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IN-STREAM CONSTRUCTION & BANK PROTECTION: LESSONS LEARNED

What am I talking about today?

- Stream Restoration
- My lessons learned!
- Things to think about.
- Directed to Designers and Contractors

Smaller Rivers, Creeks and Streams

- +/- 50' bottom channel width or smaller

Things to think about- Designers - Contractors – Reviewers (DCRs)

Site Limitations

- Land Ownership – are you sure?
- Utilities –
  - Are there low wires that will restrict access or vehicle movement?
  - Buried utilities?
- Phasing?

Think about-

- Sensitive habitats
  - Do you need to fence off an area?
  - Do you need signs?
- Terrain
  - What type of equipment can access the area?
    - How do you foresee the work being completed?
  - Can what you propose be physically constructed?
    - Every phase?

DCRs think the project all the way through

- Develop a construction sequencing plan from day one to close out, taking all aspects of the project into consideration.

Have a meeting!

- Designers – Meet with qualified contractors during design to make sure your design can be constructed, and to refine your construction sequencing.
- Have a pre-construction meeting
  - Discuss
    - Responsibilities
    - Sensitive areas
    - Special concerns

Design Considerations

- Bank – what is it made of
  - Sand , gravel, cohesive clay, topsoil?
  - How steep?
  - How eroded? And why?
  - Shade suppressed?
- Bed
  - Clay? Sand? Sand and gravel? Cobbles?
  - Velocity? Depth?
- Context of location, are there structures at risk?
  - Is there room to lay back the slopes? If not, your choice of bank treatments becomes limited.
- Protection of downstream areas from sedimentation

Before you break ground make sure that…

- Are all the permits in place?
  - Corps of Engineers, IEPA, County, City, Soil and Water Conservation District, NPDES, IDNR-OWR?
  - Do you have copies?
  - NPDES NOI filed, Permit received?
  - SWPPP on site?
    - Who is responsible for completing the NPDES compliance visits?
  - What is the protocol if rain and flooding is forecast?

Site Access

- Use an existing access into site?
  - Separate stabilized construction entrance

Clearing

- How will the clearing be done?
- Do you have to cross the stream?
- In-stream?
- Equipment size?
- On site disposal?
  - Burned on site?
  - Chipped and Spread?
  - Hauled offsite?
  - Big cost considerations
  - Big arguments!

Clearing

- Are there large debris jams that will take larger equipment to remove?

Staging

- Access from road
- Access to creek
- Space requirements
- Have the plans provided enough room for a the materials

Topsoil and Spoil

- Is there enough topsoil onsite to complete the work?
  - There is a good chance there isn't if you are only working on the stream bank.
  - Do the plans/quantities account for this?
- Where will spoil be disposed of?
  - Do you have enough topsoil to cover the spoil pile?
  - Blanket?
  - Seed mix?

Work in the Dry or Wet?

- Is the work to be completed in the dry?
  - Pump around?
    - Pump/pipe sizing
  - Ditch around?
  - Isolate flow to one side or the other using non-erodible structure such as:
    - Portadam
    - Inflatable bladders
    - 1-ton sand bags

Dry Construction

- Pipe around?
  - Block off and divert creek into by-pass pipe

Pipe/Pump through

Pump Around

Pumping Costs

- Pumping cost can be extraordinary!
  - Make sure the costs have been calculated.
    - A recent project of ours was $25,000/day
    - Another project total construction cost was 6 mil, of which 1.5 mil was pumping.
  - Is the project union?
    - 24/7 manning of pumps?
    - What is happening on the weekends?

Pumping

- The site will go under water with a storm.
  - What level of protection are you designing for?

Portadams

- Isolate flow to one side or the other using a Portadam

Inflatable Bladders

Stabilized By-Pass Channel

Temporary Creek Crossing

- Pipes with stone
- Bridged

Construction Platform

- Where are you going to sit the excavator?
  - On top – work bottom up.

Construction Platform

Construction Platform

Construction Platform

- Or do you have to create a bench?

Everyone needs to know the following:

- **It dictates** the design and construction
  - If you are the designer, you need to think about it.
  - If you are the contractor and you have to warranty the work, I would be very concerned if the designer did not take it into consideration.
- Your installation needs to take it into consideration.

So what is **it**?

The Scour Line!

Scour Line

- In general, the elevation of the scour line on a creek, stream or river correlates to the elevation of a Two Year Storm.
- The scour line is the interface between bare earth and vegetation.

Scour Line

- Why is this important?
- Little Story…..

15+ Years Later

Scour Line

- The Designers needs to walk the site and understand the context.
- Is there a scour line?
- What is causing the scour line?
  - Scour or water level fluctuations
- How much do water levels fluctuate, or are they pretty stable?
- Is there vegetation currently growing down to the water line?
  - If not, how high!
  - Design accordingly!!!!!!

Scour Line

- Are you expecting the contractor to warranty plants down to the waterline, are they really going to grow there?
- If you are the designer, are you proposing something that just won't happen?
- If you are the reviewer, are you approving something that you are pretty sure may fail – speak up, ask questions.
- It is a disservice, to design or approve a plan that is likely to fail.

Scour Line

- Do I hard armor, or do I vegetate!!!
- Scour line around 6” in cohesive non-erodible soil probably okay. Erodible soil?? Probably not!
- Scour line > 6” or 8”, you probably want to use toe protection
- These are generalities, but error on toe protection.
- Find out what this elevation is because it will drive the design and the installation!

How high should the stone go?

- At least the height of a 2-year storm
  - Preferably higher.

Substrate

- Sand , gravel, cohesive clay, silt, goo?
  - How deep?
  - Will my boulders sink?
  - Do you need to undercut to solid ground?
- What size particles are being moved at low flow?
- What size particles are being moved at high flow?
  - Size your particles…Cobbles, Boulders, etc. in excess of what high flow will carry.

Particle Sizing

Bed Shape

- Don’t make the bed flat!

Or this could happen!

More likely this?

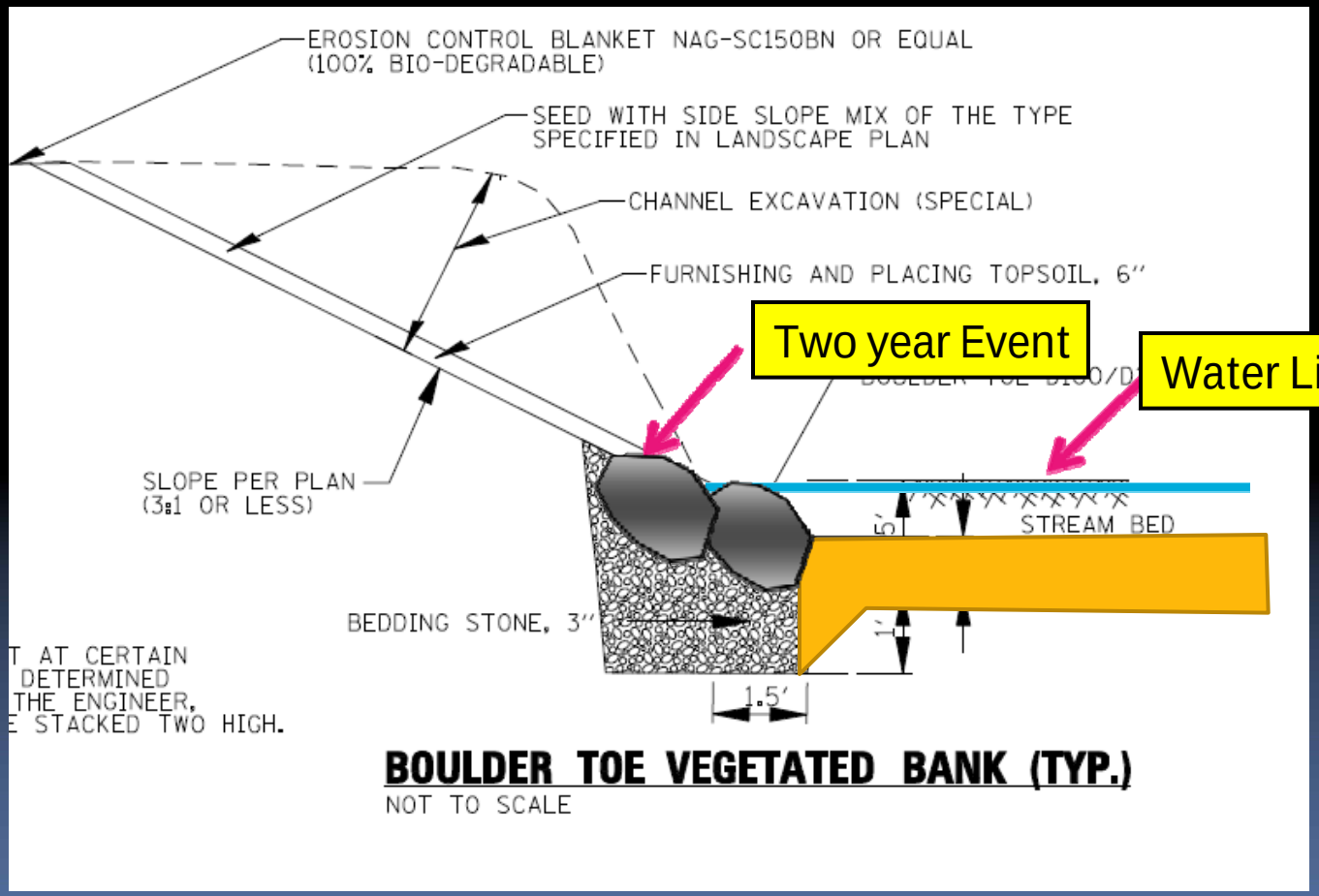
The stream will want to become braided with islands and create new channels.

A nice “U” Shape

Boulder Toe Construction

- The right and wrong ways to construct.

Boulder Toe Detail



Boulder Toe

- WRONG!!!!
- What's going to happen?

Boulder Toe

- Right!
- See the boulder under water, stacked with a second boulder at the water line.

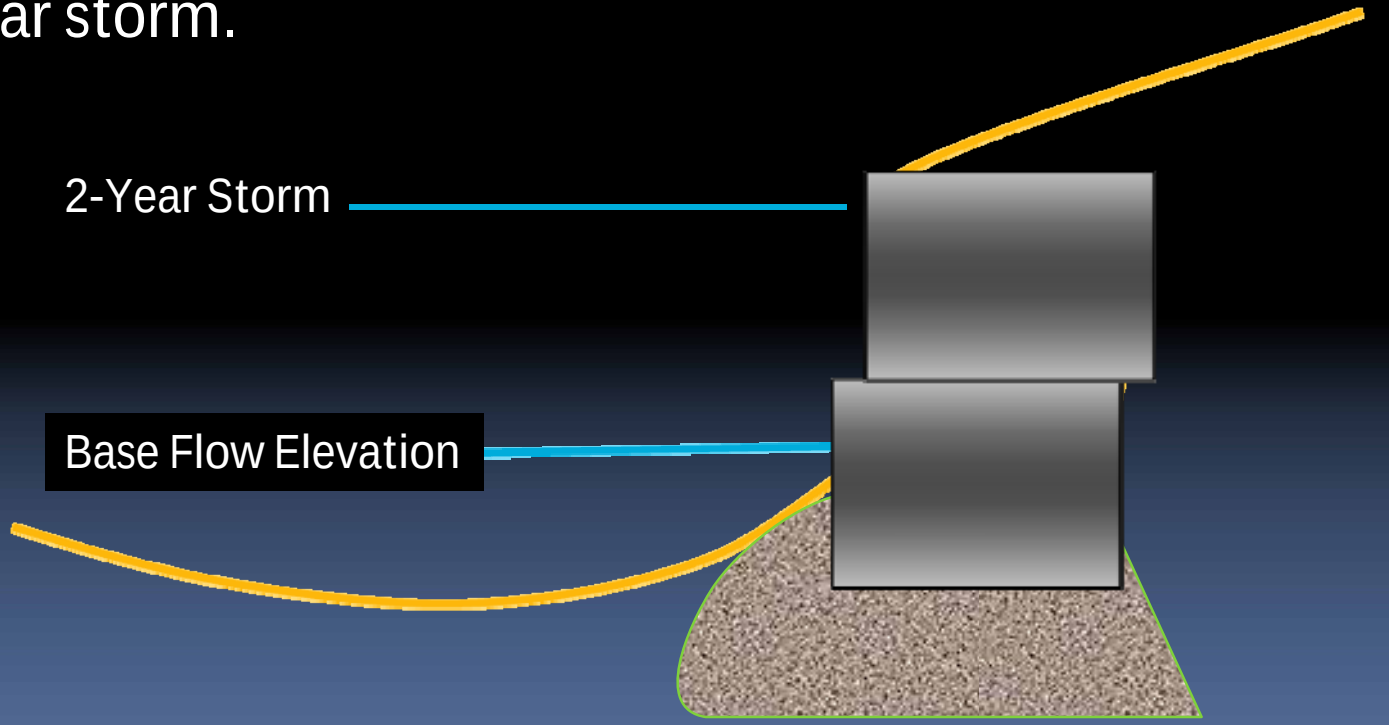
Boulder Toe

Gabion Baskets

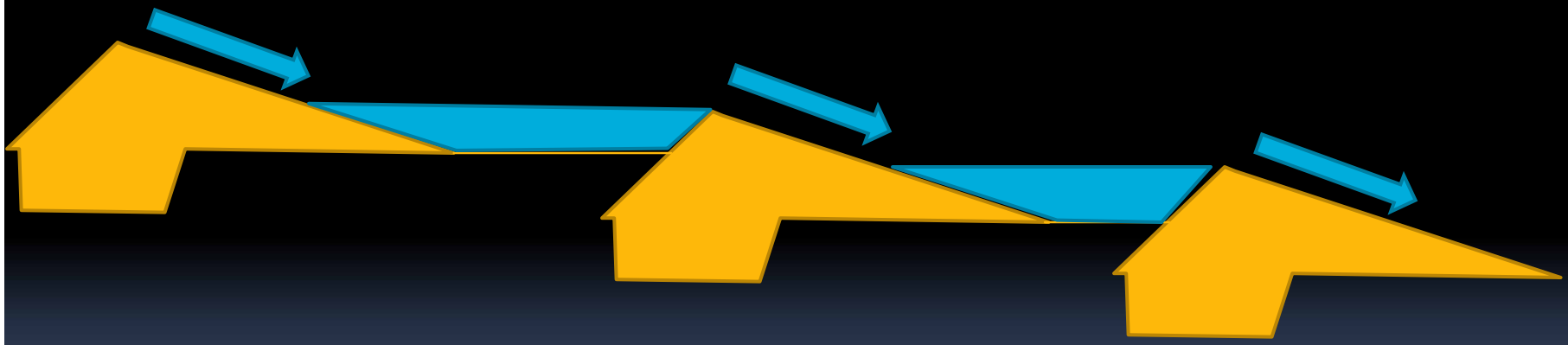
- Resist erosion and movement
- Provide a solid foundation
- Great for tight spaces
- Can be vegetated by using a soil stone mixture with a fabric lining

Gabion Baskets

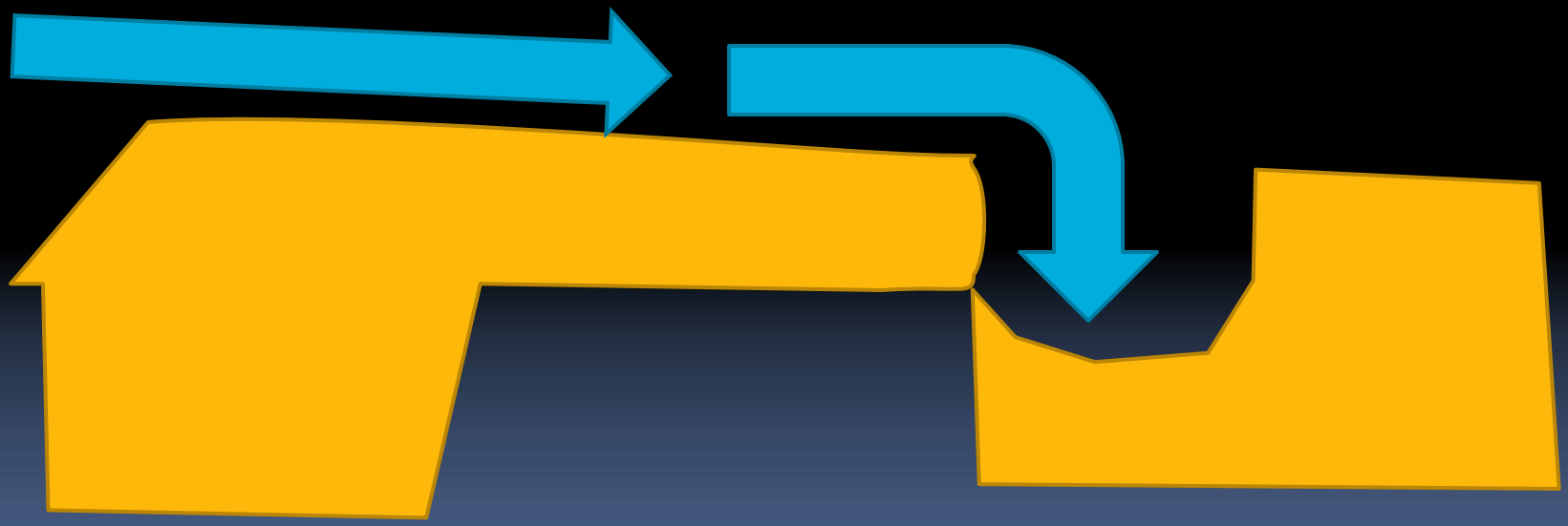
- Waterline should intersect near middle of bottom basket
- Basket bottom should not be able to be scoured out or undermined
- Top of baskets should ideally be at least as high as the two year storm.



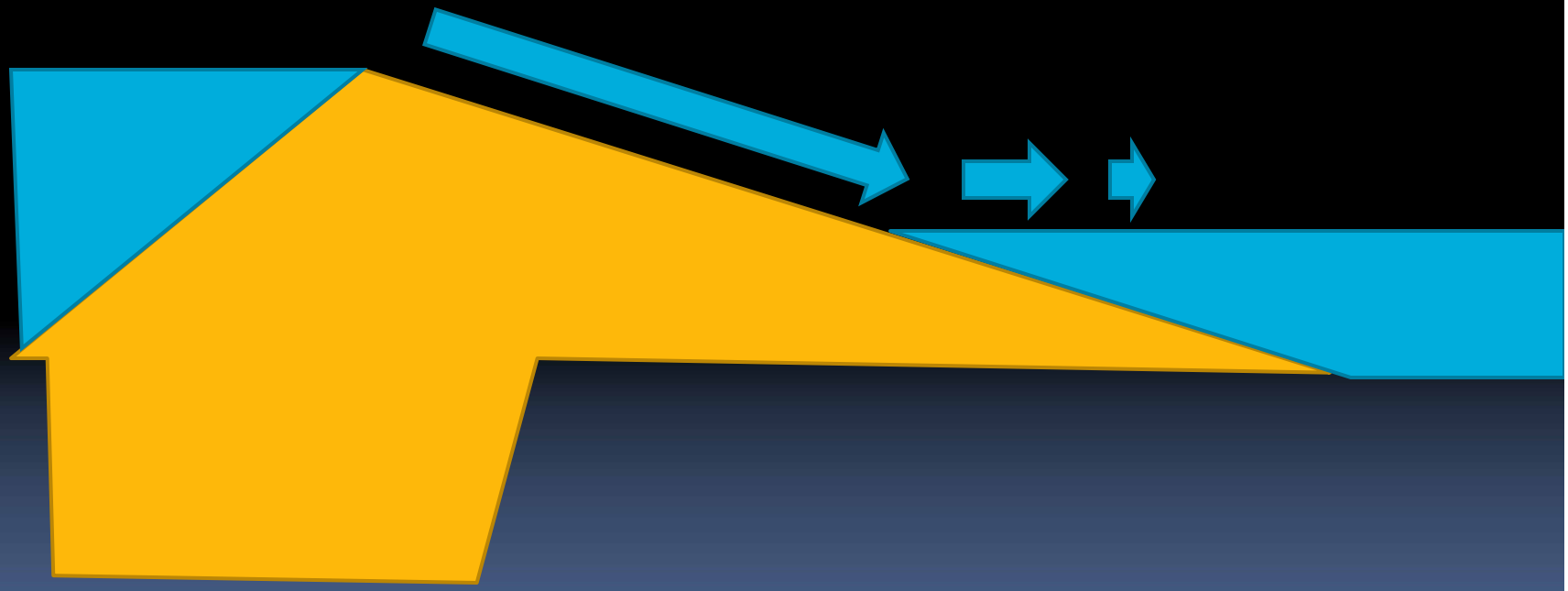
Proper Riffle Crest/Pool Relationship



Riffle – Wrong, Wrong, Wrong

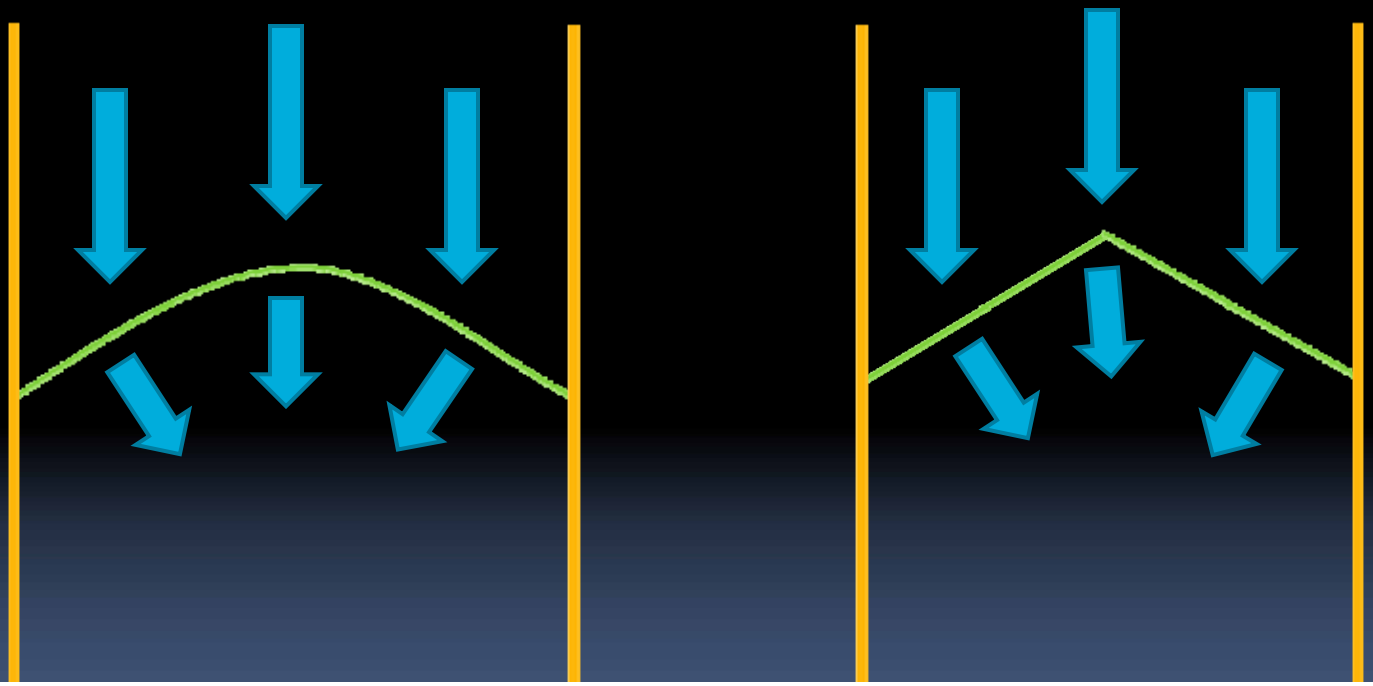


Make sure the toe of the riffle is below the calm water!!!!



Let the calm water be the energy dissipation, not the creek bed.

Appropriate Riffle Crest Shape – Plan/top View

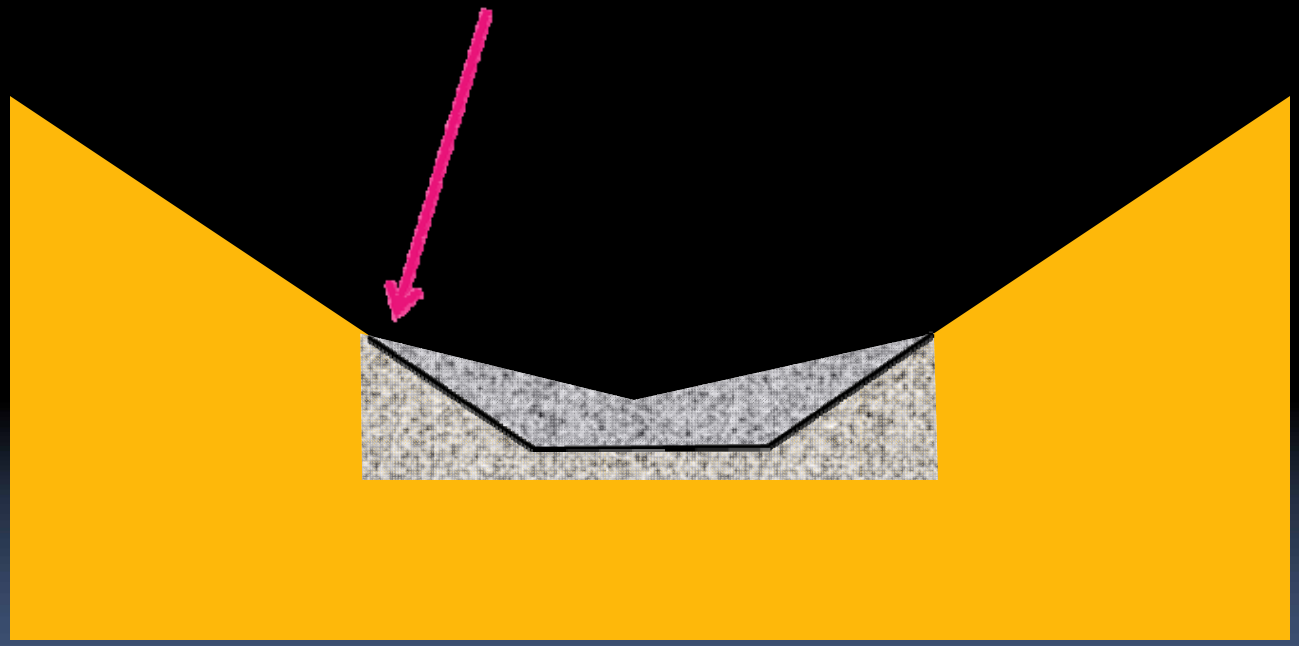


A straight Riffle Crest is okay provided the middle is depressed

Appropriate Riffle Crest Shape – Front View

Key Riffles into the bank

Two year storm elevation or higher



Riffles

- Make sure the boulders/stone are sized accordingly
  - Always need bigger than you think
  - Sized based on high flow energy not low flow
  - I always go larger than the calculation tells me.
- If more than 1% slope on channel profile, need to use step pools instead of riffles.

Riffle Spacing

- On average 1 riffle installed every 5 to 6 bank full widths
- This is a guide. This is not cookie cutter.
  - Very flat channels may require greater spacing and lower crest height
  - Steep channels: tighter spacing, greater height
- Riffle crests typically have a +/-8” difference compared to the next riffle.
  - Sometimes more sometimes less.

Bankfull

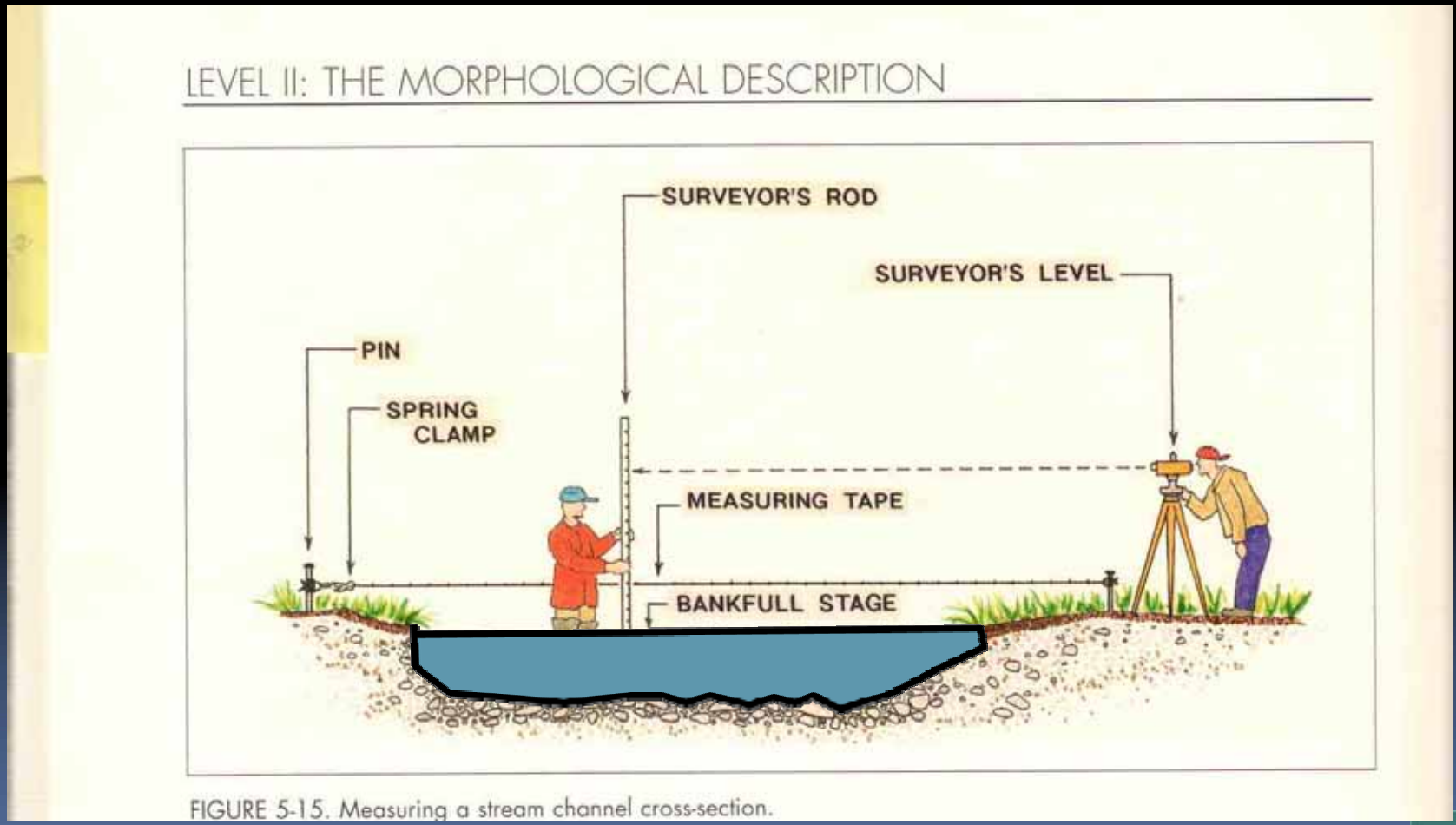
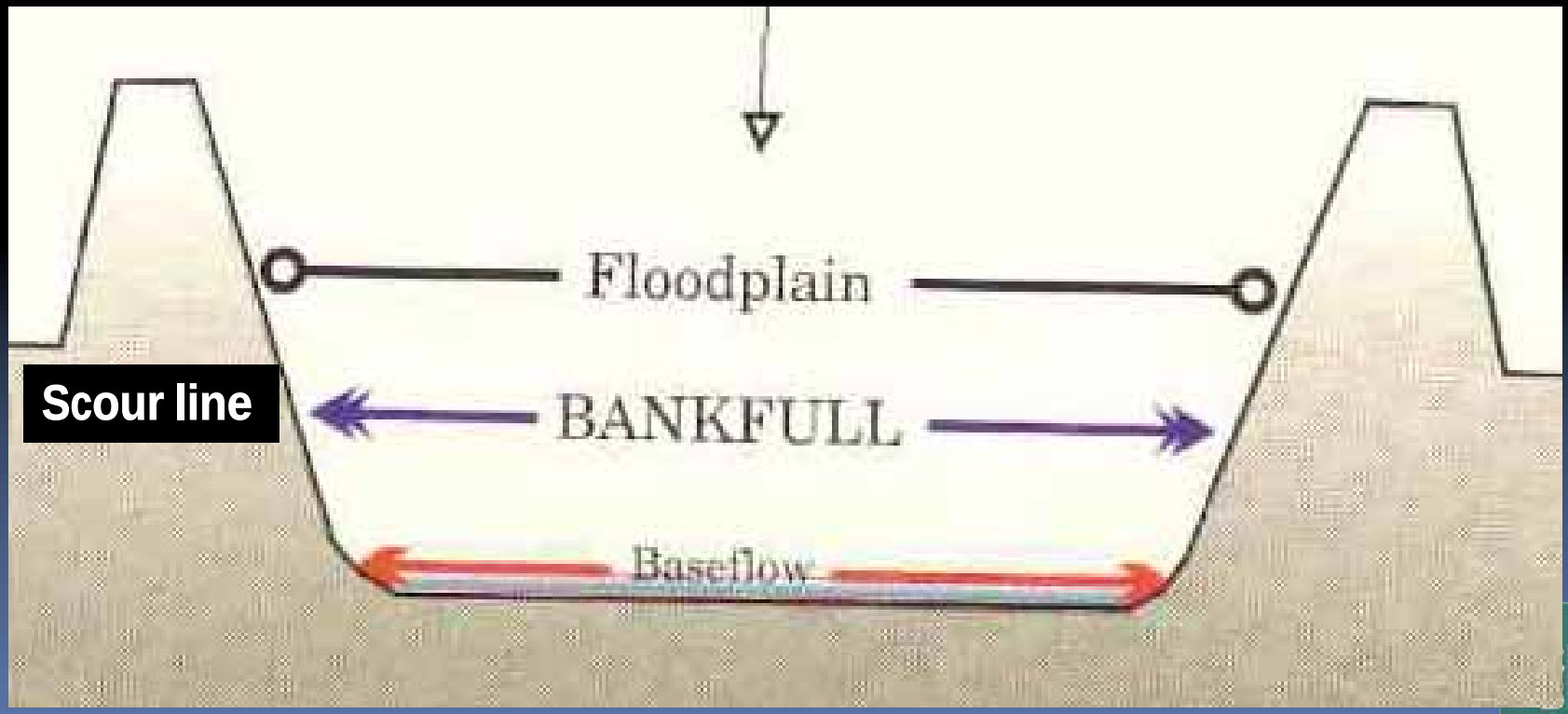


FIGURE 5-15. Measuring a stream channel cross-section.

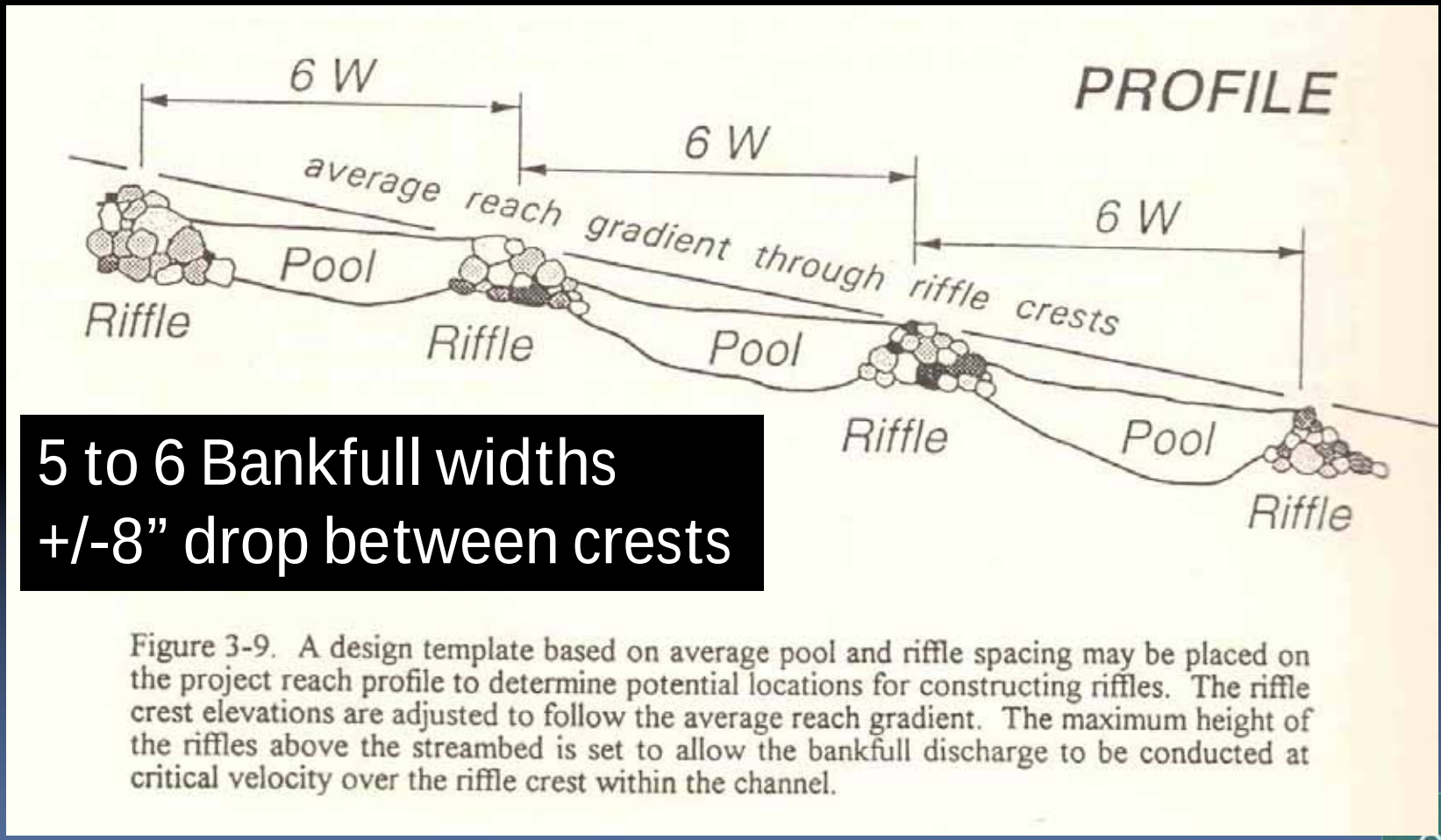
Channelized Bankfull

Should generally be considered the Two Year Storm

- Survey the scour line elevation for the length of the project



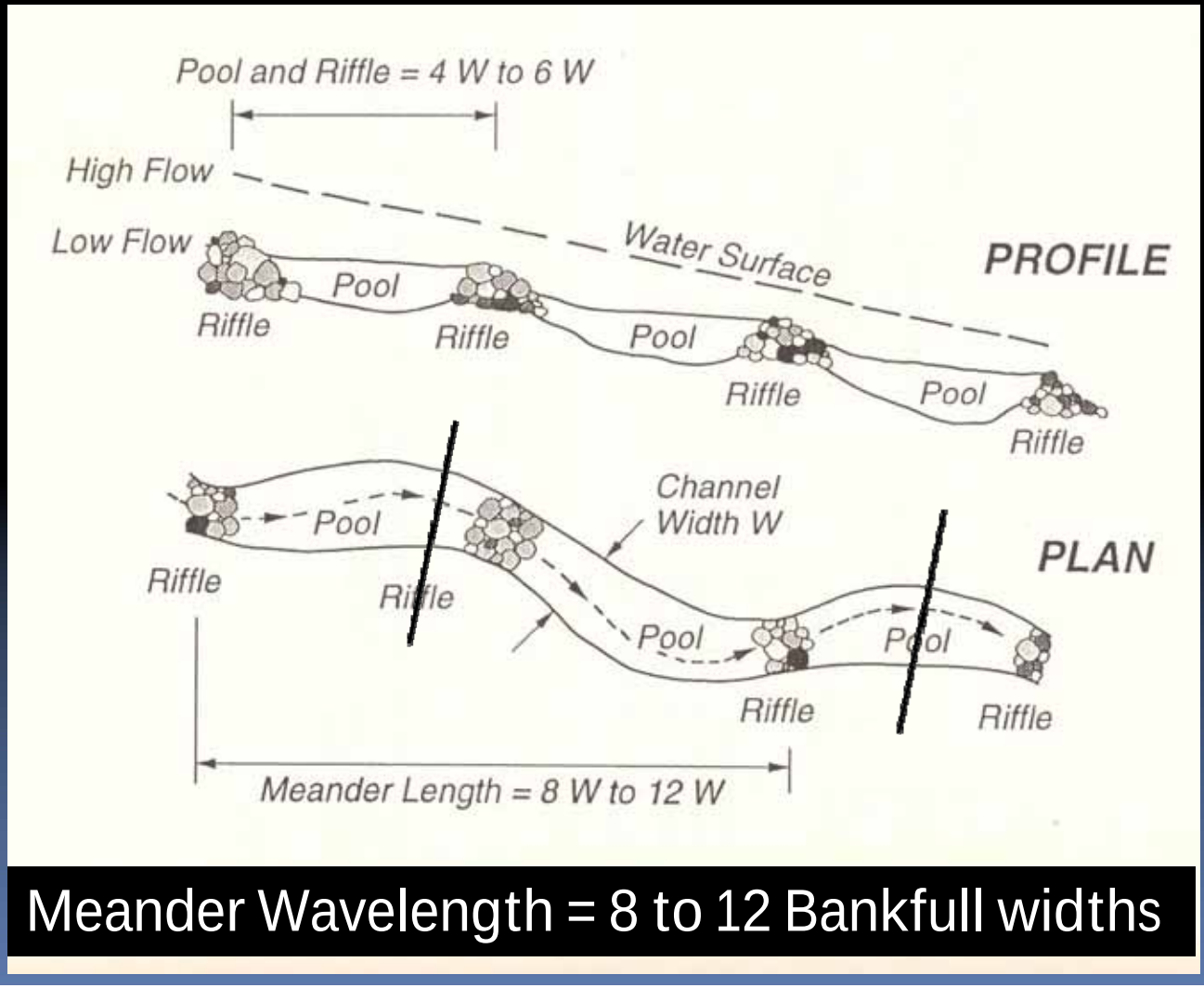
Riffle Spacing



5 to 6 Bankfull widths
+/-8” drop between crests

Figure 3-9. A design template based on average pool and riffle spacing may be placed on the project reach profile to determine potential locations for constructing riffles. The riffle crest elevations are adjusted to follow the average reach gradient. The maximum height of the riffles above the streambed is set to allow the bankfull discharge to be conducted at critical velocity over the riffle crest within the channel.

Riffle Spacing/Meander Length



Meander Wavelength = 8 to 12 Bankfull widths

Questions?

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