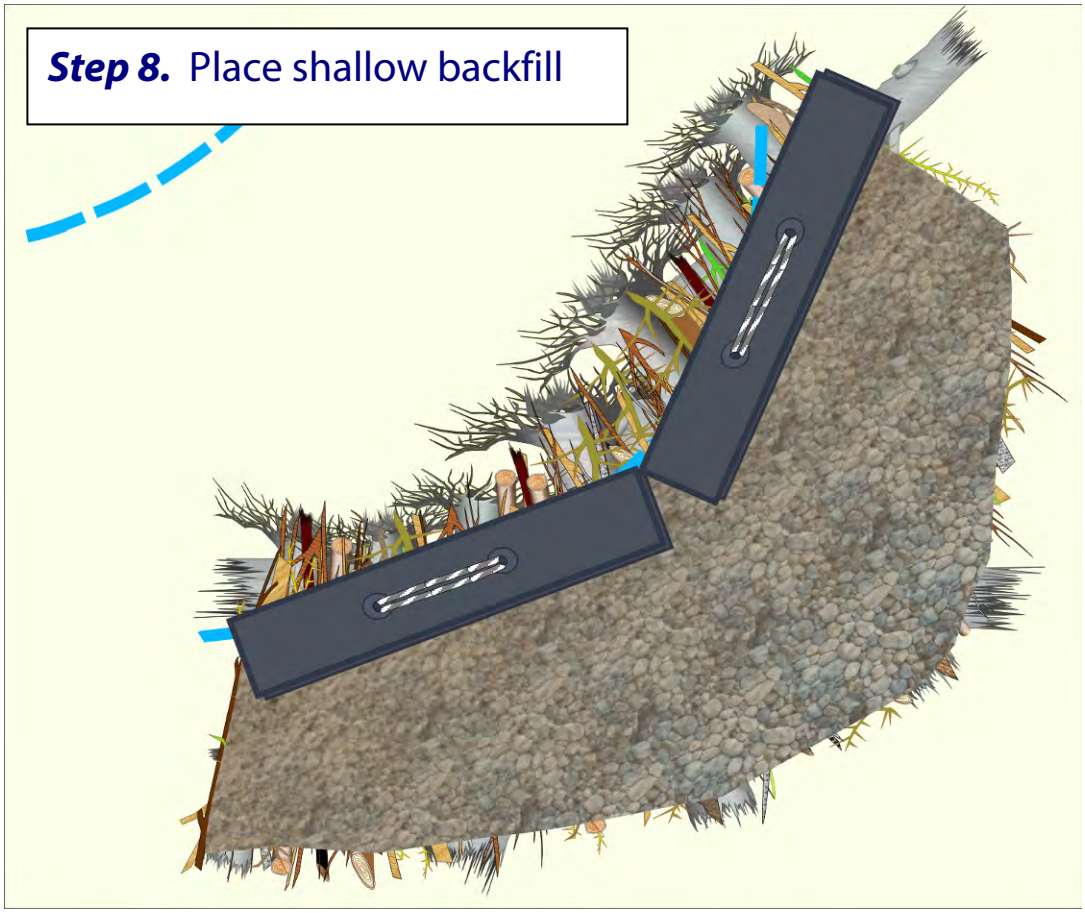

Step 4. Place footer logs (foundation)

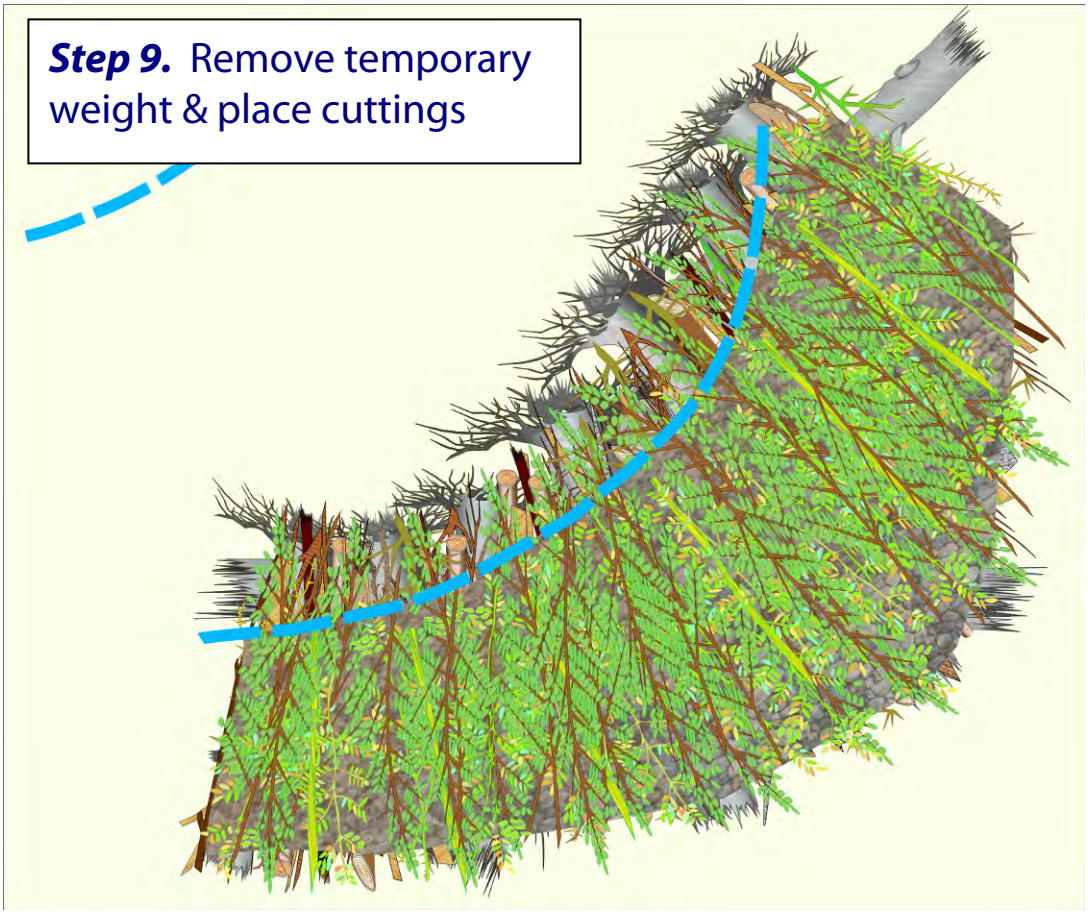

Angles for Foundation Logs: 15 – 25°
The angle between the bank and the inside of the protruding log, measured from the convergence of the bank tangent to the inside of the log tangent
Inside of Log Tangent
20° Log 2
Log 3
Bank Tangent
Inside of Log Tangent
Log 3 25°
Bank Tangent
Log 1
Inside of Log Tangent
16° log 1
Bank Tangent
Log 2


Step 5. Place root wad logs cantilevered over foundation logs

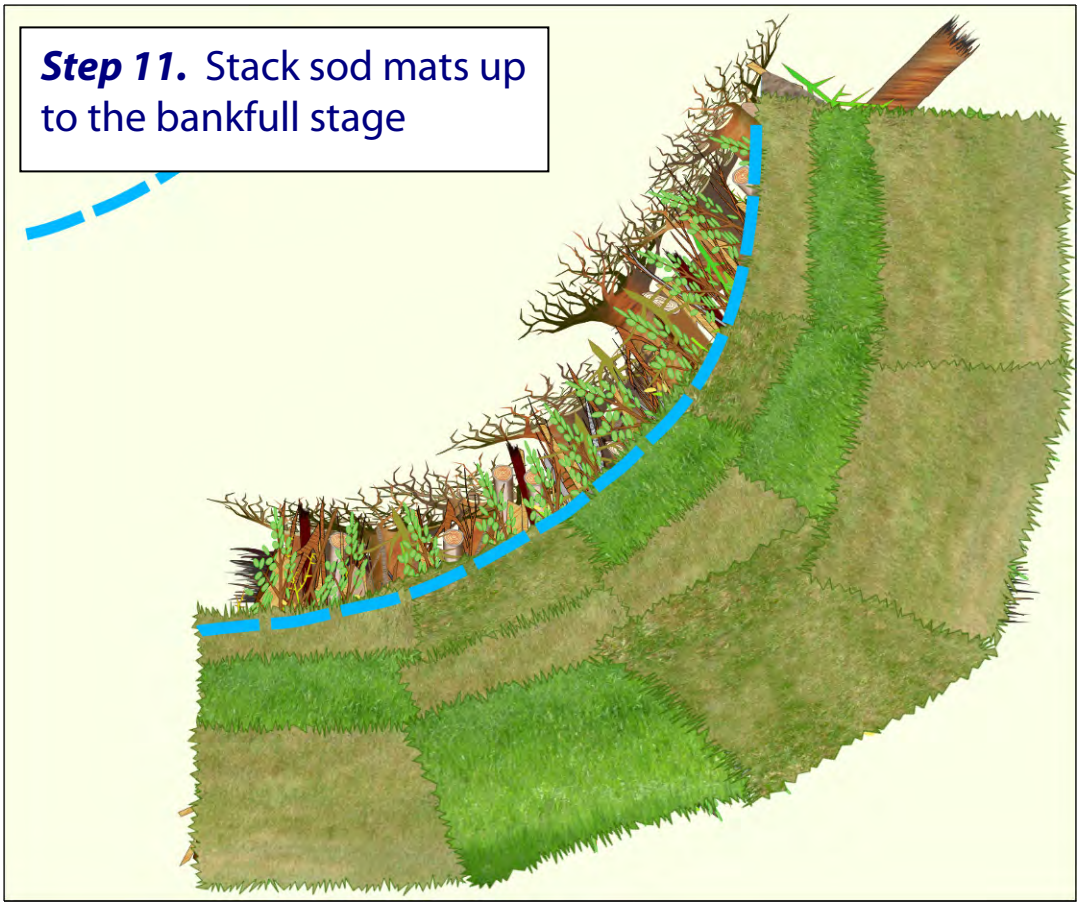

Step 6. Place filler material (e.g., small logs, limbs, tree tops and brush) parallel to root wads

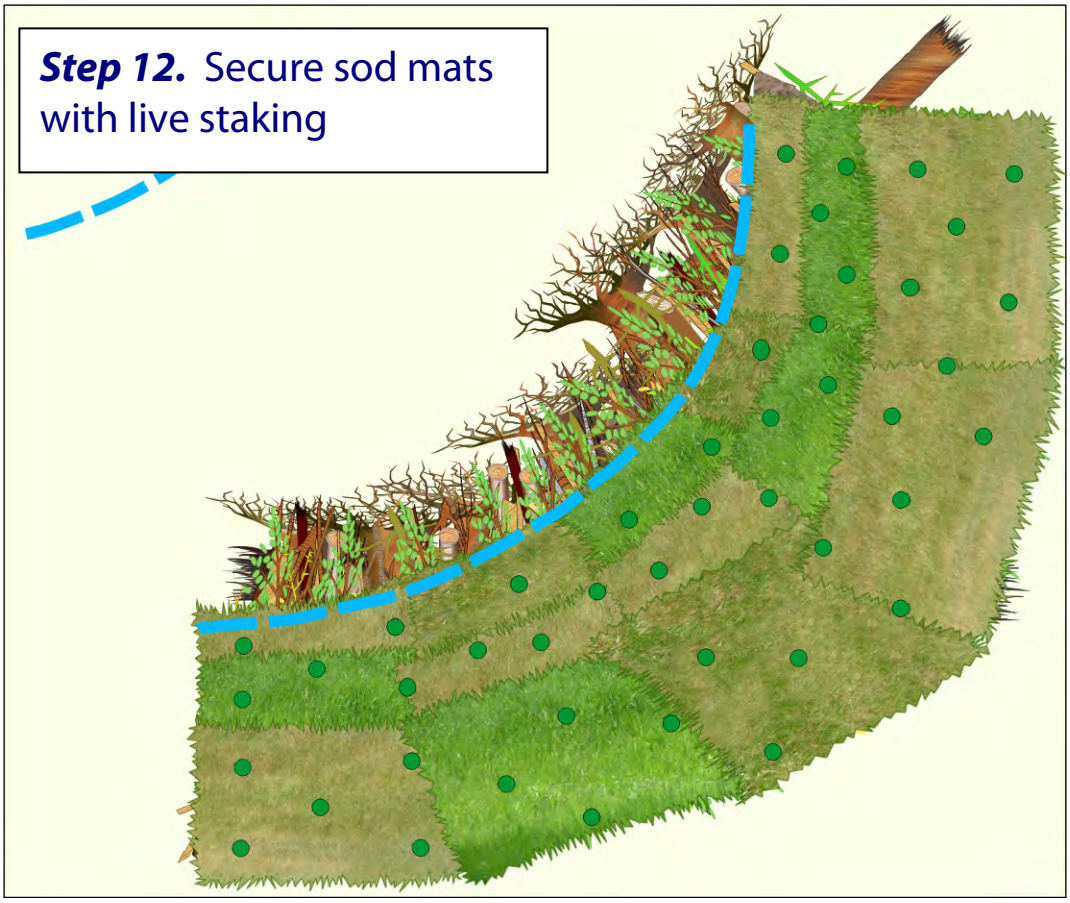

Step 7. Add temporary counter weight to submerge logs

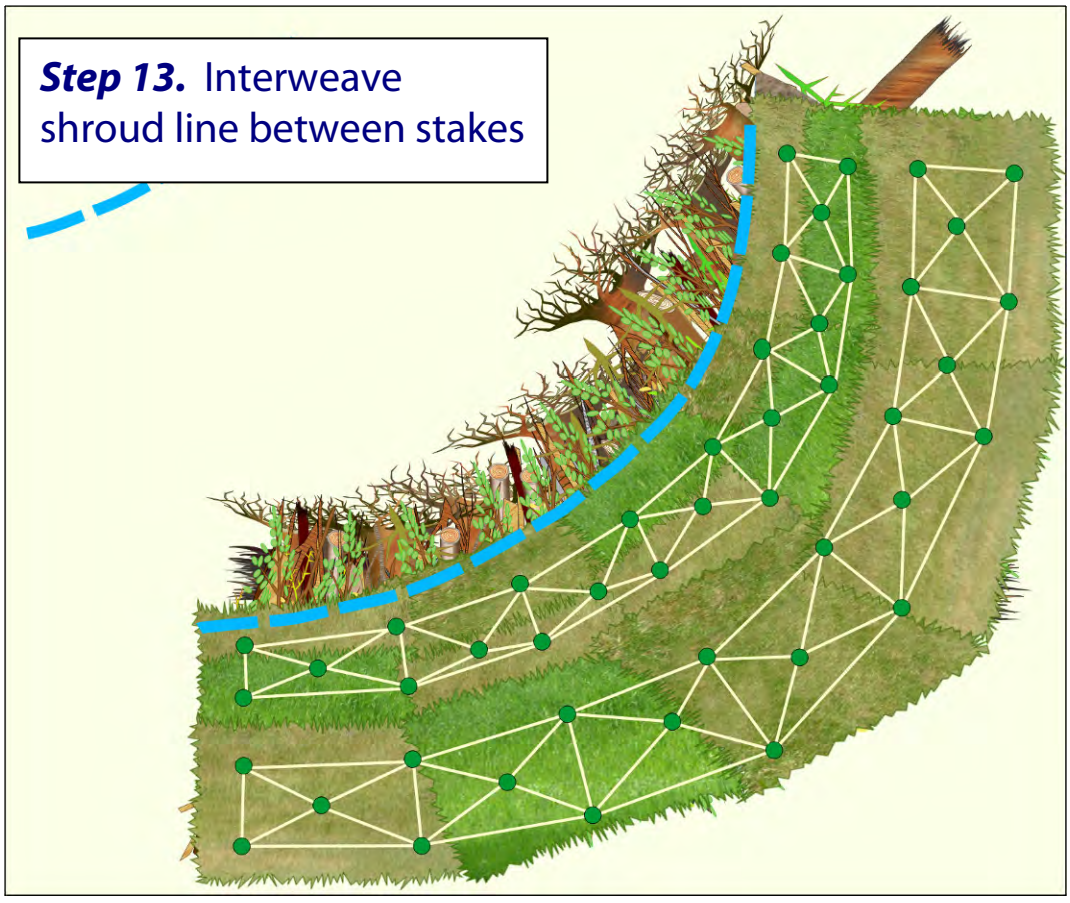

Step 8. Place shallow backfill

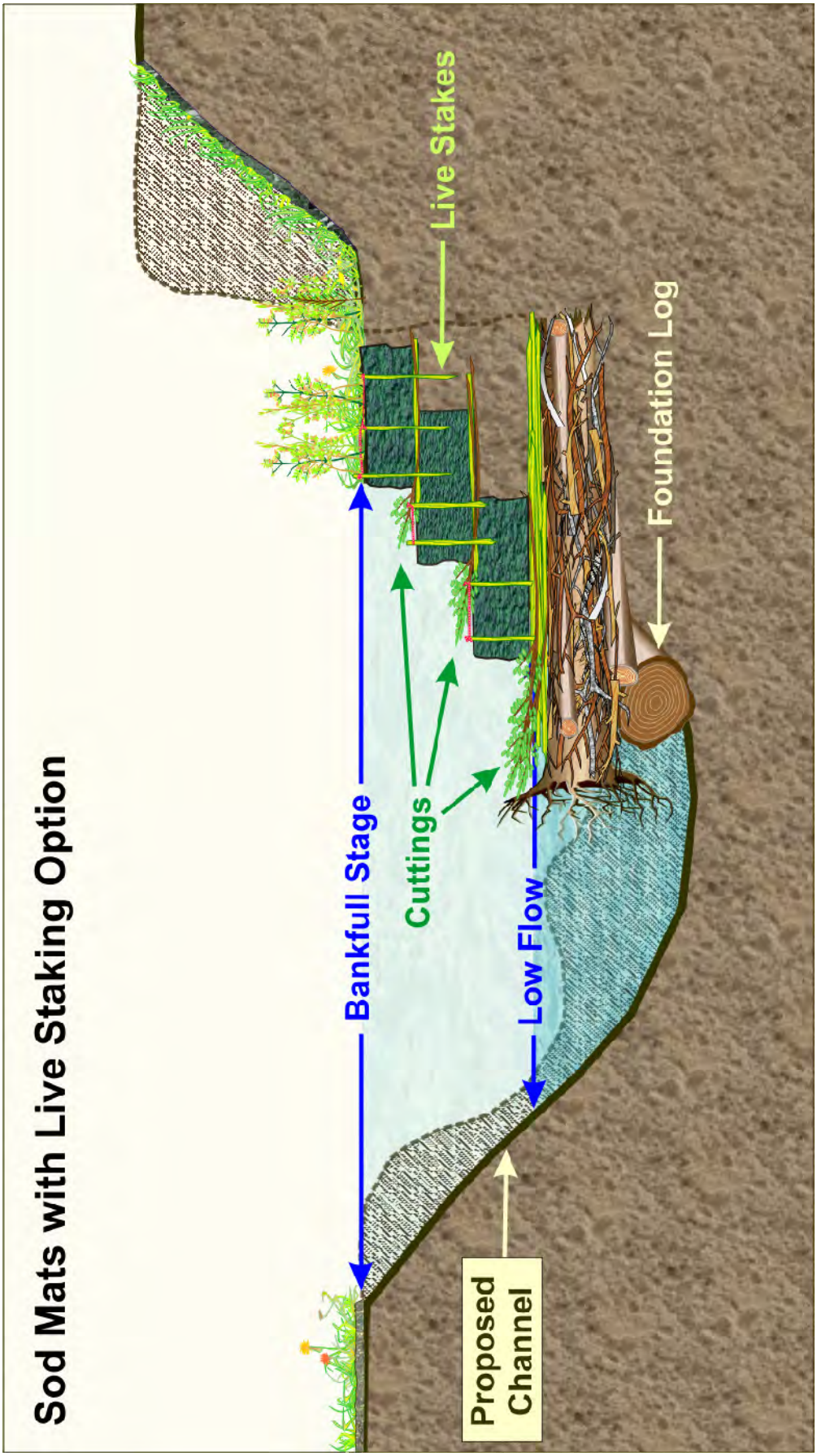

Step 9. Remove temporary weight & place cuttings


Step 10. Place backfill over cuttings


Step 11. Stack sod mats up to the bankfull stage

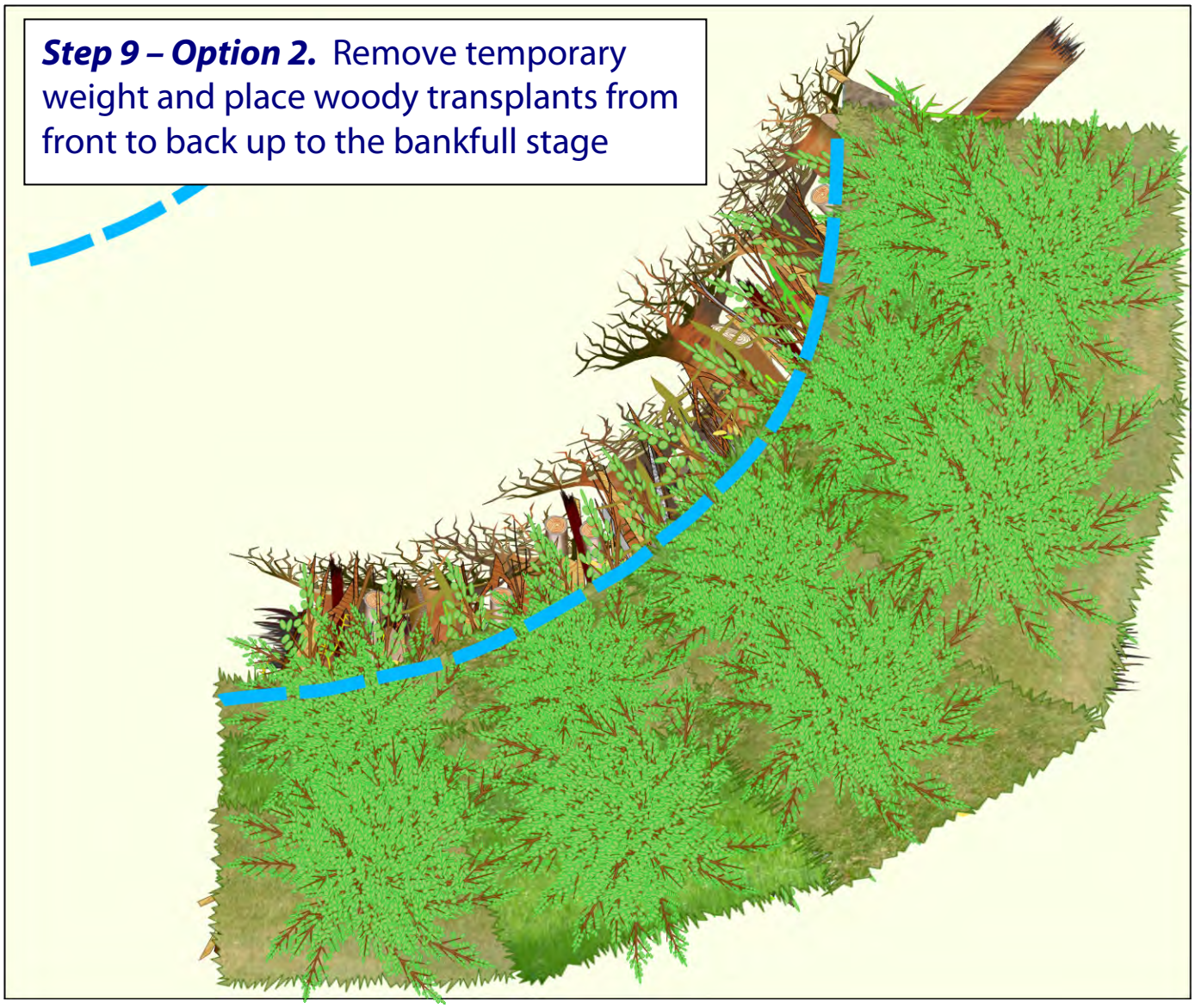

Step 12. Secure sod mats with live staking

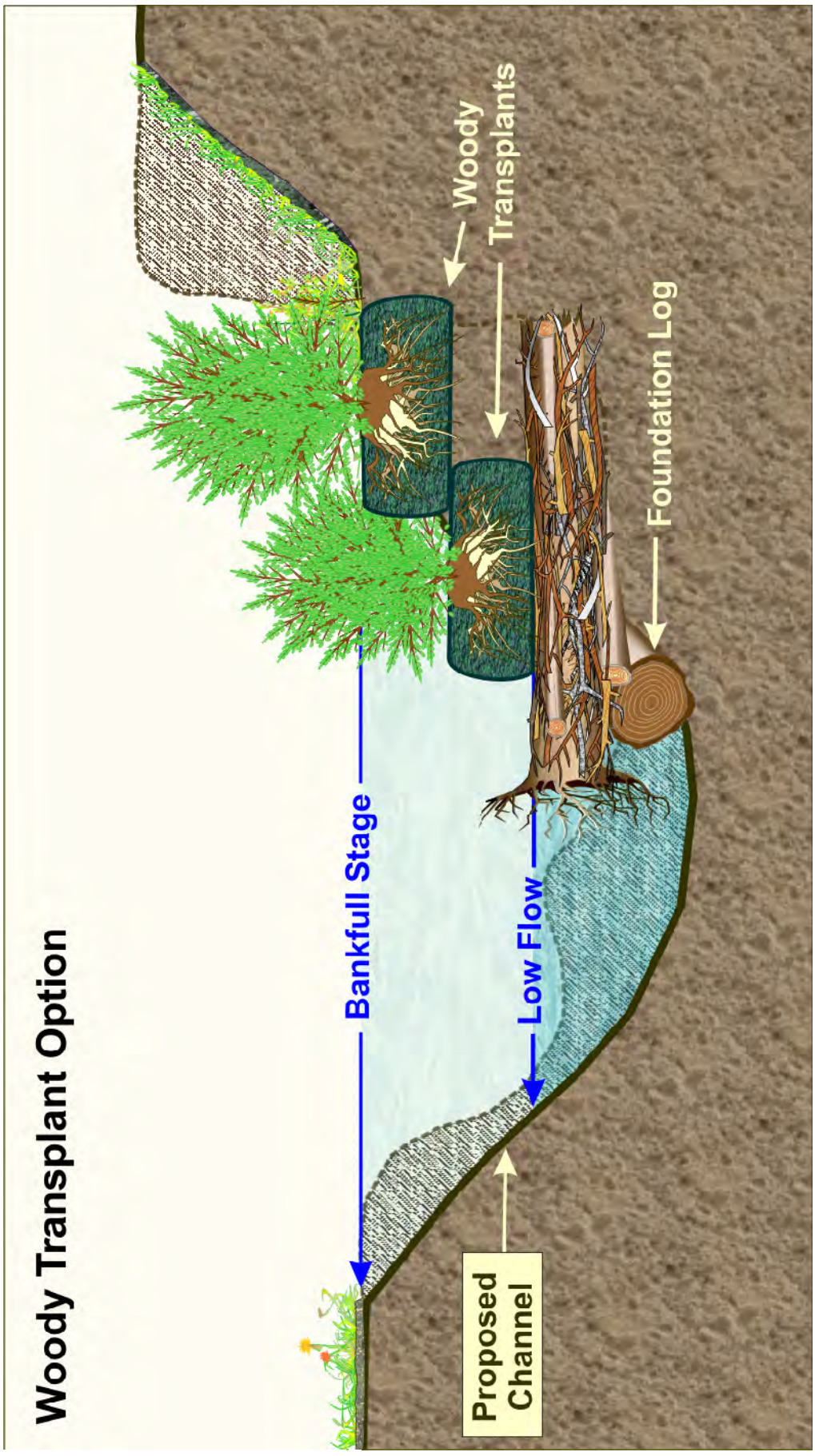

Step 13. Interweave shroud line between stakes


Sod Mats with Live Staking Option
Live Stakes
Foundation Log
Bankfull Stage
Cuttings
Low Flow
Proposed Channel

Option 2 –
Use Woody Transplants instead of Sod Mats and Cuttings

- Complete ***Steps 1–8*** from ***Option 1:***
  - ***Step 1*** – Reshape channel
  - ***Step 2*** – Divert flow from bank
  - ***Step 3*** – Pre-dig channel bed for toe wood
  - ***Step 4*** – Place footer logs (foundation) – be sure angles are correct
  - ***Step 5*** – Place root wad logs cantilevered over foundation logs
  - ***Step 6*** – Place filler material (e.g., small logs, limbs, tree tops and brush) parallel to root wads
  - ***Step 7*** – Add temporary counter weight to submerge logs
  - ***Step 8*** – Place shallow backfill

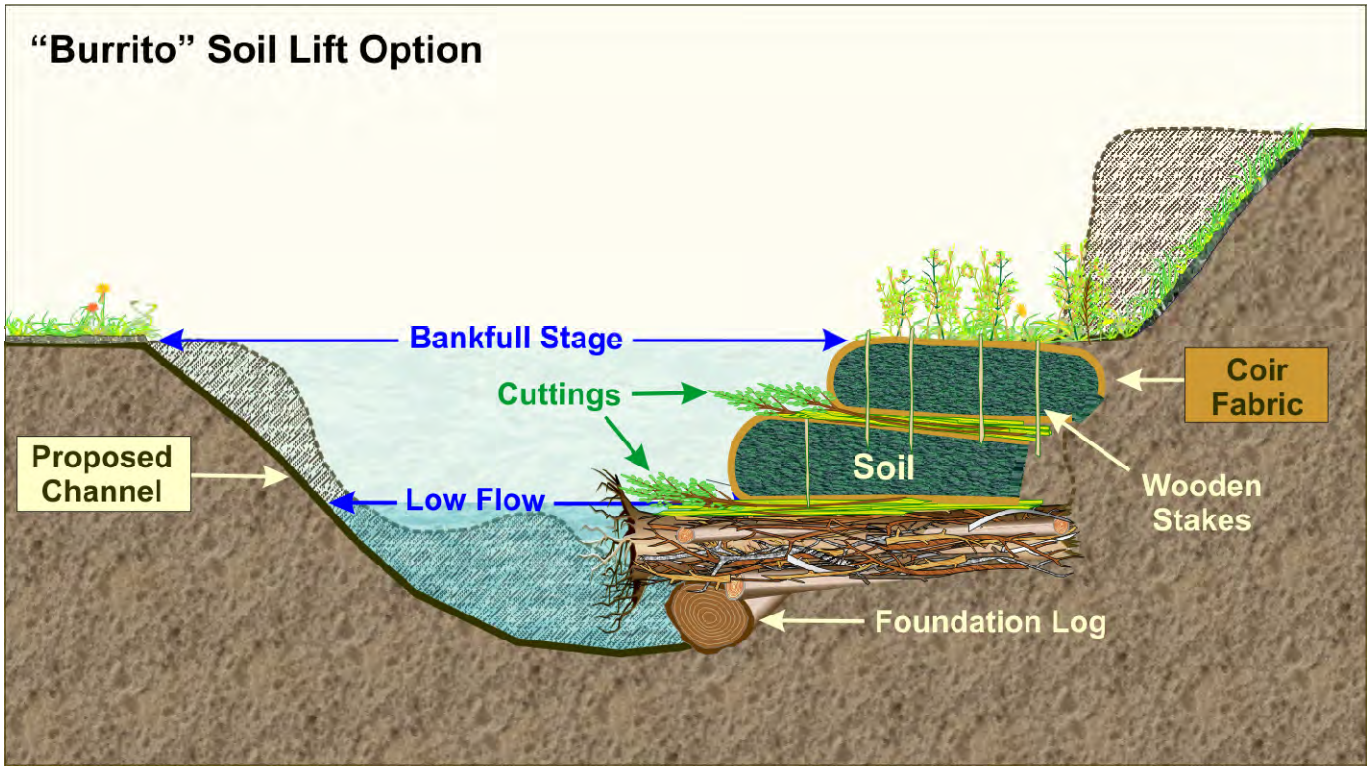


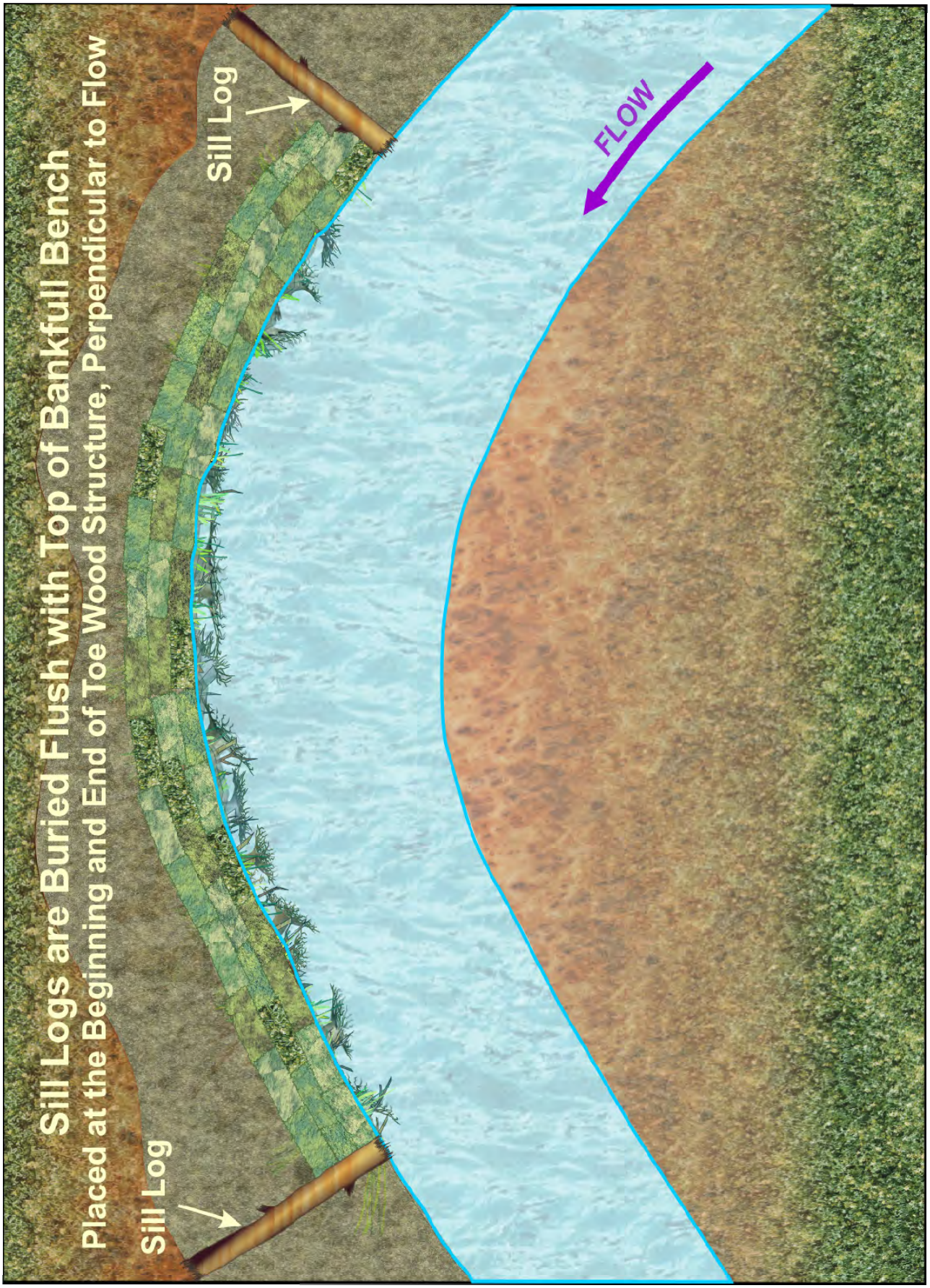

Woody Transplant Option
Woody Transplants
Foundation Log
Bankfull Stage
Low Flow
Proposed Channel

Option 3 –
Use Cuttings and "Burrito" Soil Lifts

- Complete ***Steps 1–10*** from ***Option 1:***
  - ***Step 1*** – Reshape channel
  - ***Step 2*** – Divert flow from bank
  - ***Step 3*** – Pre-dig channel bed for toe wood
  - ***Step 4*** – Place footer logs (foundation) – be sure angles are correct
  - ***Step 5*** – Place root wad logs cantilevered over foundation logs
  - ***Step 6*** – Place filler material (e.g., small logs, limbs, tree tops and brush) parallel to root wads
  - ***Step 7*** – Add temporary counter weight to submerge logs
  - ***Step 8*** – Place shallow backfill
  - ***Step 9*** – Remove temporary weight & place cuttings
  - ***Step 10*** – Place backfill over cuttings

Step 11 – Option 3. Install "burrito" soil lifts and layers of cuttings between soil lifts up to the bankfull stage




Sill Logs are Buried Flush with Top of Bankfull Bench
Placed at the Beginning and End of Toe Wood Structure, Perpendicular to Flow
Sill Log
Sill Log
FLOW


Bitterroot River Restoration, Site #2, Toe Wood Structures
Active bank erosion below home, Pre-restoration
Completed toe wood on new bankfull bench
Active bank erosion, Pre-restoration
Post-restoration after flood, same location as photo left
Post-Flood, Note shroud line between live stakes
Post-flood Response – Post-restoration