Glossary

Land Subsidence in the United States

These definitions are based on the American Geological Institute's **Glossary of Geology** (4th edition) and **Glossary of Hydrology**, and USGS Water Supply Paper 2025, "Glossary of selected terms useful in studies of the mechanics of aquifer systems and land subsidence due to fluid withdrawal" (Poland, and others, 1971).

Aquifer A saturated, permeable, geologic unit that can transmit significant quantities of ground water under ordinary hydraulic gradients and is permeable enough to yield economic quantities of water to wells.

Aquifer, Artesian See *Aquifer, Confined, and Artesian*.

Aquifer, Confined An artesian aquifer that is confined between two aquitards.

Aquifer,Unconfined A water-table aquifer in which the water table forms the upper boundary.

Aquifer System A heterogeneous body of interbedded permeable and poorly permeable geologic units that function as a water-yielding hydraulic unit at a regional scale. The aquifer system may comprise one or more aquifers within which aquitards are interspersed. Confining units may separate the aquifers and impede the vertical exchange of ground water between aquifers within the aquifer system.

Aquitard A saturated, but poorly permeable, geologic unit that impedes ground-water movement and does not yield water freely to wells, but which may transmit appreciable water to and from adjacent aquifers and, where sufficiently thick, may constitute an important groundwater storage unit. Areally extensive aquitards may function regionally as confining units within aquifer systems. See also *Confining Unit*.

Artesian An adjective referring to confined aquifers. Sometimes the term artesian is used to denote a portion of a confined aquifer where the altitudes of the potentiometric surface are above land surface (flowing wells and artesian wells are synonymous in this usage). But more generally the term indicates that the altitudes of the potentiometric surface are above the altitude of the base of the confining unit (artesian wells and flowing wells are not synonymous in this case). See *Aquifer, Confined*.

Blue hole A subsurface void, usually a solution sinkhole, developed in carbonate rocks that are open to the Earth's surface and contains tidally influenced waters of fresh, marine, or mixed chemistry.

Cave A natural underground open space or series of open spaces and passages large enough for a person to enter, generally with a connection to the surface; often formed by solution of limestone.

Cavern A cave, with the implication of a large size.

Cenote Steep-walled natural well that extends below the water table; generally caused by collapse of a cave roof; term reserved for features found in the Yucatan Peninsula of Mexico.

Confining Unit A saturated, relatively low-permeability geologic unit that is areally extensive and serves to confine an adjacent artesian aquifer or aquifers. Leaky confining units may transmit appreciable water to and from adjacent aquifers. See also *Aquitard*.

Compaction In this Circular, compaction is used in its geologic sense and refers to the inelastic compression of the aquifer system. Compaction of the aquifer system reflects the rearrangement of the mineral grain pore structure and largely nonrecoverable reduction of the porosity under stresses greater than the preconsolidation stress. Compaction, as used here, is synonymous with the term "virgin consolidation" used by soils engineers. The term refers to both the process and the measured change in thickness. As a practical matter, a very small amount (1 to 5 percent) of the compaction is recoverable as a slight elastic rebound of the compacted material if stresses are reduced.

Compaction, Residual Compaction that would ultimately occur if a given increase in applied stress were maintained until steady-state pore pressures were achieved. Residual compaction may also be defined as the difference between (1) the amount of compaction that will occur ultimately for a given increase in applied stress, and (2) that which has occurred at a specified time.

Compression In this Circular, compression refers to the decrease in thickness of sediments, as a result of increase in vertical compressive stress. Compression may be elastic (fully recoverable) or inelastic (nonrecoverable).

Consolidation In soil mechanics, consolidation is the adjustment of a saturated soil in response to increased load, involving the squeezing of water from the pores and a decrease in void ratio or porosity of the soil. In this Circular, the geologic term "compaction" is used in preference to consolidation.

Datum See *Geodetic Datum.*

Ellipsoid, Earth A mathematically determined three-dimensional surface obtained by rotating an ellipse about its semi-minor axis. In the case of the Earth, the ellipsoid is the modeled shape of its surface, which is relatively flattened in the polar axis.

Ellipsoid, Height The distance of a point above the ellipsoid measured perpendicular to the surface of the ellipsoid.

Exfoliation The process by which concentric scales, plates, or shells of rock, from less than a centimeter to several meters in thickness, are stripped from the bare surface of a large rock mass. See *spall.*

Geodetic Datum A set of constants specifying the coordinate system used for geodetic control, for example, for calculating the coordinates of points on the Earth.

Geoid, Earth The sea-level equipotential surface or figure of the Earth. If the Earth were completely covered by a shallow sea, the surface of this sea would conform to the geoid shaped by the hydrodynamic equilibrium of the water subject to gravitational and rotational forces. Mountains and valleys are departures from this reference geoid.

Head, Hydraulic A measure of the potential for fluid flow. The height of the free surface of a body of water above a given subsurface point.

Hydraulic Conductivity A measure of the medium's capacity to transmit a particular fluid. 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. In contrast to permeability, it is a function of the properties of the liquid as well as the porous medium.

Hydrocompaction The process of volume decrease and density increase that occurs when certain moisture-deficient deposits compact as they are wetted for the first time since burial. The vertical downward movement of the land surface that results from this process has also been termed "shallow subsidence" and "near-surface subsidence."

Karst A type of topography that is formed on limestone, dolomite, gypsum and other rocks, primarily by dissolution, and that is characterized by sinkholes, caves, and subterranean drainage.

Karstification Action by water, mainly chemical but also mechanical, that produces features of a karst topography.

Karst, Mantled A terrane of karst features, usually subdued, and covered by soil or a thin alluvium.

Load We refer to *Load* as synonymous with *Stress*.

Overdraft Any withdrawal of ground water in excess of the *Safe Yield*.

Paleokarst A karstified area that has been buried by later deposition of sediments.

Permeability The capacity of a porous rock, sediment, or soil for transmitting a fluid. Unlike hydraulic conductivity, it is a function only of the medium.

pH A measure of the acid/base property of a material sample. The negative logarithm of the hydrogen ion concentration; pH 7 is neutral with respect to distilled, deionized water; pH less than 7 is more acidic; pH greater than 7 is more basic.

Piezometric Surface See *Potentiometric Surface.*

Plutonic A loosely defined term with a number of current usages. We use it to describe igneous rock bodies that crystallized at great depth or, more generally, any intrusive igneous rock.

Porosity The percentage of the soil or rock volume that is occupied by pore space, void of material. The porosity is defined by the ratio of void space to the total volume of a specimen.

Potentiometric Surface An imaginary surface representing the total head of ground water and defined by the level to which the water will rise in a tightly cased well. See *Head, Hydraulic*.

Recharge The process involved in addition of water to the saturated zone, naturally by precipitation or runoff, or artificially by spreading or injection.

Sinkhole A depression in a karst area. At land surface its shape is generally circular and its size measured in meters to tens of meters; underground it is commonly funnel-shaped and associated with subterranean drainage.

Safe Yield See *Yield, Safe.*

Specific Storage The volume of water that an aquifer system releases or takes into storage per unit volume per unit change in head. The specific storage is equivalent to the *Storage Coefficient* divided by the thickness of the aquifer system.

Spall A chip or fragment removed from a rock surface by weathering; especially by the process of exfoliation. See *exfoliation.*

Spring Any natural discharge of water from rock or soil onto the land surface or into a surface-water body.

Storage The capacity of an aquifer, aquitard, or aquifer system to release or accept water into ground-water storage, per unit change in hydraulic head. See *Storage Coefficient* and *Specific Storage.*

Storage Coefficient The volume of water that an aquifer system releases or takes into storage per unit surface area per unit change in head.

Strain Relative change in the volume, area or length of a body as a result of *stress*. The change is expressed in terms of the amount of displacement measured in the body divided by its original volume, area, or length, and referred to as either a volume strain, areal strain, or one-dimensional strain, respectively. The unit measure of strain is dimensionless, as its value represents the fractional change from the former size.

Stress In a solid body, the force (per unit area) acting on any surface within it; also refers to the applied force (per unit area) that creates the internal force. Stress is variously expressed in units of pressure, such as pounds per square inch, kilograms per square meter, or Pascals.

Stress, Applied The downward stress imposed on a specified horizontal plane within an aquifer system. At any given level in the aquifer system, the applied stress is the force or weight (per unit area) of sediments and moisture above the water table, plus the submerged weight (per unit area), accounting for buoyancy of the saturated sediments overlying the specified plane at that level, plus or minus the net seepage stress generated by flow (upward or downward component) through the specified plane in the aquifer system.

Stress, Effective Stress (pressure) that is borne by and transmitted through the grain-to-grain contacts of a deposit, and thus affects its porosity and other physical properties. In one-dimensional compression, effective stress is the average grain-to-grain load per unit area in a plane normal to the applied stress. At any given depth, the effective

	stress is the weight (per unit area) of sediments and moisture above the water table, plus the submerged weight (per unit area) of sediments between the water table and the specified depth, plus or minus the seepage stress (hydrodynamic drag) produced by downward or upward components, respectively, of water movement through the saturated sediments above the specified depth. Effective stress may also be defined as the difference between the geostatic stress and fluid pressure at a given depth in a saturated deposit, and represents that portion of the applied stress which becomes effective as intergranular stress.
Stress, Geostatic (Lithostatic)	The total weight (per unit area) of sediments and water above some plane of reference. Geostatic stress normal to any horizontal plane of reference in a saturated deposit may also be defined as the sum of the effective stress and the fluid pressure at that depth.
Stress, Preconsolidation	The maximum antecedent effective stress to which a deposit has been subjected and which it can withstand without undergoing additional permanent deformation. Stress changes in the range less than the preconsolidation stress produce elastic deformations of small magnitude. In fine-grained materials, stress increases beyond the preconsolidation stress produce much larger deformations that are principally inelastic (nonrecoverable). Synonymous with "virgin stress."
Stress, Seepage	Force (per unit area) transferred from the water to the medium by viscous friction when water flows through a porous medium. The force transferred to the medium is equal to the loss of hydraulic head and is termed the seepage force exerted in the direction of flow.
Subsidence	Sinking or settlement of the land surface, due to any of several processes. As commonly used, the term relates to the vertical downward movement of natural surfaces although small-scale horizontal components may be present. The term does not include landslides, which have large-scale horizontal displacements, or settlements of artificial fills.
Subsidence, Near-Surface	See *Hydrocompaction.*
Subsidence, Shallow	See *Hydrocompaction.*
Transmissivity	The rate at which water at the prevailing kinematic viscosity is transmitted through a unit width of aquifer under a unit hydraulic gradient. See also *Hydraulic Conductivity*.
Vug	A small cavity or chamber in rock that may be lined with crystals.
Water Table	The surface of a body of unconfined ground water at which the pressure is equal to atmospheric pressure.
Yield, Operational	See *Yield, Optimal.*
Yield, Optimal	An optimal amount of ground water, by virtue of its use, that should be withdrawn from an aquifer system or ground-water basin each year. It is a dynamic quantity that must be determined from a set of alternative ground-water management decisions subject to goals, objectives, and constraints of the management plan.

Yield, Perennial The amount of usable water from an aquifer that can be economically consumed each year for an indefinite period of time. It is a specified amount that is commonly specified equal to the mean annual recharge to the aquifer system, which thereby limits the amount of ground water that can be pumped for beneficial use.

Yield, Safe The amount of ground water that can be safely withdrawn from a ground-water basin annually, without producing an undesirable result. Undesirable results include but are not limited to depletion of ground-water storage, the intrusion of water of undesirable quality, the contraventions of existing water rights, the deterioration of the economic advantages of pumping (such as excessively lowered water levels and the attendant increased pumping lifts and associated energy costs), excessive depletion of streamflow by induced infiltration, and land subsidence.