

Groundwater Hydrology Solved Problems Pdf

Groundwater Hydrology Solved Problems Pdf Groundwater Hydrology Solved Problems A Comprehensive Guide Groundwater the unseen reservoir beneath our feet plays a crucial role in sustaining life and supporting human activities Understanding the principles of groundwater hydrology is vital for managing this precious resource effectively This article provides a comprehensive guide to groundwater hydrology focusing on solving problems through practical examples and detailed explanations

Fundamentals of Groundwater Hydrology Groundwater hydrology is the study of the occurrence movement and distribution of underground water Key concepts include

- Aquifers** Underground layers of rock or sediment that can hold and transmit water
- Aquicludes** Impermeable layers that restrict water flow
- Water table** The upper surface of the saturated zone where pore spaces are filled with water
- Recharge** The process of replenishing groundwater through infiltration from rainfall or snowmelt
- Discharge** The outflow of groundwater to surface water bodies springs or wells
- Hydraulic Conductivity** A measure of the ease with which water flows through a porous medium
- Transmissivity** A measure of the rate of groundwater flow through a saturated aquifer

Solved Problems Illustrating Groundwater Concepts

1 Darcys Law and Groundwater Flow Problem A confined aquifer has a hydraulic conductivity of 104 ms and a thickness of 20 m If the hydraulic head gradient is 0.01 what is the groundwater flow rate

Solution Darcys Law states that the flow rate Q is proportional to the hydraulic conductivity K the crosssectional area A and the hydraulic head gradient i $Q = K A i$ A thickness 20 m 1 m 20 m^2 2 Therefore $Q = 104 \text{ ms} \cdot 20 \text{ m}^2 \cdot 0.01 = 2105 \text{ m}^3\text{s}$ 2

Well Hydraulics Problem A well is pumped at a rate of $1000 \text{ m}^3\text{day}$ The drawdown at the well is 5 m The radius of influence is 500 m Calculate the transmissivity of the aquifer

Solution The transmissivity T can be determined using the Theis equation $T = \frac{Q \ln(r/r_w)}{2s}$ Where Q pumping rate r radius of influence r_w well radius s drawdown Assuming a well radius of 0.5 m we get $T = \frac{1000 \text{ m}^3\text{day} \ln(500/0.5)}{2 \cdot 5 \text{ m}} = 1591 \text{ m}^2\text{day}$ 3

Groundwater Recharge and Discharge Problem A 10 km^2 catchment receives an annual rainfall of 800 mm The infiltration rate is 20 Calculate the annual recharge to the underlying aquifer

Solution Annual rainfall in meters $800 \text{ mm} = 0.8 \text{ m}$ Total rainfall volume catchment area rainfall depth $10 \text{ km}^2 \cdot 0.8 \text{ m} = 8 \cdot 10^6 \text{ m}^3$ Annual recharge rainfall volume infiltration rate $8 \cdot 10^6 \text{ m}^3 \cdot 0.2 = 1.6 \cdot 10^6 \text{ m}^3$ 4

Groundwater Contamination Problem A leaking underground storage tank UST releases a contaminant into an unconfined aquifer The contaminant plume has a length of 100 m and a width of 50 m The average groundwater velocity is 0.1 mday How long will it take for the plume to reach a nearby well located 500 m from the source

Solution Travel time distance velocity Distance to well 500 m 3 Travel time $500 \text{ m} / 0.1 \text{ mday} = 5000 \text{ days} = 13.7 \text{ years}$ 5

Groundwater Management and Sustainability Problem A region is facing groundwater depletion due to excessive pumping What strategies can be implemented to ensure sustainable groundwater

management Solution Water conservation Implementing measures to reduce water consumption in agriculture industries and households Artificial recharge Infiltrating surface water to replenish the aquifer Well management Optimizing well spacing and pumping rates to minimize drawdown and prevent interference Rainwater harvesting Collecting and storing rainwater for various purposes Water pricing Implementing water pricing mechanisms to encourage conservation Aquifer storage and recovery Storing excess water in aquifers during wet periods for later use Conclusion Solving groundwater hydrology problems requires a thorough understanding of the underlying principles and a systematic approach This article has provided a framework for analyzing various aspects of groundwater flow well hydraulics recharge discharge and contamination By applying these concepts and tools we can effectively manage and protect this vital resource for current and future generations Further Learning Groundwater Hydrology by David K Todd Applied Groundwater Hydrology by Charles F Ferris Groundwater A Foundation for Understanding and Management by John D Hem Groundwater Modeling by GF Pinder and EA Bredehoeft References Groundwater Hydrology by David K Todd Applied Groundwater Hydrology by Charles F Ferris Theis C V 1935 The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage Transactions of the American Geophysical Union 16 519524 Note This article provides a brief overview of groundwater hydrology and solved problems 4 Further research and study are recommended for a comprehensive understanding of this complex field

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