Keeping Water on the Land Longer

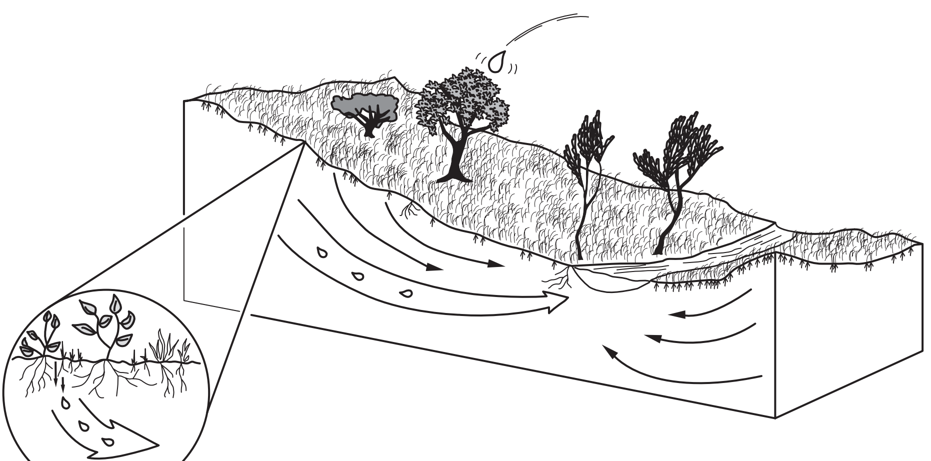
How can we help keep our land healthy and productive?

Although nature is infinitely complex, basic principles still apply in most situations. For example:

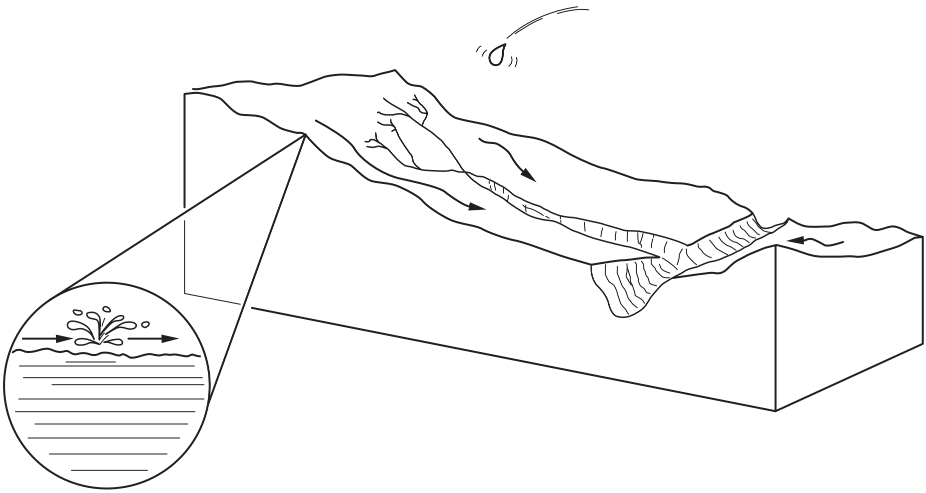
The longer water remains on or in the land before running off, the more productive the land will be.

When water leaves the land too soon, not only is that water no longer available for plants to use, but the land and water can be degraded as a result. This is especially true in arid and semiarid regions. If we want the land to be more productive, we must ***keep water on the land longer***.

A good way to see this principle in action is to follow the journey of two raindrops after they hit the earth.



Drop A falls onto a leaf or a blade of grass that absorbs most of the energy of its fall. It then gently enters the soil and—because there are lots of air spaces between individual bits of soil—it soaks down deep into the earth. Once within the soil, Drop A may be taken up by the roots of a plant and released back into the atmosphere through the plant's life processes. Or Drop A may take another path and slowly make its way down to a stream, where it can contribute to the flow long after the storm that generated it has passed.

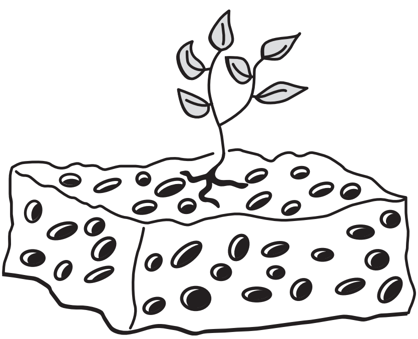


Drop B falls onto bare soil. Because of the momentum built up by its fall from the cloud, Drop B has a lot of energy when it hits the soil. Small bits of the soil surface may be broken off by Drop B's impact. Some of these bits of soil are actually driven into small holes between the soil pieces, effectively sealing the soil surface. Drop B now has a good chance of staying on the soil surface. It may simply evaporate from the soil surface or, in combination with other drops of water, Drop B may flow off the land, taking some of the soil with it. Any plants growing in the area can no longer use the soil that was removed or the water that carried it away.

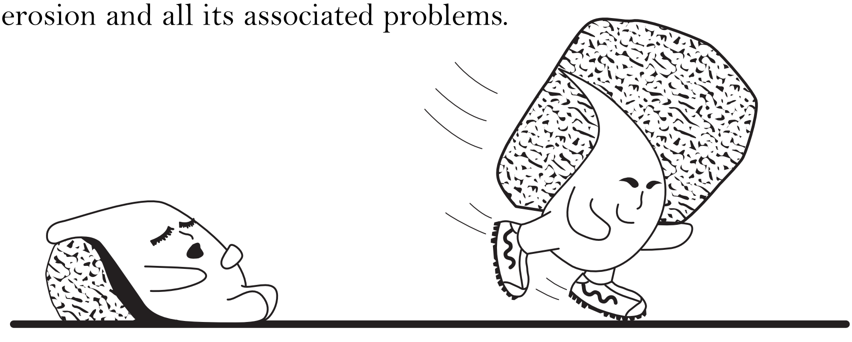
This process of impact, runoff, and erosion, as undergone by Drop B, is much more rapid than the process of being absorbed into the soil, as happened to Drop A. Floods, erosion, and a loss of soil productivity may result. Rapid runoff can take two resources (soil and water) and turn them into problems (floods and sediment). The slower process of water being absorbed into the soil to be released through the transpiration of plants or to flow into groundwater systems not only helps keep the soil in place and provides for prolonged runoff but also improves plant productivity.

So, what can we do to *keep water on the land longer*?

One of the best ways to understand how to ***keep water on the land longer*** is to think of the soil as a sponge. The better the sponge, the more water is absorbed and the longer it takes to run off the land.



Another way of looking at the same problem is to think of flowing water in terms of energy. ***The faster water flows, the more and bigger rocks it can carry.*** We want to keep soil in place. So, if we can keep flow energies low, we can reduce erosion and all its associated problems.



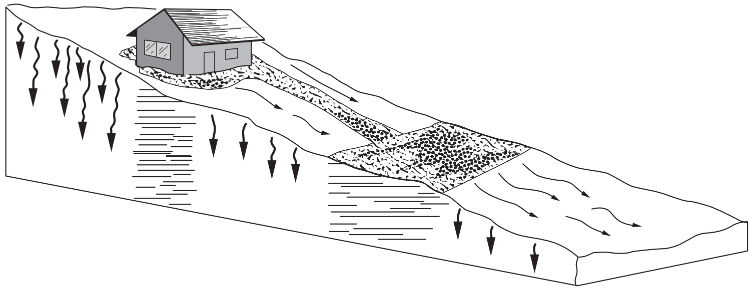
Roads and houses

While roads and houses are an essential part of our lives, they can also cause problems by reducing the effectiveness of the soil sponge and increasing flow energies.

They do this in two ways. First, they intercept surface flows and channel them to different locations. This helps keep the surface of the road intact and the inside of the house dry—but it may also result in channeling more water into a given drainage than it can effectively handle, thus increasing erosion and lowering water quality.

Second, the surface of a road or house roof does not absorb water as well as uncompacted soil. Comparing a roof or road surface to surrounding uncompacted soil soon after a brief rainstorm will clearly show this. The roof or road will have visible water running off where none is visible on the lawn or soil surface. The area covered by the roof or road is no longer available to absorb the water, essentially decreasing the size of the soil sponge.

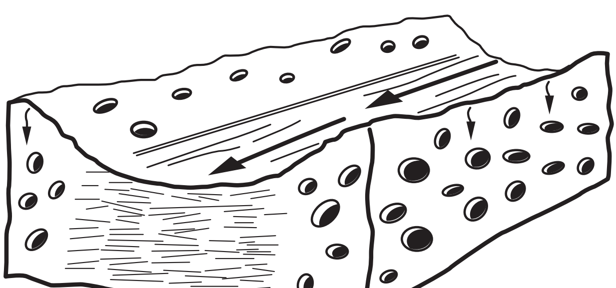
For the most part, a single house or road may cause only local changes and may not, by itself, have much of an effect on how water behaves on a landscape scale. A large housing or any other development, however, can have quite a dramatic effect! This is one reason why many people are concerned about urban sprawl or the expansion of suburbs into previously open areas.



Soil compaction

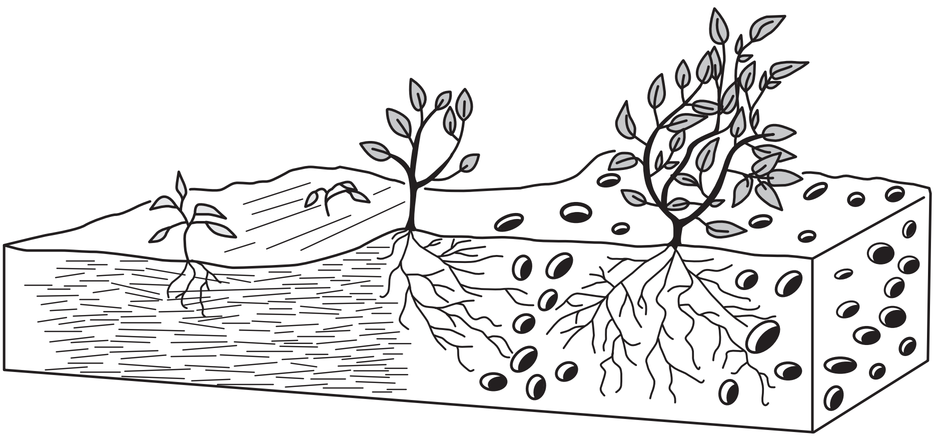
Soil is made up not only of bits of rock and organic matter but also the spaces between them. It is through these spaces that air and water flow down to the roots of plants and into the groundwater system. This is why gardeners and farmers till their soil before they plant. Compacting the soil is like squeezing the soil sponge, shrinking and closing off the holes in the soil—making it more difficult for water to flow and plant roots to penetrate. This means that less water can flow into the soil and more water will flow off the surface.

There are several ways in which soil can become compacted. In the case of roads and other construction, soil is often intentionally compacted to make it stronger and less likely to change shape. But soil can also be compacted unintentionally by people and animals walking or driving over it. Even one pass by a vehicle over uncompacted soil can make a marked difference in the condition of the soil.



Moist soils compact more easily than dry soils. Water between the soil particles acts as a lubricant, making it easier for the bits of soil to flow past each other. This is why farmers and gardeners wait until their soil has dried out slightly before they till it. If they till too early, they will compact rather than fluff up the soil.

Improper grazing management can concentrate animals in one area for prolonged periods of time. While the animals' footprints can create the image of a churned surface, the soil beneath may actually be compacted, reducing the effectiveness of the soil sponge and negatively affecting plant productivity.

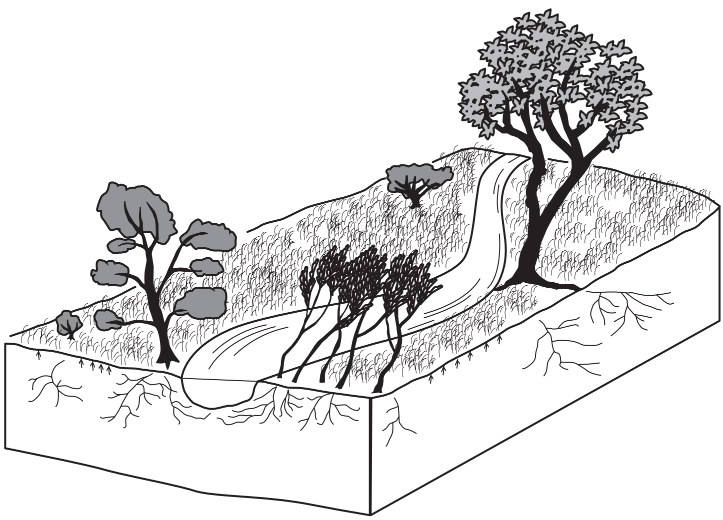


Soil compaction can affect plant productivity in several ways. As the soil becomes compacted, less space is available for plant roots and the plant must expend more energy to expand its root system. Water, air, and the nutrients they carry cannot penetrate as deeply nor as easily into compacted soil as they can into uncompacted soil. Thus, the amount of nutrients available to plants is reduced, which may result in smaller, less healthy plants both above and below the soil surface..

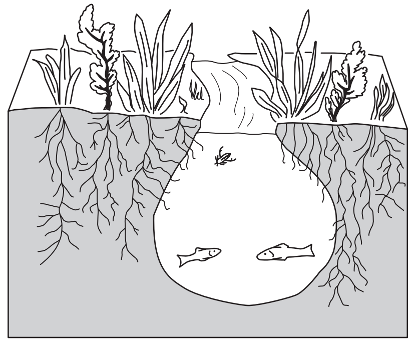
Soil compaction can be reversed over time. The main agents that help reverse the process of soil compaction are freezing and thawing of the soil, growth of plant roots, and the movements of organisms that live in the soil—such as earthworms.

Streams and Riparian Areas

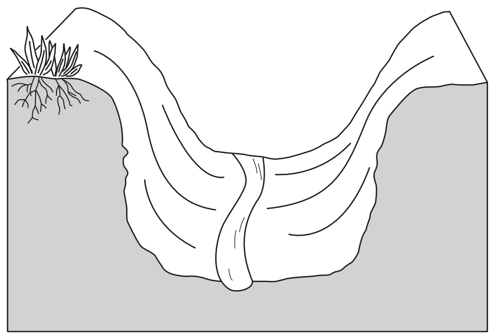
Even though water flows much faster down streams than it does through soil, there are many ways to ***keep water on the land longer*** in and near streams. The first is to ensure that the areas next to streams, known as "riparian areas," are filled with the right plants and healthy soil. The plants and soil act together like a sponge, absorbing the water and energy of high flows and slowly releasing the stored water.



A second way to ***keep water on the land longer*** in and near streams is to keep streams in their proper shape. Streams with healthy riparian areas ***keep water on the land longer*** than streams with degraded riparian areas. The shape of a stream is technically referred to as "stream morphology." A stream takes on different shapes, depending on the slope of the land and the material it is flowing through. The presence of large rocks or steep slopes can determine the shape of some sections—or "reaches"—of a stream. Other reaches of a stream may be dependent on finer soils containing plants and plant roots to give them their shape.



Many stream channels depend upon vegetation for stability. Not only do plant roots help hold the soil but the above-ground portion of the plant helps reduce erosion by buffering the energy of high flows and raindrop impacts. Plants also capture soil being moved by water by reducing the speed of the water's flow and allowing the bits of soil to settle out.



A stream's shape is not static. It can change slowly over time as a result of the continually shifting balance of forces that give it its natural shape. But it can also change rapidly in response to more dramatic events such as earthquakes or human-caused disruptions. The processes that build streams and stream health tend to be long term and slow. Processes that degrade streams and their riparian areas tend to be rapid.

Sometimes, humans intentionally or unintentionally change the shape of a stream. This can cause dramatic changes both upstream and downstream from the change as the entire stream channel adjusts to a change at one location.

Changes in the health and vigor of vegetation, the degree of soil compaction, or even the volume and timing of water can affect one another or the entire stream system. For example, if too many animals (wild or domestic) graze along a stream, they can not only directly affect the vegetation by eating the surface portion of the plants but they can also increase soil compaction and physically alter the channel's shape. In turn, the amount of water that can be absorbed into the soil is reduced, and the flow of water off the land is accelerated.

While all of this is going on, the potential for flooding downstream is increasing as the amount of water being stored in the soil is reduced. What was once productive soil may now become a problem for people and animals downstream.

With proper management, this process of degradation can be reversed. Stream channel degradation can be a rapid and dramatic process, changing in days what it took centuries to build. But the process of recovery can be very slow. Once soil is lost, it cannot be easily regained. The best solution to this problem is to avoid causing damage to the land in the first place through careful planning and forethought.

So, what can I do to *keep water on the land longer*?

Vegetation cover can be maintained or increased. Plants not only help break the impact of falling raindrops but their roots help hold the soil together and open up channels so that water can flow more easily and deeply into the soil. Efforts small and large—from landscaping your front yard to developing efficient methods to manage livestock grazing—can make a real difference.

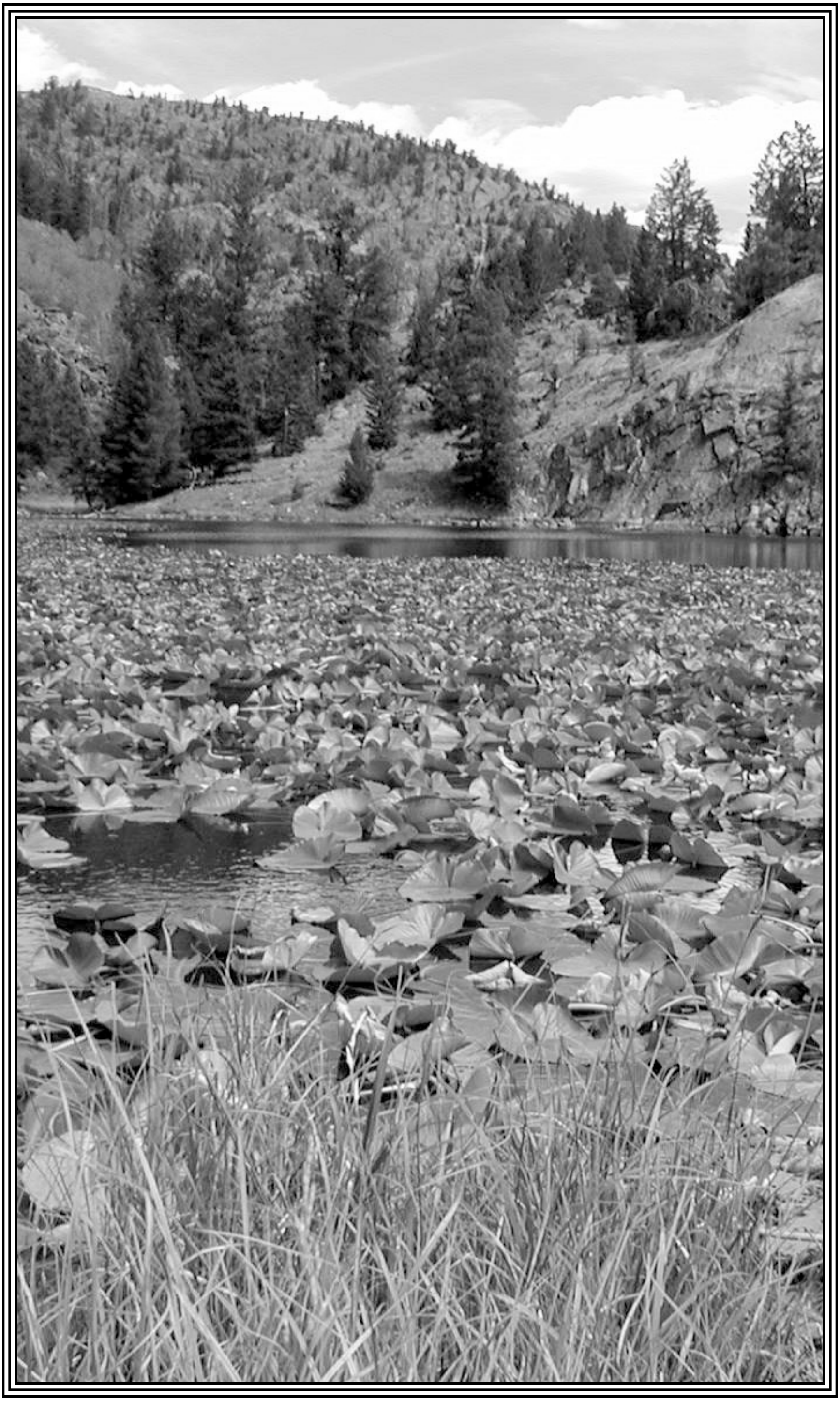
Soil compaction can be reduced or avoided. The process of soil compaction has been well studied and we have developed ways to reduce or eliminate soil compaction that can be easily applied by reduce or eliminate soil compaction that can be easily applied by almost everyone. One of the easiest approaches is to avoid disturbing wet soils, which are much more vulnerable to compaction than are drier soils.

Proper design, construction, and maintenance of roads, housing developments, and drainage systems can help reduce the amount of soil sponge that is removed from the system. Protecting drainages from increased flow energies is another important consideration—including the possibility of leaving areas undeveloped so that they may continue to function as parts of the active soil sponge.

Work together—cooperation is a powerful tool!

Your local land management agencies and universities can provide you with contacts who will expand on these and other ideas to help you do your part in ***keeping water on the land longer.***

Where degradation occurs, healing the land must be a priority. We need to realize that cooperation and recognition of common goals will achieve much more than finger pointing ever can. We have the knowledge and the ability to help the land heal itself. The challenge is to agree among ourselves that to do so is worth the effort.



Thanks to Wayne Elmore of BLM's National Riparian Service Team in Prineville, Oregon for the original inspiration.

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