# Henry's Fork Foundation Water Glossary

All terms defined elsewhere in the glossary are hyperlinked.

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## Hydrology Terminology

**Acre-feet** A unit of volume; the volume of water needed to cover one acre in a foot of water. Also equivalent to a football field covered in water one foot deep or 325,851 gallons of water.

**Actual flow** The surface flow observed in a stream, reflecting natural flow, reservoir storage or delivery, and/or reach gains. Actual flow, for example, is often referenced when flow reflected by USGS stream gages are reading higher than actual flow due to an increase in aquatic vegetation in the steam channel.

**Agricultural moisture availability** Total precipitation minus evapotranspiration. Higher moisture availability decreases irrigation demand through a combination of higher precipitation and lower evapotranspiration. In turn, lower irrigation demand can be met with less draft of reservoirs like Island Park.

**Aquifer** A body of porous rock or sediment that holds groundwater. Water from precipitation, runoff, or a stream enters an aquifer by seeping through the ground. Groundwater stored in an aquifer resurfaces at springs and seeps or can be withdrawn through wells.

**Baseflow** The portion of streamflow that is not runoff; it is maintained by shallow subsurface flow that enters the stream from springs, soils, and/or aquifers.

**Canal company** A private company formed by a group of irrigators to divert and deliver water to its shareholders. Canal companies hold water rights, so purchasing a share enables water rights for the purchasing individual. The amount of water allocated to the individual is usually proportional to the share. Henry's Fork Foundation and Friends of the Teton River work with several individual canal companies on projects to improve water management.

**Cfs (cubic feet per second, $ft^3/s$)** A rate of flow calculated by multiplying stream depth x width x velocity; cfs measures volume and speed of streamflow. Imagine one cubic foot as a basketball, with cfs as how many basketballs are moving past a given point per second. One cfs is roughly equal to two acre-feet per day.

**Conjunctive management/administration** The management or administration of surface water and groundwater as one unit. Prior to 1993 in Idaho, surface water and groundwater were managed and administered as separate water sources, despite being hydrologically connected.

**Hydraulically connected** Water connected via an aquifer in such a way that change in hydraulic pressure in one location produces a change in flow at another. The lower Henry's Fork is hydraulically connected to American Falls Reservoir because both water bodies exchange water with the Eastern Snake Plain Aquifer.

**Hydrologically connected** Water within the same watershed, basin, or administrative unit. The Teton Valley Aquifer is hydrologically connected to the lower Henry's Fork because outflow from the aquifer feeds the Teton River, a tributary of the lower Henry's Fork. However, the Teton Valley Aquifer is not hydraulically connected to the lower Henry's Fork because water is not exchanged between the two.

**Consumptive water use** Water permanently removed from its source that is no longer available. Consumptive uses include transpiration by plants and evaporation from the surface of a reservoir.

**Crosscut Canal** Fremont-Madison Irrigation District's Crosscut Canal diverts water from the Henry's Fork to the Teton River. The canal diverts water directly below the Fall River-Henry's Fork junction and ends just upstream of the USGS Teton River near St. Anthony gage. The canal delivers 1) natural flow and storage water to Fall River Canal and 2) FMID storage water from Island Park and Grassy Lake reservoirs to Teton River diversions.

**Discharge** A synonym for streamflow. The amount of water moving past a given point in a stream at a certain time.

**Diversion** Surface water diverted from a reach through pumps or canals to supply irrigation or other beneficial uses **or** the physical location (also known as the point of diversion) where surface water is removed from the stream.

**Draft** When outflow from a reservoir is greater than inflow; i.e., when there is more water leaving the reservoir than entering. The majority of work conducted by HFF aims to minimize the draft of Island Park Reservoir, which in turn allows for greater reservoir carryover.

**Environmental flow/minimum instream flow** The minimum amount of water needed to sustain and preserve downstream resources such as fisheries, wildlife, recreation, aesthetics, and water quality. These flows are typically legal actions put in place by government agencies; for example, a fish species placed under the Endangered Species Act could result in the establishment of an environmental flow.

**Evaporation** The process by which water changes from liquid to gas and is lost to the atmosphere. Evaporation requires heat and can be increased by wind. Total evaporation from lakes and reservoirs is greater than from rivers because the surface area of lakes and reservoirs is larger.

**Evapotranspiration (ET)** The sum of all land evaporation and transpiration from plants. Transpiration is most simply described as the evaporation of water from plant leaves. Water is produced within the plant during cellular respiration and is also moved from roots to leaves completing metabolic processes; water vapor is released through pores in the leaves called stomata.

**Flow augmentation** Release of storage water from the upper Snake, Boise, and Payette reservoir systems for the purpose of facilitating downstream migration of juvenile salmon through the lower Snake River. Flow augmentation is required under the Endangered Species Act and is a project of the US Bureau of Reclamation and the National Marine Fisheries Service (NOAA Fisheries).

**Freshet** An early spring flood of water resulting from a heavy rain or snowmelt event—typically the most significant spring flooding event for both humans and the river's ecosystem. A freshet is part of the natural hydrologic rhythm of the Henry's Fork that benefits trout and insect habitats and populations. In regulated rivers such as the Henry's Fork, the natural freshet can be mimicked by managed freshet releases from reservoirs. The high flow of the freshet also mobilizes fine sediment in certain reaches of the Henry's Fork to remove years of accumulation. The freshet is particularly effective for exporting sediment from the Last Chance-Pinehaven reach, where sediment accumulated during the 1992 drawdown of Island Park Reservoir.

**Gage shift** The update to a rating curve that occurs when there is a difference between streamflow estimated from the rating curve and the actual streamflow. This difference occurs when the stage used to predict streamflow is altered by stream conditions, such as aquatic vegetation growth or when gravel is deposited. In order to make the gage shift, an amount is added or subtracted from the stage measured by the gage until the predicted discharge matches the actual streamflow. In the Henry's Fork, the shift is needed when aquatic vegetation growth fills in the stream channel and displaces water. For example, in August 2013, a shift of -0.76 feet (a negative shift) was measured to correct the USGS gage reading downstream of Island Park Reservoir. This meant USGS needed to subtract 0.76 feet from the measured water height because plants were taking up 0.76 feet of depth in the stream channel. A shift can occur in the other direction as well, by adding to the measured stage and increasing the shift. For example, when the same plant growth that caused the -0.76 foot shift in August 2013 started to deteriorate in early September 2013, the plants began to take up less room in the stream channel. To account for less plant material filling in the channel, a positive shift of 0.36 feet needed to occur, moving the shift from -0.76 feet to around -0.4 feet.

**Groundwater** Water found underground, stored in aquifers and soils. Groundwater resurfaces and feeds streams, rivers, and springs. The Eastern Snake Plain Aquifer, for example, underlies parts of the Henry's Fork downstream of Ashton and supplies groundwater for baseflow. This can improve summer streamflow and provide cool water for trout.

**Hydrologic regime** The variability in streamflow observed over seasons and years quantified by five parameters: duration, frequency, magnitude, rate of change, and timing. The hydrologic regime of the Henry's Fork is regulated, meaning it is determined by both human and natural processes.

**Duration** The period of time associated with specific flow conditions.
**Frequency** How often a flow above a given magnitude reoccurs over a time interval.
**Magnitude** The amount of water moving past a fixed location per unit of time (discharge).
**Rate of Change** How quickly flow changes from one magnitude to another.
**Timing** The predictability of flows or the regularity of flows of defined magnitude.

**Natural hydrologic regime** A hydrologic regime that is unaffected by use and management of water or is the regime that would be present in a regulated system in the absence of regulation. The natural hydrologic regime is determined by climate and geology. Some small tributaries of the Henry's Fork are natural regimes, but the system as a whole is highly regulated.

**Regulated hydrologic regime** A hydrologic regime that is affected by use and management of water (human factors) as well as natural factors. The regulated regime is determined by climate and geology, plus the effects of reservoirs, diversions, and other water regulation.

**Incidental aquifer recharge** The unintentional infiltration of water into an aquifer including seepage loss from unlined canals and reservoirs. A significant source of incidental recharge is irrigation seepage from flooding fields. In fact, 40 to 70 percent of groundwater recharge comes from irrigation seepage in the Upper Snake River Basin. Incidental recharge is decreasing, however, with the increase of irrigation efficiency.

**Inflow** Surface water entering a specified reach or reservoir, measured in cfs.

**Irrigation efficiency** The fraction of water withdrawn from a stream or aquifer for irrigation that is used consumptively by the irrigated crops. Greater irrigation efficiency means that a higher fraction of withdrawn water is consumed by the plants. Technology has been developed to increase irrigation efficiency, including sprinklers that target individual plants directly instead of flooding an entire field. Flooding in the Upper Snake Region contributes to incidental aquifer recharge, but the transition to sprinklers has decreased that. Pipes are also used instead of canals, which reduce seepage loss and evaporation.

**Irrigation efficiency paradox** The idea that irrigation efficiency, developed to decrease water use, rarely accomplishes that. In fact, certain irrigation efficiency technologies can increase the consumptive use of water. More precise application of water using sprinklers can increase yield. If water users decrease diversion, they may risk losing their water right under the "use it or lose it" clause of the prior appropriation doctrine. This can result in a transition to higher-value crops that use more water. Also, any water not diverted by one user will become available to the next junior user. The water will usually be diverted regardless.

**Irrigator** An individual or company that extracts water to supply it to land or crops to assist in growth.

**Low-flow indicator** An established low streamflow to be targeted during irrigation season, with the aim of minimizing draft of Island Park Reservoir, while also keeping enough water in the river to meet downstream needs. These indicators are agreed upon by the Drought Management Planning Committee.

**Macrophytes** Aquatic plants that have roots, stems, and leaves like their terrestrial counterparts. This group does not include algae, which do not have roots, stems, and leaves. Macrophytes play many important ecological roles in the Henry's Fork, but they are also the primary cause of stream gage shift as they grow and decay over the summer and fall.

**Managed aquifer recharge (MAR)** The intentional injection of surface water into aquifers through wells or infiltration. This essentially stores available surface water in the aquifer for subsequent use or environmental benefit. In the Henry's Fork, MAR is conducted using natural infiltration in ponds or canals with high seepage rates.

**Natural flow/Natural Streamflow** The water supply that comes from melted snowpack, runoff, and precipitation; water that would be in the river without diversions, irrigation return flows, and/or reservoirs. Note that the Idaho Department of Water Resources includes irrigation return flows in its calculation of natural flow, whereas HFF does not.

**Orographic precipitation** The process by which precipitation increases with elevation. As air is forced to rise over mountains, it cools and water vapor condenses, creating precipitation.

**Outflow** Surface water leaving a reach or being released from a reservoir, measured in cfs.

**Point of diversion (POD)** The location on a stream or aquifer where water is withdrawn.

**Prior Appropriation** A system of water management that gives priority to those water rights that were established prior to others and therefore have the right to divert or store natural flow before other water rights established at a later date. Essentially, those who were using the water first are given first priority to its use, i.e. "first in time is first in right". Prior appropriation also requires the beneficial use of water; uses include irrigation, domestic, and fish propagation. The system also specifies that the water must be used for its beneficial use in a reasonable amount of time, i.e. "use it or lose it"; one year of water must be used in 5 years, or users risk losing their right.

**Rating curve (stage-discharge relationship)** The mathematical relationship between depth (called river stage) and flow (discharge) at a given stream location. Stage is measured and used to calculate a corresponding discharge. The rating curve is an accurate representation of the stage-discharge relationship under average conditions; however, the stream conditions can change with aquatic vegetation growth and sediment accumulation or scour. To account for changes from the average conditions and relationship, a shift must be made to the stage by adding or subtracting height, referred to as a gage shift. The rating curve is also called the stage-discharge relationship.

**Reach** A segment of a stream. Examples on the Henry's Fork include Box Canyon, Warm River to Ashton, Ora to Vernon.

**Reach gain** The gain or loss of water between the beginning and end of a stream reach**.** The Henry's Fork is highly connected to an aquifer, making groundwater exchange (either gain of flow from the aquifer or loss of flow to the aquifer) the main factor in reach gains.

**Reach loss** A negative reach gain.

**Recession** Decrease in streamflow after a peak from snowmelt or rainfall as streamflow transitions to baseflow.

**Recruitment** The number of individuals added to a population in a given time, referring to immigration or births. For fish, recruitment is the number of fish surviving to enter the fishery or a specific life stage. HFF is greatly motivated by trout recruitment and its relationship with reservoir carryover and winter flow.

**Regulated flow** Flow in a stream that is at least partially controlled by structures such as dams, reservoirs, and diversions.

**Reservoir carryover** Water or storage remaining in a reservoir after irrigation season that is held through winter into the next irrigation season. Carryover is the single most important factor in determining winter flow downstream of Island Park Reservoir, which in turn is the most important factor that determines juvenile trout recruitment.

**Runoff** A flow of water resulting from precipitation, melting snow, or irrigation water that is not absorbed into the ground and contributes to streamflow.

**Seepage loss** Surface water percolating through the bottom of unlined canals, stream channels, or reservoir bottoms; seepage loss becomes groundwater.

**SnoTel Sites** SnoTel or Snow Telemetry Sites are a series of automated, remote, high-elevation monitoring sites for mountain watersheds in the U.S. They collect data on precipitation, snowpack, temperature, and other climatic factors and are maintained by the USDA Natural Resources Conservation Service. HFF uses publicly-available data from nine of these SnoTel Sites for monitoring, modeling, and predicting streamflow.

**Snow water equivalent (SWE)** A common snowpack measurement, SWE is the amount of liquid water contained within the snowpack. It is the depth of water that would be left in a cylindrical container (a "can") of snow if it were to completely melt.

**Snowpack** The accumulation of snow in layers from multiple snowfall events that compacts and does not melt until spring temperatures rise above freezing. When snowpack melts, it becomes snowmelt; snowpack is a water supply for the Henry's Fork.

**Stage** The water level above an arbitrary point (usually the base of the stream bed) in a stream measured in linear units (feet in the U.S., meters in the metric system).

**Stochastic** Refers to a randomly determined process; a stochastic model is based on probability distributions and produces different random outcomes.

**Storage** Water stored in and delivered from reservoirs.

**Streamflow** The amount of water flowing past a given point in a stream at a given point of time (discharge).

**Surface water** Water found in oceans, lakes, rivers, streams, reservoirs, and channels on the surface of the earth. Surface water can seep into the ground and become groundwater. Surface water in rivers, lakes, and other fresh water sources account for 0.3 percent of all freshwater on earth.

**Upper Snake River Reservoir System** The reservoirs located in the Upper Snake River Basin: Henry's Lake, Island Park, Grassy Lake, Jackson Lake, Palisades, Ririe, American Falls, and Lake Walcott. Their total combined storage capacity is 4,045,695 acre-feet.

**Water District 1** A water district is a government entity responsible for distributing water based on water rights. The distribution of water within a water district is controlled by an appointed or elected watermaster. In Idaho, Water District 1 covers the Snake River above Milner Dam, except a few tributaries.

**Water right** A right for use of waters of the State guaranteed by the Idaho Constitution, but only may be used when water is available. Senior water rights are the oldest water rights and junior water rights are newer water rights.

**Water right priority** An element of a water right under prior appropriation that is determined by the date the water right was established. Priority determines who gets water during a shortage. If there is not enough water to satisfy all water rights, then the oldest water rights are filled first in the order of their establishment until there is no water left. For example, American Falls Reservoir's water right was established in 1921, whereas the water rights in Jackson Lake were established in the 1910s. Thus, Jackson Lake's water right will be filled before the right in American Falls.

**Water rights accounting** The measurement and distribution of natural flow and storage to reservoirs and diversions conducted by each water district. Natural flow and storage are distributed based on water right priorities, the concept of "first in time is first in right". Water District 1 administers the distribution of water to all water rights from headwaters of the Snake to Milner Dam.

**Water withdrawal** The process of diverting, extracting, or removing water from a source.

**Water year** A term used in hydrology that defines 12 months between October 1 of one year and September 30 of the next (coincides with the federal fiscal year). October 1 generally corresponds to the end of the growing season and start of the wet season in the western U.S., which is essential for snowmelt dependent systems like the Henry's Fork.

**Watershed Yield** The amount of natural runoff measured as actual streamflow at a given location.

**600-cfs rule** Developed by Dr. Rob Van Kirk, the rule indicates the need for draft of Island Park Reservoir to keep streamflow in the lower Henry's Fork near the low-flow indicators there. The rule states that total streamflow (natural flow plus reservoir draft) needs to exceed total diversion by roughly 600 cfs. This is the amount needed to leave a total of around 400 cfs in the lower Henry's Fork and South Fork Teton River downstream of all diversions and compensate for seepage loss (~200 cfs) from stream channels in the lower watershed.

## Collaborating Organizations

**Drought Management Planning Committee (DMPC)** The committee was created in 2003 by an Act of Congress to address drought management issues for all water uses including irrigation and fisheries. Its primary goal is to "maintain or enhance watershed health and ecology, even in years of below-average precipitation, in balance with agricultural needs through flexible and adaptive water management". Its objectives are to manage Island Park Reservoir in a way that supports fisheries, agriculture, and hydropower, maintain and enhance water supply for those same activities, maintain functional hydrologic regimes regardless of whether they are natural or regulated, and provide streamflow in the Henry's Fork in times of limited water. The committee is made up of representatives from the Fremont-Madison Irrigation District, HFF, the North Fork Reservoir Company, Trout Unlimited, The Nature Conservancy, and the U.S. Bureau of Reclamation. DMPC meetings are open to the public and numerous other agencies and organizations routinely attend.

**Fall River Rural Electric Cooperative (FRREC)** FRREC owns and operates hydroelectric power plants at Island Park Dam, Buffalo River Dam, Felt Dam on the Teton River, and Chester Dam on the Henry's Fork. HFF has collaborated with FRREC for years in operation and monitoring of the Buffalo River fish ladder. FRREC also serves as the dam tender at Island Park Dam and adjusts outflow there upon receipt of formal flow-change orders from USBR.

**Fremont-Madison Irrigation District (FMID)** Established in 1935, the irrigation district serves 285,000 acres of land in eastern Idaho and is responsible for both surface water management and groundwater recharge efforts. During irrigation season, FMID controls reservoir outflow to deliver storage water to users along the Henry's Fork and its tributaries.

**Henry's Fork Watershed Council (HFWC)** A grassroots organization and community forum that takes a collaborative, community-based approach to problem solving issues within the Henry's Fork Watershed and among its citizens, scientists, and interacting organizations. The council was formed in 1994 after a call for a collaborative effort among parties and improvement of relationships among conflicting interests within the Henry's Fork Watershed. The FMID and HFF volunteered to work together to lead the council, despite being most at odds at the time with water uses in the watershed. The council coordinates projects and funding, reviews project proposals, and educates both the government and citizens on happenings within the watershed.

**North Fork Reservoir Company** A private company of water users that owns and operates the dam at Henry's Lake and owns the water rights to all water stored in Henry's Lake.

**United States Bureau of Reclamation (USBR)** The USBR is a federal agency that oversees water resource management and built Island Park Reservoir, Grassy Lake, and the Crosscut Canal in the Henry's Fork Watershed. Its mission is to manage, develop, and protect water and related resources in both environmentally and economically sound manners while protecting public interest. USBR assisted in the economic development of the West by constructing dams, hydroelectric facilities, and canals. It is currently the largest wholesaler of water in the US and the second largest producer of hydroelectricity in the US, with 53 powerplants. USBR is responsible for filling its reservoirs, including Island Park, primarily during the period outside of irrigation season and is a major partner, with FMID, in implementing water management strategies that maximize carryover in Island Park Reservoir while meeting irrigation needs.