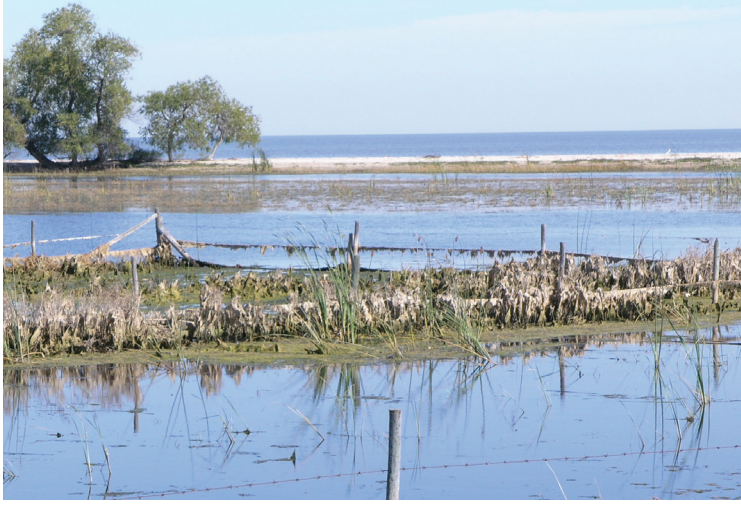

Forage and Rangeland Restoration Reference Guide

March 2012
Manitoba Agriculture, Food and Rural Initiatives

Manitoba

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Forage Restoration Extension Campaign 2012

The flood of 2011 in Manitoba caused numerous forage acres to be drowned out and in need of restoration. When flood water recedes, what is left behind can make restoration difficult. Silt, debris, invasive species, loss of fertility and weed pressure are issues that may have to be addressed before re-establishing your forage acres. This covers issues producers will be facing this spring. It includes a brief narrative for each topic with links to technical bulletins, factsheets and other details to help make management decisions in 2012 and beyond.

1. Field Clean Up

1.1 Debris

Debris carried onto your fields by flood waters pose no agronomic issues other than acting as obstacles during any field operations. For example, debris such as clumps of grass, stones, and garbage will affect seed and fertilizer placement and smother growth, leaving dead patches to deal with later. Debris such as fence posts, trees and large stones limit field travel and must be removed before renovation can begin. Many producers pull drag bars (ex: multiple I-beams, or stacks of old grader blades) behind their tractors to help collect this debris and scrape the bark off any small woody growth to control it. Caution should be taken during field operations to ensure your own equipment is not damaged (ex: flat tires). Producers should assess any potential hazards (ex: nails, steel) in their fields before beginning clean up. If a burn is done, it will make nutrients more available to immediate plant growth, but up to 90 per cent the nitrogen and sulphur are lost in the process; phosphorus and potassium less so. Producers need help from local groups to clean up debris (ex: 4H groups, student groups).

1.2 Introduction of New Weeds

Flooding, and flood mitigation strategies (ex: building dikes) can introduce new weeds on your farm (ex: Leafy Spurge). High risk areas should be monitored repeatedly to ensure new weeds do not establish on your farm. Once weeds have been located you need to determine if they pose any risks to livestock, and if there is a risk of them spreading across your pasture and reducing your long-term carrying capacity. If this is an issue on your farm, many weeds can be controlled with herbicides or cultural management practices such as tillage. Weed populations should be monitored repeatedly to ensure they are not spreading, and controlled as needed. This includes multiple herbicide or tillage practices.

1.2.1 Cattails and Bulrushes

Common cattails are a familiar sight along the shore of shallow water bodies and ditches. Cattails are hardy perennial aquatic plants that can grow up to ten feet tall and have leaves up to 2.5 centimetres (one inch) wide. The seeds of the plant are very small, but numerous, and will germinate immediately under favorable conditions. Ideal germination conditions are warm temperatures (25 to 30 C); low oxygen (less than two per cent); moist soil and long days with short nights; and a maximum of 1.25 centimetres (½ inch) of standing water. Light availability is a critical component of cattail germination. Exact intensity requirements vary among species, but in general, cattails favor higher intensity light over

low intensity light during germination. Because cattails are creeping rooted with quick growing shoots, they can quickly dominate an area. .

The best forms of control involve using a combination of approaches over a series of time. In freezing prone areas, the cattail population will be partially controlled as soils dry and roots freeze over winter.

- Read more**:** Cattail Germination | eHow.com

1.2.1.1 Cutting/Mowing

Cutting cattails is an excellent way of exposing the soil to the drying power of the sun. However, caution should be used because mature cattails can damage cutting equipment. Baling cattails is an option for building wind breaks and filling in low spots in the dry lot. It is not as useful for bedding as it is abrasive and doesn't absorb moisture. Mixing it with cereal straw is an option to extend your bedding supply. Caution should be used when baling cattails that are very dry as they can damage balers by plugging pickups and rollers.

Mowing cattails is also a good option to reduce seeding impediments and to expose the soil to the sun. In many scenarios you can use minimal tillage and then seed into the mowed residue.

1.2.1.2 Burning

Burning is an option to remove these species from a forage field before tame forage re-establishment. On native fields, burning will minimize these species and allow re-growth of native forages. If a burn is planned, seeding should take place as soon as possible to take advantage of the fertile ashes. Burning is an option, but you need to be well organized and ensure the correct environmental conditions are in place. Important considerations include:

- Ensure people in the vicinity of the proposed burning are aware of your intentions as there may be citizens with respiratory risk.
- Research the current and forecasted weather conditions focusing on wind direction and speed.
- Inform your municipality of your plans to burn, because a local ban may be in place.
- Inform the local fire department of your plan to burn.
- A burning permit may be required from Manitoba Conservation if it's in a wooded district between April 1 and November 15.
- You are allowed to burn from dawn to dusk between November 16 and July 31. Night time burning is banned, year round.
- Some things you'll need are:
    - a proper fire guard around the perimeter
    - fires must be supervised at all times until the fire has completely ceased
    - and most importantly, you've applied for the proper **burning permit** supplied by Manitoba Conservation.
- Better success has been obtained by windrowing the residue to improve burning.

Click here for Frequently Asked Questions about the Manitoba Crop Residue Burning Program

Is burning trees and bush from land clearing restricted?

> The Burning of Crop Residue and Non-Crop Herbage Regulation does not restrict burning trees and brush from land clearing. However, Manitoba Conservation requires a permit for any burning within the wooded district between April 1 and November 15.

What is non-crop herbage and what burning controls apply to it?

> Non-crop herbage is the growth that occurs in areas such as yards, ditches, rights-of-way, native pastures and waste areas. These areas can be burned between sunrise and sunset any day of the year. The year round night ban still applies to non-crop herbage.

Use this link to find more general information on burning permits in Manitoba.

1.2.1.3 Feed Value

Wetland forage species can be fed to livestock but there are a few concerns to be aware of. Cattails provide a lot of biomass and have a nutritional value similar to that of cereal straw. Use caution with reed canary grass unless the variety name is known because some varieties have high levels of anti-nutritive alkaloids which can only be fed if blended with other feeds. Reed Canary grass should be harvested at a young age to increase quality and palatability. Excessive amounts of smart weed (Lady's Thumb) in the ration is known to cause photosensitivity in livestock (animal skin is sensitive to the sun). Kochia, a common weed in saline areas, has good nutritional value in the early stages of maturity but may be high in salts, so intake should be limited.

See the links below for more detail on management of problem weeds in pastures:

- Poisoning of Livestock by Plants
- Problem Weeds - A Cattlemen's Guide
- Canadian Poisonous Plants Information System – Please visit: www.cbif.gc.ca/pls/pp/poison

When young cattails are harvested, they have a slightly higher value than cereal straw with about six per cent protein and 50 per cent TDN. Mature cattails have no feed value. Although feed tests show bulrushes are similar to cattails in terms of protein and TDN, bulrushes are very fibrous and are not consumed readily by cattle. They may also be used for bedding or bale stacks for windbreaks.

Intensive grazing bulrushes and cattails have shown to be an effective way to control populations. They should not be relied on for the entire grazing season. Supplemental feeding is required due to their poor feed value. For further information, contact your nutritionist or MAFRI GO office.

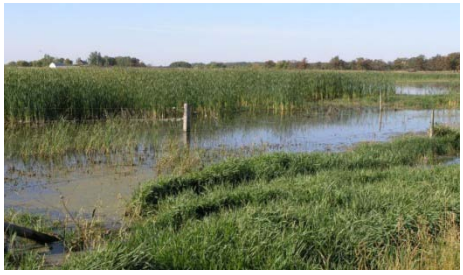
- Read more: Effects of Intense Grazing on Cattails
- Read more: Alternative Feeds for Ruminants

2. Stand Management

2.1 Managing Forage Stands Under Water

A flooded a forage stand has limited amounts of oxygen in the soil profile. Since plant roots require oxygen to remain healthy, plant productivity and survival are reduced when soil moisture levels are too high. There is no precise way to predict the flood damage to perennial forage fields and every field will react differently. The important factors are: the degree and duration of flooding; the species present; the age of stand; the health and vigour of the plants; soil fertility level; stage of development of the plant at the time of flooding; and the air temperature.

In spring, alfalfa can generally withstand one to two weeks of fully saturated soils. Alsike clover is more tolerant at two to three weeks. Red clover likely is the most tolerant at around three to four weeks. Grasses tolerate fully saturated soils better. Brome grass tolerates over three weeks of saturation, while meadow fescue, meadow foxtail and timothy can tolerate six weeks or more. In some cases plants will regrow after longer floods; but in a weakened state.



- Read more: Managing Forage Stands under Water

2.2 Alfalfa Winterkill

Limited snowfall in the winter of 2011/12 may result in significant winterkill. Although temperatures have been mild, the limited amount of snowfall left many alfalfa stands exposed to freezing temperatures. Alfalfa crowns will tolerate soil temperatures as low as minus 12°C. When temperatures drop below this, water in the taproot and crown cells freeze and form ice crystals that puncture cell membranes. When the roots and crowns thaw, water and cell contents leak from the cells causing the plant to die. Current Manitoba soil probes show soil temperatures within the top five centimetres (two inches) have dropped to a low of -6.5°C to -10°C.

Heaving, which pushes crowns out of the ground, exposes the crown to freezing temperature and breaks the tap root just below the surface. Ice sheeting is one of the more risky factors affecting alfalfa. Although dormant, forage crops still need to exchange air in winter. Rainfall or melting snow, followed by cold temperatures, can result in ice that smothers forage stands.

To determine the severity of injury, dig up some plants in spring and assess crown and taproot condition. If you choose to leave the stand, give the roots a chance to store energy by waiting until they are 50 per cent in bloom to harvest the first cut. To better understand the factors that contributes to winterkill and how to assess the damage, go to these links:

- Alfalfa Winter Kill (MFC)
- Identifying Winter Kill in Alfalfa
- Alfalfa Winterkill Weather Factors (OMAFRA)

2.3 Assessing Alfalfa Stands

Whether it's flooding or winterkill, you need to assess your stand when the alfalfa is about 15 centimetres (six inches) tall using stems per 0.09 square metres (one square foot) as your density measure. In optimum conditions, a pure alfalfa stand should target a stem density of 55 stems per square foot to maximize yield potential. There may be some yield loss when stem counts are between 40 and 50, and consider replacing the stand if there are less than 35 stems and the crown and root health is poor.

- Read more: Alfalfa Stand Assessment – University of Wisconsin

See point 7 below, *Tame Forage Assessment* for details on assessing grass stands.

2.4 Alfalfa Autotoxicity and Flooding

Alfalfa autotoxicity presents an issue when attempting to seed alfalfa back into a previous alfalfa stand. Alfalfa produces a toxin called medicarpin which allows the plant to manage its own stand densities. The effects of the toxin last the life of the plant. They include pruned roots, poor seedling vigour and low yields. Alfalfa can be reseeded into alfalfa residue following the recommended waiting period of 12 months. This time can be used to summer fallow or grow a crop. Summer fallow is not recommended in areas with salinity issues as this can worsen the problem. There are a number of conditions that affect the amount of toxin in the soil and your ability to seed alfalfa back into that land.

- Age of the Stand: There are no autotoxicity issues in alfalfa stands less than 24 months old. For example, stands seeded in the spring of 2009 and after, can be reseeded as soon as conditions allow, without concern for autotoxicity. Stands seeded before the spring of 2009, can be reseeded after 12 months has past. The 12 month period may either include growing another crop, summer fallow, or flooded soils.
- Stand Density: The toxin is found in the leaves, which limits the lateral distribution of the toxin to the area under the canopy. As we move away from the center of the plant the effect of the toxin diminishes. For example, a stand with one plant every 40 centimetres (16 inches) could be reseeded with little effect on germination, but some effect on yield. This would only be suitable for a short term fix to carry your stand for one more season. A stand with one plant every 60

centimetres (24 inches) could be reseeded with no effect on germination and minimal effect on yield.

- Soil type: The toxin is water soluble and is transported with water down and out of the rooting zone, or in some cases laterally as water flows off of saturated soils. Soils with a lot of downward water movement would see less effect from the toxin.
- Tillage: Zero or minimal till fields may see a longer lasting effect of the toxin as experience has shown that the effect of tillage (ex: introducing air, warming and mixing the soil) dilutes the toxin and increases biological activity in the soil and the breakdown of the toxin.
- Delayed seeding: Delaying the seeding date can also reduce the effect of the toxin. This only improves it slightly and should be used as a temporary fix to carry your stand for one more season.

- Alfalfa Autotoxicity (OMAFRA)
- Seeding Alfalfa into Alfalfa (U of Wisconsin)

2.5 Terminating Your Forage Stand

Many producers are using forages in their crop rotations to improve nitrogen levels in the soil; as a method of weed control; and to improve soil tilth and percolation. The most commonly used forage is alfalfa, although alfalfa/grass mixtures are also used.

Normally, alfalfa is left in the crop rotation for three to five years before being removed. Currently, a combination of tillage and herbicide is the most common method of removing forages from the rotation. See this link for common herbicides used to control alfalfa Getting Out of Alfalfa With Herbicides .

When terminating forage stands with resilient species (ex: Kentucky Blue Grass), or (ex: Canada thistle, dandelion or quackgrass), stronger control methods are needed. Tillage is useful but can be expensive and removal of a forage stand may take as many as six passes to get it to the desirable seedbed for the new stand.

Tillage alone also does not guarantee that you will get weed and grass control the following year. Tillage can also bring dormant weed seeds to the surface causing them to germinate.

Terminating forages with glyphosates is a cost effective method of removing an existing forage stand. Glyphosates can eliminate weed competition for the subsequent years and at the same time save soil moisture lost by tillage. It is generally recommended to spray out existing stands in fall with a minimum of two litres per 0.4 hectares (0.5 gallons per acre) of glyphosate to provide effective control of the forages all weeds., This should be followed by tillage to prepare the seed bed. Perennial broadleaf species should be at the bud to bloom stage and the grass species should have three to four leaves, and must be actively growing for the best results. Delaying tillage 10 to 14 days after the application will allow the roots to decompose, resulting in lower tillage requirements.

3. Forage Stand Establishment

Establishing a forage stand is a long term investment which begins at least one year in advance. Several factors play important roles in achieving success in establishing the stand. Typically, the decision to plant a particular field to forage should be made more than a year ahead to deal with outstanding weed issues; suppress or kill the existing forage stand; build a feeding program that can accommodate establishment lag times; avoid herbicide residues in the soil; and plan for the right seeding date.

3.1 Timing

Spring seeding is the optimal time to take advantage of cooler temperatures, and available moisture. Summer plantings (July) are generally less successful, but can work during cooler summers with sufficient rain. Fall plantings are preferred over summer plantings as they tend to have cooler temperatures and rain, as long as sufficient time is given for the plants to establish before the fall frosts. Dormant plantings can also be successful. There are a number of concerns to be aware of; use these links for more information.

- Summer Seeding Forages (OMAFRA)
- Tips for Improving Forage Establishment Success (PDF)
- Sod Seeding into Existing Forage Stands (PDF)
- Sod Seeding Manual: Seeding forages into existing stands using minimal tillage (PDF)
- Sod Seeding Alfalfa
- Forage Seed Mixture Calculator
- Legume Inoculation Cuts Fertilizer Need
- Underseeded Red Clover in Winter Wheat

3.2 Over Seeding/ Sod Seeding

Caution should be exercised when attempting to thicken up old stands with new plants without sufficiently controlling the existing stand.

3.3 Seeding Methods

The seeding method chosen will determine your stand establishment success. Not all methods are suitable to all environments.

- Drill: Using seeding equipment that places the seed directly in the furrow is the most successful method for establishing forages. This ensures proper seed-to-soil contact, and the protection of inoculant applied on legume seeds which is a concern for dormant plantings. Forages must be planted shallow to maximize germination and establishment success, generally a depth of six millimetres (1/4 inch) is enough.

- Broadcast: Broadcasting is the predominant form of seeding forages in Manitoba, and can be successful on tilled soils with proper weed control with herbicides or tillage. Proper seed incorporation such as harrowing or packing, or rolling is especially important if you are broadcast seeding. The roller can also help in pushing down stones. Attempting this method on sod or a thick layer of thatch is very risky and

not recommended because it can result in poor germination and inconsistent stand. Options for incorporating on sod are aggressive harrowing, a pass with an Aerway, or heavy cattle traffic.

- Aerial: Aerial seeding is a risky option for seeding fields that remain too wet to access. This is not a recommended practice, unless the seeds can be incorporated soon after with a harrowing pass.
- Nurse Crops: Nurse crops (ex: oats and barley) are generally no longer recommended because they reduce the yield of the perennial forage in the understory. If used, the nurse crop must be seeded at half the recommended seeding rate, harvested prior to maturity and removed from the field within five days. Cutting higher is also recommended to avoid cutting the establishing forage crop.
  Perennial forage stands planted without a nurse crop should be cut to control weeds within six to eight weeks after planting or when the forage is at the four to six leaf stage.

3.4 Seeding Rate

Seeding rates vary slightly depending on the goal. New stands should have target seedling densities between 30 to 40 seedlings 0.09 square metres (one square foot) in the first year. To do so, increase the seeding rate to account for poor seed-to-soil contact, hard seed, disease and insect predation, and uneven germination. Thickening up existing stands is very difficult unless the stand is suppressed with either a half rate of herbicide or has been severely overgrazed before seeding.

Calibrating seeders

- Perennial Forage Establishment in Alberta
- How to Calibrate Your Fertilizer Spreader
- Calibrating Drill Seed Meters

3.5 Inoculants

Legume seed should be inoculated immediately before planting to encourage early and increased development of nodules on the root. Inoculants are bacteria. As living organisms, they can have an expiry date. Inoculants and seed treated with inoculants must be stored in a cool, dry place to maintain the viability of the bacteria. Once treated with inoculants, bacteria can remain on seed and stored for a season if properly stored in a cool dry location. Once planted, the bacteria will need to be in the soil within days to avoid succumbing to dehydration and exposure. For this reason, broadcasting treated seed on thatch is not a recommended practice. All broadcasted seed must be followed by harrowing or other incorporation techniques to ensure the survival of the bacteria. Treated seed that's been stored for more than two years should be re-inoculated with new inoculants.

Inoculants are host-specific, so not all inoculants work on all legumes. For example, inoculants for clover or trefoil will not work on alfalfa. Normally, this is not an issue when purchasing seed from a seed company, as they will often pre-inoculate the seed before packaging it. This type of inoculants may also have a longer shelf life, depending on the polymer coating the seed company may have used.

It is important to check for the level of nodulation (the success of inoculation) and the rate of nitrogen fixation. Approximately one month after emergence, carefully remove a few random plants from the soil and check for the number of nodules on roots. The number of nodules and the rate of nitrogen fixation

peaks just before bloom. There should be clusters of nodules growing around the crown area and each nodule should be pink to red in colour on the inside. Creamy white indicates the nodule is immature; pale green indicates the nodule is not healthy.

Seed carried over from last year should be tested for germination to verify the quality and of the seed and adjust seeding rates.

4. Annual Forages

4.1 Winter and Spring Cereals for Pasture: Emergency Feeds

If you have drowned out forage land and need pasture for this year, you may consider growing a winter cereal, (ex: spring seeded fall rye, a combination of a winter and spring cereal sown together).
The advantage of spring seeding fall rye, winter wheat or winter triticale is that seed is readily available, easy to establish and is ready for grazing in about six weeks. The best option is depended on your soil and climate. Combining the winter cereal with a spring annual (ex: barley, oats, or annual ryegrass) will provide grazing approximately two weeks earlier. After about two grazings, the winter cereal will carry you through the rest of the summer and fall.

Proper management of the stand is essential to get the maximum production. This includes fertilization and rotational grazing. Studies in Alberta found that one week grazing followed by three to four weeks rest provided the highest production levels.

Some cautions are worth noting such as low mineral content, possible nitrate poisoning under heavy fertilization and diarrhea in livestock.

Check out the following fact sheets for details on seeding rates, fertility and more:

- Winter Cereals for Pasture
- Annual Crops: an Excellent Way to Increase Your Feeding Flexibility
- Using Annual Forages

4.2 Extended Grazing Systems

Extending the grazing season has become common practice for many livestock producers in Manitoba. There are many benefits including minimal harvesting costs, improved manure distribution, lower feeding costs and giving fall pastures well deserved rest. Extended grazing is ideal for mature animals in good condition, coming off fall pastures. If extended grazing involves lower quality feed, it will not be suited to calves, poor condition cows or yearling heifers with higher energy (lower fibre) and sometimes higher protein requirements.

There are a number of options for cow-calf producers to extend the grazing season into the winter months and cut winter feeding costs. The links below provide the key factors to consider when planning a winter grazing system.

- A Guide to Extended Grazing
- Corn Grazing factsheet
- Winter Grazing Options
- Bale Grazing

5. Perennial Forage Mixtures

5.1 What To Use

The most common forages are meadow, smooth, and hybrid brome grasses, orchard grass, timothy, intermediate wheatgrass, tall fescue and alfalfa. These are common as they are very suited to Manitoba's general climate and soils; they live longer, and are high producing, reasonably priced and available. If your land generally does not have any special problems one or a combination of these grasses and alfalfa will probably suit 90 per cent of your needs. Meadow brome grass, orchard grass, and tall fescue are primarily used for pasture. Smooth brome grass timothy and intermediate wheatgrass are primarily used for hay. Alfalfa and hybrid brome grass can be used for either pasture or hay.

There are approximately 37 grass and legume species available to Manitoba producers and many of these are for use in special circumstances (land that has limiting factors such as salinity, flooding, drought, high pH, or low pH). Using the *Forage Adaptation Guide* will help you to select forages that are going to perform best on your land.

Keep in mind that some species are more suited to conservation programs than as forage for livestock. Two of them are tall wheatgrass that has very high salt tolerance; and Dahurian wild ryegrass which is quick to establish on erodible land. Since you may be seeding land that was flooded, a primary question you must answer is whether this was an unusual occurrence or one that is likely to keep repeating.

Contact your forage specialist to discuss on selecting the right forages for you land and purpose.

- Common Manitoba Hay Crops
- Selecting Alfalfa Varieties
- How to Purchase High Quality Forage Seed
- Seed Manitoba: Variety Selection and Growers Guide

5.2 Other Legumes

For most producers, the inclusion of a legume in the forage stand is important from a production perspective. If flooding, wet soils or a low pH soil limit your ability to use alfalfa in your forage stand, there are a few other choices. Birdsfoot trefoil and red clover have high flood tolerance and a high-to-moderate tolerance of acidic soils. Other concerns may include the risk of bloat. Cicer milkvetch, birdsfoot trefoil and sainfoin do not cause bloating.

5.3 Forages for Saline Soils

Although salinity will not disappear, effective water management can reduce or stop salts from reaching the soil surface where they inhibit plant growth. Perennial forages will use more water than annual cropping systems and can help to dry the rooting zone thereby allowing rain water to infiltrate the soil profile, taking salts with it and below the rooting zone. In the immediate saline areas, forages with high salt tolerance will need to be seeded. Going from the highest salt tolerance to moderate tolerance are: tall wheatgrass, green wheatgrass, beardless wildrye, slender wheatgrass, altai wild rye, Russian wild-rye, western wheatgrass, tall fescue, alfalfa, sweet clover, birdsfoot trefoil and brome grasses. In areas around the saline area, deep rooted, high water use forages (ex: alfalfa) combined with a grass can help stop water from reaching the saline area.

- Read more: Perennial Forages for Saline Seeps
- Forages for Improving Saline Soils

6. Pasture Planning

6.1 Pasture Planning Check List

1. Has carrying capacity for pasture (each paddock) been determined?
2. Has the layout of fences been determined? Do they take into account riparian areas, water locations, different forage resources and topography?
3. Are paddocks designed to help with livestock distribution (square rather than long and narrow)?
4. What other livestock distribution tools are planned for each paddock?
5. Has a grazing system been determined: rotation, start and end dates, season of use, rest periods?
6. Is an alternate plan in place in case of drought, flood, fire, or other disaster?

If you lost your fences due to flooding, now may be the time to completely rethink your pasture layout, including multiple paddocks for planned grazing. Fences are more than just a means of containing the animals. They also influence how the animals use the pasture. Well thought out fence placement can enhance livestock distribution and reduce your time and costs in yearly repairs. Fencing design may take into account one or more of the following features: water, shade, vegetation type and topography.

Water is often a deciding factor in where and how many paddocks can be made. Things to keep in mind are that long narrow paddocks cause animals to overgraze the end near the water and under use land furthest from the water. Pie shaped systems also add the problem of the animals being squeezed from

the wide end of the pasture into a narrower space leading to the water. This causes excessive trailing, leading to compacted, eroded and unproductive land.

When animals have to travel more than a 0.4 kilometres (.25 miles) to water, they will travel as a herd. This puts extreme pressure on the water system and the possibility that some animals will not get enough water. Water systems in these circumstances need to have large water holding capacity and/or rapid refill capacity. When water is taken to the animal, the animals can access water about 183 metres (600 feet) from the grazing area. This means livestock distribution will be better, and the livestock will visit the water in smaller groups, decreasing the trough and refill capacity needs.
When a paddock has trees for shade, it is important that there is enough shade for all of the animals. Not enough shade causes severe crowding under the trees. It is better to have no shade at all. In Manitoba, shade is really only required during a few of the hottest weeks of the year. Plan your pasture rotation so that paddocks with trees are available during those peak times.

Fencing to define different vegetation types can provide you with more control of the animals, grazing patterns and provide needed rest to favoured areas. If possible, fence a wooded area separate from a grassland area. If they are fenced together, the grassland will be overgrazed long before the livestock will move into the treed area for browsing and grazing. Another example is upland and lowland grass, where the livestock will overgraze upland grasses long before they will move into the lowlands. If you wait for the livestock to switch in either of these cases, the favoured and more productive grasslands will be severely overgrazed while you will not get adequate use of the treed or lowland areas.

Topography is the last consideration when fencing a pasture. The fence should be placed at the top of a slope as opposed to the bottom. When the fence is placed at the top livestock will travel up the slope while grazing and then return to the bottom. If the fence is placed at the bottom of a slope, the livestock will graze down the slope, congregate at the bottom against the fence and be very reluctant to go back up the slope. This puts pressure on your fence line and causes excessive trampling and trailing along the fence line. Fence lines that go straight up and down steep slopes will cause the animals to go down the fence line. This creates trails that easily erode during snow melt and rain. In severe cases, the erosion can cause deep gullies and even loss of the fence line.

- A Guide to Management Intensive Grazing
- Rotational Grazing

6.2 Management on Large Tracts of Land
Not all land is suited to division into smaller paddocks. Rotational grazing, cell grazing, management intensive grazing, mob grazing are a few of the names that these various systems go by. Land that is highly variable (ex: ridge and swale, pothole with frequent mixing of clumps of trees and grassland or poor and/or fragile soils; and any combination) will probably not make the investment of infrastructure and time pay for itself. If you manage land like this, use studies on range management.

Range management principles are based on a few assumptions:

- The land is poor for any number of reasons such as poor soils, stones, steep slopes, or lowlands.
- The land cannot or will not be cultivated, seeded, sprayed or fertilized because of its limitations.

Management of such lands has been developed and is based on ecological principles and this management is preformed through the use of the livestock.

There are four main Principles to good Management Grazing Practices:

1. Balance livestock forage needs with the pasture production.
2. Distribute the animals over the entire usable pasture.
3. Provide effective rest to the pasture.
4. Avoid grazing during vulnerable periods.

Overgrazing happens when plants are exposed to heavy grazing for extended periods of time, without sufficient recovery periods. See calculating carrying capacity for details.

Once you have a calculation of carrying capacity, it is important to stock your land to this capability. Adjustments either up or down should be based on the current year's weather and forage production. The second principle is probably where you can make the greatest impacts as a manager. Tools to help distribute livestock include salt, minerals, water and fencing. You can gain a certain amount of control over livestock movement simply by carefully placing salt and minerals in key, under used areas of your pasture.

The next step would be to develop water in key locations far from other water sources and close to good forage resources. On very large pastures, the access or turning on of one water source while shutting down another, combined with salt placement can provide a reasonable rotation without any additional fencing. Even dividing a pasture with one fence will allow you total control over livestock movement and will provide key grazing areas with 50 per cent more rest. Fencing can be a key component of planning livestock distribution throughout your pastures.

The third and most important principle is to rest the forage plants. Rest must occur during the growing season so that plants can restore themselves. Using the distribution tools and/or fencing will allow plants time to recover from being grazed. This is very important to maintaining a productive forage stand. Producer targets should be at least 60 days rest.

The fourth principle is to avoid or mitigate grazing during vulnerable periods. In most cases, great gains can be accomplished by ensuring that the forage is in the 3.5 leaf stage before grazing begins in the spring. If grazing must begin before the forage resource is ready, supplemental feeding and a very long rest period after grazing will help mitigate the damage to the forage resource.

- Read more: Range Grazing Tips

6.3 Riparian Area Planning

A riparian area is the land between the water and the drier upland. It is affected by abundant water for part or all of the year. The vegetation growing in this zone is different than that grow in the water or in the drier upland. In drier years, it is the area that stays green.

After extensive and long-term flooding, many of the valuable trees, shrubs and native vegetation in these areas have been killed. It is important to regenerate these trees, shrubs and adapted native vegetation. The temptation to cleanup these areas and plant them in tame forages is highly discouraged. The native trees, shrubs and vegetation are highly adapted to fluctuating water tables and they protect the stream or lakeshore from erosion. The root system of tame forages is not strong enough to hold stream banks and lakeshores together. The erosion process will be accelerated causing loss of pasture and fence lines.

- Read more: Riparian Management
- Manitoba Forage Council's *Pasture Planner workbook,* has details on the cost of building fences.

7. Tame Pasture Assessment

These pasture assessment questions will help you determine if your pasture needs rejuvenation or management changes. Though is does not cover flooded acres specifically the questions will help you decide whether or not your stand is adequate, needs to be replaced or need management changes.

1. Do seeded forage plants, or productive desirable forages, still dominate the stand?
2. Are annual and/or perennial and/or noxious weeds present?
3. Are areas not covered by growing plants covered with litter (dead and decaying plants)?
4. Is there a lot of bare ground, rutting, compaction, or poor fertility?
5. Is woody vegetation present?

- Alberta Tame Pasture Scorecard Overview
- The Tame Pasture Score Card
- Assessing Tame Pastures Before Rejuvenating

8. Field Management

8.1 Water Management

As flood waters recede, many forage fields may require maintenance of the existing drainage system or development of new drains to remove water. Note that all drains in Manitoba, including infield drains, must have a **Water Control Works Licence**. This includes the construction of new drains and maintenance of existing drains.

- Minor Works Drainage Licensing
- Water Control Works Licence Application Form
- Soil Management Guide, Chapter 3 – Water Use and Moisture Management
- Soil Management Guide, Chapter 6 – Drainage Management

8.2 Soil Erosion

Where topsoil has been eroded, soil organic matter and the natural water holding capacity of the soil will also be reduced, along with the loss of natural fertility. It will be even more important here to fertilize the soil accordingly to make up for those fertility losses. The use of manure can bring even more value to the field as it supplies organic matter along with nutrients.

- Productivity Impact of Eroded Soil
- *Soil Management Guide,* Chapter 7 – Soil Erosion

8.3 Silt Deposition

Sediment deposit from flooding can either degrade or improve soil structure, depending on the type of sediment that was deposited and on what type of soil it was deposited. Silt deposits can bring new nutrients to the field. But flooding can also remove nutrients that are water soluble or attached to soil particles that run off the field. It is important to soil test before to re-establishing the forage crop.

In general, silt can be tilled into the soil before to re-seeding unless it is a thick enough deposit (ex: 150 millimetres six inches or greater) that it should be removed before the field is worked. If the new silt layer on your field is causing soil crusting issues, consider planting your forage with a nurse crop to maximize emergence.

- Read more: *Sediment Deposition on Cropland (USDA)*

9. Soil Management

9.1 Soil Testing

After a flood, it is especially important to complete a soil test once the soil is dry. This is not only to determine nutrient availability for the crop you are about to re-establish, but also to monitor soil salinity.

When flooded, the microorganisms in the soil quickly use up all the available oxygen, creating an anaerobic (non oxygen) environment. As a result, denitrification occurs, where nitrate-nitrogen is converted to nitrate gas and is released to the atmosphere. This can result in a high loss of nitrate-N.

Nitrate-N and sulphur(S) may be lost due to leaching on lighter textured soils during a flood.

Flooding can also affect phosphorus (P) availability and movement in the soil. When soil is flooded for at least two to four weeks, the P in the soil can become more mobile (moves into a dissolved state). It is also important to look at the Olsen P soil test results to watch for any changes to soil P compared to before the flood occurred.

When soil testing, make sure to take a composite sample (sample from multiple areas in the field and mix together; do not mix samples from saline areas into the composite sample) at up to 150 millimetres (six inches) to 610, millimetres (24 inches). Saline areas should be sampled separately for lab analysis.

Note that when a commercial lab analyzes for soil salinity (electrical conductivity, or EC), they use a 1:1 soil:water mixture. This is a faster and less expensive test than the saturated paste method (used by research and soil survey labs) but gives an EC reading approximately one-half of that of the saturated paste method. Double the EC values from the 1:1 method by to approximate EC values from the saturated paste method. This is especially important to note when considering EC tolerance of crops as many of the crop tolerance values are based on the saturated paste method.

- Soil Testing in Manitoba
- Selecting and Using a Soil Testing Laboratory
- Soil Testing: A Basis for Making Fertilizer Recommendations or Just a Balancing Act?

9.2 Soil Fertility

As described above, the soil test is a simple way to determine the overall effect of flooding on soil nutrient loss. Once that test has been completed, you can now consider how to best feed the crop you are about to re-establish. After a flood, you can expect that N, S, and possibly P, will have been lost. If the soils are still wet in spring at time of seeding, the availability of the P that remains in the soil will be reduced. Note that you will need to band P fertilizer in the spring to help get the crop established. Also, sandy soils are generally known to be low in potassium, so potash may be required to improve forage production.

- Wet Soils Influence Soil Fertility
- Manitoba Soil Fertility Guide

9.3 Soil Salinity

Soil salinity limits plant growth due to the presence of soluble salts in soils which hold water more tightly than the plants can extract it. As a result, many plants will exhibit symptoms of droughtiness, but the soil is often relatively moist.

Soil salinity requires the presence of soluble salts either in the subsoil, groundwater, or both. It also needs high water tables within 1.8 metres (six feet) of the soil surface that can result in soluble salts moving into the root zone through upward movement of water (ex: wicking to the surface). Excess moisture received in wet years contributes to the overall salinity problem over time. During years of high precipitation, there may be sufficient leaching and dilution of the salts that the crop may not be as affected. In dry years, increased evaporation dries out the soil and draws salts up to the surface, producing white crusts.

There are no simple solutions to soil salinity, but there are strategies to manage salinity within a crop rotation. Proper selection of a saline tolerant crop will help ensure establishment of a crop in the saline area and help use up soil moisture and draw down the water table below the saline region. A soil test is highly recommended to determine the EC tolerance required by the crop. Avoid deep tillage in saline regions, as this will bring salts up to the surface. Also, remember that there are no quick chemical fixes to cure soil salinity.

- Read more: *Soil Management Guide*, Chapter 5 – Soil Salinity:

9.4 Soil Compaction

Most compaction caused by wheel traffic occurs to a depth of0.3 to .09 metres (one to three feet) on the first pass over the field. The first pass accounts for up to 80 per cent of the compaction that four passes would cause on the same spot.

Soils that are most susceptible to compaction are those that are moist. The larger pores are air-filled and can be squeezed together, limiting water movement, soil air movement, seedling emergence and root growth. Fully saturated soils have all soil pores completely full of water. The soil cannot be compacted, although the ruts and hoof impressions left behind do require tillage and/or rolling to smooth out. Remember to wait until the soil is dry enough to withstand compaction due to tillage or traffic when smoothing out ruts, otherwise you will cause the soil to compact.

In general, under favourable conditions, winter freezing and thawing of the soil can correct human-induced compaction problems up to a depth of 0.9 metres (two to three feet). A subsoiler can be used to break up soil compaction. The fuel requirement to treat a field may be greater than the yield benefit from the activity.

- Read more: *Soil Management Guide*, Chapter 9 – Soil Compaction