Standard Operating Procedure (SOP) 4.8.4

Gravel Permeability (Standpipe)

Adopted from: Keith Barnard & Scott McBain. "Standpipe to Determine Permeability, Dissolved Oxigen, and Vertical Particle Size Distribution in Salmonid spawwning Gravels" Fish Habitat Relationships Technical Bulletin No. 15. April 1994
http://www.fs.fed.us/biology/fishecology/currents/currents15.pdf Accessed 11/16/2009

When assessing a streambed for spawning suitability it is best to survey the channel during flows similar to those occurring during spawning periods. The expected flows will allow surveys of the stream bed's actual grain constituents during spawning. A survey of a channel bed during a time of higher or lower flows than expected during spawning periods will result in larger or finer grain sediment than would occur during spawning periods. Fine sediment infiltrates the gravel and can be detrimental to spawning habitat. Fine sediment reduces intra-gravel water flow, reducing dissolved oxygen required for egg and alevin (underyearling parr or fingerlings) survival.

Streambed substrate may be evaluated to assess spawning suitability and to predict survival-to-emergence of salmon/steelhead eggs and alevins (Vick & Pedersen, 2000). A standpipe may be used to measure permeability by driving it into the substrate to a certain depth (about 1 foot), and the use of a pump (Fig. 1).

The standpipe is driven into the gravel column until the perforations reach the desired sampling depth. Intra-gravel water enters the pipe through the holes and rises to the level equal to the outside water surface. A graduated suction apparatus maintains a 2.5 cm pressure head, causing water to flow through the gravel and into the standpipe (Barnard & McBain, 1994). In maintaining this pressure head, the suction apparatus evacuates water from the standpipe at a rate equal to inflow. This water is stored in a 1,000 ml graduated cylinder so that the volume per unit time (i.e., inflow rate) can be measured.

To measure intra-gravel DO (or any other water quality parameter), water in the standpipe must be removed because it includes surface water. When water is pumped out of the standpipe, intra-gravel water refills the standpipe from the desired sample depth. An electronic probe can then be lowered into the standpipe to measure dissolved oxygen.

The sample permeability is interpolated from an empirical permeability versus corrected inflow rate calibration curve (discussed below, Figure 2). This permeability value "KT" should be standardized to a temperature of 10 degrees Celsius by a viscosity correction factor "X" (Figure 3; Terhune, 1958) as:

$K_{10} = XK_T$

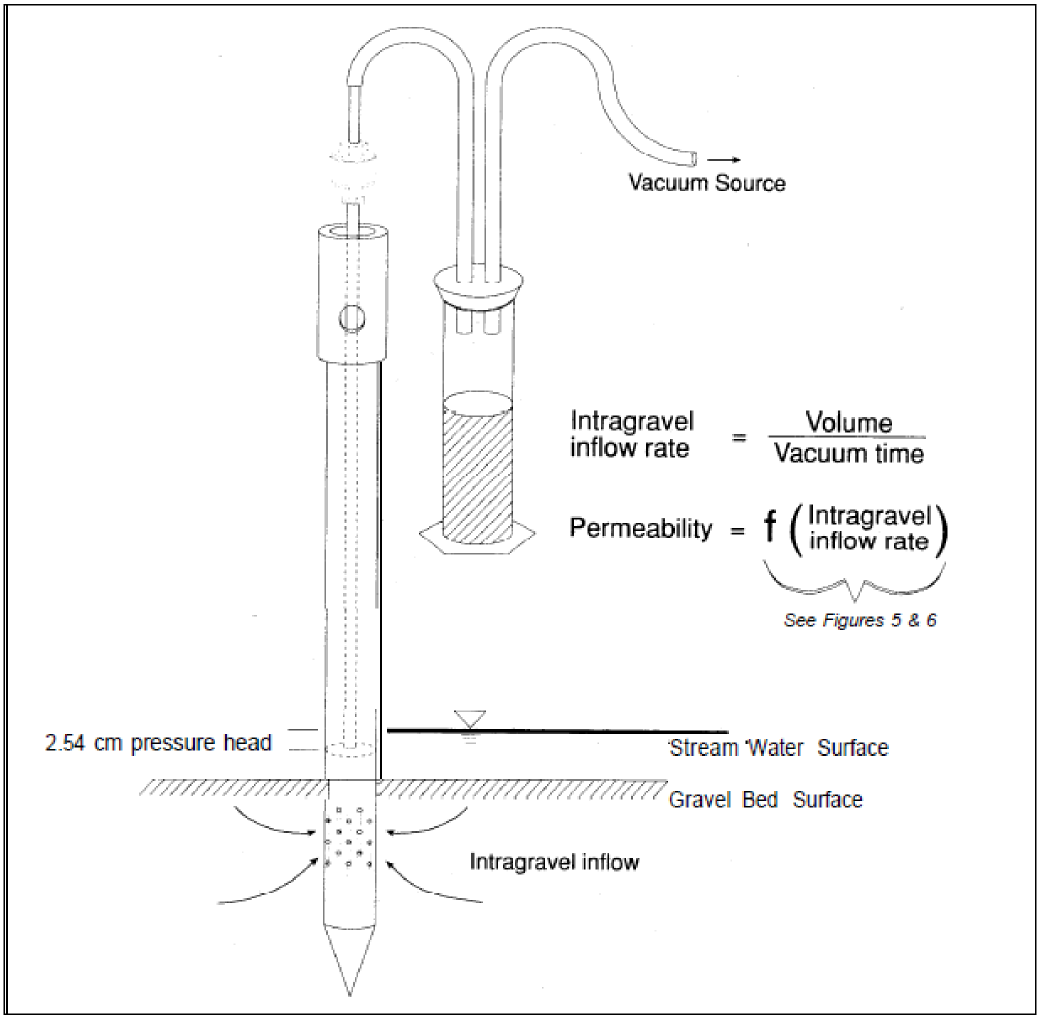

Figure 1. Permeability measurements using a modified standpipe.

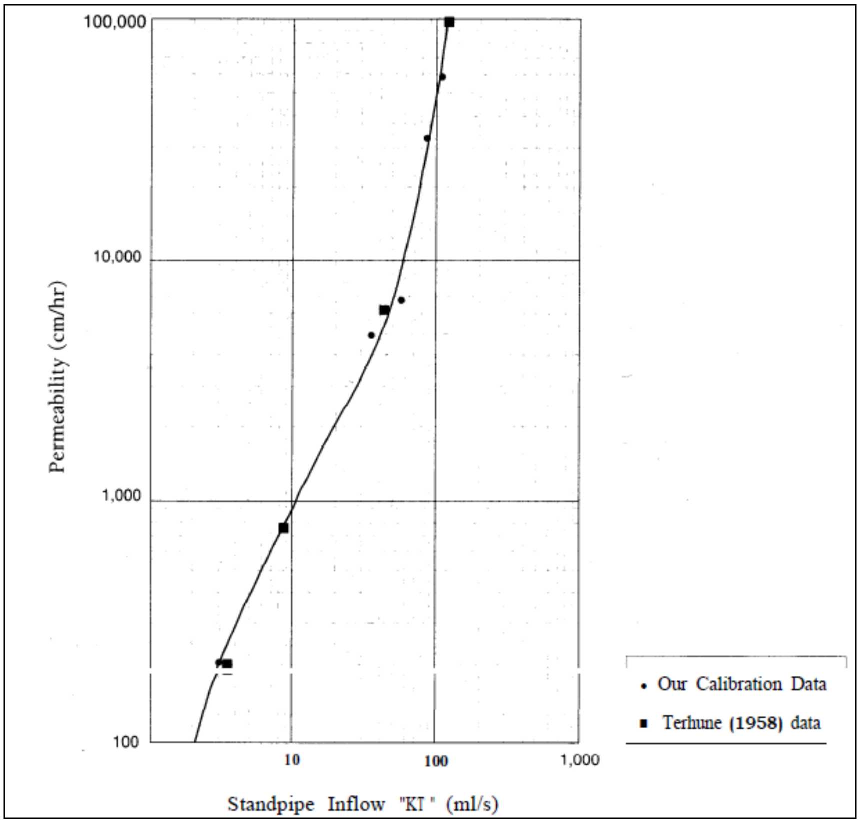

Figure 2. Permeability vs. standpipe inflow rate calibration curve.

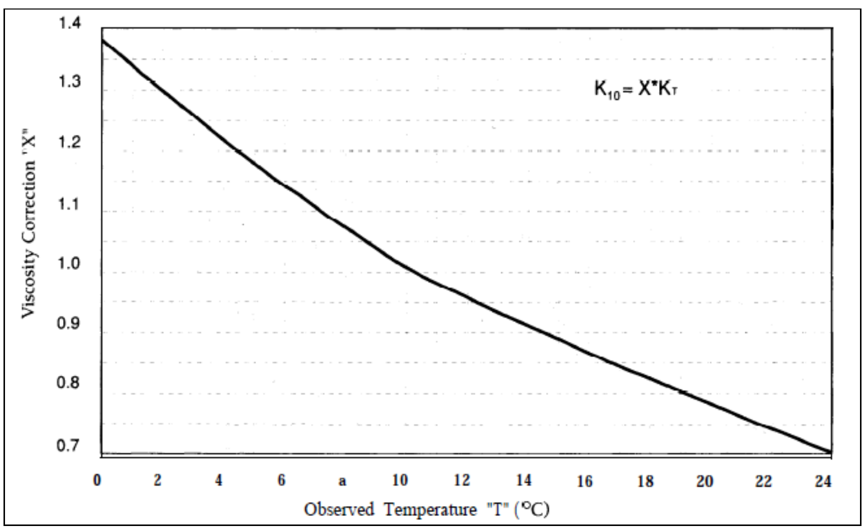

Figure 3. Permeability correction curve to account for viscosity changes with temperature

Table 1. Geomorphically-based habitat classification system developed for the American River (Snider et al. 1992).

Deleted:

LEVEL 1 - STUDY REACH This is the broadest level of classification based on gradient, tidal influence and general characteristics.	
LEVEL 2 - MAJOR CHANNEL FEATURES This level is based on areas of hydraulic control and areas in between. There are three categories within this level.	
Bar Complexes	River areas in which submerged and emergent bars are the primary channel feature.
Flatwater	Areas where primary channel is uniform and without gravel bars or any channel control.
Off-Channel	Areas distinctly separate from main channel.
LEVEL 3 - CHANNEL FEATURE TYPES This is the most descriptive level in terms of channel structure and includes eleven categories.	
Island Complex	Stable island located in main channel; supports established riparian vegetation.
Mid-Channel Bar	Temporary island located in main channel; generally lacks established riparian vegetation.
Lateral Bar	Contiguous with one main-channel bank, does not span channel; less built up than island complex; lacks established riparian vegetation.
Channel-Spanning Bar	Spans entire channel at approximate right angle.
Transverse Bar	Spans entire channel at approximate acute angle.
Channel Bend	Main channel primarily curved.
Straight Channel	Straight Channel
Straight Channel Split	Channel Main channel split into two or more channels.
Contiguous	Off-channel area contiguous with main channel.
Non-Contiguous	Off-channel area not contiguous with main channel.
Chevron Bar	Describes habitat enhancement structures.
LEVEL 4 - HABITAT UNITS This level includes the classic pool, riffle, run, and glide habitats.	
Pool Head	Transition area from fast water unit to a pool; water surface slope decrease and bed slope increases.
Pool Body	Very slow velocity; generally contains deepest portion of pool.
Pool Tail	Transition area into fast water unit; depth decreases and velocity increases.
Glide	Relatively low gradient and below average depths and velocities; no turbulence.
Run	Moderate gradient with above average depths and velocities; low to moderate turbulence.
Moderate Riffle	Relatively high gradient with above average velocities, below average depths; surface turbulence and channel controls.
Backwater	Low-velocity areas not contiguous with the main channel; often associated with downstream ends of lateral bars, and shaded by riparian vegetation.

References

Barnard, K., and S. McBain. 1994. Standpipe to determine permeability, dissolved oxygen, and vertical particle size distribution in salmonid spawning gravels. Fish Habitat Relationships Technical Bulletin No. 15. USDA Forest Service.

Snider, W. B., D. B. Christophel, D. L. Jackson, and P. M. Bratovich. 1992. Habitat characterization of
the lower American River. MOU between Beak Consultants and California Department of Fish and Game.

Terhune, L.D.B. 1958. The Mark VI Groundwater Standpipe for MeasuringSeepage Through Salmon Spawning Gravel. Canada Fisheries Research Board Journal, 15: 1027-1063.

Vick Jennifer & Pedersen Dirk. 2000. Calaveras River Spawning Gravel Assessment. Stillwater Ecosystem, Watershed & Riverine Science.