

APPENDIX A GLOSSARY

Abrade: Wear or scour by water and by the material transported by water

Adfluvial: Produced by river action. Also occasionally used in reference to fish that mature in lakes and migrate upstream into tributaries to spawn.

Aggradation: The geologic process by which stream bed is raised in elevation by the deposition of additional material transported from upstream. The opposite of degradation.

Alviens: Newly hatched fish with the yolk sack still attached

Anadromous fish: Fish such as salmon and some trout, that are born in freshwater rivers and tributaries, migrate downstream and mature in the ocean and return to freshwater to spawn.

Apron: Erosion protection placed below streambed in an area of high velocity flow such as downstream of a culvert.

Armor: a surficial layer of coarse grained sediments that are rarely transported and protect the underlying sediment from erosion and transport.

Armoring: Lining of stream channel or banks with rock or other material to protect slopes from scour.

Aufeis: Build up of ice in stream channels or within a culvert.

Baffle: Wood, concrete or metal mounted in a series on the floor and/or wall of a culvert to increase boundary roughness and thereby reduce the average water velocity in the culvert.

Bankfull Width: refers to the stream width that occurs when a fairly large storm comes that occurs once every two years.

Bed: The land below the ordinary high water lines of state waters. This definition shall not include irrigation ditches, canals, storm water run-off devices, or artificial watercourses except where they exist in a natural watercourse that has been altered by man.

Bed load: The part of sediment transport not in suspension consisting of coarse material moving on or near the channel bed.

Bed roughness: Irregularity of streambed material (i.e., gravel, cobbles) that contributes resistance to streamflow. Commonly measured as Manning's roughness coefficient.

Bituminous: Material consisting of hydrocarbons mainly, as in asphalt or tar.

Box culvert: Square shaped concrete or wood culvert usually assembled in the field.

Burst swimming speed: The highest rate of speed a fish can generate for a short period of time (such as several seconds). Also called Darting Speed.

Cascade: A series of small vertical drops within a channel that may be natural or man made.

Channel: A natural or man made waterway that has definite bed and banks that confine water.

Channel cross section: Channel cross section shape is neither arbitrary nor entirely predictable. It is a function of flow, quantity and caliber of sediment, composition of the bed and banks, and influence of vegetation. An idealized channel cross-section has the following features:

- Active channel width and depth
- Bankfull channel width and depth
- Flood plain width

Adjustments to channel cross section commonly occur as a result of changes in land use practices, sediment supply, hydrology, bank materials, or due to channel incision.

Channel Bed Slope: Vertical change with respect to horizontal distance within the channel (Gradient). Refer to Appendix E for information on how to measure.

Channel Bed Width: The channel bed width is the dimension across the channel between ordinary high water marks. Refer to Appendix E for definition and information on how to measure.

Channelization: Straightening or diverting a waterway into a new channel.

Cobble embededness: The degree to which dominant stream substrates are buried by other materials such as sand or silt.

Cofferdam: Temporary enclosure built in a water course and pumped dry to permit work on a structure by separating the work area from the water.

Corrugations: Alternating series of grooves and ridges formed into a galvanized steel or aluminum culvert.

Critical depth: Depth of flow at which specific energy is a minimum—water depth in a conduit at which under certain conditions maximum flow will occur. These other conditions are—the conduit is on the critical slope with the water flowing at its critical velocity and there is an adequate supply of water. The depth of water flowing in an open channel or a conduit partially filled, for which the velocity head equals one-half the hydraulic mean depth.

Critical flow: A condition that exists at the critical depth, and where the sum of the velocity head and static head is a minimum.

Critical slope: The slope at which maximum flow will occur at minimum velocity. The slope or grade that is exactly equal to the loss of head per foot resulting from flow at a depth that will

give uniform flow at critical depth.

Critical velocity: Mean velocity of flow when flow is at critical depth.

Culvert: Usually a factory assembled round-shaped conduit connected together with couplers or bands. It differs from a bridge in that it is usually constructed entirely below the road surface.

Debris: Includes gravel, cobble, rubble, and boulder-sized sediments as well as trees and other organic detritus scattered about by either natural processes or human influences.

Degradation: Erosional removal of streambed material that results in a lowering of the bed elevation throughout a reach. (Opposite of *Aggradation*.)

Deposition: Settlement of material onto the channel bed.

Design discharge: A quantity of flow that is expected at a certain point as a result of a design storm. Usually expressed as a rate of flow in cubic ft³ per second.

Design frequency: The recurrence interval for hydrologic events used for design purposes. As an example, a design frequency of 50 years means a storm of magnitude that would be expected to recur on the average of once in every 50 years.

Design life: The length of time that is economically sound for a structure to serve without major repairs.

De-watering: Removing water from an area.

Downstream Weir: Refers to a structure(s) placed downstream of the culvert that spans the stream and backs up water towards or into the culvert. They are often used for Back watering or for helping control erosion at the culvert's outlet.

Embankment: A structure of soil, aggregate, or rock material constructed above the natural ground surface.

Embedding a culvert: is to put in larger and smaller sediment in a continuous interlocking manner

Filter fabric: A natural or synthetic fabric used to block sediment from water flowing through a subsurface or surface area such as through a revetment or through a channel.

Fish habitat: Resources and conditions essential for the production of fish including sufficient water quality and quantity, spawning and nursery and rearing areas and food supply areas all of which fish depend directly or indirectly for their processes.

Fish migration: The movement of individual fish and/or fish populations for any purpose, including feeding, spawning, rearing, etc.

Fishway: A system that may include special attraction devices, entrances, collection and transportation channels, a fish ladder, exit and operation and maintenance standards.

Fork length: The length of a fish measured from the most anterior part of the head to the deepest point of the notch in the tail fin.

Gabion: A patented woven wire basket filled with rocks of such a size that they do not pass through the openings in the basket. Individual baskets are stacked in place like building blocks and filled with rock to form erosion resistant structures.

Genetic segregation: The separation of a genetically distinct population from its original gene pool, or the separation of a portion of a population that may not possess the genetic range of the original population.

Geomorphology: The study of physical features associated with landscapes and their evolution. Includes factors such as; stream gradient, elevation, parent material, stream size, valley bottom width, and others.

Grade stabilization or grade control: Stabilization of the streambed elevation against degradation. Usually a natural or man made hard point in the channel that holds a set elevation.

Gradient (slope): The rate of rise or fall of a grade—expressed as a percentage or ratio as determined by a change in elevation to the length.

Head - (static): Height of water above any plane or point of reference. (The energy possessed by each unit of weight of a liquid. Expressed as the vertical height through which a unit of weight would have to fall to release the average energy possessed.) Unit of measure is usually ft or m.

$$\begin{aligned} &\text{Relation between pressure head expressed in lb/in}^2 \\ &\text{and lb/ft}^2 \text{ is } \frac{\text{lb/in}^2 \times 144}{\text{Density in lb/ft}^3} \text{ for water at 66 F} \\ &\text{Head in feet} = \frac{\text{Density in lb/ft}^3}{1 \text{ lb/in}^2} = 2.31 \text{ ft} \end{aligned}$$

Headcut: The erosion of the channel bed progressing in an upstream direction creating an incised channel.

Hydraulic gradient: A line which represents the relative force available due to the potential energy available. This is a combination of energy due to the height of the water and internal pressure. In an open channel, the line corresponds to the water surface. In a closed conduit, if several openings are placed along the top of the pipe and open end tubes inserted, a line connecting the water levels in the tubes inserted represents the hydraulic grade line.

Hydraulic jump: Abrupt rise in water surface depth. The surface of the jump is very rough and turbulent. This condition occurs when critical flow turns to subcritical flow. The resulting loss of energy is released into turbulent flow.

Hydraulic radius: The cross-sectional area of a stream of water divided by the length of that part of its periphery in contact with its containing conduit; the ratio of area to wetted perimeter.

Hydrograph: Plot of stream flow as time for a given drainage for a typical or specified rainfall distribution of some specified duration.

Incipient motion: is the critical point at which a particle (sand, pebble, or rock) is balanced between stability and motion.

Incision: The resulting change in channel cross section from the process of degradation.

Inlet: Refers to the culverts upstream end

Impoundment: The process of damming water. Also the resulting body of water from a dam or weir.

Invert: That part of a culvert that is the lowest part of the internal cross section.

Invertebrate: Animals that contain no backbone such as insects or crustaceans.

Jute: Fiber used to make rope, twine or burlap. It is used in the construction of some geotextile fabrics.

Jump or rest Pool; refers to a pool below the culvert or below a culvert weir which fish will use for resting and to get momentum to jump over an outlet drop or drop from a weir.

Juvenile: Young fish, one that has not reached full maturity.

Large Woody debris (LWD): Any large piece of woody material such as root wads, logs, and trees in or intruding into a stream channel.

Manning's formula or equation: An equation for determining the quantity of flow whose factors are the hydraulic radius, cross section area of flow, and a coefficient of roughness.

Maturation: The process of development into an adult.

Mitigation: Actions to avoid or compensate for the impacts to fish life resulting from the proposed project activity. (WAC 220-110-050).

Morphology (stream): The study of the form and structure of creeks, streams, and rivers.

Nomographs: A graph or chart that reduces a mathematical formula to curves so that its value can be read on the chart's coordinates for any value assigned for the variables involved.

Nursery: A rearing area for juvenile fish.

Ordinary High Water Mark: Generally, the lowest limit of perennial vegetation. There are also legal definitions of OHW that include characteristics of erosion and sediment.

The ordinary High Water Mark can usually be identified by physical scarring along the bank or shore, or by other distinctive signs. This scarring is the mark along the bank where the action of water is so common as to leave a natural line impressed on the bank. That line may be indicated by erosion, shelving, changes in soil characteristics, destruction of terrestrial vegetation, the presence of litter or debris, or other distinctive physical characteristics.

The legal definition of OHW as defined in the WAC (220-110-020(31))is:

“Ordinary high water line means the mark on the shores of all waters that will be found by examining the bed and banks and ascertaining where the presence and action of waters are so common and usual and so long continued in ordinary years, as to mark upon the soil or vegetation a character distinct from that of the abutting upland; provided, that in any area where the ordinary high water line cannot be found, the ordinary high water line adjoining saltwater shall be the line of mean higher high water and the ordinary high water line adjoining freshwater shall be the elevation of the mean annual flood”.

Considerable judgment is required to identify representative OHW marks. It may be difficult to identify the mark on cut banks. In warm months grasses or hanging vegetation may obscure the OHW mark. Artificial structures (culverts, bridges, or other constrictions) can affect the OHW mark in their vicinity by creating marks on the shore which are consistent to OHW marks, but above the elevation that is usually found in undisturbed river reaches.

Outfall: The discharge end of a culvert.

Peak flow: The maximum instantaneous rate of flow during a flood.

Perching: The tendency to develop a falls or cascade at a culvert outfall due to the erosion of the stream channel downstream from a culvert or drainage structure.

Permissible velocity: is the maximum mean velocity of a channel that will not cause erosion of the channel boundary.

Pipe arch: Multi-plate or structural plate culverts assembled on a treated timber or concrete foundation. Because of their size (normally in excess of 6 ft. in diameter) and the fact they are placed on a foundation, they are normally field assembled in place. A series of interlocking steel plates are bolted together to make the required shape and length.

Prolonged swimming speed: The speed at which a fish can swim for an extended period of time (several minutes or more). Results in fatigue.

Reach: A section of a stream having a similar physical and biological characteristics.

Resident fish: A fish that spends its entire life in a limited range of habitats, such as fresh water. It should be noted that a resident fish can still be migratory.

Riffle: A reach of stream in which the water flow is rapid and usually more shallow than the reaches above and below. Natural streams often consist of a succession of pools and riffles.

Riparian: The area adjacent to flowing water (e.g., rivers, perennial or intermittent streams, seeps, or springs) that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other. *Source:* WDFW Riparian Document.

Riprap: Large durable materials (usually rocks; sometimes broken concrete, etc.) used to protect a stream bank or lake shore from erosion; may also refer to the materials used.

Riverine pond: A pond or side channel area located off of the main river channel. This type of habitat is commonly used by fish for rearing; and/or protection during adverse river conditions.

Road alignment: The horizontal route or direction of a road. It is made up of straight line tangent sections and curves.

Salmonid: Any of the fish belonging to the family Salmonidae such as whitefish, gilling, salmon, and trout. Most commonly used in reference to salmon and/or trout.

Scour: Is the result of the erosive action of flowing water, excavating and carrying away material from the bed and banks of streams.

Sediment: Eroded soil particles which are transported by wind or water and are deposited in a stream or lake.

Seeding a culvert; is putting in scattered larger sized sediment in a discontinuous manner to increase roughness or add resting areas for fish in the rocks"shadow".

Shear strength: The characteristic of soil, rock and root structure that resists one unit of material sliding along another.

Shear stress: is a measure of the erosive force acting on the channel boundary, with the force acting parallel to the area. It is given as force per unit area. Lbs/ft². In a channel, shear stress is created by water flowing parallel to the boundaries of the channel.

Sinking a culvert: refers to putting the bottom of the culvert in lower than the existing streambed. It is measured from the streambed that exists after installation of a culvert. This is also called depressed inlet or countersinking when the inlet is sunk more than the outlet.

Spawning bed: A habitat used by fish for spawning.

Streambed simulation: refers to the concept of trying to simulate natural conditions inside the culvert by either embedding the culvert with material similar to the streambed, using an open bottom structure, or adding roughness elements that collect substrate and naturally embedded the culvert.

Structural plate: Corrugated steel plates or sheets, bolted together to form large pipes, pipe arches, marches, and other structures.

Substrate: Mineral and organic material that forms the bed of a stream.

Supercritical flow: The flow of water at a high velocity. It is usually defined as rapid, shooting, or torrential.

Sustained swimming speed: The swimming speed fish can maintain indefinitely without fatigue. Also called cruising speed.

Tailout: The downstream end of a pool where the bed surface gradually rises and the water depth increases. It may vary in length, but usually occurs immediately upstream of a riffle.

Tailwater: The water just downstream from a structure.

Ten-year flood: Maximum quantity of water flow per second expected at a particular water crossing, on a statistical average, once every ten years. It has a 10 percent probability of occurring in any given year. Other return frequencies are defined in a similar manner.

Thalweg: The longitudinal line of deepest water within a stream.

Toe: The break in slope at the foot of a bank where the bank meets the bed.

Tractive force: is the name for shear stress, specific to river channels. The term shear stress is universal and can be applied to many applications. Tractive force is shear stress acting on stream banks.

Watershed: Region or area contributing to the supply of a stream or lake; drainage basis, catchment area.

Weir: Small dam in a stream that causes water to back up behind it, and flow over or through it. Many times has a notch to control where the water flows over it.

Width depth ratio: is a commonly used indicator of channel shape, and reflects Sediment load, bank materials, channel pattern, and extent of vegetative bank reinforcement.