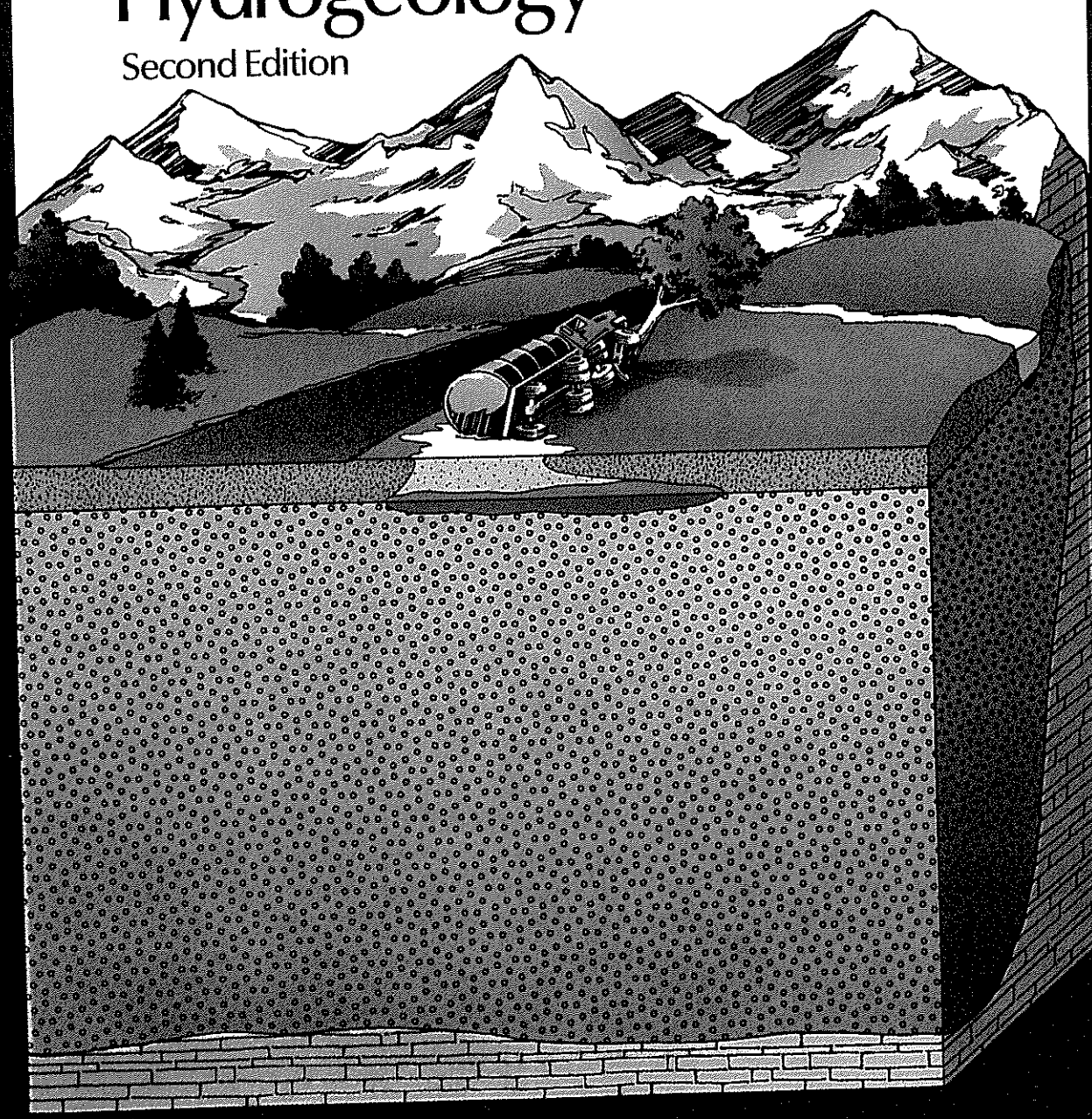
C. W. Fetter

Applied Hydrogeology

Second Edition



This book is dedicated to my wife,
Nancy, and my children: Bill, Rob, and Elizabeth.

Cover Art: Michael Linley
Macmillan Publishing Company
866 Third Avenue, New York, New York 10022

Collier Macmillan Canada, Inc.
Suite 200
1200 Eglinton Avenue, E.
Don Mills, Ontario, M3C 3N1

This book was set in Times Roman and Optima.

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Production Coordinator: Molly Kyle
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Text Designer: Cynthia Brunk

Library of Congress Catalog Card Number: 87-62679
International Standard Book Number: 0-675-20887-4
Printed in the United States of America
Print 5 6 7 8 9 Year 1 2 3 4 5

Hvorslev method A procedure for performing a slug test in a piezometer that partially penetrates a water-table aquifer.

Hydraulic conductivity A coefficient of proportionality describing the rate at which water can move through a permeable medium. The density and kinematic viscosity of the water must be considered in determining hydraulic conductivity.

Hydraulic diffusivity A property of an aquifer or confining bed defined as the ratio of the transmissivity to the storativity.

Hydraulic gradient The change in total head with a change in distance in a given direction. The direction is that which yields a maximum rate of decrease in head.

Hydraulic head *See* head, total.

Hydrochemical facies Bodies of water with separate but distinct chemical compositions contained in an aquifer.

Hydrodynamic dispersion The process by which ground water containing a solute is diluted with uncontaminated ground water as it moves through an aquifer.

Hydrogeology The study of the interrelationships of geologic materials and processes with water, especially ground water.

Hydrograph A graph that shows some property of ground water or surface water as a function of time.

Hydrologic equation An expression of the law of mass conservation for purposes of water budgets. It may be stated as inflow equals outflow plus or minus changes in storage.

Hydrology The study of the occurrence, distribution, and chemistry of all waters of the earth.

Hydrophyte A type of plant that grows with the root system submerged in standing water.

Hydrostratigraphic unit A formation, part of a formation, or group of formations in which there are similar hydrologic characteristics allowing for grouping into aquifers or confining layers.

Hygroscopic water Water that clings to the surfaces of mineral particles in the zone of aeration.

Ideal gas A gas having a volume that varies inversely with pressure at a constant temperature and that also expands by 1/273 of its volume at 0° C for each degree rise in temperature at constant pressure.

Image well An imaginary well that can be used to simulate the effect of a hydrologic barrier, such as a recharge boundary or a barrier boundary, on the hydraulics of a pumping or recharge well.

Infiltration The flow of water downward from the land surface into and through the upper soil layers.

Infiltration capacity The maximum rate at which infiltration can occur under specific conditions of soil moisture. For a given soil, the infiltration capacity is a function of the water content.

Injection well A well drilled and constructed in such a manner that water can be pumped into an aquifer in order to recharge it.

Interception The process by which precipitation is captured on the surfaces of vegetation before it reaches the land surface.

Interception loss Rainfall that evaporates from standing vegetation.

Interflow The lateral movement of water in the unsaturated zone during and immediately

after a precipitation event. The water moving as interflow discharges directly into a stream or lake.

Intermediate zone That part of the unsaturated zone below the root zone and above the capillary fringe.

Intrinsic permeability Pertaining to the relative ease with which a porous medium can transmit a liquid under a hydraulic or potential gradient. It is a property of the porous medium and is independent of the nature of the liquid or the potential field.

Ion exchange A process by which an ion in a mineral lattice is replaced by another ion that was present in an aqueous solution.

Isocon A line drawn on a map to indicate equal concentrations of a solute in ground water.

Isohyetal line A line drawn on a map, all points along which receive equal amounts of precipitation.

Isotropy The condition in which hydraulic properties of the aquifer are equal in all directions.

Jacob straight-line method A graphical method using semilogarithmic paper and the Theis equation for evaluating the results of a pumping test.

Juvenile water Water entering the hydrologic cycle for the first time.

Karst The type of geologic terrane underlain by carbonate rocks where significant solution of the rock has occurred due to flowing ground water.

Kemmerer sampler A sampling device that can be lowered either into a deep well or into a lake in order to retrieve a water sample from a particular depth in the well or the lake.

Kinematic viscosity The ratio of dynamic viscosity to mass density. It is obtained by dividing dynamic viscosity by the fluid density. Units of kinematic viscosity are square meters per second.

Laminar flow That type of flow in which the fluid particles follow paths that are smooth, straight, and parallel to the channel walls. In laminar flow, the viscosity of the fluid damps out turbulent motion. *Compare with* Turbulent flow.

Langmuir isotherm An empirical equation that describes the amount of solute adsorbed onto a soil surface.

Land pan A device used to measure free-water evaporation.

Laplace equation The partial differential equation governing steady-state flow of ground water.

Law of mass action The law stating that for a reversible chemical reaction the rate of reaction is proportional to the concentrations of the reactants.

Leachate Water that contains a high amount of dissolved solids and is created by liquid seeping from a landfill.

Leachate collection system A system installed in conjunction with a liner to capture the leachate that may be generated from a landfill so that it may be taken away and treated.

Leaky confining layer A low-permeability layer that can transmit water at sufficient rates to furnish some recharge to a well pumping from an underlying aquifer. Also called aquitard.

Lineament A natural linear surface longer than a mile (1500 meters).

Liner A low-permeability material, such as clay or plastic sheeting, that is put beneath

Seismic refraction A method of determining subsurface geophysical properties by measuring the length of time it takes for artificially generated seismic waves to pass through the ground.

Shelby tube A sampling device that is pushed into an unconsolidated aquifer ahead of the drill bit. Typically, the Shelby tube is pushed by hydraulic means.

Single-point resistance log A borehole log made by lowering a single electrode into the well with the other electrode at the ground surface. It measures the overall electrical resistivity of the formation and drilling fluid between the surface and the probe.

Sinkhole spring A spring created by ground water flowing from a sinkhole in karst terrane.

Slug test An aquifer test made either by pouring a small instantaneous charge of water into a well or by withdrawing a slug of water from the well. A synonym for this test, when a slug of water is removed from the well, is a bail-down test.

Slurry wall An underground wall designed to stop ground-water flow; constructed by digging a trench and backfilling it with a slurry rich in bentonite clay.

Soil liquefaction A process that occurs when saturated sediments are shaken by an earthquake. The soil can lose its strength and cause the collapse of structures with foundations in the sediment.

Soil moisture The water contained in the unsaturated zone.

Solubility product The equilibrium constant that describes a solution of a slightly soluble salt in water.

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 of the water level in the well. Specific capacity should be described on the basis of the number of hours of pumping prior to the time the drawdown measurement is made. It will generally decrease with time as the drawdown increases.

Specific discharge An apparent velocity calculated from Darcy's law; represents the flow rate at which water would flow in an aquifer if the aquifer were an open conduit.

Specific electrical conductance The ability of water to transmit an electrical current. It is related to the concentration and charge of ions present in the water.

Specific retention The ratio of the volume of water the rock or sediment will retain against the pull of gravity to the total volume of the rock or sediment.

Specific weight The weight of a substance per unit volume. The units are newtons per cubic meter.

Specific yield The ratio of the volume of water a rock or soil will yield by gravity drainage to the volume of the rock or soil. Gravity drainage may take many months to occur.

Spiked sample A water sample to which a known quantity of a solute has been added so that the accuracy of the laboratory in analyzing the sample can be determined.

Split-spoon sample A sample of unconsolidated material taken by driving a sampling device ahead of the drill bit in a boring. The split-spoon sampler is typically advanced by the repetitive dropping of a weight.

Spontaneous potential log A borehole log made by measuring the natural electrical potential that develops between the formation and the borehole fluids.

Stagnation point A place in a ground-water flow field at which the ground water is not moving. The magnitude of vectors of hydraulic head at the point are equal but opposite in direction.

Stem flow The process by which rainwater drips and flows down the stems and branches of plants.

Stiff pattern A graphical means of presenting the chemical analysis of the major cations and anions of a water sample.

Storage, specific The amount of water released from or taken into storage per unit volume of a porous medium per unit change in head.

Storativity The volume of water an aquifer releases from or takes into storage per unit surface area of the aquifer per unit change in head. It is equal to the product of specific storage and aquifer thickness. In an unconfined aquifer, the storativity is equivalent to the specific yield. Also called storage coefficient.

Storm hydrograph A graph of the discharge of a stream over the time period when, in addition to direct precipitation, overland flow, interflow, and return flow are adding to the flow of the stream. The storm hydrograph will peak owing to the addition of these flow elements.

Stream, gaining A stream or reach of a stream, the flow of which is being increased by inflow of ground water. Also known as an effluent stream.

Stream, losing A stream or reach of a stream that is losing water by seepage into the ground. Also known as an influent stream.

Successive overrelaxation method A particular type of method for solving for the head in a finite-difference ground-water model.

Suction lysimeter A device for withdrawing pore water samples from the unsaturated zone by applying tension to a porous ceramic cup.

Swallow hole A vertical shaft in a karst terrane leading from a surface stream into an underground cavern.

Tensiometer A device used to measure the soil-moisture tension in the unsaturated zone.

Tension The condition under which pore water exists at a pressure less than atmospheric.

Theis equation An equation for the flow of ground water in a fully confined aquifer.

Theissen method A process used to determine the effective uniform depth of precipitation over a drainage basin with a nonuniform distribution of rain gages.

Throughflow The lateral movement of water in an unsaturated zone during and immediately after a precipitation event. The water from throughflow seeps out at the base of slopes and then flows across the ground surface as return flow, ultimately reaching a stream or lake.

Time of concentration The time it takes for water to flow from the most distant part of the drainage basin to the measuring point.

Tortuosity The actual length of a ground-water–flow path, which is sinuous in form, divided by the straight-line distance between the ends of the flow path.

Transmissivity The rate at which water of a prevailing density and viscosity is transmitted through a unit width of an aquifer or confining bed under a unit hydraulic gradient. It is a function of properties of the liquid, the porous media, and the thickness of the porous media.

Transpiration The process by which plants give off water vapor through their leaves.

Trilinear diagram A method of graphically plotting the chemical composition of the major anions and cations of a water sample.

Turbidity Cloudiness in water due to suspended and colloidal organic and inorganic material.