GLOSSARY

acre foot: The volume of a one-acre area (43,560 square feet) one foot thick, or 43,560 cubic feet or 1,233 cubic meters. It is the unit commonly used in measuring volumes of water or reservoir storage space.

actual evapotranspiration: The amount of water loss that occurs by evapotranspiration, which may be less than the amount lost from a full water supply.

advection: The mass transport by the velocity field of groundwater.

advective transport: The travel of solute with groundwater, with the mean flow direction and speed of the groundwater.

alluvium: A general term for clay, silt, sand, gravel or similar unconsolidated detrital material, deposited during comparatively recent geologic time by a stream or other body of running water.

analytical model: A representation of a physical system that consists of a set of differential, integral, or integro-differential equations, along with their solutions.

anisotropy: The condition under which one or more of the properties at a point in a system varies according to direction.

aquifer system: A heterogeneous body of intercalated permeable and less permeable material that acts as a water-yielding hydraulic unit of regional extent.

aquifer test: A controlled test involving the withdrawal of measured rates of water from, or addition of water to, a well and the measurement of resulting changes in head in nearby observation wells, both during and after the period of discharge or addition.

area of influence: The area surrounding a pumping or recharging well within which the potentiometric surface is affected by the withdrawal or injection of water at the well.

baseflow: Sustained or dry weather streamflow. In most streams, baseflow is composed largely of groundwater effluent. [L^3T^{-1}]

bias: $\frac{1}{N}\left\{\sum_{i-1}^{N}\left(h_{io} - h_{ic}\right)\right\}$, [L], where h_{io} = observed head, h_{ic} = calculated head and N = number of observations.

body of water: A separate entity or mass of water, distinguished from other water masses; e.g., an ocean, sea, stream, lake, pond, pool and water in an aquifer are distinct "bodies of water".

boundary condition: A point or zone of entry or exit of water to or from a system. Boundary conditions are topological features of a model, exercising qualitative control over model results. Boundary conditions are normally specified by a given head at the boundary (prescribed head boundary), a given flow across the boundary (prescribed flow boundary), or a mixture of the two (mixed or head dependent boundary). Examples of boundaries include surface-water bodies, pumping wells, impermeable rocks and water tables.

calibration ratio: Root mean square error/Δh, where Δh is difference between minimum and maximum values of model-simulated heads.

capture: The decrease in discharge from an aquifer plus the increase in recharge, caused by pumping groundwater. The decrease in discharge may occur in the form of decreases in groundwater discharge into streams, lakes and the ocean, or from decreases in the component of evapotranspiration that is derived from the saturated zone.

cfs: cubic feet per second

complexity: The property by which a system contains many interacting subsystems of interest to the observer.

computer code: A set of computer instructions written in a language such as FORTRAN, C, or a spreadsheet or database language. Computer codes are used as tools in modeling, performing tasks such as reading data, performing computations, and outputting results.

conceptual model: A hypothesis or set of hypotheses that is a simplified but plausible description of a process, condition or system. It is developed from existing data and knowledge of physical principles.

conjunctive use of water: The joining together of two sources of water, such as groundwater and surface water, to serve a particular use.

consumptive irrigation requirement (CIR): The quantity of irrigation water expressed as a depth or volume, exclusive of effective precipitation, that is consumptively used by plants or is evaporated from the soil surface in a specific period of time. It does not include incidental depletions nor does it include water requirements for leaching, frost protection, wind erosion protection or plant cooling. Such requirements are accounted for in the on-farm efficiency values. The consumptive irrigation requirement may be numerically determined by subtracting effective rainfall from consumptive use.

consumptive use (U) or evapotranspiration (ET): The unit amount of water consumed on a given area in transpiration, building of plant tissue and evaporated from adjacent soil, water surface snow or intercepted precipitation in a specific period of time. The term includes effective rainfall. Consumptive use may be expressed either in volume per unit area such as acre inches or acre feet per acre or depth, such as in inches or feet. Note, however, that consumptive use of water by a crop does not include incidental depletions.

continuity equation: An axiom stating that the rate of flow past one section of a conduit or permeable material is equal to the rate of flow past another section of the same conduit or permeable material plus or minus any additions or subtractions between the two sections.

cubic feet per second: A unit expressing a rate of discharge. One cubic foot per second is equal to the discharge of a stream of rectangular cross section, one foot wide and one foot deep, that is flowing at an average velocity of one foot per second.

depletion: That part of withdrawal that has been evaporated, transpired, incorporated into crops or products, consumed by man or livestock or otherwise removed

from the water environment. It includes that portion of groundwater recharge resulting from seepage or deep percolation (in connection with a water use) that is not economically recoverable in a reasonable number of years or is not usable.

dewatering: The process of partially removing water; it may refer to removal of water from a basin, tank, reservoir, aquifer or other storage unit, or to separation of water from solid material.

diffusion: The process by which both ionic and molecular species dissolved in water move from areas of higher concentration to areas of lower concentration. Movement is random and is proportional to the gradient of concentration. The process tends to distribute the particles more uniformly.

digital elevation model (DEM): point elevation data stored in digital computer files consisting of grid locations (x and y) and point elevation data (z).

dip: The maximum angle formed between a geologic surface and the horizontal plane.

direct runoff: The runoff reaching stream channels immediately after rainfall or snow melting.

discharge area: An area in which subsurface water, including both groundwater and vadose water, is discharged to the land surface, to bodies of surface water or to the atmosphere.

discharge: The net outflow rate of water from part of a hydrologic system, as in a defined channel, or, the amount of water leaving the saturated zone across the water-table surface. [L^3T^{-1}]

dispersion: The spread of a solute in flowing groundwater along and perpendicular to the mean flow path by the combined processes of diffusion and physical mixing of the groundwater with water that has lower concentrations of the solute.

downgradient: A direction toward which groundwater flows; similar to downstream for surface water.

drainage basin: A region or area bounded by a drainage divide and occupied by a drainage system; specifically, the tract of country that gathers water originating

as precipitation and contributes it to a particular stream channel or system of channels, or to a lake, reservoir or other body of water.

drawdown: The change in hydraulic head or water level over a particular time interval or due to a particular aquifer stress.

Dupuit assumptions: In groundwater systems bounded by a free surface, flowlines are assumed to be horizontal, equipotentials vertical, and the hydraulic gradient is equal to the slope of the free surface. Thus, flow with and without a free surface is simulated by the same governing equation.

duration curve A graphic illustration of how often a given quantity is equaled or exceeded during a given span of time, e.g., a flow-duration curve.

duty of water: The quantity (or depth) of irrigation water required for a given area for the purpose of producing a particular crop; it is commonly expressed in acre feet per acre, or simply as depth in inches or feet.

effective porosity: The percent of the total volume of a given mass of soil or rock that consists of interconnected interstices. The use of this term as a synonym of specific yield is to be discouraged. The specific discharge divided by the mean velocity of a conservative tracer.

effective velocity: The actual velocity of groundwater percolating through water-bearing material. It is measured by the volume of groundwater passing through a unit cross-sectional area divided by effective porosity.

evaporation discharge: The release of water from the saturated zone by evaporation from the soil (soil discharge) or by the transpiration of plants (vegetal discharge).

evapotranspiration: Loss of water from a land area through transpiration of plants and evaporation from the soil and surface-water bodies. Also, the volume of water lost through evapotranspiration.

external boundaries: A zone of entry or exit of water to or from a system located on the exterior surface of the system space.

farm delivery requirements (FDR): The quantity of water, exclusive of effective rainfall, that is delivered to the farm headgate or is diverted from a source of water which

originates on the farm itself, such as a well or spring, to satisfy the consumptive irrigation requirements of crops grown on a farm in a specific period of time. The farm delivery requirements is computed by dividing the consumptive irrigation requirement, expressed as a depth of volume, by the on-farm irrigation efficiency, expressed as a decimal.

finite-difference model: A digital groundwater-flow model that typically utilizes a rectangular grid. Spatial and temporal derivatives are approximated using Taylor series expansions.

finite-element model: A digital groundwater-flow model where the aquifer is described by a mesh formed by multiple polygonal cells. Spatial derivatives are approximated using polynomials that are functions of spatial coordinates. Finite-element models can be better than finite-difference models at representing complex aquifer-boundary geometrics.

flood: A rising body of water (as in a stream, lake or sea, or behind a dam) that overtops its natural or artificial confines and that covers land not normally under water; especially any relatively high streamflow that overflows its banks in any reach of the stream.

flow-duration curve: A type of duration curve showing how often a particular stream discharge is equaled or exceeded.

flux: A stream of flowing water; a flood or an outflow. Specific discharge.

frequency curve: A curve that graphically represents a frequency distribution, e.g., a smooth line drawn on a histogram when the class interval is made small.

frequency distribution: A systematic arrangement of statistical data (such as a graphic or tabular display of the number of observations on a variable) in which the variable is divided into mutually exclusive and exhaustive discrete categories or classes, and that indicates the frequencies or relative frequencies that correspond to each of the categories or classes. If the categories are arranged by increasing magnitude, the graphic is a histogram.

gaging station: A particular site on a stream, canal, lake or reservoir where systematic observations of gage height, discharge or water quality (or any combination of these) are obtained.

geographic information system: A computer program and associated databases that permit cartographic information (including geologic information) to be queried by the geographic coordinates of features. Usually the data are organized in "layers" representing different geographic entities such as hydrology, culture, topography, etc.

GIS: Geographic information system.

groundwater budget: A numerical account, the groundwater equation, of the recharge, discharge and changes in storage of an aquifer, part of an aquifer or system of aquifers.

groundwater equation: The equation that balances the groundwater budget; $P = RO + ET + R + D + \Delta S$ where P is rainfall, RO is surface-water runoff, ET is evaporation and transpiration loss, R is groundwater recharge, D is groundwater discharged from the area and ΔS is change in groundwater storage. A mathematical statement of groundwater losses and gains in a specified area.

groundwater flux: specific discharge.

groundwater reservoir: A term used to refer to all saturated pore space in the rocks in the saturated zone.

groundwater storage: The quantity of water in the saturated zone. Water available only from storage as opposed to capture.

groundwater: That portion of the subsurface water that is in the saturated zone from which wells, springs and groundwater runoff is supplied. Loosely, all subsurface water, as distinct from surface water.

head: Hydraulic head. The height above a standard datum of the surface of a column of fluid. Water-level elevation in a well, or elevation to which the water of a well will rise. When not otherwise specified, it usually refers to static head. Energy contained in a water mass, produced by elevation, pressure or velocity.

head-dependent boundary: A boundary condition that adds water to or removes water from a model in proportion to the difference between hydraulic head in the aquifer and a reference hydraulic head.

high-level groundwater: Groundwater occurring above the basal water table and separated from it by less permeable material.

historical stress: Stresses in an aquifer that took place before the time of study. Typically refers to previous groundwater withdrawals from manmade works.

homogeneity: A characteristic of a porous medium in which material properties are identical everywhere.

hydraulic conductivity (K): A coefficient of proportionality describing the rate at which water moves through a unit cross sectional area of permeable medium under a unit hydraulic gradient. Also called permeability.

hydraulic conductivity tensor: A three by three matrix whose entries are computed for each location in space and each orientation of the coordinate system. The product of the hydraulic conductivity tensor and the hydraulic gradient vector is the groundwater-flow vector.

hydraulic conductivity: The volume of water at the existing kinematic viscosity that will move in a porous medium in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow. In contrast to permeability, it is a function of the properties of the liquid as well as of the porous medium.

hydraulic connection: A condition that allows interaction between points in a hydrologic system in proportion to the hydraulic gradient between them due to continuity of saturation and permeability of the system.

hydraulic diffusivity: The ratio of transmissivity to storage coefficient, or hydraulic conductivity to specific storage (K/S_s) (T/S). Hydraulic diffusivity characterizes the rate of expansion of the area of influence of a hydraulic stress. [L^2T^{-1}]

hydraulic gradient: The change in hydraulic head per unit distance between points of interest.

hydraulic head (h): Water level expressed as the sum of water pressure plus elevation. Also, potential energy contained in a water mass produced by elevation, pressure, velocity, solutes or molecular forces. Soil water pressure may be positive in a saturated zone, or negative in an unsaturated zone. [L]

hydraulic response: A change in water level or flow rate at one location due to a hydraulic stress at another location.

hydraulic stress: A withdrawal or addition of water, to or from, a hydrologic system that changes the pattern of flow in the system.

hydrograph: A graph showing stage, flow, velocity or other characteristics of water with respect to time. A stream hydrograph commonly shows rate of flow; a groundwater hydrograph, water level or head.

hydrologic budget: An accounting of the inflow to, outflow from, and storage in a hydrologic unit such as a drainage basin, aquifer, soil zone, lake or reservoir; the relationship between evaporation, precipitation, runoff and the change in water storage, expressed by the hydrologic equation.

hydrologic model: A statement of simplified relationships abstracted from a natural hydrologic system. Model parameter specifications are developed from selected observations of the properties of interest to suit the model purpose.

hydrologic properties: Those properties of a rock that govern the entrance of water and the capacity to hold, transmit and deliver water, e.g., porosity, effective porosity, specific retention, permeability, storativity, transmissivity and direction of maximum and minimum permeability.

hydrologic system: A space through which interrelated water moves and in which water is stored. A hydrologic system may include geologic units along with streams and recharge and discharge features.

hydrostratigraphic unit: A body of rock having considerable lateral extent and exhibiting reasonably distinct geologic and hydrologic properties.

infiltration ratio: R/K where R is recharge rate and K is hydraulic conductivity, both in units of length per unit time.

infrared: Pertaining to or designating that part of the electromagnetic spectrum ranging in wavelength from 0.7 μm to about 1 μm.

internal boundaries: A zone of entry or exit of water from a system located inside the surface of the system space.

interrelated water: Water connected by a continuous zone of saturation such that a hydraulic stress in one part of the water body can cause a hydraulic response at other locations.

interrupted stream: A stream that contains perennial reaches with intervening reaches.

Landsat: The series of satellites that collect multispectral images of the Earth's surface in the visible, reflected and thermal infrared bands.

leakance: The rate of vertical flow across a unit (horizontal) area of a confining bed into (or out of) an aquifer under one unit of head difference across this layer. The ratio K/b, in which K and b are the vertical hydraulic conductivity and the thicknesses, respectively, of the confining bed.

main stem: The principal course of a stream.

maximum contaminant level: The highest concentration of a solute permissible in a public water supply as specified in the National Interim Primary Drinking Water Standards for the U.S.

model calibration: The process by which the specifications of a digital computer model are varied in order to match calculated values with historical data sets of other variables, such as hydraulic heads water-table elevations or discharge rates.

model grid: A network of points or cells that is used to represent a region of space during the modeling of that region.

model resolution: The density of points or cells in a model grid. A grid with more points or cells for a given area is said to have a higher resolution.

model: A simplified representation of selected aspects of a natural system used to simulate features and processes of interest within the natural system.

moisture content: The amount of moisture in a given soil mass, expressed as weight of water dived by weight of even-dried soil, multiplied by 100 to give a percentage.

moisture potential: The tension on the pore water in the unsaturated zone due to the attraction of the soil-water interface.

numerical model: A representation of a physical system that consists of a set of discrete equations, along with their solutions. The set of discrete equations is normally a set of relationships among the points or cells of a model grid.

parameter: A variable in the equations of an analytical or numerical model that is specified with a characteristic value for the case being studied.

Peclet number: A dimensionless number that relates diffusion coefficient, average linear velocity and average particle diameter. It is the ratio of advectance to conductance and is an index to the degree of spreading out of a concentration profile of a tracer or contaminant in groundwater. The larger it is, the stronger the role of advection in comparison to diffusion.

perennial stream: A stream or reach of a stream that flows continuously throughout the year and whose upper surface generally stands lower than the water table in the region adjoining the stream.

porosity: The percentage of the bulk volume of a rock or soil that is occupied by interstices, whether isolated or connected.

potential evapotranspiration: Water loss that would occur by evapotranspiration if there never was a deficiency of water in the soil for use by vegetation.

principal axes of hydraulic conductivity: The orientation along which the hydraulic conductivity is a diagonal matrix. The three principal axes of hydraulic conductivity, all orthogonal to each other, form the coordinate system for this orientation.

project diversion requirement or off-farm diversion requirement (PDR): When the source of irrigation water does not originate on the farm, the project diversion requirement or off-farm diversion requirement is defined as the quantity of water exclusive of effective rainfall, which is diverted from an off-farm source to satisfy the farm delivery requirement in a specific period of time. An additional quantity of water must be diverted from the ultimate source of supply to make up for

conveyance losses between the farm headgate and the source of water. Estimated conveyance losses are added to the farm delivery requirement to arrive at the project diversion requirement. The off-farm diversion requirement may also be computed by dividing the farm delivery requirement by the off-farm conveyance efficiency, expressed as a decimal.

public water system: As defined by the USEPA, consists of a minimum of 15 service connections or regular service to at least 25 people at least 60 days a year.

reach: A continuous or extended part of a stream, viewed without interruption or chosen between two specified points.

recharge: The net addition of water to the saturated zone of a hydrologic system; also, the net amount of water added. [L^3T^{-1}]

recovery: The rise in water level in a well that occurs when discharge from that well or a nearby well is stopped. It is the inverse of drawdown.

regression analysis: A criterion for adjusting the parameters of a model to best match observed data. The best match will minimize the variation of the model values from the observed data.

residual drawdown: The difference between the projected pre-pumping water-level trend and the water level in a well or piezometer at any time during pumping or injection or immediately after it has stopped.

retardation: The reduced mobility of a solute through a geologic medium at a velocity less than that of the flowing groundwater due to sorption or other removal of the solute onto the porous medium.

return flow: Water returning to a system after being withdrawn or diverted from the system. Commonly refers to water returning to a stream after being diverted for irrigation.

riparian vegetation: Vegetation located on the banks of a stream or other body of surface water.

riparian: Pertaining to or situated on the bank of a body of water, especially of a watercourse of such as a river, e.g., "riparian land" situated along or abutting

upon a stream bank, or a "riparian owner" who lies or has property on a riverbank.

root mean square error: $\left\{\frac{\sum_{i-1}^{N}\left(h_{io}-h_{ic}\right)^2}{N}\right\}^{1/2}$, [L], where h_{io} = observed head, h_{ic} = calculated head and N = number of observations.

R-squared: $\left\{1-\frac{\sum_{i-1}^{N}\left(h_{io}-h_{ic}\right)^2}{\sum_{i-1}^{N}\left(h_{io}-\overline{h}\right)^2}\right\}$, [L], where h_{io} = observed head, h_{ic} = calculated head, N = number of nodes with variable head and $\overline{h}$ = mean of h_{io}.

saturated zone: A subsurface zone in which all the interstices are filled with water under pressure greater than that of the atmosphere. Although the zone may contain gas-filled interstices or interstices filled with fluids other than water, it is still considered saturated. This zone is separated from the unsaturated zone (above) by the water table.

seepage face: A zone along a slope, such as the bank of a stream, along which water emerges at atmospheric pressure and flows down the slope.

selection criteria: A set of attributes or qualities upon which a set of competing alternatives are judged with respect to the best alternative or alternatives.

SF1: MODFLOW parameter representing the primary storage coefficient.

SF2: MODFLOW parameter representing the secondary storage coefficient.

specific capacity: An expression of the productivity of a well, obtained by dividing the rate of discharge of water from the well by the drawdown in the well.

specific conductance: specific electrical conductivity.

specific discharge (q): The rate of discharge of groundwater across a unit area perpendicular to the direction of flow. Also called Darcy velocity. Specific discharge has the dimensions of velocity, and can indicate particle velocity if *q* is divided by effective porosity. [LT^{-1}]

specific electrical conductivity: A measure of the ability of a sample of water to conduct electricity. It is the reciprocal of the resistance in ohms measured between opposite faces of a centimeter cube of an aqueous solution at a specified temperature; standard reporting units are micomhos per centimeter or micro siemens per centimeter.

specific storage (S_S): The volume of water volume released from the system per unit of aquifer volume for a unit change in head. [L^{-1}] Below the water table, it has two components, pore-volume change and expansion of water. At the water table, a third component is dewatering of pores.

specific yield (Sy): A ratio of the volume of water that a given mass of saturated rock or soil will yield by gravity to the volume of that mass. This ratio is stated as a percentage.

specified head: A hydraulic head that is set as a boundary condition, rather than computed as a model result.

specified-flow: A flow rate at a given location that is set as a boundary condition, rather than computed as a model result.

standard deviation of residual error: $\left\{ \frac{N\sum_{i-1}^{N}\left(h_{io}-h_{ic}\right)^2-\left[\sum_{i-1}^{N}\left(h_{io}-h_{ic}\right)\right]^2}{N(N-1)} \right\}^{1/2}$, [L], where h_{io} = observed head, h_{ic} = calculated head and N = number of nodes with variable head.

static level: Water level of a well that is not being affected by pumping from the well.

steady-state: A condition in which water levels and flows are not changing with time.

stochastic model: A mathematical mode in which information on coefficients appears in the form of probability distributions of values rather than as deterministic values.

storage coefficient (S): The volume of water an aquifer releases or takes into storage per unit surface area of the aquifer per unit change in head. It is a dimensionless

ratio of the volume of water stored per volumetric change in potentiometric surface. Storage coefficient is the product of specific storage and saturated thickness.

storativity: See storage coefficient.

stream depletion: Reduction in the flow rate of a stream due to groundwater withdrawal.

stream gaging: Measurement of the velocity of a stream of water in a channel or open conduit and of the cross-sectional area of the water, in order to determine discharge.

stream line: An imaginary line connecting a series of fluid particles in a moving fluid so that the velocity factor of every particle on that line is tangent to it.

streamflow: The rate (volume of water per unit time) of flow of water at a given point of a stream.

strike: The direction of a line formed by the intersection of a geologic unit with the horizontal plane.

surface water: All waters on the surface of the Earth, including water in ponds, lakes, inland seas, streams and wetlands.

tensor: A matrix whose entries are functions. The entries of the matrix take different values at different points in space, under different condition, or along different directions of orientation.

tracer: Any substance that is used in a process to trace its course, including natural and artificial substances.

TRAN: MODFLOW parameter representing transmissivity. [L^2T^{-1}]

transient: The condition in which hydraulic head or flow rate in a hydrologic system is changing with time.

transmissivity (T): The rate at which water is transmitted through a unit width of a groundwater system under a unit hydraulic gradient. [L^2T^{-1}]

unsaturated zone: A subsurface zone containing water under pressure less than that of the atmosphere, including water held by capillarity; and containing air or gases

generally under atmospheric pressure. This zone is limited above by the land surface and below by the surface of the saturated zone.

VCONT: MODFLOW parameter representing vertical leakance. [T^{-1}]

vertical hydraulic gradient: The hydraulic gradient taken at measuring points at separate vertical elevations.

vertical leakance: The rate at which water is transmitted vertically between two specified levels of a groundwater system, per unit area, under a unit hydraulic head difference between the levels. [T^{-1}]

water balance: An accounting of the inflow to, outflow from, and change in storage in, a hydrologic system during an interval of time.

water budget: a water balance

water level: Water-surface elevation, stage or depth. The free surface of a body of water. The elevation of the free surface of a body of water above or below any datum. The surface of water standing in a well, usually indicative of the position of the water table or other potentiometric surface.

water right: The entitlement to withdraw and beneficially use a specified amount of the water of a hydrologic system.

watercourse: A natural, well-defined channel produced wholly or in part by a definite flow of water, continuous or intermittent. Also, a ditch, canal, aqueduct or other artificial channel for the conveyance of water.

waterlogging: The accumulation of saturated moisture in the soil within the zone or depth desirable for root development of plants. Accumulating water on top of soil where the water table and ground surface coincide.

wellhead protection area: A protected surface and subsurface zone surrounding a well or wellfield supplying a public water system to keep contaminants from reaching the well water.

withdrawal: The quantify of water taken from a groundwater or surface-water source. A diversion is the same as a withdrawal.

withdrawals: Removal of water from a hydrologic system for use, as from pumping wells or canal diversions.

yield: The quantity of water, expressed as a rate of flow, that can be collected for a given use or uses from surface-water or groundwater sources. The yield may vary with the use proposed, with the plan of development and also with economic considerations. Runoff. The streamflow in a given interval of time derived from a unit area of watershed, usually expressed in cubic feet per second per square mile. The rate of pumping water from a well or wellfield without lowering the water level below the pump intake.

zone of capture: The area surrounding a pumping well that encounters all areas or features that supply groundwater recharge to the well.

zone of influence: The area surrounding a pumping or recharging well within which the water table or potentiometric surface has been changed due to the well's pumping or recharge.

zone of saturation: Groundwater at pressure greater than atmospheric pressure.