

Managing Small-Acreage Horse Farms in Western Oregon and Western Washington

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Photo: Melissa Fery, © Oregon State University

What do you want from your farm?

Some goals for a well-managed, small-acreage horse farm are to:

- Improve pasture productivity to reduce the need to purchase hay.
- Reduce parasite loads on pastures.
- Promote pasture grass vigor to prolong pasture life.
- Reduce or eliminate mud.
- Manage manure for use on or off the farm.
- Promote horse health through mud and manure control.
- Reduce or eliminate weeds.
- Support owner satisfaction and convenience.

The key to meeting these goals is realizing that horses, grass, manure, soil and water are interconnected. How you manage one affects the others. When, where and how long your animals graze affects grass regrowth, weed competition and the safety of well water. How you deal with water runoff affects your horse's health, nearby streams and your enjoyment of the farm. By properly managing each aspect of your farm, you will have more productive pastures, less mud, healthier horses and greater satisfaction.

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SUMMARY

Seven steps to a safe, efficient, environmentally friendly horse farm



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To establish and maintain productive pastures, you must follow several basic principles to ensure vigorous plant growth and minimize the damage horses cause to pastures. It is important to understand how forage plants grow and how pastures fit into an overall horse management system.

Horse pastures are different from other pastures. A dense cover, free of weeds and mud, is the primary objective of many landowners; meeting a horse's nutritional needs may be a secondary consideration. Nutritional needs are often met using hay, alone or with grain. Pasture may only provide supplemental feed, exercise and recreation.

Pasture condition is up to you; you are in control. To maintain a dense, green, weed- and mud-free pasture, you need to meet the water and nutritional needs of pasture forage plants and carefully control when and how long horses are on the pasture.

This publication is intended for small-acreage horse farms (1 to 10 acres) in the high-rainfall areas of western Oregon and western Washington. We've tailored these recommendations to address the unique problems on small-acreage farms; however, everything described here can be scaled to larger farms.



Photo: Melissa Fery, © Oregon State University

Figure 1. The key to achieving a well-managed horse farm is understanding that horses, grass, manure, soil and water are interconnected — how you manage one affects the others.

Mud, manure and horse health

Living in mud and manure is unhealthy for horses. Mud harbors bacteria, parasites and fungi that can cause health problems.

Mud fever (or scratches) is a common condition usually affecting horses' lower limbs. A typical symptom is inflammation of the skin and crusty scabs. Usually, it is caused when bacteria penetrate skin damaged or softened from exposure to wetness or mud or both. The bacteria that causes mud fever thrive in wet, muddy conditions. On the upper body, the same condition is referred to as rain scald (dermatophilosis).



Photo: Melissa Fery, © Oregon State University

Figure 2. Standing in mud and manure can cause health problems for horses. Manage grazing, manure and the flow of water across your property to prevent mud.

Wet conditions can soften hooves and soles, causing cracking and splitting and making horses more susceptible to stone bruising, abscesses and other lameness. Thrush is a common foot condition from bacterial or fungal infection. The organisms that cause the infection thrive in environments without oxygen, so hooves packed with mud and manure are a perfect breeding ground for thrush.

When horses are exposed to uncomposted manure, they may suffer increased internal parasite infestations. For example, when horses graze pasture that has been grazed previously, they risk ingesting parasite larvae found in manure and on the lower portion of the grass plants. Unless carefully managed, horses can reinfest themselves.

Other problems associated with mud include:

- Sand colic, a serious digestive disorder occurring when horses are fed on muddy ground and ingest dirt and sand.
- Low body temperature, an inability to thrive, and hypothermia. Livestock in these conditions burn more calories just keeping warm and require more feed. This is particularly problematic for young animals.
- Slick and unsafe footing that can cause injuries.
- Insects, especially flies, that breed in mud and manure. Insects are annoying at best. At worst, they carry disease, and their bites can cause allergic reactions and animal-trauma.

What makes horses different?

Horses adapted to arid grasslands. In their natural environment, they roam on extensive rangeland and stay in one area for only a short time with minimal impact on the environment. When horses are kept on small

acres, horse owners must use good management practices to minimize negative impacts on the land.

Activity level

Horses are heavy animals with large hooves that are often steel-shod. Unlike other livestock, they can be very active. In contrast, mature cattle tend to eat, lie down while they digest their meal, and make an occasional trip to the water trough. Horse owners enjoy watching their animals run and play. However, this activity can severely damage pastures if concentrated on a small acreage during the wet season.

Eating habits

Unlike sheep or cattle, horses have both upper and lower teeth. They also have nimble, sensitive lips which enable them to grasp small pieces of grass. As a result of these traits, horses can graze plants very close to the ground, resulting in overgrazing and pasture damage unless managed by knowledgeable caretakers. Although sheep and cattle can also overgraze pastures, horses can quickly and efficiently eat grasses to the soil surface. When this occurs regularly, it often kills grass, resulting in higher hay costs, weed patches, high internal parasite loads and the need for expensive pasture renovation.

Horses bite off the tops of preferred plants in an area of the pasture until that spot is grazed short. They continue to graze regrowth on the preferred plant. Horses prefer the base of grass stems — which has significantly higher sugar and carbohydrate content — and will often bypass tall, mature grasses to re-graze the regrowth of preferred species.

Horses are considered “recreational grazers,” meaning they will continue to graze after they have met their nutritional requirements. Table 1 compares the activities of horses, cattle and sheep on pastures. If unmanaged, horses will spend over half the day eating.

Table 1. Daily activities of horses, cattle and sheep on pastures (hours spent)

	Horses	Cattle	Sheep
Grazing	14	9	9
Standing	8	4	3
Lying down	1	9	11

Table used with permission from S. Bittman, O. Schmidt and T.N. Cramer, 1998. *Advanced Forage Management: A Production Guide for Coastal British Columbia and the Pacific Northwest*. Pacific Field Corn Association, Agassiz, British Columbia.



Photo: Melissa Fery, © Oregon State University

Figure 3. Horses are efficient grazers and will bite the top off preferred plants until that area is grazed short, which can easily lead to weed invasions and excess mud.

Step 1. Keep animals off wet pastures

To keep your pastures in good shape and reduce the mud on your farm, keep horses off the pasture during the wet season. Horses on wet pastures kill grass and create mud by continuously grazing and trampling grass, churning up the soil and compacting it with their hooves. Soil compaction compresses the soil, which reduces the amount of air-filled pore spaces. This kills plant roots and reduces soil drainage, creating even more mud.

This situation is miserable for horses and humans alike, but it doesn’t end there. Weeds have room to grow in the weakened grass stands of poorly managed pastures. Desirable plants can’t grow in compacted soil, so undesirable plants that are well adapted to these conditions take over. Spring and early summer bring a



Photo: Melissa Fery, © Oregon State University

Figure 4. Keep horses off pastures during the rainy season. Because wet soil compacts under pressure from horse hooves, keep horses in a sacrifice area during wet months. A sacrifice area is an area of pasture that you use to hold horses while allowing other parts of the pasture to rest.

crop of weeds, some of which are toxic to horses. The pasture becomes bare in the summer, except for some hardy weeds.

Bare ground and less grass mean having to purchase more hay. It also means there are fewer plants to protect the soil from erosion or to use the nutrients in manure and urine. During the rainy season, soil, nitrogen, phosphorus and bacteria (such as fecal coliforms) may run off the farm, contaminating streams and household wells.

How do you do keep animals off wet pastures?

By using a paddock — a small enclosure, such as a corral, run or pen — you can control your horse's outdoor living quarters. A paddock is a type of sacrifice area.

Use the sacrifice area for your horses during the winter, early spring, summer and fall *before* your pastures become overgrazed. A paddock also is useful for separating or confining animals, controlling the amount of grass or feed they consume, and caring for sick or injured animals.

Locate the paddock on high ground away from water and wells. It should be convenient to your barn or loafing shed to make it easy to care for your horses and maintain the area. A good option is to connect a run to each stall. This chore-efficient arrangement gives the horse free access to the stall, and you'll have a clean, dry and convenient place to feed.

The size of the area can vary to fit the size of your farm, the number of horses, their ages and temperaments, and other needs. A general rule is to allow approximately 300 to 400 square feet per horse. A small paddock the size of a generous box stall (16 x 16 feet) could be adequate for some horses. A larger area that allows for running and playing might be 20 to 30 feet wide by as much as 100 feet long. You can also design a multiuse area such as a small outdoor arena or round pen for exercise and confinement when needed.

Footing is a crucial feature of a paddock. The goal is to have a safe, well-drained, "all-weather" surface. Common footings include gravel, sand, and chipped or shredded wood products. Each footing has benefits and drawbacks, so spend some time investigating what will work best for you. As a guideline, put down twice as much footing as you have mud in the winter. If you have 3 inches of mud, put down at least 6 inches of footing.

Gravel drains well and provides a solid, level surface; when managed correctly, it lasts many years. Use 3/8- to 5/8-inch minus crushed gravel. Use a minimum 2:1 ratio of gravel to mud. For greater longevity, apply at least 6 to 8 inches of gravel. Gravel applied directly over soil will gradually settle into the soil.



Photo: Melissa Fery, © Oregon State University

Figure 5. Paddocks should fit the number, size and personalities of your horses; fences should be strong, safe and secure.



Photo: Melissa Fery, © Oregon State University

Figure 6. Footing material, such as gravel can be added to provide a dry, stable surface. Other options for footing include sand or shredded wood.

Coarse, washed sand, containing very little fine silt and clay particles, is another option that drains well. Avoid feeding horses on sand surfaces; ingesting sand may lead to colic.

Wood chips or shredded wood ("hog fuel") provides a cushioned surface that reduces urine odors. These materials will hold moisture, pack down and decompose over time so that a new layer will be needed every year or two. Check with the supplier to find out what type of wood you are purchasing; some types, for example, black walnut, are toxic to horses.

Use geotextile cloth or filter fabric with these footings to separate layers, improve drainage and prevent footing from settling into the soil. Filter fabric is a woven plastic or felted material used in road building and other construction projects. Its small holes permit water but not sand or silt, to pass through.

Apply these fabrics to a level, graded surface and cover with a minimum of 6 inches of footing (more is better). For the best drainage, cover the fabric with at least a 3-inch layer of crushed rock ($\frac{3}{4}$ - to 1½-inch gravel), followed by another layer of fabric and the footing of choice: 6 inches of gravel or sand, or up to 12 inches of shredded wood.

It is important to minimize water runoff through sacrifice areas. Refer to “Install rain gutters and downspouts” on page 14 for more information.

Fences for paddocks should be as safe as possible. Horses can be hard on fences, but electric wire provides a good psychological barrier. Gates must be large enough for farm equipment and deliveries. Also, be sure your fence is the correct height: 5 feet is a good paddock fence height for most horses. Consider the thickness of the footing layer when putting in fence posts.

There is a wide variety of materials for paddock fences. Wood is an excellent option, but some horses may chew wood if they are bored or hungry. Prefabricated metal panels designed for horses last a long time with little maintenance. Some wire fencing options are safe for horses. If you use electric fencing, for example, an electric wire along the top rail, consider using wide electric tape for better visibility. Barbed wire is never recommended with horses due to the risk of severe injuries.

Your paddock is an integral part of your pasture rotation system; it is your horse’s outdoor home in the winter. During the grazing season, use the paddock to allow the pasture to regrow and to prevent overgrazing. Hold horses in the paddock after they have grazed sufficiently for the day or to control their intake of lush spring grass if they are prone to laminitis.

Pick up manure every 1 to 3 days to prevent the buildup of a soupy surface layer and to reduce insects and parasites. Even the best-maintained paddock will have some contaminated runoff. A buffer strip of grass or other vegetation around the paddock will intercept this runoff and prevent it from entering nearby streams or groundwater (see page 13).

For some horse owners, the most reasonable solution to keep horses off wet pastures is to board them during the winter.

Paddock Paradise track system

Another option for a multiuse sacrifice area is to create a narrow exercise track around a pasture with fencing. A track system gives horses more options for mental stimulation and movement. Feed and water stations set up around the track keep horses moving, though these areas will require management.



Photo: from *Paddock Paradise* by Jaime Jackson, used with permission.

Step 2. Manage pastures for optimal grass growth

Horses evolved on vast grasslands and thrive when they have access to daily grazing and exercise. Well-managed pastures are an important part of any small-acreage horse farm. Grazing and moving around a pasture help food move properly through a horse’s digestive system. A well-managed pasture can reduce feed costs significantly while providing high-quality forage and exercise.

Healthy grass also keeps water clean by using the nitrogen and phosphorus in manure and urine. It traps and filters runoff carrying soil particles, bacteria and excess nutrients that otherwise might contaminate household wells and streams.



Photo: Melissa Fery, © Oregon State University

Figure 8. Move animals to another area when a pasture has been grazed to 3 to 4 inches. Allow grass to regrow to 6 to 8 inches before grazing again.



Photo: Melissa Fery, © Oregon State University

Figure 9. Poorly managed pastures can be overwhelmed by weeds. Good grazing practices can significantly reduce weed problems.

Poorly managed pastures become muddy in the winter, weedy in the spring and dusty in the summer.

Grazing timing, intensity and duration

Restricting access to pastures and controlling the intensity and duration of pasture use is your most important pasture management strategy. Control grazing by keeping horses in sacrifice areas whenever pastures are not suitable for grazing (see page 5). Use pastures only when green cover is more than 3 inches tall, and the soil is firm and not saturated with water. Short-term grazing restrictions, when conditions are not optimal, will result in long-term gains in plant health, pasture productivity and soil health.

How grass grows

Plants manufacture sugars and complex carbohydrates in their leaves using solar energy, carbon dioxide from the air, and water. This process requires “solar receptors” (green leaves). Overgrazing removes too many leaves, slows growth and damages root systems.

Plants regrow at growing points. One growing point, called the apical meristem, is at the tip of a stem. Eventually, this growing point will develop a seedhead. Another growing point is at the collar, which is at the base of the leaf blade (See Figure 10). When growing points are grazed off, plants are unable to regrow. All plants are susceptible to overgrazing, some more than others.

Pasture plants store sugars and carbohydrates to survive the winter. This stored food allows plants to begin growing again the following spring. Good management during the fall is critical. Grass plants store nutrients for spring growth in the lowest 3 inches of the plants; protect this area from grazing. The more nutrients stored there, the more vigorous spring growth will be. Time a final fall grazing so that plants can regrow before winter dormancy. Leave them no shorter than 3 inches. This practice ensures a supply of growth buds

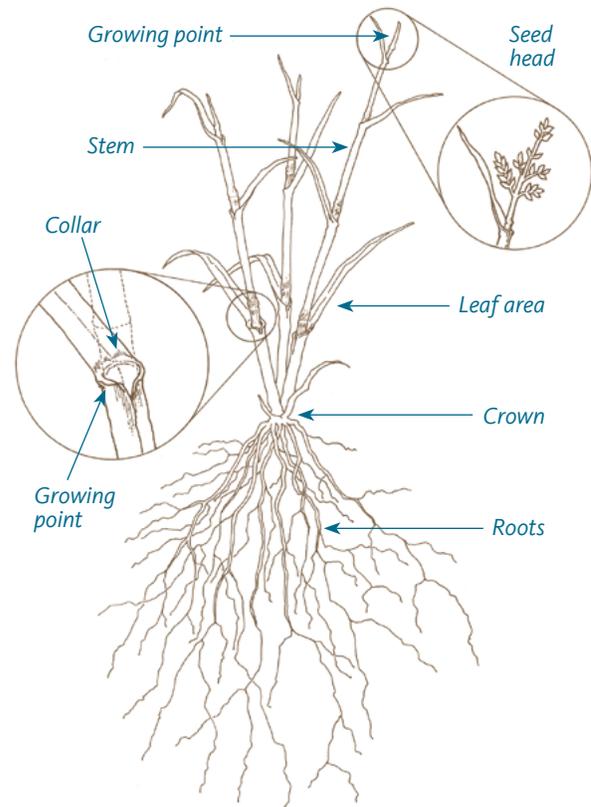


Illustration © Oregon State University

Figure 10. Above- and below-ground forage plant structure.

for the next year and a reservoir of energy for a good start in the spring.

For a better understanding of the principles of grass growth and regrowth, visit the Forage Information System and the Western Oregon and Washing Pasture Calendar (see “For more information” page 16).

How much should your horse eat?

Horses consume about 2 percent of their body weight per day in feed on a dry-weight basis. Fresh grass, for example, is about 80 percent water, and grass hay is 10 to 15 percent water. A 1,200-pound horse, therefore, requires 24 pounds of feed per day on a dry-weight basis and 120 pounds on an 80% moisture fresh-forage basis, or about 28 pounds of hay (10 percent moisture). Over a year, this equals more than 5 tons of hay per horse.

Horses need forages for normal functioning of their digestive system, and forage requirements are supplied most easily by pasture and hay. Horses are herbivores but do not have a compound stomach like ruminants. Instead, horses have a simple stomach that works much like a human’s stomach and an enlarged cecum that allows them to digest fibrous feeds. However, horses do not effectively digest low-quality forages; therefore, they require higher quality, more digestible forages.

You can maintain mature horses that perform minimal work with good-quality forages and no grain supplement. Growing, breeding or working horses may require grain or other concentrates to meet their nutritional needs. For optimal horse health, growth and development, forages should supply at least one-half of the daily feed ration.

The portion of a horse's forage requirements supplied by pasture depends on the size of the pasture, the number of horses, the length of the growing season and the quality of the forage. In general, a 1,200-pound horse needs about 2 acres of well-managed pasture for grazing. The amount varies widely, however, depending on pasture plant species and the amount and frequency of rainfall or irrigation water provided. New owners or managers can provide a safety buffer by doubling this estimate and carefully monitoring pasture conditions, feed supply and horses' body condition.

Manage pasture fertility to promote productive stands of grasses and other forages

Like horses, plants need nutrients in adequate and balanced amounts. Fertilizing pastures promotes strong stands of desirable pasture plants that are better able to compete with weeds. Fertilization also boosts forage production.

Fertilizers typically provide nitrogen (N), phosphorus (P), potassium (K), and sometimes sulfur (S) and calcium (Ca). These nutrients can come from synthetic or organic sources. Manure and composted manure can provide many required plant nutrients and improve the biological activity of soil. (See "Manage manure and bedding resources," page 11.)

A soil test is the best way to determine which nutrients are needed for a pasture and in what amounts. See *A Guide to Collecting Soil Samples for Farms and Gardens* (EC 628) and *Analytical Laboratories Serving Oregon* (EM 8677) listed in "For more information" (page 16).

Always apply N just before an active grass-growing period — early spring and early fall. Apply 30 to 50 pounds of N per acre one or two times per year.

Pastures with a mix of grass and legume require less N fertilizer because legumes fix N₂ from the air through a symbiotic process with rhizobia bacteria in root nodules. Plants can use this N for their growth requirements.

Do not over apply N; it increases the potential for N leaching into runoff. High N applications to forages and weeds may cause N toxicity in livestock, especially during dry years. Although N poisoning in horses is rare, excess dietary nitrogen can cause gastrointestinal irritation, diarrhea, colic and laminitis in horses. Over

Keys to successful pasture management

One key to successful pasture management is understanding that horses do not have to be on pasture all the time or even every day; they should graze only when adequate grass is available and the soil is not saturated. Sacrifice areas prevent overgrazing and give pastures time to recover and regrow before re-grazing. Other recommendations are:

- Do not graze pastures when soil is saturated. Doing so creates mud, damages plants, compacts the soil, increases weeds, and reduces grass production.
- Let horses graze grasses to no lower than 3 to 4 inches in height. This maintains growing points for rapid regrowth and sufficient leaf area for sunlight absorption, which improves plant vigor.
- Allow plants to recover after grazing. Subdivide pastures into smaller areas with portable electric fencing. Move animals when a paddock has been grazed to 3 to 4 inches. Allow grass to regrow to 6 to 8 inches before re-grazing. If no areas have regrown sufficiently when additional forage is needed, feed horses in a sacrifice area until regrowth is sufficient.
- Limit legumes to less than 30 percent of a pasture mix to reduce the risk of colic and other digestive system problems. For more information, consult your county OSU Extension office or your veterinarian.

application of any fertilizer is a waste of money and a threat to soil and water quality.

Apply S at a rate of approximately 30 pounds per acre every other year. Apply P, K and Ca only according to recommendations based on soil test results.

Use irrigation water efficiently

Most pastures in western Oregon and western Washington are non-irrigated; they depend on rain to supply water needs. These pastures are productive during the fall, spring and early summer but are moisture-stressed during the summer. Irrigation is required to maintain active plant growth during the summer. If you have irrigation rights, your pastures can continue to grow and provide forage during dry, summer months.

As summer approaches, soils dry, soil temperatures increase, and plants begin to go dormant. Begin

irrigation early enough to prevent the onset of dormancy. Sandy soils with limited water holding capacity may require late spring irrigation. Irrigation should take into consideration the infiltration rate and water-holding capacity of the soil. For help developing an irrigation management plan, contact an irrigation specialist or your local USDA Natural Resources Conservation Service office.

To avoid plant damage and soil compaction, wait 3 or 4 days after irrigating before allowing horses to graze pastures. As always, wait until the pasture is 6 to 8 inches tall before grazing, and graze no lower than 3 inches.

Selecting the right plants for pasture renovation

Pastures that have lost desirable forage species may be overseeded or completely renovated to provide quality pasture for horses.

Overseeding

To improve a pasture stand and fill in bare spots, broadcast 5 to 10 pounds of seed per acre over the pasture in late September or early October. Lightly harrow or roll seed into moist soil to ensure seed-soil contact. Alternately, allow horses to create seed-soil contact with their hooves. Perennial ryegrass is well-adapted to broadcast overseeding.

Renovation

Severe pasture damage may require complete pasture renovation. Complete renovation requires destroying the old sod with herbicides or tillage, preparing the seedbed and re-seeding. Pasture renovation is costly. Before you consider renovating a pasture, exhaust other means of improvement, such as grazing management, overseeding, increased irrigation efficiency and fertilization.

Delay grazing on a newly plowed and reseeded pasture until the soil is dry enough to support horses. Use the “pull test” to determine whether seedlings are sufficiently anchored by their roots to resist the pull of a grazing horse. This will ensure that plants become well established and firmly rooted in the ground. Don’t graze a reseeded pasture until the new growth is at least 6 to 8 inches tall, and graze lightly during the first season, leaving at least 4 inches of the leaf.

Seed mixtures

Tailor pasture mixes to the soil type and to the expected use of the pasture. Soils common to western Oregon and western Washington range from saturated to excessively well-drained. Pastures may be intended for grazing, haying or both. Other pastures may serve

Table 2. Basic options for pasture grasses

Soil type	Grazing only or grazing and hay	Exercise area
Well-drained	Tall fescue* Orchardgrass Perennial ryegrass*	Bentgrass Fine fescue* Tall fescue*
Somewhat poorly drained	Tall fescue* Perennial ryegrass*	Bentgrass Fine fescue* Tall fescue*

*Ryegrass and fescue species should always be endophyte-free.

From: *Pasture and Hayland Renovation for Western Washington and Oregon*. EB 1870. Washington State University Extension.

as an exercise area rather than a feed source and will require a sod able to stand a lot of abuse.

Table 2 offers some basic options for pasture grasses. Always select endophyte-free cultivars of perennial ryegrass and tall fescue. Endophytes are explained in detail on page 10.

Tall fescue is better adapted than some other grasses for horse pastures in western Oregon and Washington. Tall fescue tolerates acid soils, low fertility, poorly drained soils, drought and damage from horse hooves.

Perennial ryegrass is another option for horse pastures. It establishes quickly and is highly palatable, but it may be difficult to maintain as a horse pasture unless soil fertility and grazing are well managed.

Orchardgrass is palatable and grows well in shaded areas but requires well-drained soils. Tall fescue, perennial ryegrass and orchardgrass are good candidates for irrigated pastures.

Bentgrass and fine fescue are both low-growing grasses that tolerate the heavy use of exercise areas. Bentgrass is reasonably palatable; fine fescue is less so. Tall fescue works in an exercise area.

Kentucky bluegrass and timothy are two species of grass familiar to most horse owners; however, they are not good selections for horse pastures. Kentucky bluegrass is not well-adapted to western Oregon and western Washington; it is susceptible to fungal diseases that reduce the quality of the grass. Timothy is an excellent option for hay but is not suitable for horse pastures; ill-timed grazing damages timothy. Bromegrass species (except grazing bromegrass, *Bromus stamineus*) are similar to timothy and are susceptible to grazing damage; they will not persist in horse pastures.

Pasture grasses may be used alone, mixed together or mixed with a legume. Pasture mixes with more than one grass can work well if they are grazed only and not hayed. Grass mixtures can be challenging because

horses will prefer one grass to others, resulting in uneven grazing across the pasture.

Seeding rates vary depending on the type of grass. For example, for tall fescue use at least 30 pounds of seed per acre or more if planting into a rough seedbed. A tall fescue/perennial ryegrass mixture should be two-thirds tall fescue and one-third perennial ryegrass. If you want to include a legume, add 2 to 3 pounds of white clover seed per acre. Consult *Pasture and Hayland Renovation for Western Washington and Oregon* (EB 1870) for seeding rates for other forages.

Endophytes

Some cultivars of perennial ryegrass and tall fescue contain an endophytic fungus — one that lives within the plant. Tall fescues intended for turf typically contain the endophyte, while forage-types do not. Toxins associated with this fungus can lower reproductive rates and cause abortion, lack of milk production and prolonged gestation. Always use endophyte-free seed when establishing perennial ryegrass or tall fescue stands for horses. Remove pregnant mares from pastures containing endophyte-infested pastures at least 90 days before foaling.

If you have concerns about the endophyte status of your pasture, contact the Oregon State University Endophyte Service Lab (<http://oregonstate.edu/endophyte-lab/>) for more information about testing. If you have not observed reproductive or lactation problems on your current pasture, you probably have no reason to be concerned.

Putting the principles into practice

Two essential principles of good pasture management are:

1. Never graze grass too short.
2. Never graze grass too often.

Grass that is grazed no closer than 3 inches and allowed to rest regrows quickly during the growing season. Grass grazed closer than 3 inches requires more time to regrow, and is susceptible to and weakened by competition from weeds.

Different grasses vary in their optimum grazing height. Tall fescue should be grazed to about 4 inches. Creeping bentgrass, with stolons, can be grazed to about 2 inches. Stolons are above-ground runners that root at the node. The preferred practice is to graze bentgrass higher on the stem to avoid ingestion of parasitic larvae.

Single, large pastures are difficult to manage for correct grass height and are prone to overgrazing. Subdividing your pasture into several smaller pastures makes grass management easier. When the first pasture



Photo: Garry Stephenson, © Oregon State University

Figure 11. Divide pastures into paddocks with fencing. Rotate horses among the paddocks to give pasture plants time to regrow before re-grazing.

has been grazed to the 3-inch level, move horses into the next pasture, rotating them through each smaller pasture in turn. Rest the first pasture until it has regrown to 6 to 8 inches, then repeat the rotation. When a single large pasture is grazed, 100 percent of it is grazed, and none of it is regrown. However, when you have four smaller pastures, you are grazing 25 percent of your pasture at any given time and resting 75 percent. Moving horses onto a new pasture every 4 to 5 days reduces ingestion of infective parasitic larvae.

Horses spot graze. Consider this as you decide when to move them to the next pasture. Mow between grazings, or at least at the end of the season, to clean up pastures, help control weeds and get everything to the same height.

There will be times when none of your pasture is sufficiently tall to graze. This situation likely will occur during the summer on unirrigated pastures and during the winter. Feed horses in your sacrifice area or paddock during these periods to prevent overgrazing of the pasture and damage from soil compaction. During the summer, horses can be turned out for exercise on dry, dormant pastures for brief periods. Restrict horses from continuous standing, grazing, pawing and other activities that are hard on dormant pasture plants.

Step 3. Control weeds to protect your horses

Mow when horses have not grazed all pasture plants to an even height. Mowing to 3 to 4 inches after moving horses to a new pasture helps control weeds and prevents grasses from developing seed heads and going

dormant. Mowing after grazing stimulates growth and makes pastures more attractive.

Weeds compete with desirable plants, and some are dangerous to horses. The best weed control strategy is to maintain healthy, vigorous grasses or grasses and legumes through proper fertilization and grazing practices. With good management, desirable pasture plants compete strongly against weeds.

Refer to “Plants, weeds and toxic plants” (page 17 in “For more information”) or take a sample plant to your county Extension office for weed identification. Weeds differ in their life cycles (for example, annual, biennial, perennial), and each type requires different management strategies. Weeds also differ in the threat they pose to grazing systems. Some are toxic, and others are noxious; some spread quickly and dominate a pasture, and others are harmless. These factors influence whether and how weeds should be managed. Some weeds are officially designated as noxious invaders and landowners are required to control them. The Oregon Department of Agriculture’s Noxious Weed list is available at <https://www.oregon.gov/oda/programs/weeds/oregonnoxiousweeds/pages/aboutoregonweeds.aspx>.

Remove established weeds by mowing, pulling or digging. Sheep and goats eat more broadleaf plants than horses and can help keep weeds under control.

If you choose to use an herbicide, time the application to the correct growth phase of the plant. The product label provides information about allowable uses, restrictions and application timing. It is a violation of federal law to apply a pesticide in a manner inconsistent with its labeling. Read the label and follow the instructions, including safety precautions and grazing restrictions.

Some herbicides make toxic weeds more palatable after application. As a result, horses may eat weeds

If you choose to use an herbicide

- Wear protective clothing and safety devices as recommended on the label. Bathe or shower after each use, and put on fresh clothes.
- Read the herbicide label, even if you’ve used the herbicide before. Follow the instructions on the label (and any other directions you have) closely. The label is the law.
- Be cautious when you apply herbicides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from herbicide use and misuse.

they normally would avoid, which can cause mild to severe health problems. The best way to protect horses from toxic weeds is to develop and implement a weed control program. You will find additional resources in “Plants, weeds and toxic plants” (page 17 in “For more information”).

Steps to weed control

Major weed problems are rare in well-managed pastures. Grazing management is the best tool in weed control programs. Manage desirable forage species so that they are healthy and can compete against weeds. Here are steps to consider for successful weed control:

- Identify weeds.
- Pull, mow, dig or spray established weeds.
- Bring in other livestock to graze undesirable plants.
- Cut off and remove weeds before seed heads develop.
- If you choose to use an herbicide, select the right one and apply it at the right time in the weed’s growth cycle. Read the label and follow all directions.
- Analyze soil and use test results to correct nutrient deficiencies that may limit grasses’ ability to compete with weeds.
- Use the grazing practices outlined in this publication to encourage desirable pasture plants.

Step 4. Manage manure and bedding resources

Cover and compost manure

A 1,200-pound horse produces 1 cubic foot of fresh manure every day. Stall waste can be a soil-building resource or a source of muck, weeds, parasites, flies and water pollutants — it all depends on the management. Improve manure handling and composting techniques with these six simple tips:

- Choose a site for manure storage and compost piles that protects water quality.
- Isolate waste piles from streams and waterways.
- Reduce stall waste volume.
- Cover waste piles to control moisture level, reduce runoff and control flies.
- Compost manure.
- Spread composted manure when plants are actively growing and can take up the nutrients.

Choose a site for manure and compost piles that protects surface water

Consider the soil types on your property when locating long-term stall waste storage. Sandy soils drain rapidly, allowing nutrients to travel quickly to groundwater. Water moves more slowly through clay soils, but these soils permit surface runoff. Observe the path running water takes across your property. Do not locate manure storage in low spots and drainage ways. Store all waste above the floodplain so it won't be carried away by high water.

Keep manure away from roof and downspout runoff. Well-planned trenching diverts water away from waste piles (see page 14). Locate a manure pile 100 feet downslope from your well to protect your drinking water supply.

Isolate waste piles from streams and waterways

Maintain vegetated buffer strips between waste piles and bodies of water to trap flowing contaminants and take up water-carried nutrients (see page 14).

Reduce stall waste volume

There's nothing you can do about the volume of manure a horse produces. However, you can affect the size of your waste pile by reducing the amount of bedding you provide. The amount of bedding required to absorb urine is far less than many horse owners provide. Horses do not require extra cushioning from bedding for comfort if the stall floor is dirt.

Rubber stall mats provide a cushioned, level surface for standing. They reduce dust and prevent horses from



Photo: Melissa Fery, © Oregon State University

Figure 12. By protecting manure piles from rain, you can retain nutrients present in manure rather than letting them run off or leach into the soil below the rooting zone.

Why is manure management important?

Proper manure management promotes horse health by reducing parasite loads in pastures. It promotes pasture health by reducing weed seeds and returning plant nutrients to the soil. It also protects water quality by stabilizing nutrients in manure and keeping them from reaching groundwater and surface water. In some cases, it will also decrease the need to purchase fertilizer.

Distributing manure is important because horses will not eat where they defecate. As a result, areas of tall, untouched grass grow up around manure piles. Harrowing or dragging a pasture once or twice a year distributes manure nutrients throughout a pasture. Another effective way to disseminate manure nutrients is to walk your pasture and kick manure piles apart. When you harrow manure in pastures, you also disperse parasite eggs and expose them to sunlight and drying conditions, reducing the viability of the eggs. Warm, dry weather helps accomplish this as well.

digging. Provide a small amount of bedding to absorb urine. Despite the initial investment, stall mats reduce bedding costs.

Wood shavings and straw are effective in reduced bedding systems. Wood pellets specifically manufactured for bedding are one option. They are easy to pick, low in dust, more absorbent than shavings and effectively control ammonia odors. Pellets take up less room in a compost pile than shavings. Search online for alternative bedding materials for horse stalls.

Regardless of the bedding used, composting reduces waste volume.

Cover waste piles to control moisture level, reduce runoff and control flies

Effective manure management requires adequate storage. Size storage areas according to the volume of manure produced and type of bedding used.

The most important practice for proper manure management is also the least expensive: cover stall waste piles with a weighted tarp. Water-filled milk jugs tied to the tarp make excellent weights. Keep the piles covered during the rainy season to reduce leaching and runoff.

The next level of management is a concrete pad with curbs and weighted tarps. Top-of-the-line manure storage includes a concrete pad with a roof, gutters and downspouts. You can adapt a classic three-bin storage system to many situations.



Photo: Melissa Fery, © Oregon State University

Figure 13. Covering stall waste with a tarp is a simple step that helps reduce runoff.

Actively compost manure

Composting stabilizes nutrients in manure. Increased air exposure supports beneficial, heat-producing bacteria and accelerates the decomposition rate. As the pile heats up to 130° to 150°F, decomposition speeds up, and most parasites, flies and weed seeds are destroyed. Manure volume is reduced by 50 to 65 percent, and valuable nutrients are stabilized.

Inadequate moisture is a common reason manure piles fail to compost. Check the moisture level when you turn the pile; add moisture if needed. Provide enough water so that materials have a thin film of moisture coating most surfaces. The space between the bedding and manure particles should contain air, not water. Compost with sufficient moisture will release a few drops of water when squeezed tightly. More than a few drops indicates too much water. Drip emitters are an effective way to add water to compost piles. Too much water promotes the growth of odor-causing anaerobic organisms.

During the wet season, it's important to cover compost piles with a weighted tarp to prevent leaching and runoff. During the dry season, it's important to cover compost piles to conserve moisture.

Aeration is another important step to compost manure. Turning a compost pile adds oxygen, mixes compost components and reduces particle size. The technique you use depends on manure volume and available equipment. Promote aeration by laying lengths of 4-inch perforated drain line pipe across the pile every 2 to 3 feet of pile depth. Pipe ends must remain exposed. Pipes are easily damaged if piles are turned by a tractor. Though expensive, forced air composting systems are also available.

Tractors and front loaders have better traction when compost is stored on a concrete pad. Turning with heavy equipment is easier if the equipment can push compost against a reinforced wall. Turn small compost piles by hand.

Spread manure and compost when plants can use it

Spread manure and compost when the soil is dry enough to permit field access and plants are actively growing. A good guideline is to spread no more than ½ inch of compost at a time, and no more than twice per year.

Spreading compost in spring might be ideal for plant growth, but heavy equipment can damage wet pastures. In late summer, actively growing pastures are short enough to allow efficient application. Empty manure storage provides space for the winter's accumulation of manure and bedding.

Don't spread manure in the late fall when dormant plants are unable to take up nutrients. This practice often leads to surface and groundwater contamination.



Photo: Melissa Fery, © Oregon State University

Figure 14. If you do not have enough land to apply manure safely, consider off-farm options that would use this resource.

Step 5. Use buffer strips

Buffer strips on small-acreage horse farms protect streams, other surface water and wellheads from runoff from paddock areas and manure piles. Buffers can be wide grassy strips (including unused pastures) or strips of trees or shrubs or both. These woody plants stabilize stream banks, filter some pollutants from runoff and may shade water. Buffers alone cannot prevent contamination of well water or streams; the best practice is to reduce contamination at its source.

Summer pasture/winter buffer

One of the most common buffers is grasses and legumes that are used for pasture and hay in the spring and summer and then left ungrazed as a buffer during times of slow plant growth, steady rain or potential flooding. This buffer is not a narrow strip along a waterway, but a series of wide, managed pastures that are grazed and rested throughout a carefully managed annual rotation to maintain a grass height of at least 3 to 4 inches. Small buffer strips between paddocks can



Photo: Melissa Fery, © Oregon State University

Figure 15. All waterways, including drainage ditches, should be protected from adjacent pastures with buffer strips to prevent runoff of water and nutrients. The ideal buffer for a natural stream includes a variety of grasses and woody plants.

also provide a behavioral buffer between horses (for example, two competing alpha males), saving on fence repair and veterinary bills, while filtering paddock runoff.

Vegetated buffers

Vegetative buffers are important along streams; they stabilize banks and provide habitat for wildlife. These areas can be planted with a variety of trees, shrubs, grasses and other plants. Exclude horses from these areas or closely monitor light spring to early summer grazing; horses may browse or trample trees and shrubs. If buffers are grazed, minimize horse access to the waterway with fencing to prevent bank trampling and keep animal waste out of water.

How wide should a buffer be?

Buffer width depends on the slope of the field, soil type and plant density. The minimum width should be 35 feet; however, wider buffers provide greater protection. Increase the buffer width under these conditions:

- On steeper sites.
- On clay, dense or compacted soils.
- Where plants are widely spaced.
- If the area above the buffer is not well vegetated.

Width is typically not an issue with summer pasture/winter filter buffers. Almost all pastures are wider than 35 feet. If you don't have room for a buffer between a paddock and drainage way, consider a soil berm (a raised strip of ground) to catch runoff and direct it to a filter strip.

How do I prepare my grass buffer each fall?

- Leave grass at least 3 to 4 inches tall at all times of the year.
- Do not apply commercial fertilizer or stockpiled manure to a buffer in late fall. The buffer should capture nutrients and bacteria, not release them.
- Remove horses about 30 days before consistent fall rains or flooding or both are expected. This buffer period allows manure deposited in the field during grazing time to break down and for plants to regrow.
- The buffer period should extend into spring until soils are no longer saturated, grasses are tall enough to graze or cut, and the chance of streamside flooding has passed.

Why are buffers important?

Buffers of grass, shrubs or trees can provide several benefits to farms including:

- Filtering mud, manure, pesticides and bacteria out of water flowing across or through soil.
- Improving infiltration of water into soil.
- Providing food and cover for wildlife.
- Protecting land from erosion.
- Improving landscape appearance.

Step 6. Install rain gutters and downspouts

The high-rainfall climate of western Oregon includes annual rainfall ranging from 35 to 100 or more inches. Rainfall alone is enough to saturate pastures and heavy use areas. The roofs of farm buildings collect rain and deposit it on already saturated ground.

Rain gutters and downspouts on farm buildings direct water away from high-use areas around barns and immediately reduces the quantity of mud. To be effective, downspouts must direct water away from animal confinement areas. In some instances, plastic pipe can carry water beyond animal confinement areas to a vegetated area. Downspout systems also can be designed to divert water to rain barrels for storage and later use.

To protect downspouts from damage, install a physical barrier, such as heavy PVC pipe or electric fence, or make them otherwise inaccessible to horses. In high-traffic areas, bury pipe for protection from horse and vehicle damage.



Photo: Melissa Fery, © Oregon State University

Figure 16. Gutters and downspouts reduce mud by directing water away from high-use areas.

Other ways to reduce runoff and mud

The natural drainage of your land might direct water into areas around or through your barn, adding significant moisture to farm buildings and sacrifice areas. If so, consider additional ways to divert water. Some possibilities include French drain lines, drainage tiles, grassed waterways, water bars (like a speed bump for water runoff), ditches and dry wells. Design help and perhaps cost-sharing is available from your local Soil and Water Conservation District, USDA Natural Resources Conservation Service or Extension office.

Planting and maintaining trees and shrubs adapted to the region can reduce the amount of water around your farm. A mature Douglas fir draws 100 to 250 gallons of water per day. Evergreen trees use water in winter when deciduous trees are dormant.

Water-tolerant shrubs along the outside of paddocks will keep the area drier and reduce runoff. Willow, cottonwood and Red Osier dogwood are native to western Oregon. Trees increase wildlife habitat, provide shade and contribute to the aesthetics of your farm and the environment.

Trees in pastures and paddocks must be protected from livestock chewing and root compaction. Fence off trees along the drip zone, where raindrops fall off branches at their outermost extremities. Consider planting trees where horses can't reach them, such as outside fence lines.

Step 7. Protect your well water

To assess the impact that you or your livestock have on the quality of your drinking water, first identify where your well is located in relation to your livestock, drain field, petroleum storage tanks and other potential sources of contamination.

Learn all you can about your well. Perform a visual inspection for cracks in the casing or other deficiencies and read your well log. The county watermaster can

Why are gutters and downspouts important?

An inch of rain on a 20 x 50 foot barn roof equals 620 gallons of water. In an area that receives 40 inches of rain per year, that's 25,000 gallons of water. This much water can create a soupy mess of mud, manure, and urine that makes horses and their owners miserable and eventually runs off into streams. It even can contaminate household wells.

Practices to protect drinking water

- Fence horses and other livestock away from wellheads. Keep livestock and manure piles at least 100 feet from wellheads.
- Use channels and berms to divert stormwater and drainage away from wellheads.
- Keep clean water clean and minimize manure-contaminated water by using gutters, downspouts, and pipes to route clean water away from manure and heavy-use areas.
- Test well water annually for *Escherichia coli* (*E. coli*) bacteria and nitrates. These indicate contamination with manure, fertilizers, septic-system waste or similar materials. *E. coli* bacteria should never be in well water.
- Do not leave a hose immersed in a stock tank. Install an anti-siphon valve for all outdoor hose spigots — especially those used to water horses or mix chemicals — to prevent backflow into groundwater and your domestic water system.
- Look at your well's sanitary seal. If you have doubts about its integrity, hire a well driller to inspect it.



Photo: Melissa Fery, © Oregon State University

Figure 17. Keep horses and other animals fenced away from your wellhead.

help you find this document. Consider these important questions:

- Is your well located in a low area of your property?
- Is the wellhead properly sealed and are the vent pipe and screen in place?
- What is the age, depth and construction quality of your well?
- What is the depth to groundwater?

Why is groundwater protection important?

Many horse owners who live in rural areas depend on groundwater from a well for their family's drinking water. Through proper management of animal waste, you can greatly reduce the risk of contaminating your source of drinking water. Groundwater also supplies your neighbors' wells and eventually runs into streams and rivers, so we all must consider those who live downstream from us. For more information about well water protection, go to the OSU Well Water Program website: <http://wellwater.oregonstate.edu>.

For more information

Agencies and organizations

The following sources can provide technical assistance and information about grant programs. Contact these statewide agencies and organizations or visit their websites to find the local office in your area.

Oregon State University Extension Service

<https://extension.oregonstate.edu/>

Oregon State University Extension Service offers educational programs, classes, tours and publications to guide landowners in managing their resources.

Oregon Department of Agriculture, Natural Resources Division

<https://www.oregon.gov/ODA/programs/NaturalResources/Pages/Default.aspx>

ODA oversees the Agriculture Water Quality Management program, issues permits, helps livestock owners comply with confined animal feeding management programs, and provides support to Soil and Water Conservation Districts.

USDA Natural Resource Conservation Service

<https://www.nrcs.usda.gov/wps/portal/nrcs/site/national/home/>

The NRCS is a federal agency that implements federal, cost-share programs to improve management of natural resources on private lands, and provides information on soil types and soil mapping.

Soil and Water Conservation Districts

<https://oacd.org/oacdpress/about-us/who-we-are/directory/>

SWCDS are subunits of governments with locally elected boards. They work closely with the ODA and NRCS. They help landowners improve management of natural resources through technical and financial assistance.

Watershed councils

<https://www.oregon.gov/oweb/resources/Pages/Watershed-Councils.aspx>

Watershed councils are local groups bringing diverse interests together to work on local natural resource concerns. They conduct watershed assessments, develop and fund watershed enhancement projects, provide educational opportunities, and work with local stakeholders to improve watershed stewardship. The Oregon Watershed Enhancement Board (<https://www.oregon.gov/oweb/Pages/index.aspx>) has more information about watershed councils throughout Oregon.

OSU Extension and additional resources

Horse facility management

Horse Facilities Handbook, Eileen Wheeler, editor (Midwest Plan Service, Iowa State University, 2005) <https://www-mwps.sws.iastate.edu/catalog/livestock-categories/equine-horse-operations/horse-facilities-handbook>

Horsekeeping on a Small Acreage: Designing and Managing Your Equine Facilities, 2nd edition, Cherry Hill (Storey Books, Pownal, VT, 2005).

Horses for Clean Water, Alayne Blickle.
<http://www.horsesforcleanwater.com>

Paddock Paradise: A Guide to Natural Horse Boarding, Jaime Jackson (Star Ridge Publishing, Centerton, AR, 2018) www.PaddockParadise.net

Pasture and grazing management

Grass Growth and Regrowth for Improved Management, Forage Information System segment; <http://forages.oregonstate.edu/regrowth>

Nutrient Management Guide for Pastures: Western Oregon and Western Washington, EM 9224 (Oregon State University Extension Service, 2019). <https://catalog.extension.oregonstate.edu/em9224>

Pasture and Grazing Management in the Pacific Northwest, PNW 614, (University of Idaho Extension, 2010). <https://www.extension.uidaho.edu/publishing/pdf/pnw/pnw0614.pdf>

Pasture and Hay for Horses (Penn State University). <http://pubs.cas.psu.edu/FreePubs/pdfs/uc099.pdf>

Pasture and Hayland Renovation for Western Washington and Oregon, EB 1870 (Washington State University Cooperative Extension, 2002). <http://cru.cahe.wsu.edu/cepublishations/eb1870/eb1870.pdf>

Pasture, Rangeland, and Grazing Management (ATTRA — Appropriate Technology Transfer for Rural Areas). <https://attra.ncat.org/pasture-rangeland-and-grazing-management/>

The Western Oregon and Washington Pasture Calendar, PNW 699 (Oregon State University, University of Idaho and Washington State University, 2017). <https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/pnw699.pdf>

Soil and fertility analysis

A Guide to Collecting Soil Samples for Farms and Gardens, EC 628 (Oregon State University Extension Service, revised 2018). <https://catalog.extension.oregonstate.edu/ec628>

Analytical Laboratories Serving Oregon, EM 8677 (Oregon State University Extension Service, revised 2017). <https://catalog.extension.oregonstate.edu/em8677>

Plants, weeds and toxic plants

Pacific Northwest Weed Management Handbook (Oregon State University Extension Service, updated annually). <https://pnwhandbooks.org/weed>

Plants of the Pacific Northwest Coast, J. Pojar, A. MacKinnon and P. Alaback (Lone Pine Publishing, Vancouver, BC, 1994).

Weeds of the West (Western Society of Weed Science, revised 2001).

Manure and composting management

Agricultural Composting and Water Quality, EM 9053 (Oregon State University, Reviewed 2017) <https://catalog.extension.oregonstate.edu/em9053>

CERWA (Compost Education & Resources for Western Agriculture). <https://www.calrecycle.ca.gov/organics/farming/agdemos/cerwa>

Fertilizing with Manure, and other Organic Amendments, PNW 533 (Washington State University Cooperative Extension, 2016). <https://catalog.extension.oregonstate.edu/pnw533>

Horse Manure Management — The Nitrogen Enhancement System, AGF-212 (The Ohio State University Extension). <https://ohioline.osu.edu/factsheet/AGF-212>

Horse Stable Manure Management. (PennState Extension, 2016) <https://extension.psu.edu/horse-stable-manure-management>

Living on the Land: Managing Manure (Oregon State University Extension Service, 2011). Available only online <https://catalog.extension.oregonstate.edu/ec1637>

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