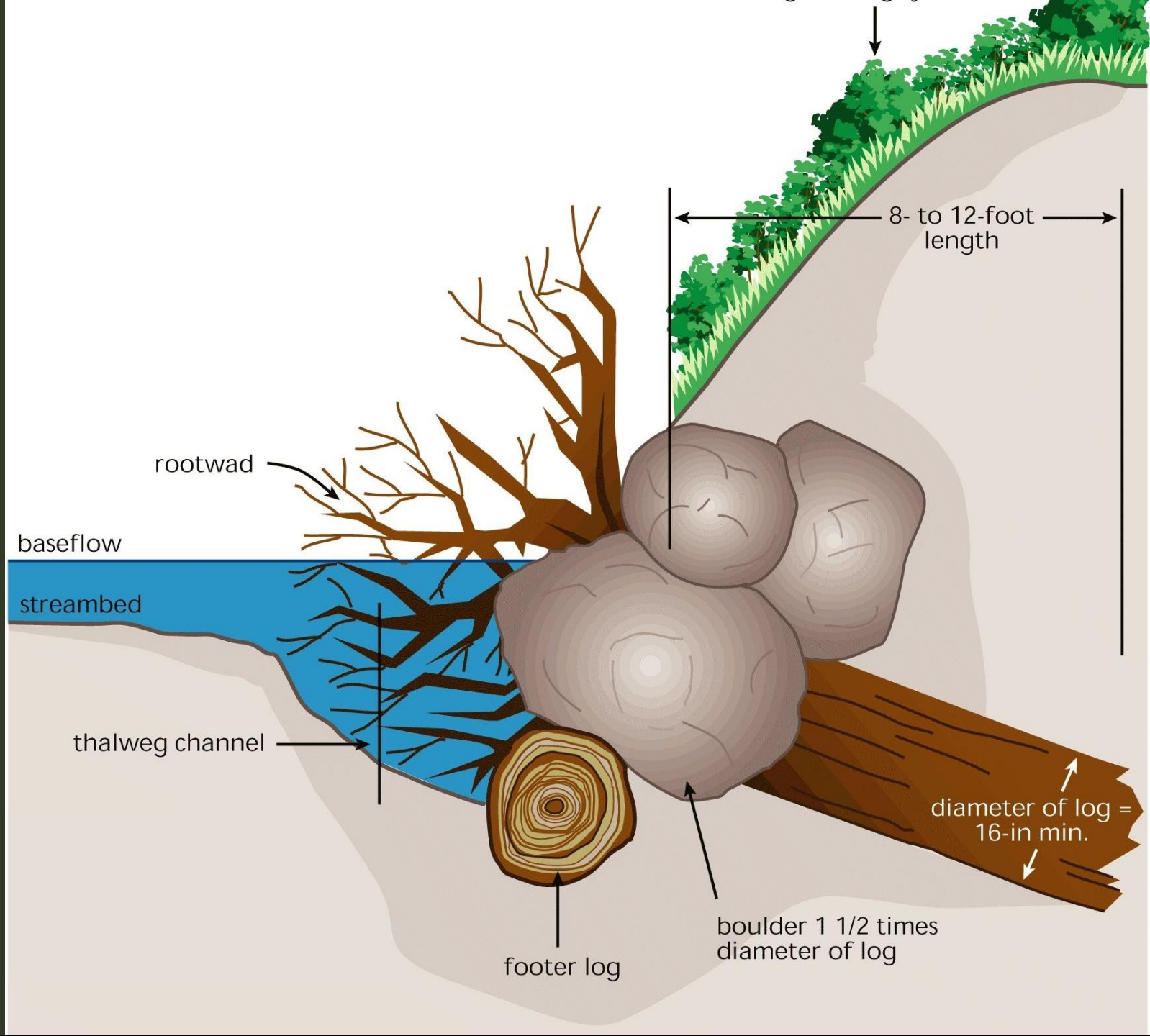
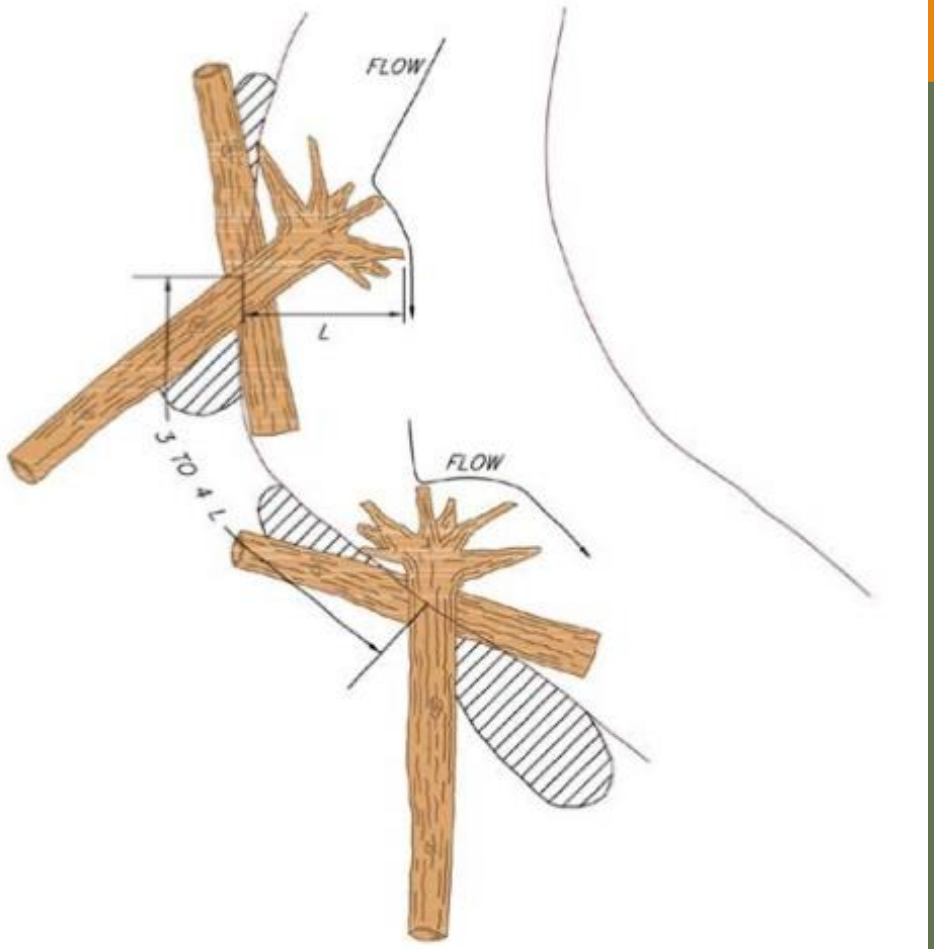
J-Hooks and Rootwads

Rootwads

- Revetments composed of logs, rootwads, and boulders selectively placed in and on streambanks.
- Provide excellent overhead cover, resting areas, shelters for insects and other fish food organisms, substrate for aquatic organisms, and increased stream velocity that results in sediment flushing and deeper scour pools.

From Engineering Field Handbook. Chapter 16. Streambank and Shoreline Protection (U.S. Natural Resource Conservation Service,1996)





ROOTWAD REVETMENT
PLAN VIEW

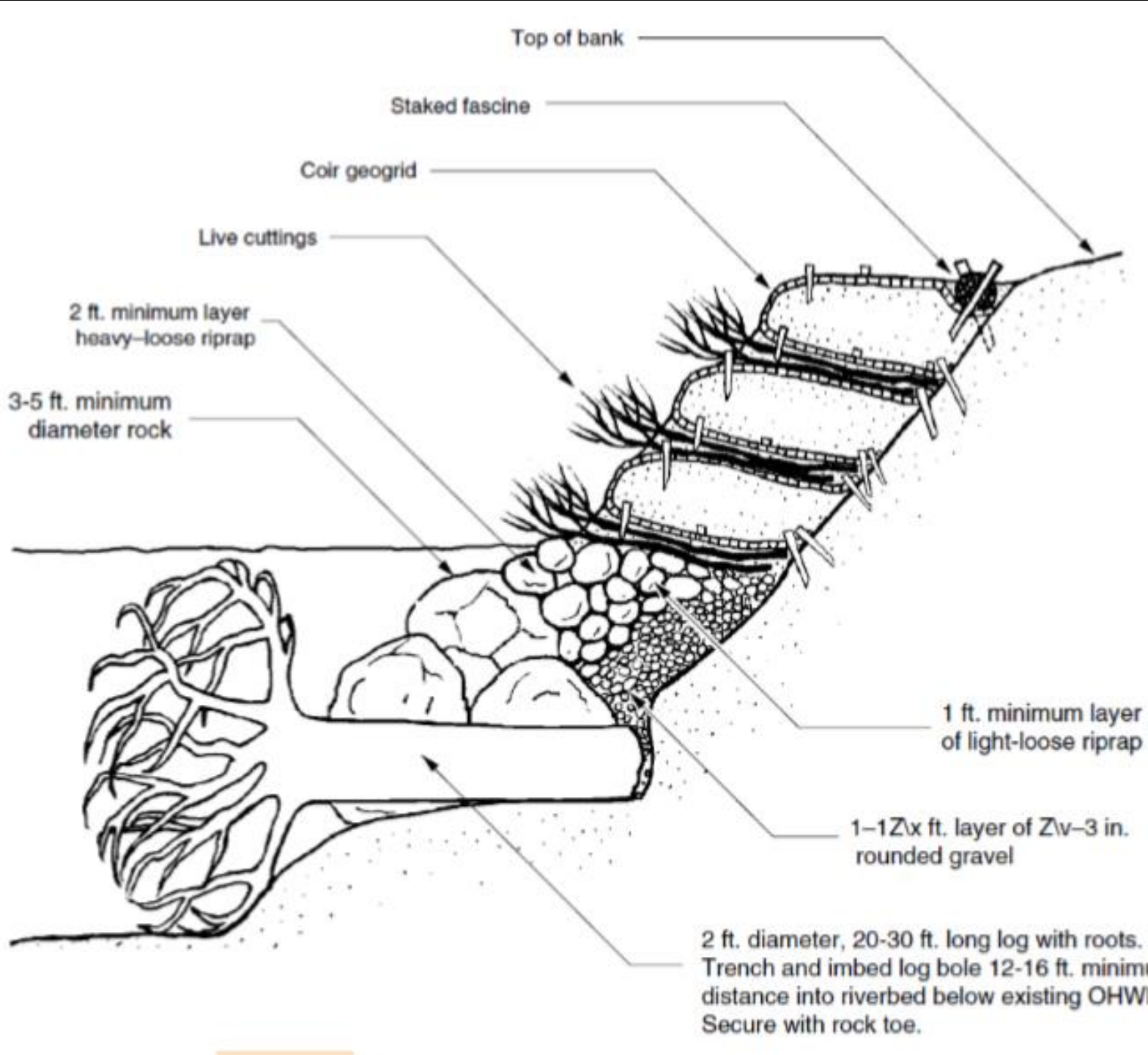
FILE: RRP

Applications and Effectiveness of Rootwads

- Used for stabilization and to create instream structures for improved fish rearing and spawning habitat.
- Effective on meandering streams with out-of-bank flow conditions.
- Will tolerate high boundary shear stress if logs and rootwads are well anchored.
- Suited to streams where fish habitat deficiencies exist.
- Should be used in combination with soil bioengineering system or vegetative plantings to stabilize the upper bank and ensure a regenerative source of streambank vegetation.
- Enhance diversity of riparian corridor when used combination with soil bio-engineering systems.
- Have limited life depending on climate and tree species used.

Design Principles

- Use logs over 16 inches in diameter that are crooked and have an irregular surface.
- Use rootwads with numerous root protrusions and 8 – to 12-foot long boles.
- Boulders should be as large as possible, but at a minimum one and one-half the log diameter. They should have an irregular surface.
- Install a footer log at the tow of the bank to stabilize the slope and provide a stable foundation for the rootwad.
- Place the footer log to the expected scour depth at a slight angle against the streamflow direction.
- Footer log must be anchored using boulders or ¾-in. rebar 54 inches or longer in combination with cables.
- Place rootwads so that the primary brace roots are flush with streambank at a slight angle in the direction of streamflow.
- Backfill with vegetative planting, soil bioengineering systems, live stakes or dormant post plantings.

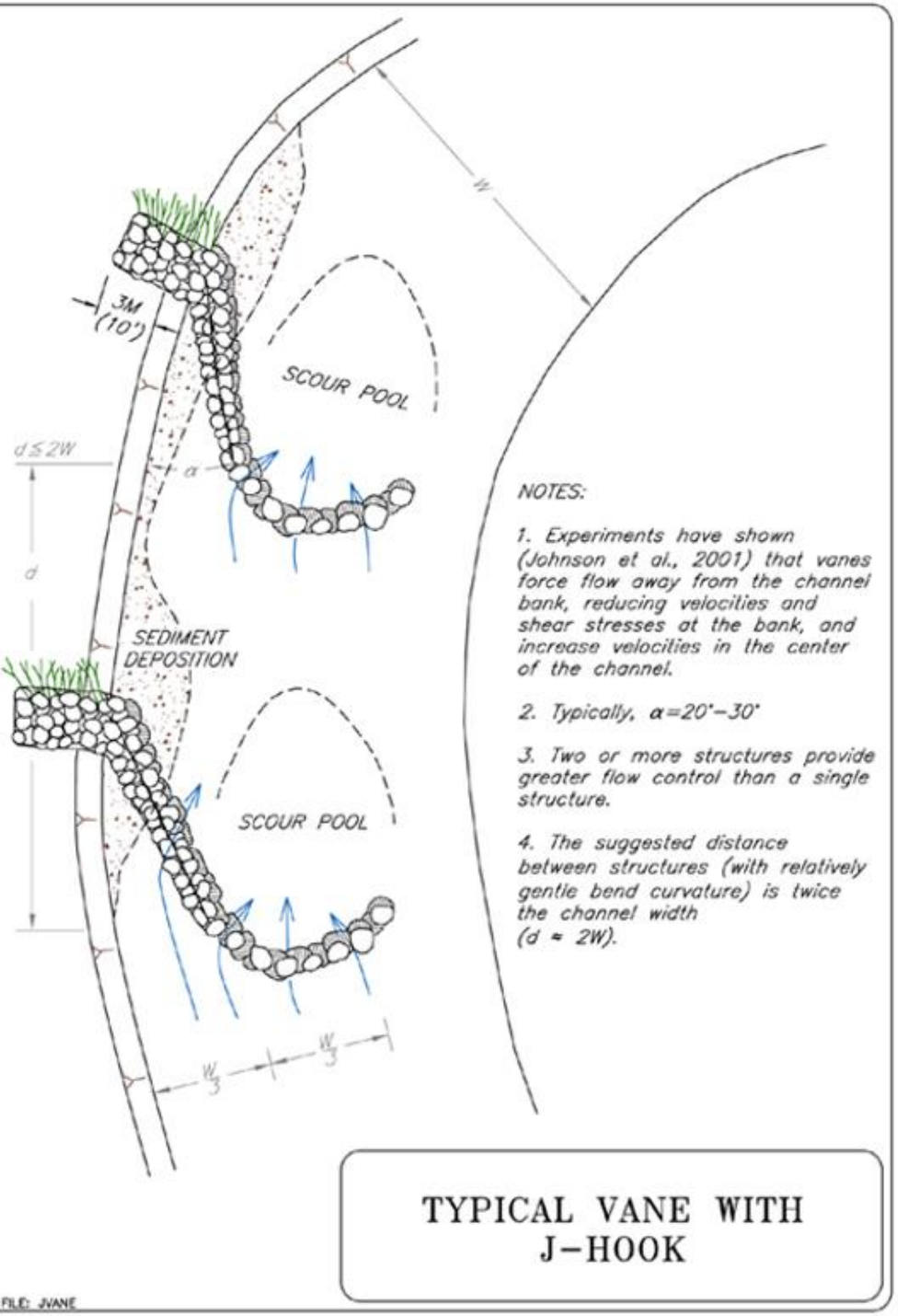


Rootwad Common Modes of Failure

- Flanking occurs when the stream moves around the structure and is caused by stream instability. The most prevalent method of failure of native material revetments is flanking.
- Flanking can be achieved by avoiding areas of instability in the upstream or downstream direction. At least one stable meander or straight reach should be upstream, and another downstream, of the project reach to ensure a consistent entrance and exit flow condition.
- Undercutting can also cause rootwad failure. Undercutting occurs when the roodwad is placed too high in the channel and flow scours the underlying soils.
- Other causes of undercutting include inadequate embedment. For banks comprised of uniform sands, rootwads have limited application.

J-Hook Vanes

- J-hooks are discontinuous, transverse structures angled into the flow and sloping from the bank into the channel.
- The vane portion of the J-hook is angled upstream to redirect overtopping flows away from the bank to protect against erosion.
- Creates interface (shear) zones between fast- and slow-moving flow forming a pool below the vane followed by a riffle at the downstream end of the pool through gravel sorting.



J-Hook Design: Position and Rock Placement

- Position the J-hook to be in the center third of the channel.
- Stones should be sized using individual stone force balance with stones embedded.
- J-hook footer stones should be long and flat with the longest axis being at least 3.5 times the shortest axis.
- Heaviest fo.oter stone should be comparable to the D100 or larger for the vane.
- Fine gravel or sandy streams an extra layer of footer stones may be necessary to accommodate the additional scour.
- Excavation for placement of the J-hook should be about twice the footer rock thickness.
- No more than about 10-15% of the header rock should be above the existing channel grade (85-90% of the vane rock, including the footer stone, would be embedded).

J-Hook Design: Scour and Constructability

- Scour depth and launch riprap volume for the vane portion of J-hooks will be determined using the procedures for bendway weirs. The "Z" value for vanes is the same as for bendway weirs (0.5). For the J-hook stones the scour depth is usually estimated to be about the same as the thickness of the footer stones for gravel bed channels.
- J-hook rocks should be placed on top of footer rocks such that each vane rock touches adjacent rocks and rests upon two halves of each footer rock below it. The vane J-hook header rocks should be placed upstream of the footer rock to form a step which is about 1/3rd as wide as the top dimension of the footer rock.

Scour Depth Equations

$d_{fo} = \frac{q_f^{2/3}}{F_{bo}^{1/3}}$, where d_{fo} = Depth for zero bed sediment transport (ft),

qf = Design flood discharge per unit width ft^3/s per ft,

F_{bo} = Blenches "zero bed factor" in ft/s^2

depth of scour is obtained from $d_s = Zd_{fo}$

J-Hook Common Modes of Failure

- Most common causes of J-hook failure is undermining due to scour.
- Providing scour protection in the form of footer rocks is necessary to prevent the downstream scour hole from undermining the rock forming the “J” tip.
- Undersized stones can be eroded during high flows and can also contribute to failure.
- There is a high likelihood of bankline scalloping between structures and structure erosion during extreme flow events.
- Vanes with J-hooks should not be used near high value river side infrastructure or where there is a potential for loss of life.

References

- Bank Stabilization Design Guidelines. (2015). *Bureau of Reclamation*, *SRH*(2015), 1–331.
- Julien, P. Y. (2018). *River mechanics*. Cambridge, United Kingdom: Cambridge University Press.