Chapter 17 Glossary and References

NJ Chapter 17 Glossary and References

Advance time (1) Time required for a given surface irrigation stream of water to move from the upper end of a field to the lower end.
(2) Time required for a given surface irrigation stream to move from one point in the field to another.

Algicide Any substance that will kill or control algae growth.

Alkali soil See sodic soil.

Allowable depletion That part of soil moisture stored in the plant root zone managed for use by plants, usually expressed as equivalent depth of water in acre inches per acre, or inches.

Alternate set irrigation A method of managing irrigation whereby, at every other irrigation, alternate furrows are irrigated or sprinklers are placed midway between theirlocations during the previous irrigation.

Application efficiency (Ea) The ratio of the average depth of irrigation water infiltrated and stored in the root zone to the average depth of irrigation water applied, expressed as a percentage. Also referred to as AE.

Application efficiency low half The ratio of the average of the low one-half of measurements of irrigation (Eh) water infiltrated and stored in the root zone to the average depth of irrigation water applied, expressed as a percentage. Also called AELH. Used as an indication for uniformity of application.

Application efficiency low The ratio of the average of the lowest one-fourth of measurements of quarter (Eq) irrigation water infiltrated to the average depth of irrigation water applied, expressed as a percentage. Also called AELQ. Used as an indication for uniformity of application.

Application rate, sprinkler The rate at which water is applied to a given area by a sprinkler system. application rate Usually expressed in inches per hour.

Application time, set time The amount of time that water is applied to an irrigation set.

Arid climate Climate characterized by low rainfall and high evaporation potential. A region is usually considered as arid when precipitation averages less than 10 inches (250 mm) per year.

Available soil water The difference between actual water content of a soil and the water held by that soil at the permanent wilting point.

Available water capacity (AWC) The portion of water in a soil that can be readily absorbed by plant roots of most crops, expressed in inches per inch, inches per foot, or

total inches for a specific soil depth. It is the amount of water stored in the soil between field capacity (FC) and permanent wilting point (WP). It is typically adjusted (AWHC).

Average annual precipitation The long-term or historic (generally 30 years or more) arithmetic mean of precipitation (rain, snow, dew) received by an area.

Average daily peak use rate Calculated or measured water used by plants in 1 day through evapotranspiration, expressed as inches per day.

Backilow prevention device Safety device that prevents the flow of water from the water distribution system back to the water source.

Basic intake rate Rate at which water percolates into soil after infiltration has decreased to a nearly constant value.

Basin irrigation Surface irrigation by flooding areas of level land surrounded by dikes. Generally used interchangeably with level border irrigation. In some areas level borders have tallwater runoff. If used in high rainfall areas, storm runoff facilities are necessary.

Blaney-Criddle Method An air temperature based method to estimate crop evapotranspiration.

Border irrigation Surface irrigation by flooding strips of land, rectangular in shape, usually level perpendicular to the irrigation slope, surrounded by dikes. Water is applied at a rate sufficient to move it down the strip in a uniform sheet. Border strips having no down field slope are referred to as level border systems. Border systems constructed on terraced lands are commonly referred to as benched borders.

Broad-crested weir Any of a group of thick-crested overspill weirs used for flow measurements in open channels. Some broad-crested weirs may have flow transitions, roundings, or plane surface ramps on the upstream side. Thin versions without transitions approach the behavior of sharp-crested weirs. Thick versions with transitions approach the behavior of long-throated flumes. Broad-crested weirs typically operate with very little head loss.

Bubbler irrigation Micro irrigation application of water to flood the soil surface using a small stream or fountain. The discharge rates for point-source bubbler emitters are greater than for drip or subsurface emitters, but generally less than 1 gallon per minute (225 L/h). A small basin is usually required to contain or control the water.

Bulk density Mass of dry soil per unit volume, determined by drying to constant weight at 105 °C, usually expressed as gmlcc or lb/ft3. Rock fragments 2 mm or larger are usually excluded or corrected for after measurement.

Cablegation A semiautomatic furrow irrigation system where a gated pipe is used to deliver water to each furrow. A continuous moving plug is attached to a speed control device with a small cable. The moving plug allows

	flow out of newly passed gates. As the plug moves downstream, the water level drops in upstream gates thereby shutting off flows.
Capillary water	Water held in the capillary or small pores of the soil, usually with soil water pressure (tension) greater than 1/3 bar. Capillary water can move in any direction.
Carryover soil moisture	Moisture stored in the soil within the root zone during the winter, at times when the crop is dormant, or before the crop is planted. This moisture is available to help meet water needs of the next crop to be grown.
Cation exchange capacity (CEC)	The sum of exchangeable cations (usually Ca, Mg, K, Na, Al, H) that the soil constituent or other material can adsorb at a specific pH, usually expressed in centimoles of charge per Kg of exchanger (cmo]IKg), or milli equivalents per 100 grams of soil at neutrality (pH = 7.0), meq/lOOg.
Check, check structure	Structure to control water depth in a canal, lateral, ditch, or irrigated field.
Chemigation	Application of chemicals to crops through an irrigation system by mixing them with irrigation water.
Christiansen's uniformity coefficient (CU)	A measure of the uniformity of irrigation water application. The average depth of irrigation water infiltrated minus the average absolute deviation from this depth, all divided by the average depth infiltrated. Also called coefficient of uniformity. Typically used with sprinkle irrigation systems.
Cipolletti weir	A sharp-crested trapezoidal weir with sides inclining outwardly at a slope of 1 horizontal to 4 vertical.
Compensating emitter	Micro irrigation system emitters designed to discharge water at a near constant rate over a wide range of lateral line pressures.
Consumptive use	See Evapotranspiration and Crop evapotranspiration.
Continuous flushing emitter	Micro irrigation system emitters designed to continuously permit passage of large solid particles while operating at a trickle or drip flow, thus reducing filtration requirements.
Contracted weir	A measuring weir that is shorter than the width of the channel and is therefore said to have side or end contractions. Sometimes called a sharpcrested weir.
Control structure	Water regulating structure, usually for open channel flow conditions.
Conveyance efficiency (Ec)	The ratio of the water delivered to the total water diverted or pumped into an open channel or pipeline at the upstream end, expressed as a

percentage.

Conveyance loss Loss of water from a channel or pipe during transport, including losses resulting from seepage, leakage, evaporation, and transpiration by plants growing in or near the channel.

Corrugation irrigation A surface irrigation system where small ditches, channels, or furrows are used to guide water downslope. Can be used in combination with graded border systems to provide more uniform flow down the border strip.

Crop coefficient (Kc) A factor used to modify potential evapotranspiration:
(1) Ratio between crop evapotranspiration (ETa) and the reference crop (ET_0) when crop is grown in large fields under optimum growing conditions, or ETc = K~ times ET_0.
(2) The ratio of the actual crop evapotranspiration to its potential evapotranspiration.

Crop evapotranspiration (ETe) The amount of water used by the crop in transpiration and building of plant tissue, and that evaporated from adjacent soil or intercepted by plant foliage. It is expressed as depth in inches or as volume in acre inches per acre. It can be daily, peak, design, monthly, or seasonal. Sometimes referred to as consumptive use (CU).

Crop growth stages Periods of like plant function during the growing season. Usually four or more periods are identified:
Initial—Between planting or when growth begins and approximately 10 percent ground cover.
Crop development—Between about 10 percent ground cover and 70 or 80 percent ground cover.
Mid season—From 70 or 80 percent ground cover to beginning of maturity. Late—From beginning of maturity to harvest.

Crop rooting depth Crop rooting depth is typically taken as the soil depth containing 80 percent of plant roots, measured in feet or inches.

Crop water stress index (CWSI) An index of moisture in a plant compared to a fully watered plant, measured and calculated by a CWSI instrument. Relative humidity, solar radiation, ambient air temperature, and plant canopy temperature are measured. Improperly called an infrared thermometer (plant canopy temperature is measured by infrared aerial photography).

Crop water use Calculated or measured water used by plants, expressed in inches per day. Same as ET~ except it is expressed as daily use only.

Cumulative intake The depth of water absorbed by soil from the time of initial water application to the specified elapsed time.

Cutback irrigation The reduction of the furrow or border inflow stream after water has advanced partly or completely through the field to reduce runoff and

improve uniformity of application.

Cutback stream Reducing surface irrigation inflow stream size (usually a half or a third) when a specified time period has elapsed or when water has advanced a designated distance down the furrow, corrugation, or border.

Cutthroat flume Open-channel waterfiow measuring device that is part of a group of shortthroated flumes that control discharge by achieving critical flow with curving streamlines through contraction. The flume is rectangular in cross section, has two main parts resembling a Parshall Flume with the contracted throat removed or cut out (hence its name), and has a flat floor throughout. Calibrations depend on laboratory ratings.

Cycle time The length of water application periods, typically used with surge irrigation.

Deep percolation (DP) Water that moves downward through the soil profile below the plant root zone and is not available for plant use. A major source of ground water pollution in some areas.

Deficit irrigation An irrigation water management alternative where the soil in the plant root zone is not refilled to field capacity in all or part of the field.

Delivery box Water control structure for diverting water from a canal to a farm unit often including a measuring device. Also called delivery site, delivery facility, and turnout.

Demand irrigation delivery Irrigation water delivery procedure where each irrigator may request irrigation water in the amount needed and at the time desired.

Depth of irrigation (1) Depth of water applied, measured in acre inches per acre.
(2) Depth of soil affected by an irrigation event.

Distribution uniformity (DU) The measure of the uniformity of irrigation water distribution over a field. NRCS typically uses DU of low one-quarter. DU of low one-quarter is the ratio of the average of the lowest one-fourth of measurements of irrigation water infiltrated to the average depth of irrigation water infiltrated, expressed as a decimal. Each value measured represents an equal area.

Distribution system A network of open canals or pipelines to distribute irrigation water at a specific design rate to multiple outlets on a farm or in a community.

Drip irrigation A micro irrigation application system wherein water is applied to the soil surface as drops or small streams through emitters. Discharge rates are generally less than 2 gallons per hour (8 L/h) for single outlet emitters and 3 gallons per hour (12 h/h) per meter for line source emitters.

Effective precipitation (Pe) The portion of precipitation that is available to meet crop evapotranspiration. It does not include precipitation that is lost to runoff, deep percolation, or evaporation before the crop can use it.

Effective rooting depth The depth from which roots extract water. The effective rooting depth is generally the depth from which the crop is currently capable of extracting soil water. However, it may also be expressed as the depth from which the crop can extract water when mature or the depth from which a future crop can extract soil water. Maximum effective root depth depends on the rooting capability of the plant, soil profile characteristics, and moisture 1~ve1s in t.h~ soil urofile.

Electrical conductivity (EC) A measure of the ability of the soil water to transfer an electrical charge. Used as an indicator for the estimation of salt concentration, measured in mmhos/cm (dS/m), at 77 °F (25 °C).
ECe = Electrical conductivity of soil water extract.
EC_1 = Electrical conductivity of irrigation water.
ECa~ = Electrical conductivity of applied water.

Electrical resistance blocks A block made up of various material containing electrical contact wires that is placed in the soils at selected depths to measure soil moisture content. Electrical resistance, as affected by moisture in the block, is read with a meter.

Emitter A small micro irrigation dispensing device designed to dissipate pressure and discharge a small uniform flow or trickle of water at a constant discharge. Also called a dripper or trickler.
Compensating emitter—Designed to discharge water at a constant rate over a wide range of lateral line pressures.
Continuous flushing emitter—Designed to continuously permit passage of small solid particles while operating at a trickle or drip flow, thus reducing filter fineness requirements.
Flushing emitter—Designed to have a flushing flow of water to clear the discharge opening every time the system is turned on.
Line-source emitter—Water is discharged from closely spaced perforations, emitters, or a porous wall along the tubing.
Long-path emitter—Employs a long capillary sized tube or channel to dissipate pressure.
Multi-outlet emitter—Supplies water to two or more points through small diameter auxiliary tubing.
Orifice emitter—Employs a series of orifices to dissipate pressure.
Vortex emitter—Employs a vortex effect to dissipate pressure.

Energy gradient, energy grade line A plotted line relating total energy elevations along an open channel or conduit, typically a pressure pipeline. (See Hydraulic grade line).

Environmental control Controlling air temperature and humidity or soil moisture conditions to minimize effects of low and high air temperatures on crop quality and quantity.

Evaporation The physical process by which a liquid is transformed to the gaseous state, which in irrigation generally is restricted to the change of water from liquid to vapor. Occurs from plant leaf surface, ground surface, water surface, and sprinkler spray.

Evaporation Pan (1) A standard U.S. Weather Bureau Class A pan (48-inch diameter by 10-inch deep) used to estimate the reference crop evapotranspiration rate. Water levels are measured daily in the pan to determine the amount of evaporation.
(2) A pan or container placed at or about crop canopy height containing water. Water evaporated from the device is measured and adjusted by a coefficient to represent estimated crop water use during the period.

Evapotranspiration (ET) The combination of water transpired from vegetation and evaporated from soil and plant surfaces. Sometimes called consumptive use (CU).

Exchange capacity The total ionic charge of the absorption complex active in the adsorption of ions. See Cation exchange capacity (CEC).

Exchangeable cation A positively charged ion held on or near the surface of a solid particle by a negative surface charge of a colloid and which may be replaced by other positively charged ions in the soil solution.

Exchangeable sodium percentage The fraction of cation exchange capacity of a soil occupied by sodium ions, (ESP) expressed as a percentage. Exchangeable sodium (meq/100 gram soil) divided by CEC (meq/100 gram soil) times 100. It is unreliable in soil containing soluble sodium silicate minerals or large amounts of sodium chloride.

Exchangeable sodium ratio (or percentage) The ratio of exchangeable sodium to all other exchangeable cations, expressed as meq/100 grams of soil or as a percentage.

FAO Blaney-Criddle Method A method to calculate grass reference crop evapotranspiration (ETc) based on long-term air temperature data, estimates for humidity, wind movement and sunshine duration, and a correction to ET~ downward for elevations above 1,000 meters above sea level.

Feel and appearance method A method to estimate soil moisture by observing and feeling a soil sample with the hand and fingers. With experience, this method can be accurate.

Field application duration (irrigation period) The elapsed time from the beginning of water application to the first irrigation set to the time at which water application is terminated on the last irrigation set of a field.

Field capacity The amount of water retained by a soil after it has been saturated and has drained freely by gravity. Can be expressed as inches, inches per inch, bars suction, or percent of total available water.

Field slope, grade The terms field slope and grade are interchangeable. Surface irrigation designers typically refer to elevation differences in the direction of water movement as the irrigation grade. Cross slope refers to the land grade perpendicular to the direction of irrigation.

Final infiltration rate See Basic intake rate.

Float valve A valve, actuated by a float, that automatically controls the flow of water.

Flood irrigation, wild flooding A surface irrigation system where water is applied to the soil surface without flow controls, such as furrows, borders (including dikes), or corrugations.

Flume (1) Open conduit for conveying water across obstructions.
(2) An entire canal or lateral elevated above natural ground, or an aqueduct.
(3) A specially calibrated structure for measuring open channel flows.

Flushing emitter A micro irrigation application device designed to have a flushing flow of water to clear the discharge opening each time the system is turned on.

Foot valve (1) A check valve used on the bottom of the suction pipe to retain the water in the pump when it is not in operation.
(2) A valve used to prevent backflow.

Free drainage Movement of water by gravitational forces through and below the plant root zone. This water is unavailable for plant use except while passing through the soil. (See Deep percolation.)

Frost protection Applying irrigation water to affect air temperature, humidity, and dew point to protect plant tissue from freezing. The primary source of heat (called heat of fusion) occurs when water turns to ice, thus protecting sensitive plant tissue. Wind machines and heating devices are also used.

Full irrigation Management of water applications to fully replace water used by plants over an entire field.

Fungicide Chemical pesticide that kills fungi or prevents them from causing diseases on plants.

Furrow (1) A trench or channel in the soil made by a tillage tool.
(2) Small channel for conveying irrigation water downslope across the field. Sometimes referred to as a rill or corrugation.

Furrow dike Small earth dike formed in a furrow to prevent water translocation. Typically used with LEPA and LPIC systems. Also used in nonirrigated fields to capture and infiltrate precipitation. Sometimes called reservoir tillage.

Furrow irrigation A surface irrigation system where water is supplied to small channels

	or furrows to guide water downslope and prevent cross flow. Called rill or corrugation irrigation in some areas.
Furrow stream	The streamfiow in a furrow, corrugation, or rill.
Gates, slide gate	A device used to control the flow of water to, from, or in a pipeline or open channel. It may be opened and closed by screw or slide action either manually or by electric, hydraulic, or pneumatic actuators. In open channels, gates slide on rails and are used to control drainage or irrigation water.
Gated pipe	Portable pipe that has small gates installed at regular intervals along one side for distributing irrigation water to corrugations, furrows, or borders.
Gravimetric (ovendry) method	A method of measuring total soil water content by sampling, weighing, and drying in a oven at 105 °C. Percent water, usually on a dry weight basis, is calculated.
Gravitational water	Soil water that moves into, through, or out of the soil under the influence of gravity.
Gross irrigation	Water actually applied, which may or may not be total irrigation water requirement; i.e., leaving storage in the soil for anticipated rainfall, harvest.
Gross irrigation requirement (Fg)	The total irrigation requirement including net crop requirement plus any losses incurred in distributing and applying water and in operating the system. It is generally expressed as depth of water in acre inches per acre or inches
Gross irrigation system capacity	Ability of an irrigation system to deliver the net required rate and volume of water necessary to meet crop water needs plus any losses during the application process. Crop water needs can include soil moisture storage for later plant use, leaching of toxic elements from the soil, air temperature modification, crop quality, and other plant needs.
Ground water	Water occurring in the zone of saturation in an aquifer or soil.
Growing season	The period, often the frost-free period, during which the climate is such that crops can be produced.
Gypsum block	An electrical resistance block in which the material used to absorb water is gypsum. It is used to measure soil water content in non-saline soils.
Head ditch	Ditch across the upper end of a field used for distributing water in surface irrigation.
Head gate	Water control structure at the entrance to a conduit or canal.

Herbicide A chemical substance designed to kill or inhibit the growth of plants, especially weeds. Types include:
Contact—A herbicide designed to kill foliage on contact. *Non-selective—A* herbicide that destroys or prevents all plant growth.
Post-emergence—A herbicide designed to be applied after a crop is above the ground.
Pre-emergence—A herbicide designed to be applied before the crop emerges through the soil surface.
Selective—A herbicide that targets specific plants.

Humid climates Climate characterized by high rainfall and low evaporation potential. A region generally is considered as humid when precipitation averages more than 40 inches (1,000 mm) per year.

Hydrant An outlet, usually portable, used for connecting surface irrigation pipe to an alfalfa valve outlet.

Hydraulic conductivity The ability of a soil to transmit water flow through it by a unit hydraulic gradient. It is the coefficient k in Darcy's Law. Darcy's Law is used to express flux density (volume of water flowing through a unit cross-sectional area per unit of time). It is usually expressed in length per time (velocity) units, i.e., cm/s, ftld. In Darcy's Law, where V = ki, k is established for a gradient of one. Sometimes called permeability.

Hydraulic grade line (HGL) A plotted line relating operational energy elevations along an open channel or closed conduit. With open channel (non-pressure) flow, the HGL is at the water surface. The HGL is the elevation water would rise in an open stand at a given location along a pressure pipeline. (See Energy grade line).

Hydraulic ram Device that uses the energy of flowing water to lift a portion of the flow to a higher elevation or greater pressure.

Infiltration, infiltration rate The downward flow of water into the soil at the air-soil interface. Water enters the soil through pores, cracks, wormholes, decayed-root holes, and cavities introduced by tillage. The rate at which water enters soil is called intake rate or infiltration rate.

Infiltrometer A device for determining the intake rate of soil.
Ring infiltrometer—Consists of metal rings that are inserted (driven) into the soil surface and filled with water. The rate at which water enters the soil is recorded.
Sprinkler infiltrometer—Consists of a sprinkler head(s) that applies water to the soil surface at a range of rates of less-than to greater-than soil infiltration rates. Maximum infiltration rates are observed and recorded.
Flowing infiltrometer—Consists of an inlet device to apply a specific flow rate to a furrow and a collection sump with a pump to return tail water to the inlet device. Water infiltrated by the soil in the test section (typically 10 meters) is replaced with water from a reservoir

to keep the flow rate constant. The rate of water infiltrated versus time is observed and plotted. Accumulated infiltration versus time is also plotted. An equation (typically for a curvilinear line) then represents the intake characteristics for that particular soil condition.

Initial intake Depth of water absorbed by a soil during the period of rapid or comparatively rapid intake following initial application. Expressed in inches per hour.

Instantaneous application rate The maximum rate, usually localized, that a sprinkler application device applies water to the soil, expressed in inches per hour. Instantaneous application rates of over 30 inches per hour have been measured near the ends of low pressure center pivot irrigation laterals.

Intake family curve, intake characteristic curve A set of accumulated intake versus time curves grouped into families having similar border or furrow intake characteristics. Intake family curves are unitless and do not represent the average infiltration rate. The infiltration process in borders differs from that in furrows, thus each irrigation system has a different set of intake family curves.

Intake family A grouping of intake characteristics into families based on field infiltrometer tests on many soils. Used to analyze and design border and furrow irrigation systems.

Intake rate The rate at which irrigation water enters the soil at the surface. Expressed as inches per hour. (See infiltration.)

Interception That part of precipitation or sprinkler irrigation system applied water caught on the vegetation and prevented from reaching the soil surface.

Inverted siphon A closed conduit with end sections above the middle section; used for crossing under a depression, under a highway or other obstruction. Sometimes called sag pipe.

Irrecoverable water loss Water loss that becomes unavailable for reuse through evaporation, phreatophyte transpiration, or ground-water recharge that is not economically recoverable.

Irrigable area Area capable of being irrigated, principally based on availability of water, suitable soils, and topography of land.

Irrigating stream (1) Flow for irrigation of a particular tract of land.
(2) Flow of water distributed at a single irrigation. Sometimes called irrigating head, normally expressed as a rate or volume.

Irrigation Applying water to the land for growing crops, reclaiming soils, temperature modification, improving crop quality, or other such uses.

Irrigation check (1) Small dike or dam used in the furrow or alongside an irrigation border to make the water spread evenly across the border.
(2) A plastic or canvas tarp dam placed in a field ditch to raise the

water level in the ditch for diversion onto a field.

Irrigation company A semi-public, private group, or commercial enterprise set up to deliver irrigation water.

Irrigation district, company A cooperative, self-governing semipublic organization set up as a subdivision of a state or local government to deliver irrigation water.

Irrigation efficiency (Ei) The ratio of the average depth of irrigation water beneficially used to the average depth applied, expressed as a percentage. Beneficial uses include satisfying the soil water deficit, leaching requirement for salinity control, and meeting other plant needs. Generally used to express overall field or farm efficiency, or seasonal irrigation efficiency.

Irrigation frequency, interval The time, generally in days, between irrigation events. Usually considered the maximum allowable time between irrigation's during the peak ET period.

Irrigation method One of four irrigation methods used to apply irrigation water: surface, sprinkle, micro, and subirrigation. One or more irrigation systems can be used to apply water by each irrigation method.

Irrigation scheduling Determining when to irrigate and how much water to apply, based upon measurements or estimates of soil moisture or crop water used by the plant.

Irrigation set The area irrigated at one time within a field.

Irrigation set time, irrigation period The amount of time required to apply a specific amount of water during one irrigation to a given area, typically refilling the plant root zone to field capacity minus expected rainfall.

Irrigation slope Elevation difference along the direction of irrigation expressed as, a percentage (feet per 100 feet) or foot per foot. Sometimes called irrigation grade.

Irrigation system Physical components (pumps, pipelines, valves, nozzles, ditches, gates, siphon tubes, turnout structures) and management used to apply irrigation water by an irrigation method. All properly designed and managed irrigation systems have the potential to uniformly apply water across a field.

Irrigation water management (IWM) Managing water resources (precipitation, applied irrigation water, humidity) to optimize water use by the plant. Soil and plant resources must also be considered.

Irrigation water requirement The calculated amount of water needed to replace soil water used by the crop (soil water deficit), for leaching undesirable elements through and below the plant root zone, plus other needs; after

considerations are made for effective precipitation.

Julian day, day of year Sequential numbering of days starting January 1 as day one and continuing until the end of the year, December 31, as day 365 (leap year day 366).

Kinematic wave A method of mathematical analysis of unsteady open channel flow in which the dynamic terms are omitted because they are small and assumed to be negligible.

Land leveling, land grading, precision land leveling Shaping the surface of the soil to planned elevations and grades.

Laser controlled leveling or grading Land leveling or grading in which a stationary laser transmitter and a laser receiving unit mounted on each earthmoving machine are used for automated grade control.

Leaching fraction The ratio of the depth of subsurface drainage water (deep percolation) to the depth of infiltrated irrigation water. (See Leaching requirement.)

Leaching requirement (1) The amount of irrigation water required to pass through the plant root zone to reduce the salt concentration in the soil for reclamation purposes.
(2) The fraction of water from irrigation or rainfall required to pass through the soil to prevent salt accumulation in the plant root zone and sustain production. (See Leaching fraction.)

Leaching Removal of soluble material from soil or other permeable material by the passage of water through it.

Length of run The distance down the furrow, corrugation, or border to the planned end of irrigation, typically the edge of the field.

Limited irrigation Management of irrigation applications to apply less water than needed to satisfy the soil water deficit in the entire root zone. Sometimes called deficit or stress irrigation.

Line-source emitter Water is discharged from closely spaced perforations, emitters, or a porous wail along a micro irrigation lateral.

Long-path emitter Employs a long capillary sized tube or channel to dissipate pressure and discharge water in discrete droplets or seeps.

Long throated flume Open-channel flow measuring devices of various cross-sections, having three to five main sections. Their operation is based on critical flow occurring in a contracted throat, with parallel walls and level floor, that is long enough to produce nearly parallel flow streamlines. This allows accurate calibration by computational methods. The name usually refers to devices with contractions from the channel sides or

from both the sides and bottom. Flumes with bottom-only contractions are traditionally referred to as a type of broad-crested weir, but are hydraulically the same as longthroated flumes.

Low energy precision application (LEPA) A water, soil, and plant management regime where precision down-in-crop applications of water are made on the soil surface at the point of use. Application devices are located in the crop canopy on drop tubes mounted on low pressure center pivot and linear move sprinkler irrigation systems. Generally limited to circular plantings on less than 1 percent slopes and no translocation of applied water. Furrow dikes, good soil condition, and crop residue are usually required to control water translocation.

Low pressure in canopy (LPIC) A low pressure in-canopy system that may or may not include a complete water, soil, and plant management regime as required in LEPA. Application devices are located in the crop canopy with drop tubes mounted on low pressure center pivot and linear move sprinkler irrigation systems. Limited water translocation within the field and some minor nonuniformity of water application usually exists.

Lysimeter An isolated block of soil, usually undisturbed and in situ, for measuring the quantity, quality, or rate of water movement through or from the soil.

Management allowed depletion (MAD) The planned soil moisture deficit at the time of irrigation. It can be expressed as the percentage of available soil water capacity or as the depth of water that has been depleted from the root zone. Sometimes called allowable soil depletion.

Manufacturer's coefficient of variation A measure of the variability of discharge of a random sample (of a given make, model, and size) of micro irrigation emitters, pressure regulators and sprinkler nozzles, as produced by the manufacturer and before any field operation or aging has taken place. It is equal to the ratio of the standard deviation of the discharge to the mean discharge of the emitters.

Matric potential Matric potential is a dynamic soil property and will be near zero for a saturated soil. Matric potential results from capillary and adsorption forces. This potential was formerly called capillary potential or capillary water.

Maximum application rate The maximum discharge, in inches per hour, at which sprinklers can apply water without causing significant translocation.

Microclimat Atmospheric conditions within or near a crop canopy.

Micro irrigation The frequent application of small quantities of water as drops, tiny streams, or miniature spray through emitters or applicators placed along a water delivery line. The micro irrigation method encompasses a number of systems or concepts, such as bubbler, drip, trickle, line

source, mist, or spray.

Mixed-flow pump A centrifugal pump in which the pressure is developed partly by centrifugal force and partly by the lifting action of the impellers in the water.

Moisture deficit, soil moisture depletion The difference between actual soil moisture and soil moisture held in the soil at the field capacity.

Moisture stake See Tensiometer

Multi-outlet emitter Supplies water to two or more points through small diameter auxiliary tubing.

Multi-stage pump A pump having more than one impeller mounted on a single shaft.

Nappe Sheet or curtain of unsubmerged water flowing from a structure, such as a weir or dam.

Net irrigation The actual amount of applied irrigation water stored in the soil for plant use or moved through the soil for leaching salts. Also includes water applied for crop quality and temperature modification; i.e., frost control, cooling plant foliage and fruit. Application losses, such as evaporation, runoff, and deep percolation, are not included. Generally measured in inches of water depth applied.

Net irrigation water requirement The depth of water, exclusive of effective precipitation, stored soil moisture, or ground water, that is required for meeting crop evapotranspiration for crop production and other related uses. Such uses may include water required for leaching, frost protection, cooling, and chemigation.

Net positive suction head The head that causes liquid to flow through the suction piping and enter (NPSH) the eye of the pump impeller. Required NPSH is a function of the pump design and varies with the capacity and speed of the pump. It must be supplied by the manufacturer. Available NPSH is a function of the system in which the pump operates and represents the energy level in the water over vapor pressure at the pump inlet. The available NPSH must equal or exceed the required NPSH or cavitation occurs.

Nonpoint source pollution (NPS) Pollution originating from diffuse areas (land surface or atmosphere) having no well-defined source.

Non-saline sodic soil A soil containing soluble salts that provide an electrical conductivity of the saturation extract (ECe) less than 4.0 mmhos/cm and an exchangeable sodium percentage (ESP) greater than 15. Commonly called black alkali or slick spots.

Nutrient management Managing the application rate and Li~-'ing of fertilizers to optimize

crop use and reduce potential pollution of ground and surface water.

Neutron gauge, neutron probe, neutron scattering device A nondestructive method, used primarily by researchers, to measure in situ soil moisture. High speed neutrons are emitted from the radioactive source. Electronic count of the returning slow speed neutrons (or reflected), primarily affected by hydrogen atoms in the soil, is calibrated to represent total soil-water content. When properly calibrated and used, the neutron moisture gauge is probably the most accurate and repeatable method to measure soil moisture. The equipment is expensive, data collection is time consuming, training and licensing for personnel using the gauge and for storage are required.

Operational spills Planned or emergency spills made along or at the end of an open ditch (lateral) in a community irrigation water delivery system. Planned spills include the discharge of administrative or carry through water carried in laterals, to allow turnouts to be opened and closed without precision management of lateral flow rates. Emergency spill structures include overflow structures to discharge precipitation runoff water that has entered an irrigation water delivery system, and relief gates to discharge irrigation water in case of ditch or structure failure. Typically planned and emergency spill structures discharge water into a natural watercourse or protected channel.

Opportunity time The time that water inundates the soil surface with opportunity to infiltrate.

Orifice emitter A micro irrigation system application device employing a series of orifices to dissipate pressure.

Orifice An opening with a closed perimeter through which water flows. Certain shapes of orifices are calibrated for use in measuring flow rates.

Overhead irrigation See Sprinkler irrigation.

Pan coefficient A factor to relate actual evapotranspiration of a crop to the rate water evaporates from a free water surface in a shallow pan. The coefficient usually changes by crop growth stage.

Parshall flume Open-channel water flow measuring devices which are a part of a group of short-throated flumes that control discharge by achieving critical flow with curving streamlines in a contracted throat section. The sidewallls of the throat section are parallel, but the floor slopes downward in the direction of flow then rises again in a diverging side wall section. Calibrations are based on laboratory ratings. The flume is used for measuring water flow rates with very small total head loss (also see venturi flume). Ten critical edges and surfaces must be met for construction of an accurate Parshall flume

Peak use rate The maximum rate at which a crop uses water, measured in inches (acre inches per acre) per unit time; i.e., inches per month, inches per week, inches per day.

Peak period ET The average daily evapotranspiration rate for a crop during the peak water use period. Sometimes commonly called peak period CU (consumptive use).

Penman-Monteith Method A (radiation and advection) method used to estimate reference crop evapotranspiration (ET0) using current climatic data including air temperature, relative humidity, wind speed, and solar radiation.

Percolation Movement of the water through the soil profile. The percolation rate is governed by the permeability or hydraulic conductivity of the soil. Both terms are used to describe the ease with which soil transmits water.

Permanent wilting point (PWP) The moisture percentage, on a dry weight basis, at which plants can no longer obtain sufficient moisture from the soil to satisfy water requirements. Plants will not fully recover when water is added to the crop root zone once permanent wilting point has been experienced. Classically, 15 atmosphere (15 bars) or 1.5 mPa, soil moisture tension is used to estimate PWP.

Permeability (1) Qualitatively, the ease with which gases, liquids, or plant roots penetrate or pass through a layer of soil
(2) Quantitatively, the specific soil property designating the rate at which gases and liquids can flow through the soil or porous media.

Pest management Management to control undesirable plants, animals, fungi, or bacteria that are troublesome, annoying, or degrading to crop quantity and quality.

Pesticide Any chemical agent used to control specific organisms. Includes insecticides, herbicides, and fungicides.

Phreatophyte transpiration Transpiration from water loving vegetation along streams and water bodies, generally considered a loss for irrigation purposes. Phreatophyte vegetation may be a highly valuable food source and habitat for fish and wildlife.

Potential evapotranspiration (ET_o) The maximum evapotranspiration that will occur when water is not limiting. In some methods of computing evapotranspiration, it is measured as evaporation of water from a free surface. When used as reference crop evapotranspiration, it is for either well watered short grass or alfalfa. Care should be used in determining which factors are used. Preferred term is reference evapotranspiration.

Project efficiency (Ep) The overall efficiency of irrigation water use in a project setting that accounts for all water uses and losses, such as crop ET, environmental

	control, salinity control, deep percolation, runoff, ditch and canal leakage, phreatophyte use, wetlands use, operational spills, and open water evaporation.
Rainfall management	Managing soil, water, and plant resources to optimize use of rainfall
Rectangular weir	Typically a sharp crested weir that is rectangular.
Reference crop evapotranspiration	The evapotranspiration from thick, healthy, well maintained grass (or alfalfa) that does not suffer any water stress. The reference crop is used to represent the water use of a standard crop in that environment even though that crop may not be physically grown in the area. ETo is generally used when referring to clipped (2 to 5 inches high) grass as the reference crop. ETr is used for 8- to 12-inch-high, 2-year-old alfalfa.
Relative humidity	The ratio of the amount of water vapor present in the atmosphere to the amount required for saturation at the same dry bulb temperature.
Replogle flume, ramp flume	A modified broad crested weir located in a short flume, lined ditch or pipeline that causes a drop in the hydraulic grade line, for measuring water flow rates. With open channel flow, there is one critical surface, which is level. With closed pipeline flowing full, the same surface can be oriented in any position parallel to the direction of flow. Very little head loss is required to accurately measure water flow rate.
Return-flow facilities, reuse facilities	A system of ditches, pipelines, pump(s), and reservoirs to collect and convey surface or subsurface runoff from an irrigated field for reuse. Sometimes called tailwater reuse facilities or pumpback facilities.
Reverse grade	A slope or grade on a field surface, crop row, or channel that slopes in the direction opposite to the prevalent or desired grade.
Riparian	(1) Typically that area of flowing streams that lies between the normal water line and some defined high water line. (2) Pertaining to the banks of a body of water; a riparian owner is one who owns the banks. (3) A riparian water right is the right to use and control water by virtue of ownership of the banks.
Root zone	Depth of soil that plant roots readily penetrate and in which the predominant root activity occurs. Preferred term is plant root zone.
Rotational delivery system	A management technique used for community irrigation water delivery systems in which water deliveries are rotated among water users often at a frequency determined by water supply availability rather than crop water need. This method of managing water deliveries results in some of the lowest on-farm irrigation water application efficiencies.
Row grade	The slope in the direction of crop rows.

Runoff, runoff loss Surface water leaving a field or farm, resulting from surface irrigation tailwater, applying water with sprinklers at a rate greater than soil infiltration and surface storage, overirrigation, and precipitation.

Saline soil A non-sodic soil containing sufficient soluble salts to impair its productivity for growing most crops. The electrical conductivity (ECe) of the saturation extract is greater than 4 mmhos/cm, and exchangeable sodium percentage (ESP) is less than 15; i.e., non-sodic. The principal ions are chloride, sulfate, small amounts of bicarbonate, and occasionally some nitrate. Actually, sensitive plants are affected at half this salinity, and highly tolerant ones at about twice this salinity.

Saline-sodic soil Soil containing both sufficient soluble salts and exchangeable sodium to interfere with the growth of most crops. The exchangeable sodium percentage (ESP) is greater than or equal to 15, and electrical conductivity of the saturation extract (ECe) is greater than 4 mmhos/cm. It is difficult to leach because the clay colloids are dispersed.

Salinity The concentration of dissolved mineral salt in water and soil on a unit volume or weight basis. May be harmful or nonharmful for the intended use of the water.

Satiation To fill most voids between soil particles with water.

Saturation To fill all (100%) voids between soil particles with water.

Seepage, seepage loss, leakage 1. Water escaping below or out from water conveyance facilities, such as open ditches, canals, natural channels, and waterways.
2. Water emerging from the ground along an extensive line or surface as contrasted with a spring where the water emerges from a localized spot.

Semiarid climate Climate characterized as neither entirely arid nor humid, but intermediate between the two conditions. A region is usually considered as semiarid when precipitation averages between 10 inches (250 mm) and 20 inches (500 mm) per year.

SI units, International System of Units An international metric system developed by General Conference on Weights and Measures, CGPM. This system provides for an established single unit that applies for each physical quantity. Units for all other mechanical quantities are derived from these basic units. See chapter 16 for complete definitions and conversions for English to metric and metric to English units.

Siphon A closed conduit used to convey water across localized minor elevation raises in grade. It generally has end sections below the middle section. A vacuum pump is commonly used to remove air and keep the siphon primed. The upstream end must be under the water

surface. Both ends must be under water, or the lower end must be closed to prime the siphon.

Siphon tube Relatively short, light-weight, curved tube used to convey water over ditchbanks to irrigate furrows or borders. The tube is typically between 1 and 4 inches in diameter 4 to 6 feet long.

Slide gate See Gate.

Sodic soil A non-saline soil containing sufficient exchangeable sodium to affect crop production and soil structure (including soil intake) under most conditions of soil and plant growth. The lower limit of the saturation extract exchangeable sodium percentage (ESP) of such soils is conventionally set at 15.

Sodium adsorption ratio (SAR) A relation between soluble sodium and soluble divalent cations that can be used to predict the exchangeable sodium percentage of soil equilibrated with a given solution. It is defined as follows:

$$\left(\frac{Na}{\frac{Ca+Mg}{2}} \right)^{1/2}$$

where: Na is sodium, Ca is calcium, and Mg is magnesium. Concentrations, denoted by parentheses, are expressed in moles per liter.

Sodium adsorption ratio, adjusted The sodium adsorption ratio of a water adjusted for the precipitation or dissolution of $Ca^{2\sim}$ and $Mg^{2\sim}$ that is expected to occur where a water reacts with alkaline earth carbonates within a soil. Numerically, it is obtained by multiplying the sodium adsorption ratio by the value (1 + 8.4 - pH~*), where pH~ is the theoretical calculation of the pH of water in contact with lime and in equilibrium with soil CO_2.

Soil aeration Process by which air and other gases enter the soil or are exchanged.

Soil crusting Compaction of the soil surface by droplet impact from sprinkle irrigation and precipitation. Well graded, medium textured, low organic matter soils tend to crust more readily than other soils.

Soil compaction Consolidation, increase in bulk density, reduction in porosity, and collapse of the soil structure when subjected to surface loads or the downward and shearing action of tillage implement surfaces.

Soil condition The physical condition of the soil related to farmability, tillage, crop growth, root development, water movement, water intake, structure, organic matter content, fertility, and biological activity.

Soil density Same as Bulk density.

Soil horizon A layer of soil differing from adjacent genetically related layers in

physical, chemical, and biological properties or characteristics.

Soil moisture tension See Soil water tension.

Soil organic matter Organic fraction of the soil, including plant and animal residue in various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population.

Soil profile Vertical section of the soil from the surface through all its horizons.

Soil sealing The orientation and consolidation of soil particles in the intermediate surface layer of soil so that it becomes almost impermeable to water.

Soil series The lowest category of U.S. System of soil taxonomy. A conceptualized class of soil bodies having similar characteristics and arrangement in the soil profile.

Soil structure The combination or arrangement of primary soil particles into secondary particles, units, or peds that make up the soil mass. These secondary units may be arranged in the soil profile in such a manner as to give a distinctive characteristic pattern. Principal types of soil structure are platy, prismatic, columnar, blocky, granular, and massive.

Soil texture Classification of soil by the relative proportions of sand, silt, and clay present in the soil. USDA uses 12 textural classes.

Soil water, soil moisture All water stored in the soil. See Water holding capacity.

Soil-water content The water content of a given volume of soil. It is determined by: gravimetnc sampling and oven drying field samples (to a standard 105 °C), neutron moisture probes, time domain (TDR) and frequency domain reflectrometry (FDR) devices commonly called RF capacitance probes, tensiometers, electrical resistance blocks, thermal dissipation blocks, and feel and appearance methods.

Soil-water deficit or depletion Amount of water required to raise the soil-water content of the crop root zone to field capacity. It is measured in inches of water.

Soil-water potential Expresses the potential energy status of soil water relative to conditions associated with pure, free water. Total soil-water potential consists of osmotic potential, gravitational potential, and matric potential. See Soilwater tension and Matric potential.

Soil-water tension A measure of the tenacity with which water is retained in the soil. It is the force per unit area that must be exerted to remove water from the soil and is usually measured in bars, or atmospheres. It is a measure of the effort required by plant roots to extract water from the soil. Measurements are made using a tensiometer in the field (limited to 1 atmos) and a pressure plate apparatus in the laboratory.

Solar radiation (Rs) Radiation from the sun that passes through the atmosphere and

reaches the combined crop and soil surface. The energy is generally in a waveband width of 0.1 to 5 microns. Net R~ is incoming minus reflected radiation from a surface.

Spile A conduit made of lath, pipe, or hose placed through ditchbanks to transfer water from an irrigation ditch to a field.

Spray irrigation The application of water by a small spray or mist to the soil surface where travel through the air becomes instrumental in the distribution of water. (used with sprinkler and micro irrigation methods).

Sprinkler distribution pattern Water depth-distance relationship measured from a single sprinkler head.

Sprinkler head A nozzle or device, which may or may not rotate, for distributing water under pressure through the air. Water is delivered to sprinkler heads by a system of pressurized pipelines.

Sprinkle irrigation Method of irrigation in which water is sprayed or sprinkled through the air to plant or ground surface. See Sprinkler irrigation system.

Sprinkler irrigation system Facility used to distribute water by the sprinkle irrigation method. Sprinkler systems are defined in the following general categories:
Periodic-move system—A system of laterals, sprinkler heads (gun types), or booms that are moved between irrigation settings. They remain stationary while applying water.
Fixed/solid-set system—A system of portable surface or permanently buried laterals totally covering the irrigated area or field. Typically several adjacent laterals or heads are operated at one time. Portable laterals are typically removed from the field at end of germination, plant establishment, or the irrigation season and are replaced the next irrigation season.
Continuous/self move system—A lateral, sprinkler (traveler), or boom that is continuous or self moving while water is being applied. Power for moving the facility is typically provided by electric or hydraulic (water) motors or small diesel engines.

Specific types of sprinkler systems under each general category include:
Boom—An elevated, cantilevered boom with sprinklers mounted on a central stand. The sprinkler-nozzle trajectory back pressure rotates the boom about a central pivot, which is towed across the field by a cable attached to a winch or tractor. Can be either periodic move or continuous move type system.
Center pivot—An automated irrigation system consisting of a sprinkler lateral rotating about a pivot point and supported by a number of selfpropelled towers. Water is supplied at the pivot point and flows outward through the pipeline supplying the individual sprinklers or spray heads. A continuous/self-move type system.
Corner pivot—An additional span or other equipment attached to the end of a center pivot irrigation system that allows the overall radius to

increase or decrease in relation to field boundaries.
Gun type—A single sprinkler head with large diameter nozzles, supported on skids or wheels. Periodically moved by hand or mechanically with a tractor, cable, or water supply hose. When the travel lane (or path) has been irrigated, the sprinkler head is relocated at the far end of the next travel lane and irrigation continues.
Lateral move, linear move—An automated irrigation machine consisting of a sprinkler line supported by a number of self-propelled towers. The entire unit moves in a generally straight path perpendicular to the lateral and irrigates a basically rectangular area. A continuous/self move type system.
Linear move—See Lateral move.
Portable handmove—Sprinkler system moved to the next irrigation set by uncoupling and picking up the pipes manually, requiring no special tools. A periodic move type system.
Side-move sprinkler—A sprinkler system with the supply pipe supported on carriages and towing small diameter trailing pipelines each fitted with several sprinkler heads. *A* periodic move type system.
Side-roll (wheel line) sprinkler—The supply pipe is usually mounted on wheels with the pipe as the axle and where the system is moved across the field by rotating the pipeline by engine power. *A* periodic move type system.
Solid-set, fixed-set—System that covers the complete field with pipes and sprinklers in such a manner that all of the field can be irrigated without moving any of the system. Laterals may be permanently buried or portable.
Towed sprinkler—System where lateral lines are mounted on wheels, sleds, or skids and are pulled or towed in a direction approximately parallel to the lateral. Rollers or wheels are secured in the ground near the main water supply line to force an offset in the tow path equal to half the distance the lateral would have been moved by hand. *A* periodic move type system.
Traveler—A single large, gun type sprinkler head with a large diameter nozzle mounted on a unit that is continuously moved across the field by supply hose or cable. The hose reel may be mounted with the sprinkler head on a trailer or on a separate trailer secured at the water supply main line, which is typically located at or near the center of the field. Sometimes called traveling gun or hosepull.

Static head The potential energy resulting from elevation differences. (See Head.)

Stilling well Pipe, chamber, or compartment having closed sides and bottom except for a comparatively small inlet connected to a main body of water. It buffers waves or surges while permitting the water level within the well to rise and fall with major fluctuations of the main water body. Used with water measuring devices to improve accuracy of measurement.

Stress irrigation Management of irrigation water to apply less than enough water to satisfy the soil-water deficiency in the entire root zone. Preferred term is limited irrigation or deficit irrigation.

Subhumid climate Climate characterized by moderate rainfall and moderate to high evaporation potential. *A* region is usually considered subhumid when precipitation averages more than 20 inches (500 mm) per year, but less than 40 inches (1,000 mm) per year.

Subirrigation Applying irrigation water below the ground surface either by raising the water table or by using a buried perforated or porous pipe system that discharges water directly into the plant root zone. Primary source of water for plant growth is provided by capillary rise of soil water above the water table (up flux) or capillary water movement away from the line source.

Surface irrigation Broad class of irrigation systems in which water is distributed over the soil surface by gravity flow (preferred term is surface irrigation method).

Surge irrigation *A* surface irrigation technique wherein flow is applied (typically to furrows or less commonly borders) intermittently during a single irrigation set.

Tailwater runoff Surface irrigation system water leaving a field or farm from the downstream end of a graded furrow, corrugation, border. Best surface irrigation distribution uniformity across the field is obtained with 30 to 50 percent tailwater runoff, unless tailwater reuse facilities are used.

Tensiometer Instrument, consisting of a porous cup filled with water and connected to a manometer or vacuum gauge, used for measuring the soil-water matric potential.

Total dissolved solids (TDS) The total dissolved mineral constituents of water.

Total dynamic head Head required to pump water from its source to the point of discharge. Equal to the static lift plus friction head losses in pipes and fittings plus velocity head.

Total suction head Head required to lift water from a water source to the centerline of the pump impeller plus velocity head, entrance losses, and friction losses in suction pipeline.

Translocation Movement of water to other area(s) than where it was applied.

Transpiration The process of plant water uptake and use, beginning with absorption through the roots and ending with transpiration at the leaf surfaces. See Evapotranspiration.

Trapezoidal flume *A* calibrated open-channel structure with sidewalls inclined to the horizontal, used to measure flow of water. Measurement is based on the principle of critical flow at a critical section.

Trapezoidal weir A sharp-crested weir of trapezoidal-shape.

Triangular weir *A* sharp-crested V-notch weir. Most common is 90 degree V-notch, but it can be any angle.

Trickle irrigation *A* micro irrigation system (low pressure and low volume) wherein water is applied to the soil surface as drops or small streams through emitters. Preferred term is Drip irrigation.

Turnout See Delivery box.

Unavailable soil water That portion of water in a soil held so tightly by adhesion and other soil forces that it cannot be absorbed by plants rapidly enough to sustain growth without permanent damage. The soil water remaining at the permanent wilting point of plants.

Valve A device to control flow that includes:
Pressurized system:
Air relief valve—Device that releases air from a pipeline automatically without permitting loss of water.
Air vacuum, air relief valve—Device that releases air from a pipeline automatically without permitting loss of water or admits air automatically if the internal pressure becomes less than atmospheric.
Backflow prevention valve—A check valve that allows flow in one direction. When closed, air is admitted to the low pressure (supply) side to prevent siphoning or backflow of water and chemicals to a water source.
Ball valve—A valve in a pipeline used to start or stop flow by rotating a sealed ball with a transverse hole approximately equal to the diameter of the pipeline. Ball rotation is typically 90 degrees for single-port control. With hole modifications, several outlets may be controlled. In this case, only partial rotation of the handle may be used. Ball valves should be opened and closed slowly to avoid high surge pressures. Headloss through a ball valve is very low.
Butterfly valve—A valve in a pipeline to start or stop flow by rotating a disk 90 degrees. The disk is about the same diameter as the pipeline. Butterfly valves should be opened and closed slowly to avoid high surge pressures (water hammer). Headloss through a butterfly valve is low.
Check valve—Valve used in a pipeline to allow flow in only one direction.
Drain valve—(a) Automatic has spring-loaded valve that automatically opens and drains the line when the pressure drops to near zero. (b) Flushing type has a valve on the end of a line to flush out dirt and debris. This may be incorporated into an end plug or end cap.
Float valve—A valve, actuated by a float, that automatically controls the flow of water.
Gate valve—A valve in a pipeline used to start or stop water flow. May be operated by hand with or with out mechanical assistance or

by high or low voltage (solenoid) electric controlled mechanical assistance. Gate valves consist of seated slide or gates operating perpendicular to the flow of water. Head loss through a gate valve is typically less than a globe valve, but more than a ball or butterfly valve.
Globe valve—A valve in a pipeline used to start or stop water flow. Globe valves stop flow by positioning a disk and gasket over a machined seat about the same diameter as the pipe. Globe valves are limited to smaller sizes because of the high velocities and very high head loss through the valve.
Pressure relief valve—A spring loaded valve set to open at a pressure slightly above the operating pressure, used to relieve excessive pressure and surges.
Solenoid valve—A misused term meaning a low voltage electrically controlled, mechanically actuated valve; typically a gate valve. Often a spring is used to hold the valve in a closed (or open) position when water pressure is low or electric energy is discontinued. (When ignition electric energy for an internal combustion engine or electric energy to a motor is discontinued, a spring closes the valve.)
Vacuum relief valve—Valve used to prevent a vacuum in pipelines and avoid collapsing of thin-wall pipe.

Non-pressure or very low pressure system:
Alfalfa valve—An outlet valve attached to the top of a short vertical pipe (riser) with an opening equal in diameter to the inside diameter of the riser pipe and a adjustable lid or cover to control water flow. *A* ring around the outside of the valve frame provides a seat and seal for a portable hydrant. Typically used in border or basin irrigation.
Orchard valve—An outlet valve installed inside a short vertical pipe (riser) with an adjustable cover or lid for flow control. Similar to an alfalfa valve, but with lower flow capacity. Typically used in basin irrigation.
Surge valve—A device in a pipe T fitting to provide flow in alternate directions at timed intervals. Used in surge irrigation.

Velocity head The energy head (H) created by water movement. The difference in elevation between the hydraulic grade line (HGL) and energy grade line (EGL). Described as $H = V2/2g$, where $g = 32.2$ ft’s/s (acceleration of gravity).

Venturi flume Flow measuring device with a contracted throat that causes a drop in the hydraulic grade line as well as an increase in velocity. Used for both open-channel and closed pipe flow measurement.

Vortex emitter *A* micro irrigation water application device that employs a vortex effect to dissipate pressure.

Water amendment (1) Fertilizer, herbicide, insecticide, or other material added to water for the enhancement of crop production.
(2) A chemical water treatment to reduce drip irrigation system emitter clogging.

Water conveyance efficiency Ratio of the volume of irrigation water delivered by a distribution system to the water introduced into the system.

Water holding capacity Total amount of water held in the soil per increment of depth. It is the amount of water held between field capacity (FC) and oven dry moisture level, expressed in inch per inch, inch per foot, or total inches for a specific soil depth. Soils that are not freely drained because they have impermeable layers can have temporary saturated conditions just above the impermeable layers. This can temproarily increase water holding capacity. Sometimes called Total water holding capacity. *See* Available water capacity.

Water leveling *A* method of landgrading wherein fields are divided into segments and flooded, and the highs are removed until all soil is beneath the water surface. Typically used with rice production.

Water rights State administered legal rights to use water supplies derived from common law, court decisions, or statutory enactments.

Water spreading Application of water to lands for the purpose of storing it as ground water for subsequent withdrawal, or *A* specialized form of surface irrigation accomplished by diverting water runoff from natural channels or water courses and spreading the flow over relatively level areas for soil storage or plant use. Typically does not supply full irrigation needs as they operate only when there is surface runoff from rainfall or snow melt events.

Water table control Controlling the water table elevation by pumping water into or discharging water from a planned subsurface irrigation or drainage system. The water table is maintained at a nearly constant elevation for each stage of plant growth and maturity.

Water table The upper surface of a saturated zone below the soil surface where the water is at atmospheric pressure.

Weirs Any of a group of flow measuring devices for open-channel flow. Weirs can be either sharp-crested or broad-crested. Flow opening may be rectangular, triangular, trapezoidal (cipolletti), or specially shaped to make the discharge linear with flow depth (sutro weir). Calibration is based on laboratory ratings.

Wilting point See Permanent wilting point.

Wind movement, daily wind run, wind speed Used to calculate reference crop evapotranspiration, usually expressed as wind run (average velocity, mph times time in hr/d).

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