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Is Soil Permeable? (ANSWERED)

Soil that allows water to pass through it, but not rapidly, is considered permeable.

But not all soil is permable.

In the article that follows, we'll explain.

Is Soil Permeable? (EXPLAINED)

When Is Soil Permeable?

Some soils are more permeable than others, allowing water droplets to flow freely between the grains of soil.

This makes soil a well-known porous material.

The ability for liquids to move through the spaces in the soil is called hydraulic conductivity and measures how easily fluids can move large distances as well as how much pressure is needed to stop them from moving.

Soils that have extremely slow rates of hydraulic conductivity are known as aquicludes and prevent water from draining into the groundwater.

Thus, soils with high levels of organic matter and smaller pore sizes, such as clay, are classified as aquicludes.

Soil texture becomes more important when thinking about the hydraulic conductivity of the soil.

Coarse-textured soils with larger pore sizes allow for greater amounts of water to pass through than fine-textured soils that have smaller pore sizes.

That being said, some vegetation can alter this process by creating physical barriers to water flow in the soil.

These vegetation roots create an environment where soil particles become more compacted and closer together than they otherwise would be without any plants present.

This reduction in hydraulic conductivity is known as closure and occurs mainly due to plant growth, not decomposition.

Thus, the presence of plants can change how easily water can pass through the soil.

Plant roots commonly found in the Tillamook State Forest in Oregon, such as Douglas fir tree roots, are a good example of soil texture.

Each tree has over 200 feet of root per acre covering the forest floor.

This amount of growth reduces the porosity of the soil, creating a physical barrier for water to move freely between soil particles.

Thus, less water is able to seep into groundwater or other layers within the soil because it is being blocked by these growing roots.

The negative effects on soil hydraulic conductivity due to vegetation go beyond what occurs above-ground; organic matter accumulation, including plant debris, affects permeability even more than the roots do.

This is because organic matter has a higher density than sand and silt particles.

By creating more compression between these soil particles, water movement is blocked further by the presence of plant decomposition.

This reduction in porosity from plant growth and decomposition is an example of how easily water can be stopped from moving within the soil as well as through soil.

Thus, the presence of vegetation decreases the permeability of soils, making them an aquiclude rather than a free-draining porous material.

Soil Porosity and Hydraulic Conductivity: How Fast Does Water Move?

Along with understanding how water behaves within the soil, it is also important to understand how quickly water moves between layers of soil and into groundwater reservoirs.

The first major factor determining the speed at which water travels through the ground is the amount of rainfall that falls on an area.

This number typically determines how fast or slow pore spaces will fill up and how quickly layers of soil will become saturated.

The amount of time it takes for pore spaces to fill up with water, known as the field capacity, is affected by what vegetation type is present on a landscape.

With forest soils, the presence of roots can decrease the total volume of soil pores able to be filled with water while also increasing the rate at which rainwater moves through these pores into groundwater storage.

Both of these adjustments result in a faster hydrologic response where more rainfall becomes runoff or groundwater recharge rather than being stored within the soil.

The second important variable determining how fast water moves through different types of soils is its movement from particle-to-particle instead of pore-to-pore.

This type of movement is referred to as matrix flow and occurs through the cracks and crevices that exist between soil particles.

This water is able to move much faster than pore-to-pore due to these paths being less obstructed by plant growth and organic matter accumulation.

Clay soils can be more easily compressed while sand and gravel consist of larger spaces between individual particles, allowing for better flow along these paths.

While this accelerated flow may seem like a good thing, it comes with serious drawbacks such as greater erosion potential and less groundwater storage capacity.

Thus, permeability allows for more rapid water movement through the ground, but also makes landscapes more vulnerable to changes in surface and groundwater availability.

Soil Permeability: What Does This Mean for Water Resources?

On a large scale, the amount of rainfall that falls on a landscape is one of the main determinants affecting how much water becomes groundwater storage or runoff.

Areas with higher amounts of permeable soils will have less groundwater storage capacity as well as a heightened risk for flooding during heavy rainfall events.

In these regions, it is vital to implement flood control measures such as dams and reservoirs in order to maintain freshwater supplies.

For example, there are numerous studies that have been conducted focusing on flood risks throughout California due to high rates of soil erosion from landslides and excessive groundwater recharge.

These floods can be harmful to both human populations and the environment.

Further, areas that receive a large amount of rainfall will experience higher rates of flooding incidents and may require improving water quality through filtration in order to make this resource available for use by inhabitants.

With climate change already leading to more intense rainfall events, it is important that efforts are made to preserve forests throughout the world in an effort to maintain clean groundwater supplies.

This preserves natural water storage capabilities as well as prevents soil erosion by allowing vegetation communities to better absorb excess precipitation.

On a local scale, soil permeability affects how quickly water can move from one location on a landscape into another or between layers of soil.

For example, construction projects place impervious surfaces such as asphalt or concrete over soil and prevent water from moving through the ground.

This often occurs in sites located in areas where there is a large amount of rainfall, but also minimizes groundwater recharge.

Erosion and runoff are two major issues that can develop when these impervious surfaces dominate landscapes, leading to increased flooding and decreased freshwater availability downstream.

Soil permeability is an important hydrologic parameter to keep in mind during site planning and development as it affects how fast and how much precipitation becomes runoff.

Areas with high rates of soil erosion coupled with lower rates of groundwater recharge will have heightened susceptibility to flooding, while those regions with low rates of surface erosion boast greater access to water resources.

Improving soil permeability can be accomplished by preserving natural vegetation communities and properly managing impervious surfaces such as asphalt.

You'll learn more here:

- Is Clay Permeable?
- Is Marble Permeable?
- Is Mudstone Permeable?
- Is Granite Permeable?
- Is Slate Permeable?
- Is Basalt Permeable?
- Is Coal Permeable?
- Is Sand Permeable?
- Is Gravel Permeable?