

Appendix A

Useful Information

Glossary of Terms

(Taken from NEH-4, Hydrology)

Italicized words and terms in a definition are defined elsewhere in the list.

Acre-foot. The amount of water that will cover one acre to a depth of one foot. Equals 43,560 cubic feet. Abbreviated ae-ft (formerly AF).

Ac-ft or AF. Abbreviation for acre-foot or acre- feet.

Annual flood. The highest peak discharge in a water year.

Annual runoff. The total natural discharge of a stream for a year, usually expressed in inches depth or ac-ft.. See *water yield*.

Annual series. A *frequency series* in which only the largest value in each year is used, such as the *annual floods*.

Annual yield. The total amount of water obtained in a year from a stream, spring, artesian well, etc. Usually expressed in inches depth, ac-ft, millions of gallons, or cubic feet.

Antecedent Moisture Condition (AMC). The degree of wetness of a watershed at the beginning of a storm.

Area rainfall. The average rainfall over an area, usually as derived from, or discussed in contrast with, *point rainfall*.

Base flow. Stream discharge derived from ground water sources. Sometimes considered to include flows from regulated lakes or reservoirs. Fluctuates much less than storm runoff.

cfs. Abbreviation for cubic feet per second. A unit of water flow. Sometimes called "second-feet."

cfs-day, Often called a *second-foot-day*. The volume of water represented by a flow of one cubic foot per second for a period of one day,

Consumptive use. A term used mainly by irrigation engineers to mean the amount of water used in crop growth plus evaporation from the soil. See evapotranspiration.

Cover. The vegetation, or vegetational debris such as mulch, that exists on the soil surface. In some classification schemes, fallow or bare soil is taken as the minimum cover class.

Cross section (stream or valley). The shape of a channel, stream, or valley, viewed across the axis. In watershed investigations, it is determined by a line approximately perpendicular to the main path of water flow, along which measurements of distance and elevation are taken to define the cross-sectional area.

Damage reach. A length of flood plain or valley selected for damage evaluation.

Degree-day. As used in snowmelt studies, a day with an average temperature one degree above 32° F. The average is usually obtained by averaging the maximum and minimum for the day. A day with an average of 40° F gives 8 degree-days.

Depth-area curve. A graph showing the change in average rainfall depth as size of area changes.

Design storm. A given rainfall amount, areal distribution, and time distribution, used to estimate runoff. The rainfall amount is either a given frequency (25-year, 50-year, etc.).

Direct runoff. The water that enters the stream channels during a storm or soon after, forming a runoff hydrograph. May consist of rainfall on the stream surface, surface runoff, and seepage of infiltrated water.

Double-mass curve. A graph in which accumulated amounts of item X are plotted versus accumulated amounts of item Y, the amounts for given times being used.

Drainage area. The area draining into a stream at a given point. The area may be of different sizes for *surface runoff*, *subsurface flow* and *base flow*, but generally the surface runoff area is used as the drainage area. See *watershed*.

Effective duration. The time in a storm during which the water supply for *direct runoff* is produced. Also used to mean the duration of *excess rainfall*.

Effective rainfall. Another term for *direct runoff*, usually not the same quantity on upland streams as on downstream rivers because of variability of seepage flows.

Emergency spillway. A rock or vegetated earth waterway around a dam built with its crest above the normally used *principal spillway*. Used to assist the principal spillway in conveying extreme amounts of runoff safely past the dam.

ET. Abbreviation for *evapotranspiration*.

Evaluation series. A list of floods or storms that produced floods during a representative period, and used in water project evaluation to obtain estimates of flood damages.

Evapotranspiration. Plant transpiration plus evaporation from the soil. Difficult to determine separately, therefore used as a unit for study. See *consumptive use*.

Excess rainfall. *Direct runoff* at the place where it originates.

Fallow. Cropland kept free of vegetation during the growing season. May be a normal part of the cropping system for weed control, water conservation, soil conditioning, etc.

f_c Symbol for the low, almost uniform, infiltration rate obtained after prolonged wetting of the soil.

Flood. In common usage, an event where a stream overflows its normal banks. In frequency analysis it means an *annual flood* that may not overflow the banks.

Flood routing. Determining the changes in a *flood wave* as it moves downstream through a valley or through a reservoir (then sometimes called *reservoir routing*). Graphical or numerical methods are used.

Flood pool- Floodwater storage in a reservoir. In a floodwater retarding reservoir, the temporary storage between the crests of the *principal* and *emergency spillways*.

Floodwater retarding structure. A dam, usually with an earth fill, having a *flood pool* where incoming flood water is temporarily stored and slowly released downstream through a *principal spillway*. The reservoir contains a *sediment pool* and sometimes storage for irrigation or other purposes.

Flood wave. The rise and fall in stream flow during and after a storm.

Frequency. An expression or measure of how often a hydrologic event of given size or magnitude should, on the average, be equaled or exceeded. For example, a 50-year frequency flood should be equaled or exceeded in size, on the average, only once in 50 years. In drought or deficiency studies it usually defines how many years will, on the average, be equal to or less than a given size or magnitude.

Frequency line. The line on probability paper that represents a series of events and their frequencies.

Frequency series. A sequence or array of actual events (floods, etc.) suitable for use in frequency analysis; or, a sequence or array of hypothetical events obtained from a frequency analysis.

Ground water. The water in the saturated zone beneath the *water table*. A source of *base flow* in streams.

Hazen method. It consists of using the Hazen equation and *log-normal paper* (or Hazen paper) to obtain frequencies. More generally, it consists also of skewness computations described by Allen Hazen in his book, "Flood Flows," published in 1930 by John Wiley and Sons, Inc., New York, N.Y.

Historical series. A list of all actual storms (or floods) that caused flood damage in a watershed, in a given period of years, with the date of each storm or flood being known.

Hydrograph. A graph showing, for a given point on a stream or for a given point in any drainage system, the discharge, stage, velocity or other property of water with respect to time.

Hydrologic soil cover complex. A combination of a *hydrologic soil group* and a type of *cover*.

Hydrologic soil group. A group of soils having the same runoff potential under similar storm and cover conditions.

Hydrology. The science that deals with the occurrence and behavior of water in the atmosphere, on the ground, and under the ground. Rainfall intensities, rainfall interception by trees, effects of crop rotations on runoff, floods, droughts, and the flow of springs and wells, are some of the topics studied by a hydrologist.

Initial abstraction (U). When considering *surface runoff*, I is all the rainfall before runoff begins. When considering *direct runoff*, I_a consists of interception, evaporation, and the soil-water storage that must be exhausted before direct runoff may begin. Sometimes called "initial loss," about which see *loss*.

Infiltration. Rainfall minus interception, evaporation, and surface runoff. The part of rainfall that enters the soil.

Interception. Precipitation retained on plant or plant residue surfaces and finally absorbed, evaporated, or sublimated. That which flows down the plant to the ground is called "stemflow" and not counted as true interception.

Irrigation pool. Reservoir storage used to store water for release as needed in irrigation.

Isohyet, A line of a map, connecting points of equal rainfall amounts.

Lay (or lag time). The time from the centroid of rainfall to the peak of the hydrograph. It can be estimated from *time of concentration* as $0.6 T$

Land treatment measure. A tillage practice, a pattern of tillage or land use, or any land improvement, with a substantial effect of reducing runoff and sediment production or of improving use of drainage and irrigation facilities. Examples included are contouring, improved crop rotations, controlled grazing, land leveling, and field drainage. In hydrologic computations, non-beneficial measures (such as straight-row, poor-rotation corn) are included for convenience in evaluation. In general conservation work, "land treatment measure" has a broader meaning that includes measures to improve the soil, control sheet erosion, and increase soil fertility.

Land use. A land classification. *Cover*, such as row crops or pasture, indicates a kind of land use. Roads may also be classified as a separate land use.

Log paper. Short for "full-logarithmic graph paper," which is a graph paper (available commercially) that has logarithmic scales on both horizontal and vertical axes. Sometimes called "log-log paper." The scales may be any number of cycles, but are usually in combinations like $I \times I$, 2×2 , 3×3 , 3×5 , 4×7 , etc.

Log-normal. Short for "logarithmic-normal probability distribution."

Log-normal paper. Graph paper used in estimating frequencies of floods, etc. Has a logarithmic scale for the flood (or other) amounts, and a cumulative distribution scale (also called frequency or percent chance scale) for the probability plotting positions.

Loss. In hydrology, a loss for one purpose is usually a gain for another, so that the net effect may be more important than the loss. At various times, *evapotranspiration*, *initial abstraction*, *infiltration*, *surface storage*, *direct runoff*, seepage, etc. have been called losses according to the aims of a water user. See *water loss*.

Manning's n, A coefficient of roughness, used in a formula for estimating the capacity of a channel to convey water. Generally, "n" values are determined by inspection of the channel.

Mean daily. The average or mean discharge of a stream for one day. Usually given in cfs.

NEH-4. National Engineering Handbook, Section 4, Hydrology.

NEH-5. National Engineering Handbook, Section 5, Hydraulics.

Partial-duration series. A list of all events, such as floods, occurring above a selected base, without regard to the number, within a given period. In the case of floods, the selected base is usually equal to the smallest annual flood, in order to include at least one flood in each year.

Percent chance. A name often given to the probability scale on *log-normal paper*. A 2-percent chance flood is a 50-year frequency flood (see *frequency*) since $100 + \text{percent chance} = \text{frequency in years}$

Plotting position. The point computed by an equation and used to locate given data on *probability paper*.

Point rainfall. Rainfall at a single rain gage.

Principal spillway. A concrete or metal pipe or conduit used with a drop inlet dam or floodwater retarding structure. It conveys, in a safe and non erosive manner, all ordinary discharges coming into a reservoir and all of an extreme amount that does not pass through the *emergency spillway*.

Probability paper. Any graph paper prepared especially for plotting magnitudes of events versus their frequencies or probabilities. See *log-normal paper*.

Reach. A length of stream or valley, selected for convenience in a study. See *damage reach*, *stream reach*.

Recession curve. The receding portion of a hydrograph, occurring after *excess rainfall* has stopped.

Recurrence interval. The average number of years within which a given event will be equaled or exceeded. A 50-year *frequency* flood has a 50-year recurrence interval and so on.

Regional analysis. Flood frequency lines for gaged watersheds in a similar area or region are used to develop a flood frequency line for an ungaged watershed in that region. Also used with other types of hydrologic data. Method is a simple (usually graphical and freehand) form of "regression analysis" used by statisticians.

Reservoir routing. *Flood routing* through a reservoir.

s.d. Abbreviation for *standard deviation*.

Second-foot. See *cfs*.

Second-foot-day. The volume of water represented by a flow of one cubic foot per second for a period of one day.

Sediment pool. Reservoir storage provided for sediment, thus prolonging the usefulness of floodwater or irrigation pools.

Semilog paper. Short for "semilogarithmic graph paper," which is graph paper having a arithmetic scale along one axis and a logarithmic scale along the other. Either scale is used for the independent variable, as the data require. Commercially available paper has various divisions (5, 6, 7, 10 to the inch) for the arithmetic scale, and various cycles (I, 2, 3, 4, 5) for the logarithmic scale.

Small grains. Wheat, oats, barley, flax, rice, and other close-drilled or broadcast grain crops.

Soil cover complex. See *hydrologic soil cover complex*.

Soil water storage. The amount of water the soils (including geologic formations) of a watershed will store at a given time. Amounts vary from watershed to watershed. The amount for a given watershed is continually varying as rainfall or ET takes place.

Spillway. See *principal spillway* and *emergency spillway*

Standard deviation. Statisticians' name for an important measure of dispersion, abbreviated s.d. Data grouped closely about their mean have a small s.d.; grouped less closely, they have a larger s.d.

Standard rain gage. Also "standard gage." The *USNWS* non-recording rain gage, having an opening 8 inches in diameter, and a holding capacity of 24 inches of rainfall. The gage is usually examined once daily at a regular time, and the catch (if any) measured by depth in inches and hundredths of an inch.

Storage-indication method. Name often given to a flood-routing method also called the Puls method (after Louis G. Puls) though it is actually a variation of the method devised by Puls,

Stream reach. A length of stream channel Selected for use in hydraulic or other computations.

Structural measure. Any form of earthwork (dam, ditch, levee, etc.) or installation of concrete, masonry, metal or other material (drop spillway, jetties, riprap, etc.).

Subsurface runoff. Water that infiltrates the soil and reappears as seepage or spring flow, and forms part of the flood hydrograph for that storm. Difficult to determine in practice and seldom worked with separately. See *direct runoff*.

Subwatershed. A watershed that is part of a larger watershed. It is worked on separately when necessary in order to improve computational accuracy for results on a whole watershed basis, or to get results for that area only.

Surface runoff. Total rainfall minus *interception*, *evaporation*, *infiltration*, and *surface storage*, and that water which moves across the ground surface to a stream or depression.

Surface storage. Natural or man-made roughness of a land surface, which stores some or all of the surface runoff of a storm. Natural depressions, contour furrows, and terraces are usually considered as producing surface storage, but stock ponds, reservoirs, stream channel storage, etc. are generally excluded.

Synthetic series. A storm or flood series obtained by taking selected values from a frequency line based on historical data.

Time of concentration (T). The time it takes water from the most distant point (hydraulically) to reach a watershed outlet. T. varies, but often is used as constant.

Transmission loss. A reduction in volume of flow in a stream, canal, or other waterway, due to infiltration or seepage into the channel bed and banks. Evaporation is also a transmission loss, but it is ordinarily neglected under the assumption that it is small

Travel time. The average time for water to flow through a reach or other stream or valley length that is less than the total length. A travel time is part of a T. but never the whole T .

Unit hydrograph. A discharge hydrograph coming from one inch of *direct runoff* distributed uniformly over the watershed, with the direct runoff generated at a uniform rate during the given storm duration. A watershed may have 1- hour, 2-hour, etc. unit hydrographs.

USGS. United States Department of the Interior, Geological Survey.

USNWS. United States Department of Commerce, National Weather Service.

Water equivalent. The depth of water, in inches, that results from melting a given depth of snow.

Water loss. Variable meaning, depending on personal interest of water user. Farmers and ranchers usually think of flood runoff as a water loss; many river engineers think of infiltration as a water loss. See *loss*;

Watershed. The area contributing *direct runoff* to a stream. Usually it is assumed that *base flow* in the stream also comes from the same area. However, the ground water watershed may be larger or smaller.

Watershed measures. Any vegetative or structural means (including earthwork) of directly improving or conserving the soil and water resources of a watershed. See *land treatment measure* and *structural measure*.

Water table. The upper surface of *ground water*.

Water year. The year taken as beginning October 1. Often used for convenience in stream flow work, since in many areas stream flow is at its lowest at that time. Used by *USGS* in their *WSP*.

Water yield. The actual stream flow, at a given place, from a watershed. This is natural *annual runoff* that may be affected by irrigation uses, reservoir losses, diversions into or out of the watershed, etc.

WSP. Water-Supply Paper. An annual publication of the *USGS*, in which stream flow for the *water year* is given for all gaged streams in a subdivision of the United States or in Hawaii.

Independence personnel

Symbol	Unit	Definition	Symbol	Unit	Definition
a	ft ²	Cross sectional flow area	q _i	cfs	Peak inflow discharge
A _m	mi ²	Drainage area	q _o	cfs	Peak outflow discharge
CN		Runoff curve number	q _p	cfs	Peak discharge
CN _c		Composite runoff curve number	q _t	Csm/in	Tabular hydrograph unit discharge
CN _p		Pervious runoff curve number	q _u	Csm/in	Unit peak discharge
E _{max}		Maximum stage	Q	in	Runoff
F _p		Pond and swamp adjustment factor	r	ft	Hydraulic radius
H _w	ft	Head over weir crest	R		Ratio of unconnected impervious area to total impervious area
I _a	in	Initial abstraction	s	ft/ft	Slope of hydraulic grade line
L	ft	Flow length	S	in	Potential maximum retention after runoff begins
L _w	ft	Weir crest length	t	hr	Hydrograph time
m		Number of flow segments	T _c	hr	Time of concentration
n		Manning's roughness coefficient	T _p	hr	Time to peak
P	in	Rainfall	T _t	hr	Travel time
P _{imp}		Percent imperviousness	V	ft/s	Average velocity
P ₂	in	Two-year frequency, 24-hr rainfall	V _r	Acre-ft, ft or watershed inch	Runoff volume
p _w	ft	Wetted perimeter	V _s	Acre-ft, ft or watershed inch	Storage volume
q	cfs	Hydrograph coordinate			

Metric Conversions

To convert to the International system of units (metric) from English units, use the following factors:

From English unit	To metric unit	Multiply by
Acre	Hectare	0.405
Square mile	Square kilometer	2.59
Cubic feet per second	Cubic meters per second	0.0283
Inch	Millimeter	25.4
Feet per second	Meters per second	0.3048
Acre-foot	Cubic meter	1233.489
Cubic foot	Cubic meter	0.0283

Perform rounding operations as appropriate to indicate the same level of precision as that of the original measurement. For example:

1. A stream discharge is recorded in cubic feet per second with three significant digits.
2. Convert stream discharge to cubic meters per second by multiplying by 0.0283.
3. Round to enough significant digits so that, when converting back to cubic feet per second, you obtain the original value (step 1) with three significant digits.

Conversions

This:Times	This	Gives You This:
cfs-day	1.983	ac-ft
cfs-day	0.03719	inches depth on 1 square mile
cfs-day per square mile	0.03719	inches depth
cfs-hour	0.08264	ac-ft
cfs-hour per square mile	0.001550	inches depth
cfs	1.983	ac-ft per day
cfs	724.0	ac-ft per year (365 days)
cfs	448.8	U.S. gallons per minute
cfs	0.6463	million U.S. gallons per day
cfs	0.03719	inches depth per day
cfm	13.57	inches depth per year (365 days)
inches per	645.3	cfs
inches per hour	1.008	cfs per acre
inches depth	53.33	ac-ft per square mile
inches depth on 1 m ²	53.33	ac-ft
ac-ft	0.5042	cfs per day
sc-ft	12.10	cfs per hour
ac-ft	0.01875	inches depth on 1 square mile
ac-ft	0.3258	million U.S. gallons
ac-ft per day	0.5042	cfs
ac-ft per square mile	0.01875	inches depth
U.S. gallons per minute	0.002228	cfs
million U.S. gallons per day	1.547	cfs
million U.S. gallons per day	3.069	ac-ft
feet per second	0.6818	miles per hour
centimeters	0.3937	inches
hectares	2.471	acres
liters	0.2642	U.S. gallons
kilograms	2.205	pounds
cubic feet	7.480	U.S. gallons
imperial gallons	1.200	U.S. gallons