

# **47 WAYS TO STAY OUT OF TROUBLE**

**Dave's Top 10 List (expanded to 47)  
Of Conceptual Design Considerations**

**This list serves as a great design  
checklist! Print it out & use it to  
make sure all of your bases are  
covered during the design process!!!**

# Dave's Design Considerations

1. What are you attempting to accomplish? Assemble the multi-disciplinary design team first. Then have the team define BOTH SHORT & LONG-TERM PROJECT GOALS early on (with input from all shareholders, agencies, & personnel who will comment on the permit). Let everyone hear everyone else's goals, set objectives! Define values. Identify existing valuable resources & how to protect them. Define any legislative constraints (Wild & Scenic Rivers Act, etc) or partnering agency guidelines. NO SHOCKING DISCLOSURES LATE IN THE DESIGN PROCESS !!
2. Can the stated project goals be accomplished with the stream in its present alignment & at its present grade? Does disconnection from the historic floodplain, water table drawdown, attack angles into downstream valued infrastructure etc., make project goals impossible to accomplish?
3. In urban areas consider the effects of your actions (increased roughness with redirective methods or full-grown vegetation), especially over time, on the 100-year flood water surface elevations. Consider herbaceous vegetation in flood sensitive areas (lays over & reduces roughness during high flow events).

# Dave's Design Considerations (Part 2)

4. What stream classification & numerical modeling efforts need to be accomplished to provide a well-engineered final design?
5. Understand constraints (wetlands, flood issues, etc.).  
Environmentally find out what you can & can't touch! Turn constraints into opportunities!!!
6. What is the **PROPER FUNCTIONING CONDITION** for the stream & riparian corridor? Is the stream trending toward stability or instability? Is the stream telling you that it needs to be longer and/or rougher? An important concept is that roughness can always be substituted for stream length.
7. Focus on restoring functions (hydraulic & biological) – not looks. Imitate nature's functions!
8. Dead things are good things (leaves, branches), can provide both vertical & horizontal structure both in water & on land! Snags (standing dead trees) are used by 85 species of birds



# Land Requirements

- Alignment
- Access
- Construction Envelope
- Ramp Locations
- Turnarounds
- Slope Laybacks
- Materials Storage
- Fabrication Yards
- Equipment Storage
- Spillway Location
- Drainage Requirements
- Dewatering Operations
- Water Infiltration
- Site Security
- Emergency Access
- Materials Disposal
- Bank Protection
- Backwater Easements
- Wetlands Enhancements
- Wildlife Habitat Protection
- Archeological Site Protection

**Purloined from Gerry Hester, Southern Nevada Water Authority**

# More of Dave's Design Considerations

9. Think educational opportunities. Think public interpretive opportunities.
- 10 Investigate right-of-way & landowner considerations.
11. The first site visit is the most important. All shareholders should be present. Project goals, functions & constraints should be discussed. Brainstorm. Think bioengineering, what types of plants are currently holding the world together, & where are they located (relative to low-flow water surface elevation, aspect, point bar, outer bank, etc?)
12. Understand the stream system. Understand the processes that are causing the bank erosion in the area of interest. Think attack angles & where stream energy is concentrated. Analyze overbank drainage. Beware of “daylighting” water flowing out of the bank material (groundwater piping). Are drains and/or filters needed?

# More of Dave's Design Considerations (Part 2)

13. Understand the effects of both system-wide aggradation or degradation on the proposed project over time. If needed, stabilize grade first. Consider the effects of localized scour. If needed, design protection works that can adjust to both localized scour, and possible future bed changes.
14. Conceptualize needed flow patterns based on required performance goals. How does the thalweg need to be aligned??
15. Historically, what did the stream look like (planform, cross-sections, bank slopes)? What type of vegetation (trees, shrubs, grasses, mixed) grew on the banks and overbank areas, & where was it located? Historically, how did the stream dissipate its energy?
16. Do you want to totally “lock” the stream into an alignment over the entire project length (bank stabilization on both banks in cross-over zones), or allow “wiggle” room?
17. Think thalweg management. Look at stream energy paths & attack angles.



**Historically, how did the river dissipate its energy ???**



**Did it move LWD, or bedload, or frequently utilize it's floodplain?**



# **A FEW MORE DESIGN THOUGHTS**

- 18. Do you want to lock the stream's base flow channel into its present alignment? Can you change the stream's alignment (or thalweg alignment) within its existing banks?**
- 19. Determine where changes in stream slope occur (transition zones). Analyze abrupt changes in stream width (both physical and hydraulic constrictions /expansions). Expansions are generally unstable! Always employ smooth expansions & contractions. Is there a sediment transport problem? Does this result in a sediment management problem? Beware of divided flow & confluences!**
- 20. Determine if future stream behavior can be based on past history (migration rates, flood stages, durations, & frequency, etc.).**
- 21. Analyze whether or not bank erosion is going to migrate upstream of the proposed project due to lateral migration and/or "fish hook" effects in the upstream bend, which can result in changes in the attack angle of flow into the project. Upstream changes usually affect the downstream planform (upstream drives downstream).**



Fish hooking bend, erosion faster  
here than at treed pointbar



# Just A Few More, I Promise!!

22. Understand how & where the outer bank in the upstream bend will control water coming into the bend of interest (vector analysis).
23. Thoroughly investigate any features in the stream you are going to rely on (natural grade control, clay outcrops, exposed pipes, etc.)
24. Do you have the Luxury of Space? Determine whether continuous or discontinuous (intermittent, redirective) bank protection can be used. Sediment starved or rich? Bedload driven? Is suspended sediment available? Can you make that sediment WORK FOR YOU (slow water to drop out sediment)?
25. Do you have the Luxury of Time? In some cases nature can strengthen the project over time, time also allows for monitoring, project performance analysis, & the use of adaptive management. Adaptive management is making minor adjustments & changes (learning by doing) after the initial construction phase to increase sub-par performance in under-performing areas of the project.

# **I Lied, Here are Some More!!!**

- 26. Investigate “straight” stream features (planform, point bar edges) to determine their causes.**
- 27. Can a reference reach in the project stream or a neighboring stream be useful? Even very short, but relatively stable sections of stream (either within or outside the project limits) might prove useful.**
- 28. Look for naturally occurring bank stabilization features in the stream. Mimic nature’s bank protection /grade control methods if possible (tree deflectors, vegetated or rock “kickers”, natural willow curtains, vegetated benches, etc.).**
- 29. Use materials and techniques that adjust (especially if grade stability is unknown). Static structures in dynamic systems tend to fail catastrophically, during the catastrophic event. Beware of “foundation dependent” methods. Perform a risk analysis on all proposed structures. Think how the stream will “see” & react to any structures you put within the flow field, even during floods.**



# I Lied, Here are Some More!!! (cont.)

30. Use a combination of methods if possible. Think in zones. Avoid longitudinal transitions, or if they are used, analyze carefully as to how the stream will “see” & react to them.
31. Start and end protection in stable (usually depositional) areas. Key all protection works into the bank. The upstream & downstream keys of a longitudinal structure should never be keyed in at right angles, 20 to 30 degrees relative to streamflow are best! Dig a hole, plant a pole!! Plant vegetation deep in the keys using a variety of techniques and material sizes (branch layering, live siltation, Instant Shade, pole plantings) to increase bank roughness and reduce near-bank velocities (thereby reducing erosive forces at the key). Plant unrooted stock deep (into the capillary zone).
32. Where are your high-flow relief areas or channels? Should some be created? How many “degrees of freedom” does the river have, how many is the project taking away? Is “melt-away”, “slow-down”, or “come-and-go” bank protection needed?



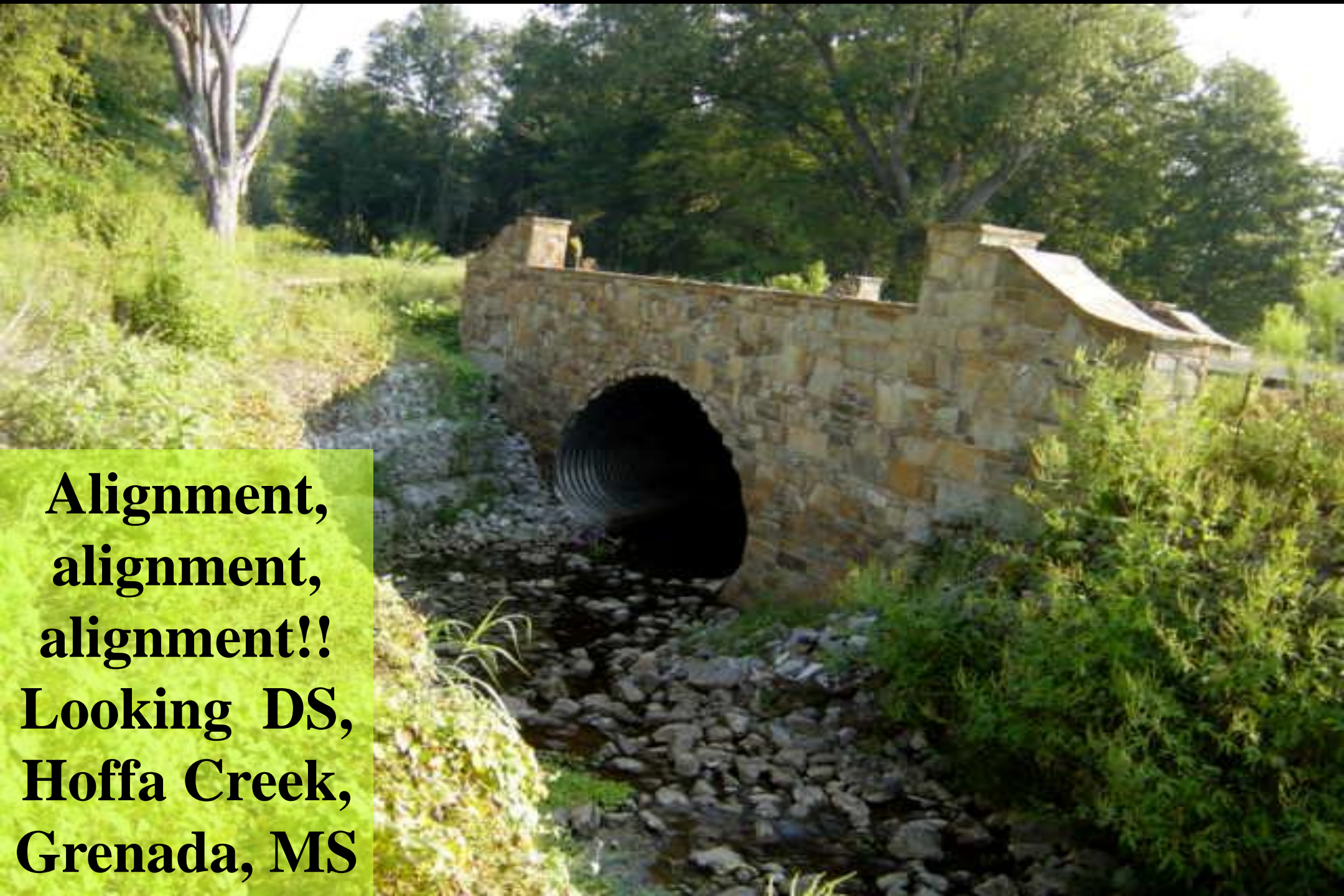
**Starting too soon & ending too  
early, Sykes Cr, MS**

1:27'98

# **DON'T BELIEVE EVERYTHING YOU HEAR**

- 33. Using your knowledge of how different techniques can possibly fail, perform a risk analysis of what methods are appropriate for your project or situation and what methods are going to be at greatest risk**
- 34. Stabilize the toe (if needed).**
- 35. Analyze the stone you will use AT THE QUARRY. Look at the maximum size, shape, gradation, durability (ask questions), and its ability to self-adjust (launch). Use self-adjusting stone if possible. Crawl up the rock pile, if the rocks tumble down that is the gradation you need. Perform a geotechnical investigation to determine if a filter is needed, use self-filtering stone if possible.**
- 36. Alignment, Alignment, Alignment!!**
- 37. Build structures that will redirect the stream but not be “felt” by the stream. Long, low, & smooth is the idea. Work with the stream, not against it. Again, think in angles!!!**





**Alignment,  
alignment,  
alignment!!  
Looking DS,  
Hoffa Creek,  
Grenada, MS**

# **DON'T BELIEVE EVERYTHING YOU HEAR (Part 2)!**

- 38. Avoid structures that protrude into the flow field causing local accelerated velocities, vortices, separation zones, or eddies, especially on the eroding outer bank (unless this is what you want).**
- 39. Experiment (either a little or a lot). VARY THINGS TO FIND OUT WHAT WORKS IN YOUR STREAM IN YOUR AREA.** In a demo project or test plots some sections should fail so as to define the lower limits of protection. Examples: plant different sizes of different species at different depths, progressively reduce height of hard protection in the downstream direction, etc.)
- 40. Use available resources.** Materials removed during construction can be stockpiled & reused & replanted (top soil, plugs of existing vegetation, tree trunks, branches, leaves, rootwads, etc.). Transplant bushes & small trees. If possible, let nature strengthen the project over time.
- 41. Analyze how the project will perform for at least the base flow, very low flow, “eye-high” flow, channel forming discharge, top-of-bank flow (one more drop of water & the floodplain gets wet), & out-of-bank flow conditions.**



# **DON'T BELIEVE EVERYTHING YOU HEAR (Part 3)**

- 42. Analyze constructability and water quality issues. Think pollution reduction**
- 43. Steal the best ideas, but always give credit. Beware of designers that have the same solution for a bunch of different proposed projects. Beware of new and unproven “flavor-of-the-week” bank protection methods. Think things through!!**
- 44. Analyze how the stream will be affected and react to everything you want to throw into its valley. Consider upstream, downstream, and near- and far-field effects of the proposed project. Consider how project effects will be perceived (especially by adjacent or downstream landowners). Perception does not always equal reality. Document the upstream, downstream, and surrounding area pre-project condition. If required, contemplate mitigation measures.**



**PIPELINE CROSSINGS AND OTHER  
OBSTRUCTIONS CAN BE ADVERSELY  
IMPACTED BY FLOATING DEBRIS, Grenada, MS.**



# THE END (REALLY)

45. A member of the design team should be on-site during construction. Plans & Specs are just that, they do not describe function (shallow spawning areas, return currents). The stream typically will change to some degree before construction begins, and design changes usually have to be made in the field. In design, construction, and inspection the “Devil is in the Details”.
46. There is never closure. Always monitor (even informally) and use adaptive management to tweak under-performing sections of the project for optimum performance.
47. Sometimes we need to just let the river be a river (move where it wants)! Remember, in the end, Mother Nature will win, SO WORK WITH HER!

“Go with the flow, like a twig on the shoulders of a mighty stream.” John Candy to Steve Martin at the end of the film: *“Planes, Trains, and Automobiles”*.

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

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**Enjoy the information!!**