# GUIDE TO NUTRIENT MANAGEMENT PLANNING

Watershed Agricultural Council
nycwatershed.org

# GUIDE TO NUTRIENT MANAGEMENT PLANNING

# 1 INTRODUCTION

## What is Nutrient Management?

Farm nutrient management as a farm environmental conservation and production best management practice, or "BMP", is the process of planning and implementing farm specific strategies to manage nutrients on farms. Our Nutrient Management Plans (NMP) are developed to prevent loss of nutrients to surface and groundwater, as well as air resources, and to improve utilization of nutrients for crop and animal production (improving production efficiency).

The purpose of farm nutrient management is to:

- Budget, supply, and conserve nutrients for plant production.
- Properly utilize manure or organic by-products as a plant nutrient source.
- Manage the accumulation and distribution of nutrients on a farm.
- Reduce odors, nitrogen emissions, and the formation of atmospheric particulates.
- Maintain or improve the physical, chemical, and biological condition of soil.

Nutrient management can be used to manage any nutrient on a farm, but in the context of water quality protection is most often used to manage the nutrients **nitrogen** (**N**) and **phosphorus (P).**

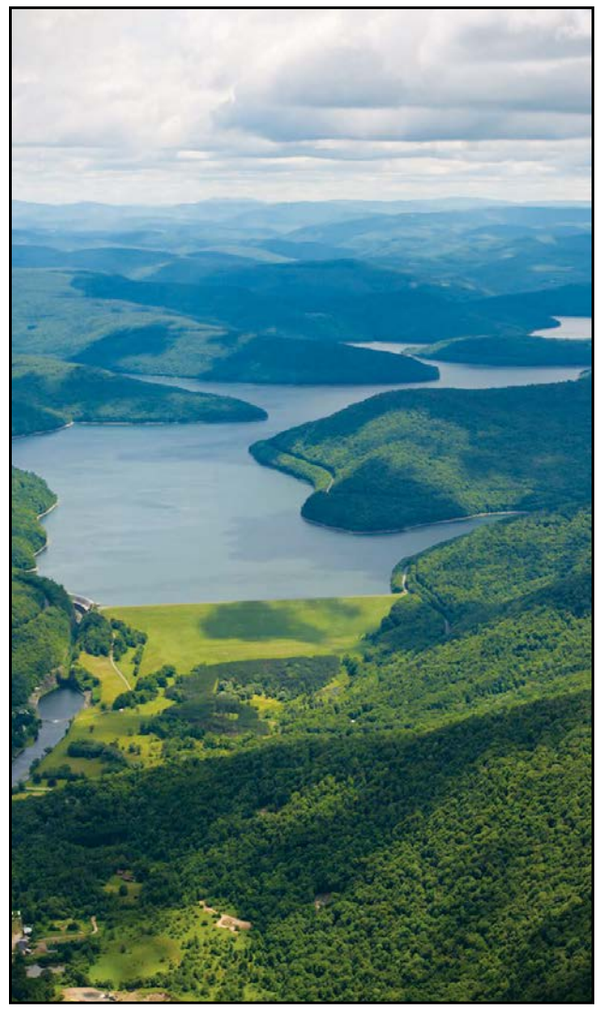


*Photo by Josh Dick Photography*

### WHY DO WE NEED NUTRIENT MANAGEMENT?

For water quality, both N and P are nutrients that often increase algae growth in surface waters. When algal growth becomes excessive, it can deplete waters of oxygen, creating "dead zones" that stifle aquatic growth as well as make water unsuitable for recreation.

Additionally, for waters used for drinking water supply, such as the NYC watershed reservoirs, increased algae in these waters increases the amount of chlorination needed to make the water safe to drink. Increased chlorination, in the presence of organic material in the water, leads to formation of trihalomethanes, a carcinogenic byproduct.

In ground water supplies, high levels of nitrate nitrogen can be detrimental to human health. From an air quality standpoint, farm nutrient management can also reduce loss of ammonium nitrogen, as well as reduced carbon dioxide, methane, and other greenhouse gases that contribute to global warming.

From a production perspective, nutrients are essential inputs for productive farms, and are valuable to the farm, and costly to purchase as fertilizer or feed. Improved nutrient management can increase farm productivity as well as improve production efficiency (unit of crop or animal output per unit of nutrient input). Nutrient management makes good business sense.

### WHOLE FARM NUTRIENT MASS BALANCE MANAGEMENT

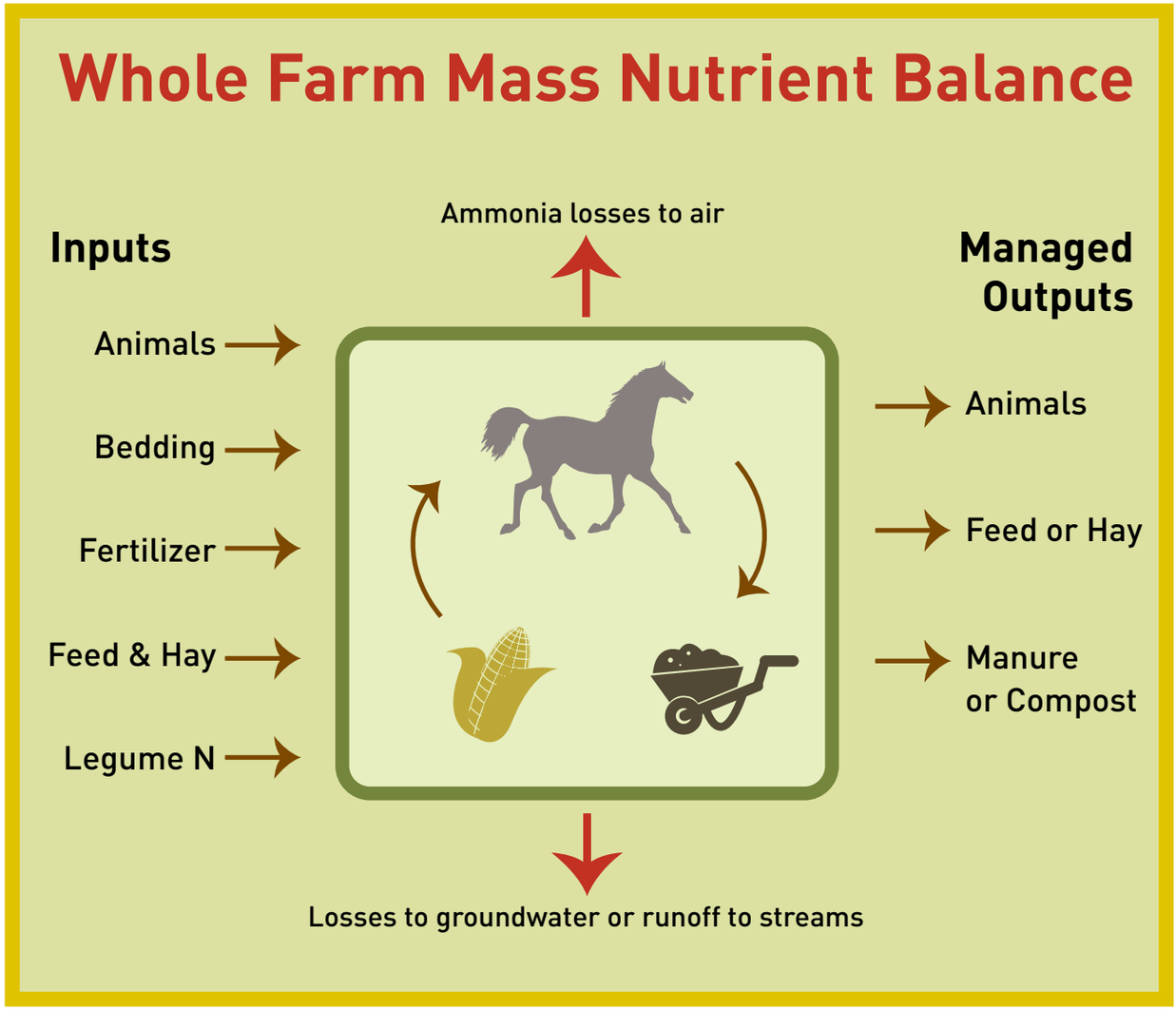
Farms contain complex movements of nutrients. They import nutrients from outside the farm boundaries in the form of feed and fertilizer, manage them within the farm boundaries, largely as manure, and export them in the form of crops, milk, and meat sold. These relationships are often described as a farm mass nutrient balance. For many livestock farms, often times more nutrients are imported than are sold, resulting in an accumulation of some nutrients (including phosphorus) in farm soils in some cases, as well as loss of nutrients to air and water.

Nutrient management can be accomplished therefore at many points at the farm; feed and fertilizer imports, crop production, manure management, and animal and crop productivity (nutrient exports).

### YOUR NUTRIENT MANAGEMENT PLAN

The intent of this nutrient management guide that accompanies your manure nutrient management plan is to provide you with an explanation of basic principles of nutrient management and nutrient management planning, useful information to help you better manage nutrients and crop production on your farm, and references to resources for more information. It is a guide that hopefully can help you make better use of your farm resources. It is designed to be a resource to complement the resources you have in your whole farm and nutrient management planners.

The soil samples and maps that accompany this guide should be used to make informed decisions on soil amendments (lime and fertilizer), as well as to address when and how much animal manure can safely be applied to your cropland and pasture.



# 2 ON – FARM WASTE MANAGEMENT

## Reducing Water Quality Concerns When Handling/Containing Manure

### FEED MANAGEMENT

The first way to begin managing manure is to optimize your livestock's diet. Depending on a variety of factors (such as size, age, and activity level), animals can digest significantly less than what they eat. This results in large quantities of nutrients excreted in manure.

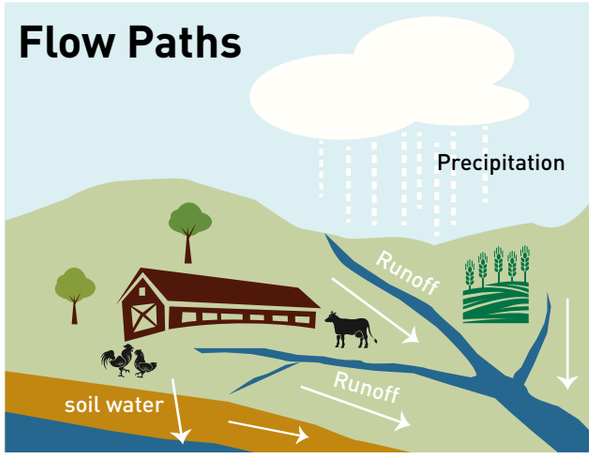
Protein contains nitrogen and phosphorus which are both macro-nutrients present in feed. One should avoid overfeeding these nutrients whenever possible. Achieving the correct balance of fiber and protein will mitigate nutrient overloads that can contaminate ground or surface water sources.

### RECOGNIZING FLOW PATHS ON YOUR FARM

A hydrological flow path is concentrated water moving from landscape to stream. Recognizing where flow paths occur on your farm is key when mitigating the transfer of pollutants.

When identifying flow paths, pay attention to topography. Where is water flowing to/leaving your fields? What agricultural activities are occurring upslope from the flow path? Is the water concentrated? Does the water directly outlet to a stream? How does the water look?

Consider also, where water is flowing in and from your farmstead. Try to keep animals and manure far out of concentrated flow paths during runoff events. Look to divert clean water and keep it out of barnyards and heavily used areas of the pasture.




Answering these simple questions can help you better plan and manage your farm business in an environmentally sound manner.

### CONSIDERATIONS WHEN STACKING/PILING MANURE:

*Temporary manure piles should be high and dry!*

- Locate your manure piles on dry, flat areas far away from hydrologically active or sensitive areas.
- Manure and farm waste are best stored on hard surfaces such as packed gravel or concrete.
- Pile when fields are inaccessible for direct spreading, when runoff from farm fields is occurring, or as required by your NMP.
- We suggest manure stored in winter be spread no later than three weeks after first cutting, and suggest manure stored in summer be spread before October 31. Maintain any water drainage structures around the perimeter of the manure pile area to prevent clean water from contacting the manure.
- Exclude as much outside "clean" water as possible from the pile area.
- If spreading is not part of your farm management, consider manure export to a neighboring farm or topsoil contractor.

### ACCORDING TO THE NY NRCS 590 NUTRIENT MANAGEMENT STANDARD, MANURE PILE AREAS MUST BE LOCATED:

- With at least a 300-foot flow path to the nearest down slope water course.
- With at least a 300 foot setback from all wells.
- Where flooding will not occur during a 25 year 24-hour storm.
- Where there is no groundwater spring, seep, or subsurface drainage in the area.

## HOW MUCH STORAGE DO YOU NEED?

The following calculations are used by the Watershed Agricultural Council's staff to help determine the necessary volume of your manure storage area. It is recommended that a storage area is big enough to stockpile 6 months worth of manure during the wet months. If you are planning to implement a manure storage on your farm ask your planner for assistance on size and placement of storage.

**Calculations:**

1. Volume of manure produced in 6 mo.
   (no. of animals) x (cf manure for 6 months)
   (table 1)
2. Volume of bedding for 6 mo.
   (lbs/mo. of bedding) x (cf bedding/lb) x (6 mo.)
   (table 2)
3. Approximate cf for 6 mo. of storage
   (volume of manure) + (volume of bedding)
4. Area needed (sqft.) for 6 mo. storage
   (approx. storage need) / (height of pile)

**Average pounds of manure produced in 6 months**

| TYPE OF ANIMAL | WEIGHT OF ANIMAL | CUBIC FEET OF MANURE FOR 6 MONTHS |
|---|---|---|
| Dairy (high milk) | 1000 | 360 cu ft. |
| Beef Cattle | 1000 | 171 cu ft. |
| Horse | 1000 | 146 cu ft. |
| Sheep/Goat | 90 | 11 cu ft. |
| Swine | 200 | 38 cu ft. |

**Volume of Bedding**

| BEDDING MATERIAL | CU FT/LB |
|---|---|
| Hay (chopped) | .08 |
| Hay (loose) | .13 |
| Straw (chopped) | .07 |
| Straw (loose) | .2 |
| Sawdust/Shavings | .06 |
| Sand | .01 |

## MANURE + SOIL + WATER = MUD

Excess mud increases the risk of harmful runoff and animal disease/injury. Properly containing and managing manure will significantly reduce mud on your farm. Suggestions include:

- **Control Runoff:** Locate barnyards at least 100 feet from wetlands, ditches, and streams. Divert dirty water to a filter area and clean water to streams and road ditches. **KEEP CLEAN WATER CLEAN!**
- **Roof Gutters:** Install roof gutters or downspouts on farm buildings. Outlet to a safe place.
- **Rotate Feeding Areas:** Reduce heavy use areas. Minimize formations of mud and maintain grass cover in pastures by managing stocking density and avoiding overgrazing.
- **Rotate Water Tanks:** Keep water tanks away from water bodies and animal laneways. This will significantly reduce constant foot traffic in the same areas as well as a concentration of manure. Rotations also allow heavily used trails to recover and reduce erosion/runoff.
- **Monitor Stocking Densities:** Align animal stocking densities with grass growth where possible so that pasture does not turn into a heavy use area. Use sacrifice areas when needed and move animals to a corral or pen when pastures are wet in the winter or when grass is less than 3 inches in the summer.
- **Reduce Animal Access to Waterways**: Fence animals out of water bodies and ditches. Buffer these areas with adequate vegetation to reduce harmful nutrient runoff and improve bank stability.
- **Install Firm Footing:** Muddy areas are often found at barn entrances, lanes, gates, and loafing areas. If possible, install concrete, gravel, or geotextile fabric in these areas.
- **Divert Clean Water:** Exclude as much outside water as possible from concentrated manure areas and maintain existing drainage/diversions. **KEEP CLEAN WATER CLEAN** and treat dirty water.
- **Remove Mud and Manure:** Doing this periodically will help dry out sensitive areas out.

*A Small Farm Planner inspects a newly constructed manure storage/composting facility. The gravel pad is located away from water courses and provides temporary manure containment until the manure is composted and spread according to the farm's Nutrient Management Plan.*

# 3 RECORD KEEPING

Nutrient Management records are a component of your Nutrient Management Plan Operation and Maintenance Agreement and an expectation of good farm management.

### WHY ARE GOOD RECORDS IMPORTANT TO YOU?

- Keeping track of manure and animal management helps you better utilize nutrients on your farm.
- Accurate records can be used in developing your Nutrient Management Plan and Whole Farm Plan.

### WHAT SHOULD YOU KEEP RECORD OF?

- Management of animal manure from livestock barns including piling and field applications.
- Management of animals (and manure deposition) on pasture.
- Application of imported nutrients (commercial fertilizer, compost, manure from another farm).
- Export of manure from farm.
- In general, records should cover *who, what, where, when, how much, and why.*
- *Who:* Is someone besides you managing your manure or grazing? Are you managing your manure with someone else's machinery? This information is important to note.
- *What:* Records should include the source of the manure being managed.
- *Where:* Where is the manure coming from and where did it end up. Examples include the locations of piling areas, what fields you spread on, where your manure was exported to, etc. For animals in pasture, knowing what paddocks your animals are in and for how long is important.
- *When:* The date of management should always be recorded. For handled manure, record when you spread, pile, or export manure. For grazing records, track the date your animals are in each paddock.
- *How much:* Records should include a general estimate of how much manure you are managing. This could include the number and size of spreader loads, tractor bucket loads, dump truck loads, or even wheelbarrow loads. When grazing animals, note the number of animals in a paddock and for how long.
- *Why:* Keeping a notes section for explanation purposes is always good to have on records. For example, if you are typically a daily spread operation but had to pile because you couldn't get to your fields you should note that on your records. If you typically rotate your animals every week but needed to move them a few days early make note of your reasoning. These types of explanations are helpful to both you and your watershed planners.

### HOW DO YOU TRACK/ORGANIZE FARM RECORDS?

- There are many methods to track farm records. Some farmers create their own record sheet. Others choose to record their manure and grazing management in a calendar. If you spread manure, your Nutrient Management Planners can provide a Loads Record Sheet.
- Included in the back of this guide is a record keeping form for both manure and grazing management. The examples below illustrate how one can utilize the two record keeping templates provided.

## 2015: Grazing Records

| NOTES | Livestock Species | # | Field ID | Jan. Week 1 | Jan. Week 2 | Jan. Week 3 | Jan. Week 4 | Feb Week 1 | Feb Week 2 | Feb Week 3 | Feb Week 4 | Mar Week 1 | Mar Week 2 | Mar Week 3 | Mar Week 4 | Apr Week 1 | Apr Week 2 | Apr Week 3 | Apr Week 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Horse | | | | | | | | | | | | | | | | | | |
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| 2015 NOTES | Livestock Species | # | Field ID | May Week 1 | May Week 2 | May Week 3 | May Week 4 | June Week 1 | June Week 2 | June Week 3 | June Week 4 | July Week 1 | July Week 2 | July Week 3 | July Week 4 | Aug Week 1 | Aug Week 2 | Aug Week 3 | Aug Week 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Horse (15) | 7 | P1 | 4 | | | | 1 | | | | | | | | | | | |
| 2 foals born | | 8 | 2 | " | | | | " | | | | | | | | | | | |
| | | 7 | 3 | | 11 | | | | 8 | | | | | | | | | | |
| | | 8 | 4 | | " | | | | " | | | | | | | | | | |
| Halter out of pasture | | 7 | 5 | | | 18 | | | | 15 | | | | | | | | | |
| MOF | | 8 | 6 | | | " | | | | " | | | | | | | | | |
| Enter - Bin | | 7 | 7 | | | | 26 | | | | 22 | | | | | | | | |
| Leave - 3 in | | 8 | 8 | | | | " | | | | " | | | | | | | | |

| 2015 NOTES | Livestock Species | # | Field ID | Sept Week 1 | Sept Week 2 | Sept Week 3 | Sept Week 4 | Oct Week 1 | Oct Week 2 | Oct Week 3 | Oct Week 4 | Nov Week 1 | Nov Week 2 | Nov Week 3 | Nov Week 4 | Dec Week 1 | Dec Week 2 | Dec Week 3 | Dec Week 4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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## 2015: Manure Management Records

| Jan. | Date | Notes | Field ID | Load Type | # Loads | Source |
|---|---|---|---|---|---|---|
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **Feb** | | | | | | |
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **March** | | | | | | |
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **April** | | | | | | |
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **May** | | Stalls picked 1x/day → pile | BY | Bobcat/tractor | 2 | Horse |
| Week 1 | | | | | | Horse |
| Week 2 | 5/9 | manure from pile → garden | | Wheelbarrow | 3 | Horse |
| Week 3 | 20 | Neighbor spreader | F1, F2, F3 | ~ 2 ton | 7 | Horse |
| Week 4 | | | | | | Horse |
| **June** | | | | | | H |
| Week 1 | | | | | | H |
| Week 2 | 6/10 | picked pasture 0 (P5-9) | P5-8 | Bucket | 2 | H |
| Week 3 | 6/17 | " | P1-4 | | 2 | H |
| Week 4 | | | | | | H |

| July | Date | Notes | Field ID | Load Type | # Loads | Source |
|---|---|---|---|---|---|---|
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **Aug** | | | | | | |
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **Sept** | | | | | | |
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **Oct** | | | | | | |
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **Nov** | | | | | | |
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |
| **Dec** | | | | | | |
| Week 1 | | | | | | |
| Week 2 | | | | | | |
| Week 3 | | | | | | |
| Week 4 | | | | | | |

# 4 FIELD HYDROLOGY

"Know where water moves on your fields. Manage manure based on that."

## LOOKING AT FIELDS FROM A DIFFERENT PERSPECTIVE

Hydrology encompasses the occurrence, distribution, and movement of water. Think about field hydrology when applying manure, fertilizer, or grazing livestock. Manage your farm in a way that keeps pathogens, nutrients, and sediments on the fields so they can benefit crop production, rather than be lost in runoff and polluting our water sources.

Knowing how water moves and leaves your fields is perhaps the most important component to nutrient management and water quality protection. *Minimize nutrient runoff by always looking at your field and envisioning what it would look like during a spring thaw or heavy rainfall event while making manure management decisions.*

## THINGS TO LOOK FOR:

### How is water moving across your fields?

Pay attention to where water concentrates into flows within the field a.k.a. the "flowpath." Looking for flowpaths is especially important during times of frozen or saturated soil conditions because risk of runoff is greatest. Spring thaw, or during extended heavy rainfall is an excellent time to observe and better understand how water flows across your farm fields.

### Where is water leaving your field?

Look to see where water exits the field and enters a watercourse. In doing so, consider indirect connections to streams via road ditches. For example, the flowpaths observed in the photo to the right exit the farm via a road ditch that outlet into a tributary of the West Branch of the Delaware River. During runoff conditions, think about whether road ditches will be running and acting as direct conveyances to streams.

### Manage manure application to avoid nutrient and pathogen loss by:

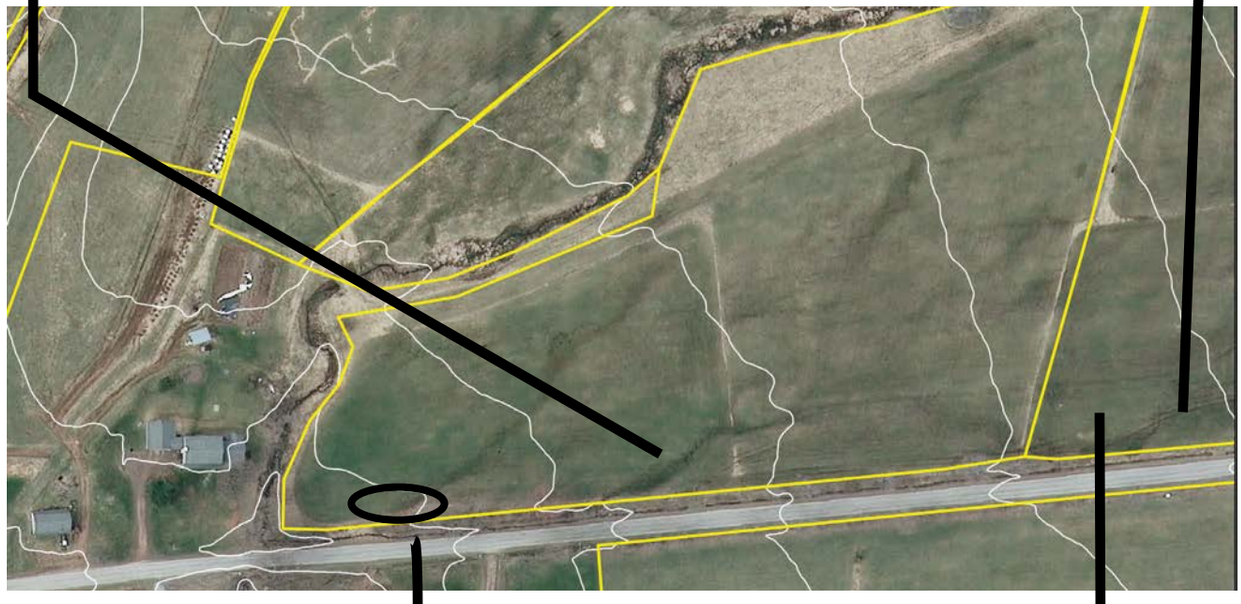
- **Check the 48 hour weather forecast prior to applying nutrients** to assess if rainfall and/or temperatures are predicted to cause snowmelt and/or runoff conditions.
- **Avoid applying manure or fertilizer nutrients within concentrated flows** during frozen and snow covered conditions.
- **Maintain the following minimum manure spreading setbacks** between manure applications and where water leaves the field and enters surface waters and surface inlets:
  - a **100**-foot setback for all crops in winter; or
  - a **100**-foot setback for row crops in summer; or
  - a **35**-foot setback for sod in summer; or
  - a **15**-foot setback with soil incorporation within 24 hours of application.
  - a **100**-foot setback for wells & springs.

NOTE: Grazing Animals Spread Manure! Consider how pasture and feeding areas can be managed according to guidelines above.

## IN-FIELD OBSERVATIONS AND NUTRIENT MANAGEMENT APPLICATION

"Thinking about where water will be flowing during a spring melt when you are applying manure or grazing livestock."

*Photos were taken March of 2015 during a spring melt event. Knowing how water moves through this field in all seasons/weather can help the farmer and Nutrient Management Planner better plan when and where to spread nutrients. Adjusting the manure application and timing may be needed to reduce loss of nutrients when the field is sensitive to runoff.*



*Water coming off of this field flows into a road ditch that leads to a major stream. Implementing a setback helps conserve vital nutrients on the field and protect water quality. In a grass field such as this, the setbacks include a 35' setback in the summer months, and a 100' buffer during winter or when the soil is saturated.*

# 5 PARASITE MANAGEMENT

## Minimizing Giardia and Cryptosporidium Pathogen Concerns

### WHAT IS GIARDIA?

Giardiasis is a common diarrheal disease caused by a protozoan parasite called Giardia. The parasites are very small in size and can only be seen under a microscope.

Giardia (a.k.a. "beaver fever") is zoonotic, meaning that it can infect humans and animals, and it has the potential to be transmitted from animals to humans and vice versa.

### LIFE CYCLE OF GIARDIA

Giardia reproduces by the trophozoite (active feeding stage of parasite) splitting in two or by encasing trophozoites in a cyst. The active trophozoites remain in the gastrointestinal tract and continue to multiply in the host's body. The cysts, holding at least two trophozoites, are excreted from the body in the feces of the animal. These cysts are hardy and can survive in the environment for a long period of time, including chlorine-treated water. When the Giardia cysts are ingested they hatch in the small intestine and release multiple trophozoites. The life cycle of Giardia then begins all over again.

Trophozoites may be passed in diarrhea, but are unable to infect other animals or humans. Only the cyst forms of the parasite are able to infect another host.

*Photo by Drew Harry*

### LIFE CYCLE OF CRYPTOSPORIDIUM

Cryptosporidium produces both thin-walled and thick-walled eggs. The thin-walled eggs remain in the gastrointestinal tract and can continue to mature and reinfect the host from within the body. The thick-walled eggs are excreted from the body in the feces of the animal. These thick-walled eggs are hardy and can survive in the environment (including recreational water sources and swimming pools with adequate amounts of chlorine) for a long period of time. When the Cryptosporidium eggs are ingested, they hatch and mature in the villi of the small intestine. Once they mature to a trophozoite (the active feeding stage of the parasite), they reproduce both thin and thick-walled eggs and begin the life cycle all over again.

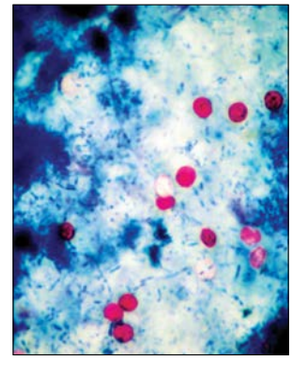
### HOW DO ANIMALS GET GIARDIA AND CRYPTOSPORIDIUM?

All animals are capable of infection. In the Catskill region of *New York City Watershed,* calves tend to be the main farm animal carriers of the parasites. Serious illness or death may occur in young, old, pregnant, and immunosuppressed animals.

In order to cause infection, the parasite must be ingested by the animal. This parasite is found in the feces of animals and humans. Therefore, if an animal ingests food, water, soil, or bedding contaminated with infected feces, that animal is at risk of becoming infected. In addition, any stationary objects contaminated with infected feces (i.e. gates, pens, doors) are also possible sources of infections.

### HOW DO YOU KNOW IF YOUR ANIMALS ARE INFECTED?

To confirm infection, you must get the animal's feces tested for the parasite. Normally, These parasites only produce illness in animals; however, immunosuppressed animals may



have trouble fighting off an infection, which could result in death.

The feeding action of the giardia parasite causes inflammation and damage to the intestinal villi resulting in the malabsorption of nutrients. Common signs of giardia include foul-smelling, light-colored diarrhea with mucus; straining to defecate; cramping; flatulence; lethargy; weight loss with adequate food intake; and un-thriftiness.

The feeding action of the crypto parasite causes yellowish, watery diarrhea, and most likely a fever in the animal. Healthy animals are usually able to recover within 2 weeks; however, a heavy infection can cause severe diarrhea, which can result in dehydration, anorexia, and rapid weight loss from malabsorption of nutrients.

*Photo by Andy Ryan Photography*

## TREATMENT

Unfortunately, there is no treatment for the Cryptosporidium parasite yet. If diarrhea persists in the animal, it is important to maintain hydration in that animal. In some cases, the diarrhea symptoms can be treated with drugs.

For ruminant animals, fenbendazole (Safeguard) or albendazole (Valbazen) are treatments for Giardia. Contact your veterinarian for recommendations regarding the number of times to treat your animals with these dewormers.

## PREVENTING PARASITE INFECTION

*Prevention is the key when it comes to avoiding parasites.*

Here are some important points to keep in mind on your farm:

- Keep infected animals separated from healthy animals.
- Always do chores for sick animals last.
- Clean and disinfect stationary objects accessible to animals.
- Remove soiled bedding often.
- Keep infected animals and fecal matter away from water and food sources.
- Do not allow animals to drink unfiltered or untreated water.
- Restrict animal and human access to manure areas.
- Practice biosecurity protocols i.e. wash hands, boots, and clothes after working with infected animals.
- Disinfect fecal-contaminated equipment well (parasites may be resistant to chlorine products).
- Vaccinate companion and farm animals.
- Take extra precautions for young, old, pregnant, and immunosuppressed animals.

# 6 RIPARIAN BUFFERS

## THE IMPORTANCE OF RIPARIAN BUFFERS

A riparian forest buffer is an area directly adjacent to a stream, river, or lake/pond that can include trees, shrubs, grass, and/or grass like plants and forbs.

The riparian area can be either native vegetation or managed improved vegetated species with harvestable crops. Buffers are designed or managed for multiple benefits including:

- The uptake of nutrients that enter the buffer from the field
- Creation of shade to lower water temperature
- Input of stream energy and nutrients
- Providing fish and wildlife habitat
- Stabilization of stream banks
- Reduction in downstream flooding
- Infiltration of water entering the buffer from the field

## PLANNING TO IMPLEMENT A BUFFER?

**Questions to ask on your farm.**

1. Is the current riparian area functioning correctly?
2. Do animals have access/are they denuding the buffer zone?
2. Is the stream bank eroding? Is the water turbid?
3. Are pesticides entering the riparian zone?
4 Is animal waste entering the riparian zone?
5. Is the soil suitable for the selected vegetation?
6. What wildlife species use the riparian zone?

## BUFFER MAINTENANCE TO INCREASE TREE SURVIVABILITY

Research from the *Stroud Water Research Center* suggests the following:

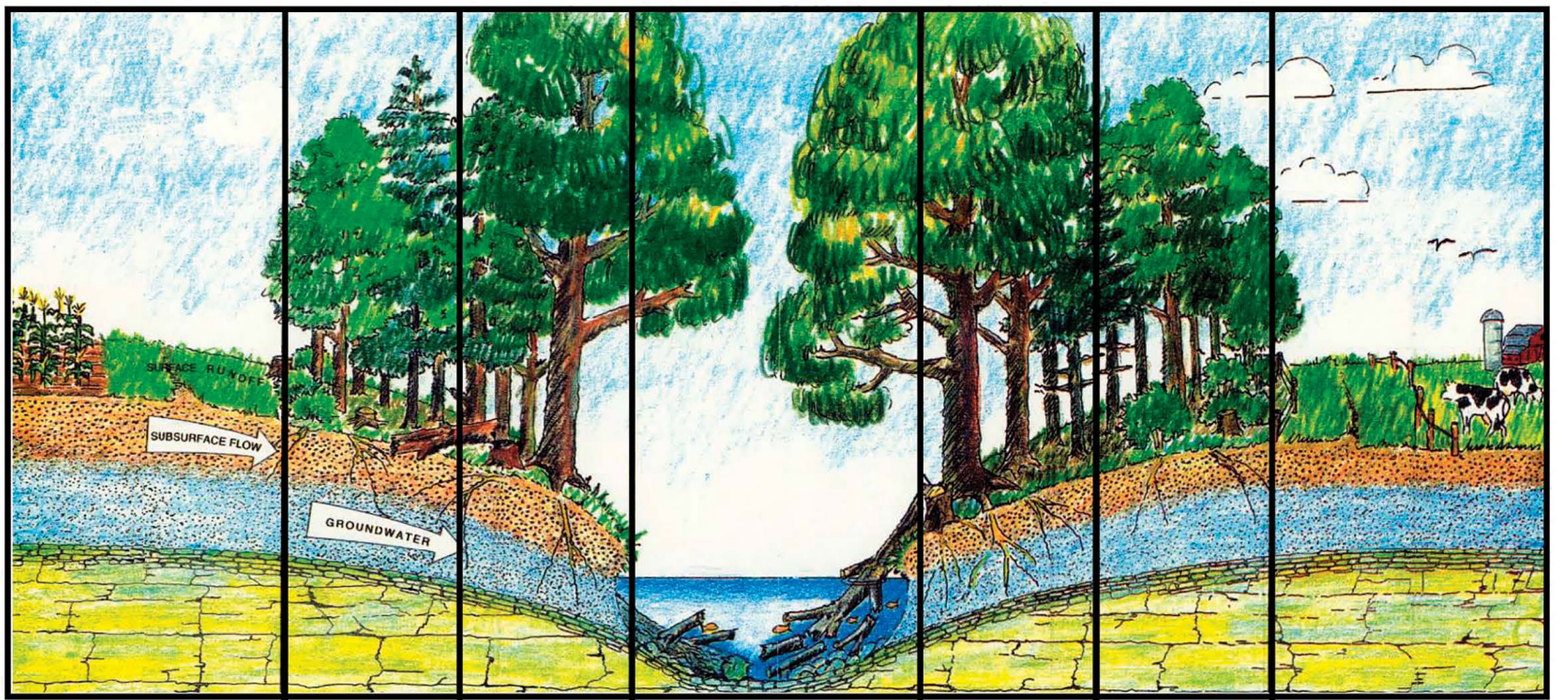
- Apply herbicide biannually for the first 4 years
- Only use herbicides approved for use near water
- Exclude livestock grazing
- Mow buffer area for the first 2-3 yrs. after planting
- Inspect for wildlife and rodent damage
- Use tree mats and tree tube shelters
- Remove tree tubes (when tree branches emerge from tops of tubes)
- Inspect buffer after high water flows
- Replant if necessary to achieve desired conditions

*Well managed buffers provide clean water, stable streams, and good wildlife habitat.*


*Degraded riparian buffers leads to stream bank erosion and loss of valuable agricultural land.*

*Photos by Jessica Rall*

## RIPARIAN FOREST BUFFER




| | Minimum 50 - 100' | Minimum 50' | | Minimum 50' | Minimum 50 - 100' | |
|---|---|---|---|---|---|---|
| Concentrated flow along with accelerated erosion and sedimentation is controlled in this area. | **Zone 2 Managed Forest Trees and Shrubs**<br>Removes, transforms or stores sediment, nutrients and other pollutants. Periodic harvesting is necessary in Zone 2 to remove nutrients sequestered in tree stems and branches and to maintain nutrient uptake through rapid tree growth. | **Zone 1 Undisturbed Forest Trees**<br>Creates a stable ecosystem adjacent to the water's edge, provides soil/water contact area to facilitate nutrient buffering processes, and provides shade to moderate and stabilize water temperature. | **Streambottom**<br>Debris dams hold detritus, nutrients and other pollutants for processing by aquatic fauna and provide cover and cooling shade for fish and other stream dwellers. | **Zone 1 Undisturbed Forest Trees**<br>Stabilizes stream banks and reduces flooding impacts by providing a wider, more natural stream channel. Tree removal is not permitted in this area. | **Zone 2 Managed Forest Trees and Shrubs**<br>Provides long term storage of nutrients in the biomass of trees and shrubs and economic benefits to the landowner if the forest resource is sustainably harvested. | Runoff enters Zone 2 as sheet flow or shallow concentrated flow over natural terrains. |

In the NYC Watershed, WAC creates buffers that couple vegetation and tree plantings with pro-active measures to fence animals out of streams and install alternative watering systems. In many cases, WAC works in partnership with the USDA Farm Service Agency to implement CREP along eligible watercourses.

**C R E P:** The USDA Conservation Reserve Enhancement Program (CREP) takes a land conservation approach to water quality. CREP offers a financial incentive that rewards landowners for converting sensitive land close to stream banks into Riparian Forest Buffers.

Talk to your planner to learn more about the CREP program and visit: fsa.usda.gov

# 7 MANAGING SOIL HEALTH FOR PASTURE AND CROPLAND

Healthy Soils Are...

### HIGH IN ORGANIC MATTER

**Organic matter matters! In fact, organic matter, enhanced by cover crops, green manure, perennial forage, compost, and manure, may be the most important component to a healthy soil.**

Carbon in organic matter is the main source of energy for soil microbes, and is key for making nutrients available to plants. Other positive influences that high levels of organic matter have on healthy soils include:

- Stabilizes and holds soil particles together
- Supplies, stores, and retains nutrients such as nitrogen, phosphorus, potassium, magnesium, and sulfur
- Improves the soil's ability to store/move air and water
- Contributes to lower soil bulk density, and reduce risk of crusting, compaction, water runoff, and soil erosion
- Makes soil more friable, less sticky, and easier to work
- Reduces the negative environmental effects of pesticides, heavy metals, and other pollutants
- Improves soil tilth in surface horizons
- Increases water infiltration rates
- Encourages plant root development and penetration

### FULL OF LIFE

**The healthiest soils are those with diversity and abundance of life.** Soil biota cycle nutrients, build the soil, and give it structure. Farmers with the healthiest soils nurture that life by creating a diversity of plant life above the soil surface, with year-round ground cover, no tillage, and judicious pesticide use.

### COVERED ALL THE TIME

**Soil should always be covered by growing plants, their residues, or a combination of the two.** Covered crops and plant residues…

- Offer soil microbes food and shelter
- Protect soil structure against disintegration by the hammering energy of raindrops
- Promote water infiltration and build moisture and nutrient reserves
- Suppress weeds early in the growing season
- Enhance decomposition and improve nutrient cycling

| ORGANISM | WHAT DOES IT DO? |
|---|---|
| Bacteria | Feed on organic matter, store and cycle nitrogen, and decompose pesticides |
| Fungi | Up to 3,000 species of fungi are in the soil. Some feed on dead organic matter like crop residues that are more difficult to break down—others are parasites that attack other microbes. Some fan out from the root to get more nutrients and hold more water for the plant, delivering nutrients to the plant in exchange for carbon. |
| Protozoa | Eat bacteria, fungi, and algea. When they eat bacteria, their main food source, they unlock nitrogenthat's released into the soil environment slowly. They convert organic nitrogen to inorganic nitrogen that's available to plants. |
| Mites | Decompose and shred organic matter as an important part of the nitrogen cycle. |
| Nemantodes | These microscopic worms are part of an important part of the nitrogen cycle. Most are non-pathogenic and don't cause disease. They eat other organisms in the soil. |
| Earthworms | Expell partially decomposed organic matter, produce nutrient-rich casts, and make lubricated tunnels that aid soil structure and water movement in the soil. |

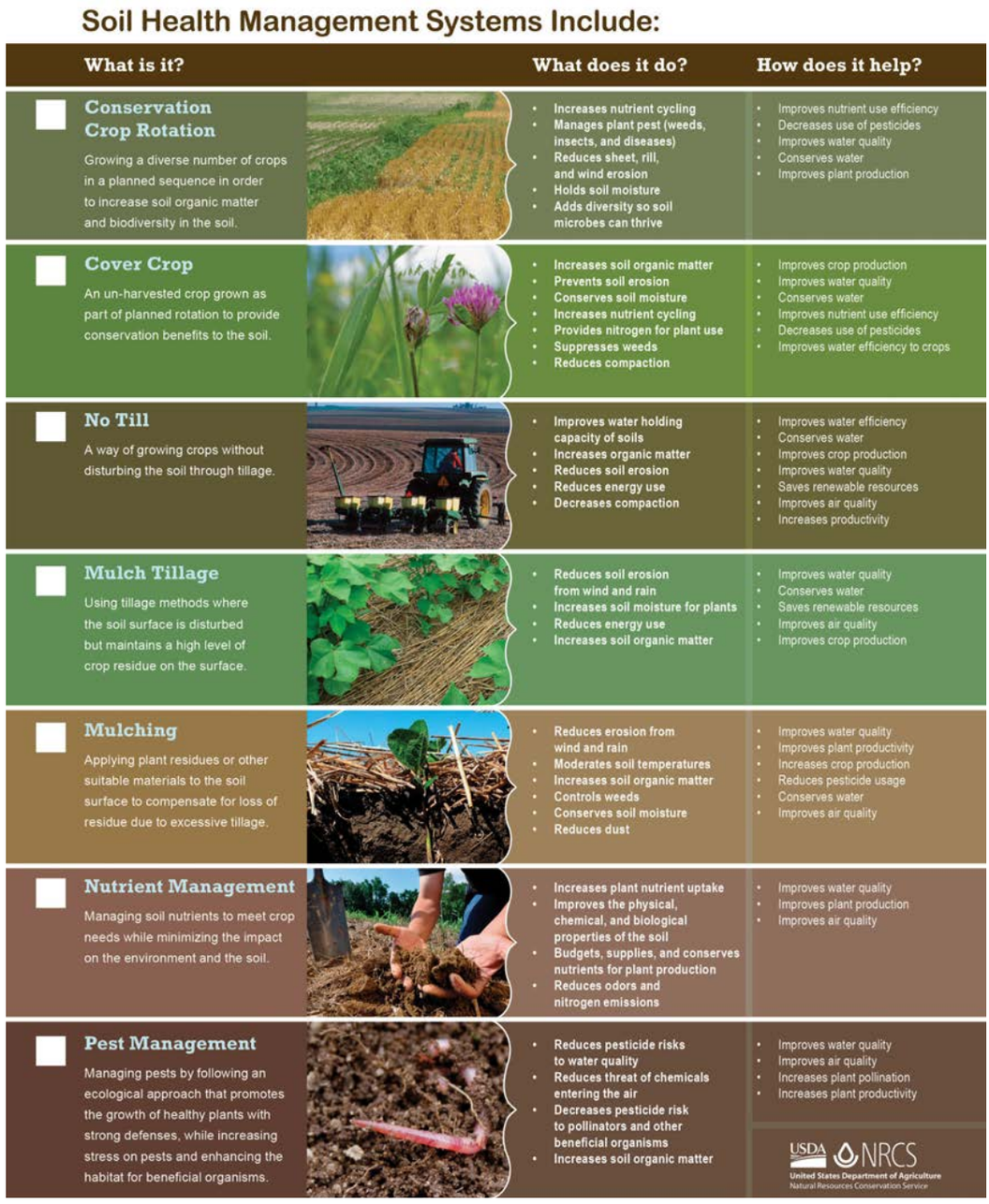
## WELL STRUCTURED

**Soil structure refers to the arrangement of the solid parts of the soil and the pore space between them.**

When the solid parts (sand, silt and clay particles) cling together as coarse, granular aggregates, the soil has a good balance of solid parts and pore space, contributing to good tilth, infiltration, and structure.

Certain management practices negatively impact soil structure. When pasturing livestock, avoid heavy use areas when possible. Heavy animal traffic can cause compaction both by trampling wet conditions and overgrazing. Tilling soils can also compact soils as well as reduce soil cover, disrupt continuous pore space, or reduce soil organic matter. By contrast, soils that are not tilled and are covered with diverse, high residue crops throughout the year have better soil structure, are highly aggregated, with high levels of organic matter and microorganism activity, high water holding capacity, high infiltration rates, and little compaction.

Use the following checklist to determine if you're using some or the entire core Soil Health Management System farming practices.



# 8 INTERPRETING YOUR SOIL TEST REPORT

## Agro-One Soil Analysis

**with Cornell Nutrient Guidelines**

Agro-One
730 Warren Road
Ithaca, NY 14850
Phone: (800) 344-2697
Fax: (607) 257-1350
www.dairyone.com

Cornell University
College of Agriculture
and Life Sciences

Dairy One

**A**

Lab Sample ID: **70800870**
Field/Location: BD 178
Date Sampled: 03/12/2011
Date Tested: 03/24/2011
Soil Name: Honeoye
Statement ID: BD 178
Description:

**B**

| Element | Morgan lbs/acre | Very Low | Low | Medium | High | Very High |
|---|---|---|---|---|---|---|
| Phosphorus (P) | 5 | | | | | |
| Potassium (K) | 164 | | | | | |
| Calcium (Ca) | 2,251 | | | | | |
| Magnesium (Mg) | 237 | | | | | |

**C**

| Element | Value | Element | Value | Element | Value |
|---|---|---|---|---|---|
| Soil pH | 6.0 | Manganese (Mn), lbs/acre | 21.3 | Organic Matter, % | 3.8 |
| Buffer pH | 5.8 | Zinc (Zn), lbs/acre | 1.6 | | |
| Iron (Fe) , lbs/acre | 11.7 | Aluminum (Al), lbs/acre | 91.9 | | |

**D**

**Crop History (1 = last year, etc.)**

| Year | Crop |
|---|---|
| 3 | Grasses Maintenance |
| 2 | Grasses Maintenance |
| 1 | Grasses Maintenance |

**E**

| Soil Fertilizer Recommendations | | tons / acre | lbs / acre | | |
|---|---|---|---|---|---|
| Year | Crop | Lime | N Range | P2O5 Range | K2O |
| 1 | Soybeans | 3.50 | 10 - 20 | 25 | 0.00 |
| 2 | Wheat | 0.00 | 30 - 40 | 40 | 20.00 |
| 3 | Soybeans | 0.00 | 10 - 20 | 25 | 0.00 |

**F**

**Comments**

Nutrient recommendations provided by Cornell University.
These are general comments. Always consult with your crop adviser for recommendations specific to your farm.
For assistance interpreting your report, contact your local Cooperative Extension office at 315-255-1183.
Yr1 If there is a non-zero P2O5 recommendation, band most if not all P2O5 at planting.
Yr1 Lime rate is for 100% ENV. To calculate actual rate: rate to use = recommended rate/ENV (of lime source) x 100.
Yr1 Apply dolomitic lime containing at least 1% Mg.
Yr1 Work lime into seed zone before planting.
Yr2 Band most if not all P2O5 at planting.
Yr2 If lodging sometimes occurs - reduce N rate by 20 lbs/acre.
Yr3 If there is a non-zero P2O5 recommendation, band most if not all P2O5 at planting.

Page 1 of 1 4M

Reading and interpreting your soil test reports can be challenging. Use the simple pictured guide to help understand your guide.

## A Sample Identification:

**Field/Location:** The FSA Tract and field number for the field. This is the unique identifier used in the Watershed Agricultural Program for each field; see your farm field map for location information.

**Date Sampled/Date Tested:** The date the Agro One lab did the analysis.

**Soil Name:** The soil type for the field; nutrient recommendations are tailored to the characteristics of each soil type.

## B Soil Analysis Results: Macro-Nutrients

**Morgan lbs/ac:** Agro One uses a Morgan solution to extract plant available nutrients from samples. The lbs/ac is an index of the amount of each major plant nutrient in an acre furrow slice of soil.

**Nutrient Status Bar chart:** A graphic depiction of the nutrient status for each nutrient:

**Very low/low:** Soil is deficient in this nutrient; crops are likely to respond to fertilization.

**Medium:** Soil is nearing optimum nutrient status; crops are moderately likely to respond to fertilization.

**High:** Soil is well supplied with this nutrient; crops are unlikely to respond to fertilization.

**Very High:** Soil has more than adequate supplies of this nutrient, nutrients may are more likely to be lost to the environment through runoff or leaching, crops are very unlikely to respond to added fertilizer.

## C Soil Analysis Results: pH, Organic Matter and Micro-Nutrients

**Soil pH:** The pH, or acidity status of the soil.

**Buffer pH:** A measure of the soils buffering capacity (the soils resistance to change in pH) used to calculate the fields lime requirement.

**Organic Matter:** The fraction of the soil that is made up of organic matter, the rest of the soil is made of minerals.

**Micro-Nutrients** (Fe, Mn, Zn, Al): The lbs./ac of these important micro-nutrients.

## D Crop History:

Crops grown years prior to sample collection, 1 previous year, 2 two years ago, etc.; this information is used to estimate nutrient availability from previous crop residue etc.

## E Soil Fertilizer Recommendations:

**Crop:** The crop to be grown; crop sequence effects the fertilizer recommendations, if you plan to grow a different crop or crop sequence than indicated, contact your Nutrient Management Planner for adjusted recommendations.

**Lime:** The tons/ac recommended to be applied, based on crop rotation, soil pH and buffer pH. See the pH and liming section for more details on soil liming.

**N Range:** The recommended nitrogen fertilizer to be applied, estimated based on crop grown, cropping history, and soil type.

**P205 and K20:** The recommended fertilizer to apply based on soil analysis and crop grown. Review the "Fertilizer Fact Sheet" section for more information.

## F Comments:

Additional comments and fertility recommendations based on the crop rotation and soil analysis.

# 9 BASIC FORAGE CROP PRODUCTION

**START WITH THE SOIL:**

The foundation of crop production is good soil fertility and the foundation of soil fertility is managing soil pH. Our soils are often at a lower pH range (5.0 – 5.8) than what is required for crops to grow best at (6.0 – 7.0 - see Soil pH and Liming section). Set the stage for profitable crop production by establishing proper soil pH through liming.

Once soil pH is addressed, there is often a need for supplemental nitrogen (N), phosphate (P) and potassium (K) (potash). These nutrients can be applied through animal manures and/or commercial fertilizer. Animal manures are generally excellent sources of phosphorus and potassium, and more slowly available nitrogen, especially if they are composted. However, if applied at phosphorus removal rates, animal manures alone do not provide enough nitrogen for crops that require higher levels of nitrogen such as corn and grass haycrops. These crops will often benefit from additional commercial fertilizer N, especially in the spring when organic nitrogen in manure is not readily available due to cool soil temperatures. Your soil test report tells you how much N, P, and K your crops require. Your Nutrient Management Planner, crop advisor, or Cooperative Extension agent can help you determine how much fertilizer or manure to apply (see the Fertilizer Fact Sheet section in this booklet).

**GRASS MANAGEMENT:**

You may already have a nice stand of haycrop. Perennial grasses can be highly productive in our region if managed properly. Following a few simple steps can lead to doubling yield per acre over less intensive management; These steps are:

1. Apply commercial fertilizer nitrogen when grass greens up in April at a rate of 75 – 100 lbs. of actual nitrogen per acre. Apply phosphorus if recommended based on the soil test. Grass response to N will be less if these nutrients are deficient as well.
2. Harvest the first cutting in mid to late May (May 18–20$^{th}$ typically). Harvest again approximately every 30 – 35 days (will likely need to have a longer 45 day+ interval in late summer).
3. Apply 50 lbs. of actual nitrogen per acre after each harvest. Livestock manure can be used to provide some of this nitrogen, but unless using liquid manure, an application of 30-40 lbs. of nitrogen from commercial fertilizer will be necessary.
4. Harvest grasses leaving a minimum stubble height of 4 inches for quickest regrowth and long term plant health.
5. Grass hay crops can still benefit from less intensive nitrogen fertilization, and pastures should not be as heavily fertilized.

**WEED CONTROL:**

Weed control in forage crop stands is critical to produce a productive crop. Ensuring proper fertility will help the grass out-compete weeds. Still, some weeds are very persistent and compete well. There are many very effective selective herbicides that are approved for use and can be used safely. Some may require a licensed pesticide applicator to apply them. Consult with your Cooperative Extension agent or other crop advisor for more information.

Weeds can also be controlled using mechanical means (tillage and reseeding, clipping frequently etc.). Full tillage (plowing plus secondary tillage) and reseed-

ing is likely the most effective mechanical weed control method for persistent perennial weeds, but likely not as effective as when combined with herbicide use.

### WHAT CROP TO GROW?

There are many crops that can be considered to provide forage for livestock production or crop sales. Consulting with a knowledgeable crop advisor such as your Nutrient Management Planner, Whole Farm Planner or Cooperative Extension agent can help you make a decision that is best for your farm. Crops that fit your soils and farm system (eg. labor, equipment, crop storage etc.) are the ones that should be considered.

Many small farms are only managing hay crops or pasture. There are several perennial forage species that are productive in New York State for these purposes. Generally they are of two types: *legumes and grasses*. Legumes are broadleaf plants that have the advantage of a symbiotic relationship with soil bacterium that allows them to fix nitrogen from the atmosphere to meet their nitrogen need. Common forage crop legumes include alfalfa, clovers, vetches, and birdsfoot trefoil. Grasses are species with narrow leaf blades, and produce distinct seed heads. Grasses can be highly productive, can tolerate lower soil pH and wetter soils than legumes, and are long lived, but require the addition of supplemental nitrogen to be productive.

A list of crop species that are adapted to our region appears below:

| CROP | USE | PROS | CONS |
|---|---|---|---|
| **Perennial grasses** (eg. Orchard Grass, Timothy,Tall Fescue, Reed Canarygrass, Perennial Ryegrass) | Hay, Chopped and Round Bale Silage, Grazing | Well adapted to our climate and soil<br>Long lived<br>Can be very productive | Requires substantial nitrogen fertilization and 3-4 harvests per season to be productive<br>Does not grow well in hot dry conditions |
| **Perennial Legumes** (Clovers, Alfalfa, Birdsfoot Trefoil, Vetch, Field Peas) | Hay, Chopped and Round Bale Silage, Grazing | Provides high quality forage<br>Does not require supplemental N fertilization<br>Produce better in hot weather than grass | Require higher soil PH than grass<br>Shorter lived, requires reseeding typically every 3–7 years |
| **Corn** | Chopped Silage; High Moisture or Dry Grain | High yield potential<br>One harvest per season<br>Grows well in hot weather<br>High enery forage due to grain content | Requires annualplanting and weed contro;<br>High cost per acre<br>requires special planting and harvst equipment |
| **Sorghum; Sorghum-Sudangrass Hybrid; Sudangrass** | Hay, Chopped and Round Bale Silage, Grazing | Grows well in hot weather<br>Provides forage during growth slump in summer forage<br>Uses little water<br>Establishes well planted later in season<br>Can be harvested 1–3 times per season<br>Grows rapidly | Requires annual planting<br>Cannot be planted early in the season due to frost<br>Must be managed to avoid prussic acid toxicity to livestock<br>grows so rapidly at some times that can miss optimal harvest window |
| **Spring Small Cereal Grains** (eg. Oats, Barley,Spring Triticale) | Hay, Chopped and Round Bale Silage, Grazing, Dry Grain and Straw | Grows well in early spring<br>should be planted early<br>Can be planted in August for fall forage<br>Can be high quality forage | Requires annual planting<br>One harvest per season<br>Lower yield than other forages |
| **Fall Small Cereal Grain** (Winter Rye, Winter Wheat, Winter Triticale) | Hay, Chopped and Round Bale Silage, Grazing, Dry Grain, and Straw | Grows during fall and early spring when other crops going dormant<br>Can provide early season forage<br>Can be high quality forage<br>Preserves soil health when used in conjunction with corn for silage | Requires annual planting<br>Requires Nitrogen fertilization for best yield<br>Mature fast and requires timely harvest for best forage quality<br>One harvest per season |

# 10 UNDERSTANDING AND USING COMMERCIAL FERTILIZERS

## COMMON TYPES OF FERTILIZER

Commercial fertilizer has value in promoting plant growth, but is recommended only when other nutrient sources insufficiently supply nutrients to the crops. The composition of applied fertilizers should be based on the fertility status of the whole farm. The only way to really know the status is to have a full set of current soil samples!

Fertilizers are labeled according to their percentage of Nitrogen (N), Phosphorus (P) and Potassium (K) content. An 18-18-18 fertilizer blend, for example, contains 18% each of N, P and K.

Common sources of fertilizers include:

### NITROGEN

**Urea: $(NH_2)_2CO$**

- Fertilizer grade: 46-0-0
- Dry fertilizer product
- Soluble, readily available N source
- Contains highest percentage of N for all dry fertilizers
- Can cause high pH near seeds
- Can reduce overall soil pH overtime (but less so than Ammonium Sulfate)
- Most common N fertilizer used on hay fields, corn, and vegetable crops

**Ammonium sulfate: $(NH_4)_2SO_4$**

- Fertilizer grade: 21-0-0-24S
- Soluble, readily available source of N and S
- $NH_3$ volatilization is generally not a concern
- Reduces soil pH overtime

**Note:** Significant N losses as volatilization of $NH_3$ may occur when Urea is surface applied. Urease and nitrification inhibitors are designed to minimize N losses.

### PHOSPHORUS

**Monoammonium Phosphate: $NH_4H_2PO_4$**

- Fertilizer grade: 11-52-0
- Physical form: solid
- Soluble, readily available source of P & N
- Most common dry P fertilizer in NY
- May create an acidic zone around fertilizer

**Triple superphosphate: $Ca(H_2PO_4)_2$**

- Fertilizer grade: 0-46-0
- Physical form: solid
- Acidifying agent
- Water-soluble

**Ammonium polyphosphate: $Ca(NH_4H_2PO_4)_2$**

- Fertilizer grade: 10-34-0 or 11-37-0
- Physical form: liquid
- Soluble, readily available source of P and N
- Popular source for starter and pop up fertilizer

**Diammonium phosphate: $(NH_4)_2H_2PO_4$**

- Fertilizer grade: 18-46-0
- Physical form: solid
- Soluble, readily available source of P & N
- Can cause seedling injury if too much is placed near the seed

### POTASSIUM

**Potassium chloride: KCl**

- Fertilizer grade: Contains 60-63% $K_2O$
- Physical form: solid
- Most abundantly used potassium fertilizer
- Often referred to as Muriate of Potash
- Water soluble source of K

## CALCULATING FERTILIZER APPLICATION RATES

Before using any fertilizers, it is important to understand how to read a fertilizer label. All fertilizers are labeled as % N - % $P_2O_5$ - % $K_2O$.
For example, a fertilizer labeled as a 20-5-10 means that the product contains, by weight: 20 percent N, 5 percent $P_2O_5$, and 10 percent $K_2O$.

The basic formula for calculating how much fertilizer to apply to a given area for a specific amount of nutrient is:
Example:

$$\text{Pounds of fertilizer} = \frac{\text{(Pounds of fertilizer needed)}}{\text{(Percent nutrient in fertilizer)}}$$

Recommendation: 80 lbs. $K_2O$/acre. How much muriate of potash should be applied to exactly meet this recommendation?

- Fertilizer grade of potash contains ~ 62% $K_2O$
- 80 lbs. / 0.62 = 129 lbs. of potash needed

## CHOOSING A RATIO

By looking at your soil test report, you can determine how much N, P and K is recommended per acre for the crop you are growing. If you wish to fertilize with a commercial fertilizer, select a fertilizer with a ratio similar to the ratio of N, P and K required by your crop. Example - if your hayland required 60 lbs. /ac N, 25 lbs. /ac P, and 30 lbs. /ac K, then a fertilizer in the ratio of a 2-1-1, such as a 20-10-10 would be appropriate to provide nutrients in a ratio close to what is required.

## FERTILIZER PLACEMENT METHODS

**Surface broadcast** is a method by which fertilizer is applied on the surface across an entire field. High capacity fertilizer spreaders are often used which spin dry fertilizer or spray liquid fertilizer on the soil surface or growing crop.

- Advantages: Fast, economical
- Disadvantages: Potential for higher nutrient losses, lower uniformity and low P efficiency in P deficient soils

**Broadcast incorporated** improves on the efficiency of surface application by incorporating fertilizer through plowing or disking.

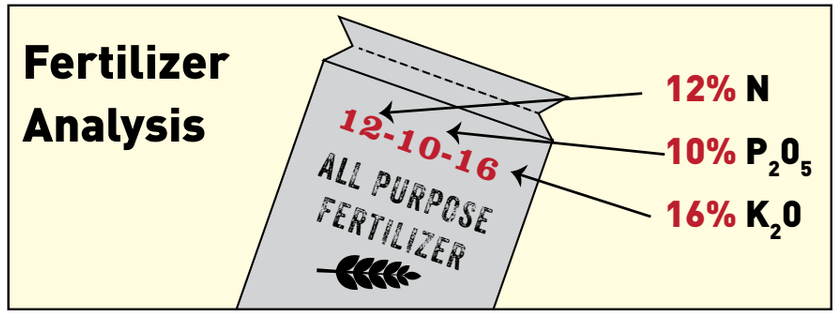
- Advantages: Reduces losses compared to broadcast, improves plant uptake
- Disadvantages: Slow, non-uniform application, erosion risk

**Topdressing** is when fertilizer or manure is spread on established fields (grasses, legumes).

- Advantages: High nutrient use efficiency
- Disadvantages: Possibility of N volatilization losses

**Band application** is also known as starter application. Fertilizer is applied in bands near where developing roots will easily reach it. A common practice is to band fertilizer 2 inches to the side and 2 inches deeper than the seeds or plants. Process can be done before or simultaneous with planting or seed drilling. Liquid or dry fertilizers can be used.

- Advantages: High nutrient use efficiency jump-starts early growth. Banding concentrates the nutrient source making it more available for plant uptake. It also slows nitrification, reducing the risk of leaching. Limit Nitrogen and Potassium to less than 50 lbs. /acre
- Disadvantages: Costly, slow; risk of salt burn to plant



# 11 SOIL PH AND LIMING

## IMPORTANCE OF SOIL PH

Soil acidity is the most common limiting factor influencing plant growth and crop production. pH is a soil characteristic that is affected by management, and is essential for optimal uptake of nutrients by plants. While the concentration of hydrogen ions is what determines a soil's pH, other factors including soil type and fertilization influence the concentration of H+, and thus the pH.

Liming soils to increase soil pH allows the plants to take up the proper nutrients. Most all economic crops, except blueberries, want a pH of 6-7. Lower pH increases the solubility of Al, Mn, and Fe, which are toxic to plants in excess. Favorable pH ranges for common crops are listed in the following table. Test soil to determine pH and liming needs.

## SOIL TYPES AND LIME REQUIREMENTS

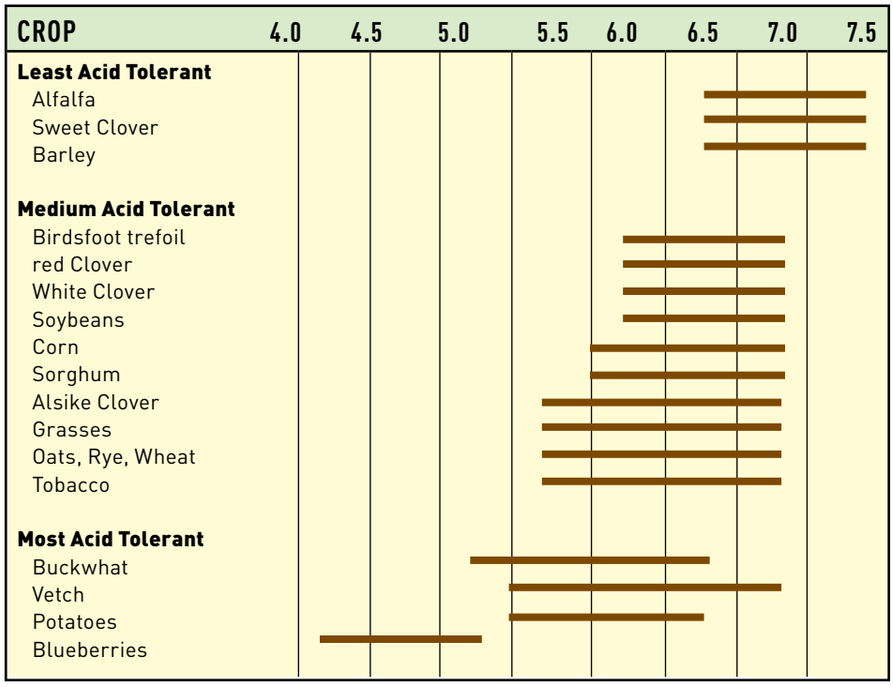
Liming requirements are greatly determined by the soils buffering capacity. Buffering capacity is a measure of soils ability to resist change in pH. Therefore, lime requirements increase with soil buffering capacity. Clay soils with high organic matter content are well buffered, and require more lime for a similar pH change than sandy soils with low organic matter. Also, because of the greater buffering, soil pH will decrease slower on soils with a high buffer capacity than on poorly-buffered, sandy soils.

## NEUTRALIZING ABILITY OF LIMING MATERIALS

Liming materials have varying levels of efficacy based on the purity, fineness, and Calcium Carbonate Equivalent.

Fineness is related to how small the lime particles are. The finer a limestone is ground, the faster it will react in the soil. Fineness is reported as a particle size distribution, usually as the percentage of the material that will pass 20, 60, and 100-mesh screens.

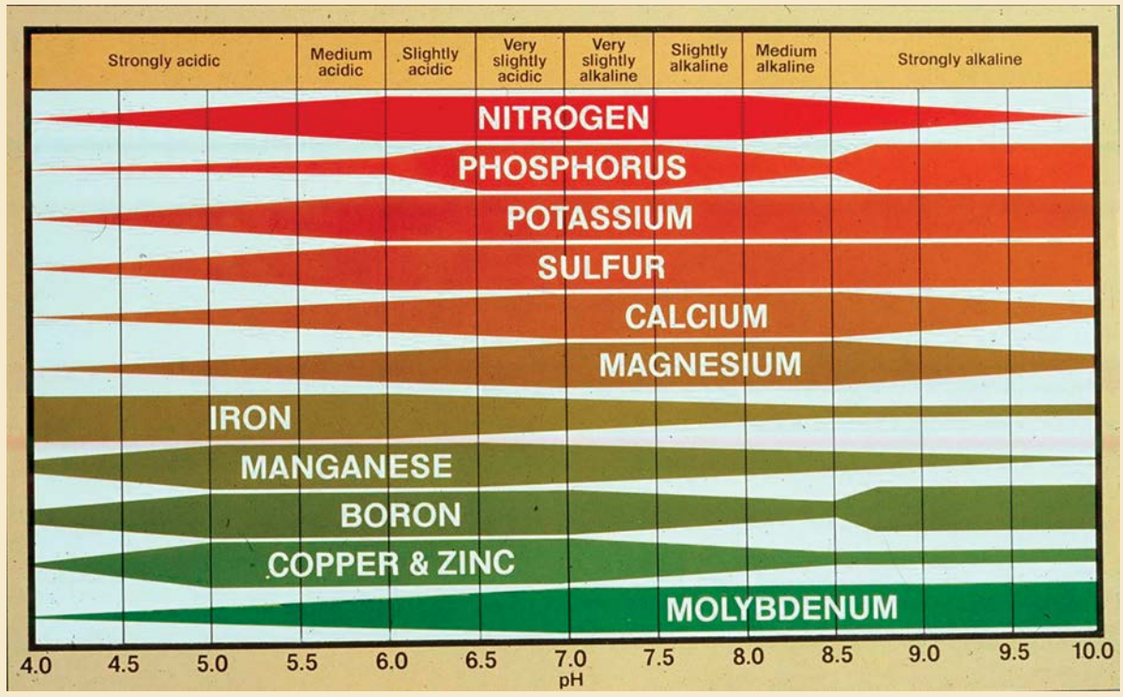
The graph to the right depicts the reaction time of lime products with differing fineness. The more fine the lime, the more effective it will be at raising soil pH in a shorter amount of time. If the liming material is too course, such as the 8-20 mesh, the soils pH remains unchanged.

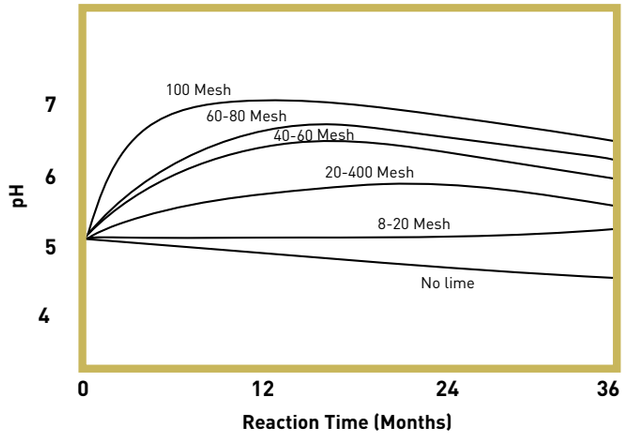



**Need Magnesium? Use Dolomitic lime.**

If your soil test indicates that magnesium is deficient for crop production, consider using a dolomitic (high magnesium) lime. These limes are usually 1.2 to> 2.5% magnesium.

## pH versus availability of nutients




Effective Neutralizing Value (ENV) allows comparison of different liming materials, determined by the Calcium Carbonate Equivalent x particle size distribution expressed as fineness.

### COST EFFECTIVENESS OF LIMESTONE

Example: to the right is a comparison of two liming materials. To determine the cost/ton of effective liming material, divide cost/ton by the ENV. In doing so you will find that although Limestone A initially seams cheaper, the cost/ton of effective neutralizing is actually significantly higher than Limestone B ($58.50 vs. $48.60). When purchasing liming material it is important to not only compare price, but quality as well.

**LIMESTONE #1 $40.00**
ENV: 0.684
- Total Neutralizing Value 78.75% $CaCO_3$

Minimum $CaCO_3$ Derived from Magnesium Sources 33.25% $CaCO_3$ Equivalence

Fineness
- 98% by Weight Passing 20 Mesh
- 70% by Weight Passing 100 mesh

**LIMESTONE #2 $45.00**
ENV: 0.926
- Total Neutralizing Value 104.3% $CaCO_3$

Minimum CaCO3 Derived from Magnesium Sources 52.2% $CaCO_3$ Equivalence

Screen Test
- 98% through 20 Mesh
- 80% through 60 Mesh
- 75% through 100 Mesh

Cost per ton of effective neutralizing:
Limestone #1: $40/0.684 = **$58.48**
Limestone #2: $45/0.926 = **$48.60**

12

# PRESCRIBED GRAZING MANAGEMENT

## Getting Started with Rotational Grazing

### WHAT IS PRESCRIBED GRAZING MANAGEMENT?

It is the management and controlled harvest of vegetation with grazing or browsing animals with the intent of achieving a specific objective. While there are several different methods of *Prescribed Grazing*, a rotational stocking method provides the greatest opportunity for enhanced livestock and pasture performance and economic benefit.

### ROTATIONAL GRAZING BASICS

A rotational stocking method utilizes multiple paddocks that are alternately grazed and rested during the grazing season. The size and number of paddocks required is dependent on the number and type of livestock, the productivity of the pastures, and the level of managerial control desired. Generally, more paddocks result in greater control, pasture utilization, and overall system success.

### HOW TO GET STARTED

- Evaluate your existing resources and management to assess what changes may be required to move the farm toward rotational grazing.
- Consult with your Whole Farm Planner and local WAC, SWCD, NRCS, and CCE personnel to help develop a Prescribed Grazing Management Plan that will detail paddock numbers, sizes, and layout, as well as, infrastructure (fence, water, lanes) designs and locations.
- Consult with a qualified nutritionist to evaluate and modify your feeding program.
- Start simple with what pasture and resources you have. Begin dividing pastures. Test soil for fertility and pH and make any needed improvements to enhance pasture production (especially lime!). Install and improve infrastructure. Be flexible; adjust, adapt, and improve your system and management as you progress.

### GENERAL GUIDELINES

**Grazing Period (Residency):**

| | |
|---|---|
| Dairy (1/2–1 day) | Beef (2–4 days) |
| Sheep/goats (3–5 days) | Horse (up to 7 days) |

**Paddock Number:**

| | |
|---|---|
| Dairy (31–61) | Beef (9–11+) |
| Sheep/goats (7–10+) | Horse (5+) |

**Grass Heights:**

Dependent on forage species, start grazing: 6"–10"; stop grazing: 2"–4"

**Forage Species:**

In general, orchard grass and improved white clovers are well suited to rotational grazing in the northeast. Other forages to consider, depending on weather and soil conditions, include canary grass, ryegrass, and red clover.

- Gather information and educate yourself. Attend pasture events like walks, workshops, and conferences. Read periodicals. Visit neighbors and ask how others manage their grazing systems. Learn more about fencing, watering options, forage alternatives, and management techniques.

## GRAZING SYSTEM COMPONENTS

**Soils & Forage:** Pastures should consist of native and improved mixes of grasses and legumes that are adapted to your farm's soils and growing conditions. What you can grow and how well it grows will depend largely on your soils and their productivity. With rotational grazing, pastures need to be managed and maintained just like any other important forage crop.

**Animals:** Rotational grazing can work for all types (species/breeds) and classes (young/mature) of livestock including beef, dairy, sheep, goats, poultry, horses, pigs, alpacas, etc.

**Fence:** Fencing is the key component for controlling livestock in a rotational system. Generally, a combination of permanent and temporary electric fence provides the greatest flexibility and control at the lowest cost.

**Water:** Water is essential for high animal performance on pasture. Water should be made available in an environmentally sound manner, in ample quality and quantity, and in close proximity to the grazing livestock. Avoid watering livestock in laneways, as this leads to a high concentration of nutrients on barren ground. Instead, try to place watering systems inside grazing paddocks, and if possible, rotate troughs to further enhance the spread of nutrients and erosion mitigation.

**Laneways:** Livestock trails should be improved or constructed to facilitate safe, clean movement to and from pasture, between paddocks, and to the water supply. Laneway use should be used to rotate livestock and should not turn into loafing areas.

**Shelter:** Depending on your livestock's needs, temporary or permanent shelter during inclement weather may be appropriate. Run-in sheds, hay-bale windbreaks, forested areas, or barn access all provide suitable shelter options.

## START PRESCRIBED GRAZING TODAY!

- **Save** time, money, soil, resources.
- **Improve** profits, forage production and utilization, animal health, water quality.
- **Reduce** stored feed costs, energy/fuel use, herbicides/pesticides applications.

### Additional Resources

- *Pasture Production Pasture & Grazing Management for NY* (Cornell)
- *Pasture Management Guide for Livestock Producers* (Iowa State)
- attra.ncat.org
- uwrf.edu/grazing
- nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044250.pdf

### Assistance

- Watershed Agricultural Council (nycwatershed.org)
- USDA Natural Resource Conservation Service (ny.nrcs.usda.gov)
- NYS Grazing Lands Conservation Initiative (glci.org)
- Soil & Water Conservation Districts (nyacd.org)
- Cornell Cooperative Extensions (cce.cornell.edu)
- Resource Conservation & Development (nyrcd.org)

*Photo by Heather Magnan*

# 13 PADDOCK MANAGEMENT FOR HORSES

**GETTING TO THE ROOT OF IT:**
If you are lucky enough to have sufficient land on your farm to allow your horse or other animals to routinely graze on grass, then you are engaging in pasture management. Well-managed pastures should be a resource for forage, exercise, rest, surface water filtration, and visual appeal. All paddocks, whether intensively grazed or rarely used, must be managed.

**SUCCESS IN YOUR PASTURE:**

### Soils
Soils are the key to pasture health. The first element of successful paddock management is understanding the nature of your soils, especially soil drainage. By understanding soil type and its ability to drain, you will be able to determine which grass species to select for planting based on their drainage tolerance. Always avoid grazing animals on either very wet or very dry ground.

### Forage
Forage or grass species are crucial to determining the success of your pasture. In addition to the above drainage considerations, you should also think about your pasture objectives. Whether your paddocks are used for your animal's forage supply or just for occasional turnout for exercise, its use will influence your seed mixture and management strategy. You should also consider the temperature range in which you need grass species to grow in, the survivability of seedlings, and its tolerance to grazing.

### Maintenance
For the maintenance of grass cover on heavily used turnout areas in the Northeastern US, an optimal mix of forages for well-drained soils is 6 lbs/acre orchardgrass, 10 lbs/ acre Kentucky bluegrass, and 1 lb/acre white clover seed. Orchardgrass can tolerate frequent grazing, is high-yielding, and establishes easily. Kentucky bluegrass is also tolerant of frequent grazing and traffic damage. Clover, a legume, will provide a protein and calcium source while also providing nitrogen for the pasture. For poorly-drained soils, substitute 8 lbs/acre reed canarygrass for orchardgrass in the above mix.

*Photo by Drew Harry*

Seeding is best accomplished by incorporating the seed with soil (rather than surface broadcasting) during the late summer or very early spring.

### Creating a Sacrifice Area for Horse Operations
A sacrifice area is an essential component of horse rotational grazing systems on small acreages. It is a relatively flat outdoor area on which no grass is expected to grow and which provides an alternative to pasturing. The area can be used for the horses' much needed daily exercise, and provides an alternative outlet for animals during saturated soil or drought conditions. The sacrifice area can also be used when pastures are over-grazed or require maintenance. Including a sacrifice area in your horse operation will reduce soil loss and water pollution by preventing erosion and can save you time and money by decreasing pasture maintenance requirements.

### Location and Sizing of Sacrifice Areas
Sacrifice areas should be easily accessible to and from stalls, and should be equipped with shelter, watering, and feeding amenities. Areas that are on higher ground with a slight slope of 1–2 percent are ideal locations for sacrifice areas. Low spots, natural drainage areas, floodplains, and resource protection areas are poor locations for sacrifice areas. Also avoid areas with slopes (30 percent or greater) that are susceptible to erosion.

A sacrifice area can be of any shape. For one horse, an area can be as small as 14 feet by 24 feet. The basic rule of thumb is that a full-grown horse should be able to make convenient turns within the sacrifice area and easily get away if it is about to be cornered by a dominating stable mate.

For information on the construction and maintenance of sacrifice areas visit: fairfaxcounty.gov.

## KEEPING IT GREEN:

### Maintaining Pasture and Soil

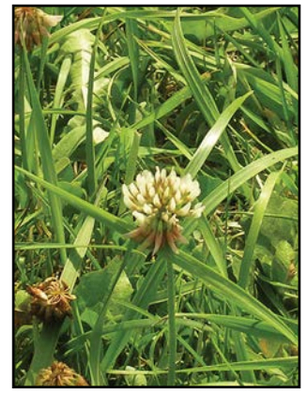
Animals will receive the greatest nutritional benefit from grazing pasture when plants are in the vegetative stage before developing a seed head, but after they have established sufficient root growth. In the Northeast using a cool season forage mix, this stage is usually when plants are between 8–10 inches high, not earlier.

Animals should be removed from a pasture when sufficient grazing has occurred; typically when grass has been eaten down to an average height of 3–4 inches. When grass has been grazed to this level, the pasture should ideally be mowed to create uniform height of about 4 inches and then rested to allow for re-growth. Generally speaking, a minimum of 14 days in the spring and up to 30 + in the summer is ideal.

Allowing paddocks to rest while enabling animals to graze can be accomplished by subdividing larger pastures and rotating animals through the smaller, fenced parcels. Managing a rotational grazing system will prevent denuding of pastures, provide greater nutrition, decrease weed growth, and ensure better distribution and uptake of nutrients (see "Prescribed Grazing Management" section).

Managing soil fertility by executing a grazing and nutrient management plan will also ensure the success of your pasture land. In addition to managing soil drainage, you can enhance the nutrient profile of your soil by adding certain inputs. This should be done according to the recommendations of soil tests.

Depending on what minerals and nutrients your soil test indicates are deficient, you may apply any number of amendments. These applications may be in the form of lime (calcium and magnesium), fertilizer (nitrogen, phosphorous, and/or potassium), tested compost, manure, or other recommendations. Work with your Nutrient Management Planner to decide what is best for your farm.



Application quantities should be based on the recommendations of your soil test and planner. The goal of creating high-quality soil should be applying nutrients in amounts that bring soil fertility to a sustainable level, while avoiding over-application.

### Additional Resources

- NYS Horse Health Assurance Program
- agmkt.state.ny.us/NYSHHAP/horsehealth.html
- NYS Department of Agriculture and Markets
- Agricultural Environmental Management Program
- agmkt.state.ny.us/soilwater/AEM
- Rutgers Cooperative Research & Extension (RCRE)
- esc.rutgers.edu

*Photo by Heather Magnan*

# 14 HAYCROP / PASTURE RENOVATION

## WHAT IS HAYCROP/PASTURE RENOVATION?

Pasture renovation consists of various practices including inter-seeding legumes and grasses, fertilizing, liming, controlling weeds, and the improvement of grazing management. These efforts seek to improve the sustainability of hay stands and pastures in terms of overall health, productivity, and vegetative composition.

## WHY SHOULD YOU RENOVATE YOUR PASTURE AND HAYFIELDS?

A combination of renovation practices implemented routinely as part of a long-term management plan can essentially "renew" a pasture and hayfields while increasing forage yield and animal performance over time. Soil erosion is reduced and a healthier stand of grass is cultivated.

### Steps to Pasture Renovation

- Conduct a soil test
- Apply lime accordingly
- Overgraze pasture to suppress weeds and existing sod
- Disturb or suppress the existing sod mechanically using aerator chain harrow
- Seed legumes/grasses
- Graze newly legume-seeded pasture
- Graze established grass-legume pastures
- Fertilize
- Re-renovate

### Steps to Haystand Renovation

- Conduct a soil test
- Apply lime accordingly
- Fall kill existing sod (if planning a complete renovation) at spring no-till seeding or late summer
- Spring till field if doing conventional spring till or summer seeding
- Seed legumes/grasses
- Fertilize
- Re-renovate

## KEY QUESTIONS TO CONSIDER:

### What are my current fertility levels?

Soil fertility information is critical to successful pasture renovation. Test your soils early in the planning process and correct issues before proceeding further with renovation. Nutrient imbalances, deficiencies, or improper soil acidity levels will negate any attempt at improving pasture composition or performance.

### Which legume or grass species/variety should I use?

There are many things to consider during seed selection. Read through the list of popular species to help you choose what is best for your pasture.

### What renovation technique is best?

The four basic techniques used in renovation include frost seeding, conventional tillage, no-till and interseeding into existing sod. Each of these techniques comes with their own pros and cons. For example, interseeding and frost seeding are done into existing sod to bolster forage production without killing the sod. Interseeding and frost seeding tend to have a lower overall successful establishment but is less disruptive to current haystand/pasture and less costly.

Research should be done to determine the renovation technique that works for your land and management.

Review the NRCS *Specification Guide Sheet for Pasture and Hay Planting* for more information.

**When should I renovate?**

Renovation timing is largely determined by the technique chosen to seed. Frost seedings are limited to the late winter/early spring when normal freezing and thawing cycles crack the soil surface open. For all other seeding techniques, the ideal time to seed is in late summer and early fall when adequate soil moisture is available.

## POPULAR GRASS SPECIES:

**Orchard Grass:** One of the first grasses to mature (May 4–May21). Higher yielding grass (5–7 ton DM/acre). Some varieties tolerate close grazing, others are better for hay. Very leafy and good summer regrowth.

**Kentucky bluegrass:** Grows earlier than most other grasses (matures early/mid May). Very common in lawns and closely grazed pastures. Lower yielding grass (approx. 4–5 tons DM/ acre). Survives continuous and close grazing.

**Timothy:** Late maturity (May 25–June 10). Medium yields (4–6 tons/DM). Very palatable and easy to establish. Doesn't regrow well alone in pastures, often planted with another grass.

**Tall Fescue:** Medium maturity (May 13–May 30). Highest yielding cool-season grass (6–8 ton DM/ acre). Endophyte free and higher palatability varieties available. Forms a dense sod and can handle high nutrient loads. Adapted to drought, wet conditions, and low pH soils. Withstands foot traffic well. Purchase only certified fungus-free seed.

**Reed Canarygrass:** Medium to late maturity (May 15–30). High yielding (4–6 tons DM/acre). Most tolerant grass of wet droughty soils, very winter hardy, and tolerates low pH. Slow to establish and challenging to manage in a grazing system.

**Ryegrasses:** Medium to late maturity (May 10–June 3). Annual perennial types. Can be very short lived in NY. High quality and palatable, but lower yielding (4–5 tons DM/acre). Best used as a nurse crop-very competitive growth.

**Smooth Bromegrass:** Mid maturity grass (May 18–26). Large range in yield potential (4–8 tons DM/ acre). Vulnerable if grazed during stem elongation. Forms a sod and can make a good long term pasture. Does not tolerate frequent grazing.

**Meadow Fescue:** Medium maturity (May 18–22). Lower yielding in pure stands (4–5 DM/ac). Very high quality. Very palatable to livestock.

**Festulolium:** Medium maturity and yield. Hybrid between meadow fescue and a ryegrass. Very well adapted to grazing systems.

## POPULAR LEGUMES:

**Alfalfa:** Highest yielding and most drought tolerant legume. Typically grown for silage and hay, but can be pastured.

**White Clover and Ladino:** Well adapted to wet soils. Not drought tolerant. Usually a top choice in NY pastures. Ladino is a more productive type.

**Red Clover:** Higher yield than white clover. Not persistent (usually lasts only 2–3 years). Can easily frost seed over existing pastures.

**Birdsfoot Trefoil:** A long lived perennial legume that tolerates wetter soils prone to heaving . This legume is one that does not cause bloat in ruminant livestock.

**Advantages to Seeding With Legumes.**

Adding legumes to a crop rotation can reduce the need for external nitrogen input. Legumes, with the proper soil bacteria, convert nitrogen gas from the air to a plant available form and replenish the soil with nitrogen after decay.

The leaching of excess nitrogen is also reduced when practicing minimal tillage in conjunction with the seeding of legumes. Remaining plant communities use the majority of the nitrogen provided by decaying legumes.

Nitrogen not used by existing plant communities is likely to remain onsite due to ample ground cover and a stable soil matrix provided by intact root systems.

# 15 COMPOSTING MANURE

## WHY COMPOST?

Composting is a managed biological process that uses the activity of micro-organisms and presence of oxygen to convert organic waste into humus, suitable for use as a soil amendment. Composted manure is therefore a valuable soil conditioner that enhances soil structure.

In addition to adding nutrients to the soil, the incorporation of manure compost can improve long-term soil quality. The organic matter in compost enhances soil nutrient-holding and water-retaining capabilities which, in turn, reduces fertilizer requirements and erosion while enhancing soil tilth.

### Common Composting Methods

**Windrow Composting** is the most common method. It involves stacking manure into long piles that are turned regularly with a front end loader. The advantages of windrow composting are that it requires no source of electricity and windrows can be built in the fields where the compost can be used. Labor intensity is a negative of this method because the temperature of the pile must be monitored often to avoid odor problems and to ensure the ingredients are composting correctly.

**Passively Aerated- Pile Composting** involves placing the manure in piles on top of a bed of coarse materials such as gravel or wood chips. A network of pipes runs through the material to provide aeration. Advantages of are that it requires less labor than windrow composting and uses no electricity. However, the process takes longer to complete. This method differs slightly from the *Aerated Static-Pile Composting* which requires a power sources to mechanically force air through aeration pipes.

For additional methods visit: extension.psu.edu.

*Photo by Jamie Taylor*

*A large windrow system. Breathable tarps allow for better control of moisture, heat and other factors that affect compost quality.*

## ELEMENTS OF COMPOSTING

Microbes have similar environmental needs as people. Elements important for rapid, efficient composting, include:

### Moisture

Compost should be kept moist, but not soggy. An ideal moisture level is 40-60%. A handful of compost will feel wet but water cannot be squeezed out of it.

### Aeration

Microbes need oxygen to break down organic materials efficiently. You can aerate your manure compost by turning the pile, adding bulking items (twigs, straw, etc.), or physically probing the pile to create air passageways.

### C:N Ratio

Scientists speak of an ideal ratio of Carbon to Nitrogen of 30 to 1, as measured on a dry weight basis.

### Pile Temperature

Maintaining a minimum pile temperature of 131°F for 3 days is desirable to destroy weed seeds or plant pathogens.

### Particle Size

Reducing the particle size of raw materials will increase the speed of the composting process to a point. However too small of particles can reduce the rate and quality of compost.

### Pile Size

The volume of your manure pile should decrease by 50% within 3 to 6 months depending on the balance of the conditions previously listed.

## WATER QUALITY PROTECTION AND RUNOFF MANAGEMENT

Just like manure piling areas, managing manure compost runoff is very important. Avoid piling in hydrologically sensitive areas and consider the following when choosing a compost site on your property.

**Soil Type** Soils can impact site design in a variety of ways. Intermediate soil types are recommended. A compost facility on soils with moderate permeability will reduce runoff generated without excessive nitrate infiltration to groundwater.

**Soil Nutrient Content** It is important to monitor the nutrient ratio of compost for Nitrogen and Phosphorus. If used to meet N needs, P applications will greatly exceed P crop removal. Test soils and monitor soil test P levels to avoid the buildup, and runoff, of excessive nutrients.

**Slope** Slope of the area to either divert uphill water away from the site or collect site runoff for management should be considered in the design process. Diversion ditches and berms which divert water around the site are recommended to help minimize runoff.

*An example of poor composting location and practice: A single stagnant pile next to a drainage way.*

**Filter Strips** Perhaps one of the most important factors is having adequate filtration between the compost site and a water source. Vegetated filter strips slow the motion of runoff and can help filter, absorb, and minimize pollutant migration. In New York State, horizontal buffers are required to be a minimum of 200 feet from wells or surface water bodies and 25 feet from drainage swales.

| SYMPTOM | PROBLEM | SOLUTION |
|---|---|---|
| Pile is wet and smells like a mixture of rancid butter, vinegar and rotten eggs | Not enough air<br>Or too much nitrogen or too wet | Turn pile<br>Mix in straw, sawdust or woodchips<br>Turn pile and add straw, sawdust or woodchips<br>Provide drainage |
| Pile does not heat up | Pile is too small<br>Or pile is too dry | Make pile larger or provide insulation<br>Add water while turning the pile |
| Pile is damp and sweet smelling but will not heat up | Not enough nitrogen | Mix in grass clippings, food scraps or other sources of nitrogen |
| Pile is attracting animals | Meat and other animal products have been included<br>Or food scraps are not well covered | Keep meat and other animal products out of the pile Enclose pile in 1/4 inch hardware cloth<br>Cover all food with brown material such as leaves, wood chips, or finished compost |

# SUMMARY OF USDA NATURAL RESOURCES CONSERVATION SERVICE - NY CONSERVATION PRACTICE STANDARD

## Nutrient Management Code 590

### DEFINITION OF NUTRIENT MANAGEMENT:

Nutrient Management is managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments. This practice is applicable to all lands where plant nutrients and soil amendments are applied.

### PURPOSE OF NUTRIENT MANAGEMENT:

- To budget, supply, and conserve nutrients for plant production.
- To minimize agricultural nonpoint source pollution of surface and groundwater resources.
- To properly utilize manure or organic by-products as a plant nutrient source.
- To protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates.
- To maintain or improve the physical, chemical, and biological condition of soil.

### GENERAL CRITERIA APPLICABLE TO ALL PURPOSES:

A nutrient budget for nitrogen, phosphorus, and potassium must be developed that considers all potential sources of nutrients including:

- Green manures
- Legumes
- Crop residues
- Compost
- Animal manure
- Organic matter
- Organic by-products
- Bio-solids
- Process waste water
- Soil biological activity
- Commercial fertilizer
- Irrigation water

The New York Nitrate Leaching Index (NY NLI) must be completed on all fields.

The New York Phosphorus Runoff Index (NY P Index) must be completed on all fields.

To optimize nutrient availability and utilization, soil pH must be maintained in a range appropriate for the crops in the rotation. Refer to Cornell University guidance for recommended crop pH levels.

### SOIL, MANURE, AND TISSUE SAMPLING AND LABORATORY ANALYSES

Nutrient planning must be based on current soil, manure, and (where used as supplemental information) tissue test results developed in accordance with Cornell University guidance, or industry practice, if recognized by the University.

Soil tests must be taken at least every three years, not to extend beyond the spring of the fourth crop year.

### NUTRIENT APPLICATION RATES

Determination of the nutrient application rate must be based on crop/cropping sequence; current soil test results; soil type; N contributions from any manure applications in the past two years, soil organic matter, and prior crops; crop yield potential; other current year nutrient applications; the NY P Index; the NY NLI; and any other applicable field-specific risk factors.

#### Nutrient Application Timing and Placement – Core Risk Assessments

Timing and placement of all nutrients must correspond as closely as practical with plant nutrient uptake (utiliza-

tion by crops), and consider nutrient source, cropping system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment results.

The planned rates of nitrogen application must be consistent with the NY NLI risk assessment and associated management recommendations per field.

A NY NLI greater than 10 indicates that the potential for nitrate leaching below the root zone and into groundwater is high and at least one of the following management practices must be implemented:

- Winter hardy cover crops or perennial grass hay fields or pasture to take up excess nitrogen, especially when fall manure is applied;
- Limiting fall manure N applications to the greater of 50 lbs/acre of first year available N or 50% of the expected N requirement of next year's crop;
- Foregoing fall incorporation of sods until spring to conserve nitrogen; etc.

The planned rates of phosphorus application must be consistent with NY P Index risk assessments and associated management recommendations per field.

**Nutrient Application Timing and Placement – Manure Application Setbacks:**

Setbacks from wells and down-gradient surface waters, surface inlets, sinkholes, swallets, and springs must be maintained for mechanical applications of manure, litter, and process wastewater.

One of the following minimum flow path distances must be maintained between manure applications and surface waters and surface inlets:

- A 100-foot setback; or
- A 35-foot setback, where the entire setback width is a vegetated buffer; or
- A 15-foot setback with incorporation within 24 hours of application.

The minimum spreading setback requirement for wells and down-gradient springs is a 100-foot setback, unless specific evidence shows that it can be done without contamination.

The minimum spreading setback requirement for down-gradient sinkholes and swallets is a 100-foot setback.

If operating near a public water supply (surface water or wellhead), employ additional setbacks as required by state and local rules.

**Nutrient Application Timing and Placement – Frozen, Snow Covered, and/or Saturated Conditions:**

Nutrients must not be mechanically surface-applied if a high probability of offsite nutrient loss is identified. Except as specifically defined, this precludes spreading when the following field conditions are present: *frozen and/or snow-covered soils* or when soils are *saturated from rainfall or snow melt*, as indicated by visible water on the soil surface with the potential to runoff (isolated areas of saturation not prone to runoff must be avoided, but do not prohibit spreading on a given field).

In instances where mechanical surface applications of manure, litter, or process wastewater to frozen and/or snow covered soils are necessary, the applications will:

- Be in accordance with the Cornell University Nutrient Guidelines, NY P Index, NY NLI, and RUSLE2;
- Be based on a check of the 48 hour weather forecast to assess if rainfall and/or temperatures are predicted to cause snowmelt and/or runoff conditions;
- Not be applied to soils designated by the soil survey as frequently flooded;
- Be in accordance with Section 1 ("Limestone areas") in "Manure and Groundwater: the Case for Protective Measures and Supporting Guidelines" for fields with soils less than 40 inches deep over carbonate bedrock;
- Not be within a 100-foot flow path distance from surface waters, surface inlets, springs, sinkholes, and swallets;
- Not be within 100 feet of wells; and not be applied in concentrated flow areas (i.e., well-defined channels within fields).

**Nutrient Application Timing and Placement – Temporary Manure Piles:**

When no storage is required by the nutrient management plan (and no waste storage facility exists on the farm), areas for temporary manure piles will be identified to safely pile manure during adverse field conditions and temporary seasonal crop constraints. Temporary manure pile areas are appropriate only for manure having a moisture content that allows it to be stacked.

Temporary manure piles must be removed and land applied according to the requirements of this standard as soon as practicable after favorable field conditions

for manure spreading return. *Temporary manure pile areas are not intended for accumulating large volumes of manure over long durations, but rather smaller volumes during conditions not conducive for field application.*

Temporary manure pile area(s) must be located:

- With at least a 300-foot setback from all wells;
- With at least a 300-foot flow distance to the nearest down-gradient watercourse;
- where the flow path provides diffuse overland flow;
- Where clean water runoff will be excluded from the temporary manure pile area;
- Where there are no groundwater springs, seeps, subsurface drainages, or longstanding groundwater concerns;
- Where access is practicable during poor weather conditions such as excessive ice, snow, or muddy ground;
- Not on soils designated as occasionally flooded or frequently flooded by the soil survey unless justified otherwise based on field observation and documented by the planner.

**Nutrient Application Timing and Placement – Additional Risk Reduction Measures:**

Nutrients must be applied with the right placement, in the right amount, at the right time, and from the right source to minimize nutrient losses to surface and groundwater. One or more of following nutrient use efficiency strategies or technologies must be used:

- Enhanced efficiency fertilizers (nitrification and urease inhibitors, slow and controlled release fertilizers);
- Incorporation or injection;
- Timing and rate of applications;
- Soil nitrate and organic N testing;
- Coordinating nutrient applications with optimum crop nutrient uptake;
- Corn Stalk Nitrate Test (CSNT), Pre-Sidedress Nitrate Test (PSNT), and Illinois Soil Nitrogen Test (ISNT);
- Tissue testing, chlorophyll meters, and spectral analysis technologies;

Other Cornell University recommended technologies that improve nutrient use efficiency and minimize surface or groundwater resource concerns;

- Application of fertilizer N no more than 30 days before planting spring planted crops; and/or
- In-season N fertilizer applications completed in accordance with Cornell Guidelines for Field Crops or adaptive N management techniques.

**CONSIDERATIONS:**

**Nutrient Application Rates, Timing, Form, and Placement – Frozen and/or Snow Covered Conditions:**

- Limit applications during frozen and/or snow covered conditions to daily production amounts.
- Reduce application rates.
- Apply only solid manure.
- Prioritize applications to fields with significant surface residue (e.g., residues associated with perennial hay, corn grain, cover crop, small grain, etc.).

- Prioritize applications to fields with longer flow distances to water, mild slopes, and/or few or no concentrated flows.

### Nutrient Application Timing and Placement – Additional Risk Reduction Measures

- Use split applications of nitrogen to deliver nutrients during periods of maximum crop utilization.
- Apply nitrogen and/or phosphorus fertilizer in a band to improve nutrient availability.
- Incorporate surface-applied manures or organic by-products if precipitation capable of producing runoff or erosion is likely within the time of planned application.

### Conservation Practices to Reduce Nutrient Runoff and Improve Nutrient Recycling

- Use manure management conservation practices to manage manure nutrients to limit losses prior to nutrient utilization.
- Use legume crops and cover crops to provide nitrogen through biological fixation and nutrient recycling to reduce nitrogen inputs for subsequent crops.
- Use practices such as cover crops, crop rotations, crop rotations with perennials, strip cropping and contour farming to reduce runoff, increase infiltration, reduce erosion, improve nutrient cycling, and reduce energy inputs and improve soil health.
- Use conservation practices that will act as buffers to trap sediment and nutrients before entering surface waters, such as filter strips, contour buffer strips, and riparian forest buffers. These practices can also reduce the loss of nitrates and soluble phosphorus.
- Use high-efficiency irrigation technologies (e.g., reduced-pressure drop nozzles for center pivots) to reduce the potential for nutrient losses.
- Use no-till/strip-till in combination with cover crops to sequester nutrients, increase soil organic matter, increase aggregate stability, reduce compaction, improve infiltration, and enhance soil biological activity to improve nutrient use efficiency.
- Modify animal diets to reduce nutrient imports and the nutrient content of manure following the NRCS Feed Management Conservation Practice Standard (592).

## OPERATION AND MAINTENANCE

Conduct periodic plan reviews to determine if adjustments or modifications to the plan are needed. At a minimum, plans must be reviewed and revised as needed based on new soil analyses, with changes in manure volumes or analyses, and/or with changes in crop management.

If concerns are suspected, fields receiving animal manures and/or biosolids must be monitored for the accumulation of heavy metals and phosphorus in accordance with Cornell University guidance and State law.

Significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation for the change.

All manure in temporary piles will be applied to fields according to the nutrient management plan when favorable field conditions for manure spreading return. Pile areas will be re-graded and re-vegetated as soon as practicable after removal of manure.

Records must be maintained for at least 5 years to document plan implementation and maintenance. As applicable, records include:

- Soil, plant tissue, water, manure, and organic by-product analyses resulting in recommendations for nutrient application;
- Quantities, analyses, and sources of nutrients applied;
- Dates and method(s) of nutrient applications, source of nutrients, and rates of application;
- Dates that temporary manure pile areas are utilized when manure application cannot be achieved;
- Weather conditions and soil moisture at the time of application;
- Lapsed time to manure incorporation;
- Irrigation events;
- Crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and crop residues removed;
- Dates of plan review, name of reviewer, and recommended changes resulting from the review;
- All enhanced efficiency fertilizer products used.

# RESOURCES

**Introduction to Nutrient Management**
Authored by: **Paul Cerosaletti,** Cornell Cooperative Extension of Delaware County, Nutrient Management Team Leader of NYC Watershed Agricultural Program

**Record Keeping**
Authored by: **Kari Shaw,** *Nutrient Management Specialist (Small Farms Program),* Watershed Agricultural Council

**On-Farm Waste Management**
emswcd.org/on-your-land/on-your-farm/horses-and-livestock/manure/

nrcs.usda.gov/wps/portal/nrcs/site/ny/home/

**Field Hydrology**
Authored by: **Paul Cerosaletti,** Cornell Cooperative Extension of Delaware County Nutrient Management Team Leader of NYC Watershed Agricultural Program

**Parasite Management**
Authored by: **Elizabeth Frisbee**, MPH, LVT. SUNY Delhi, Assistant Professor in Veterinary Science Technology

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Authored by: **Dale Dewing,** Cornell Cooperative Extension of Delaware County, Watershed Team Leader of NYC Watershed Agricultural Program
Cornell Guide for Integrated Filed Crop Management

**Basic Forage Crop Production**
Authored by: **Paul Cerosaletti,** Cornell Cooperative Extension of Delaware County, Nutrient Management Team Leader of NYC Watershed Agricultural Program

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nrcs.usda.gov/wps/portal/nrcs/site/ny/home/

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*Photo by Kristen Artz, NYC DEP.*

# UNDERSTANDING YOUR NUTRIENT MANAGEMENT PLAN

### FARM OUTLINE MAP

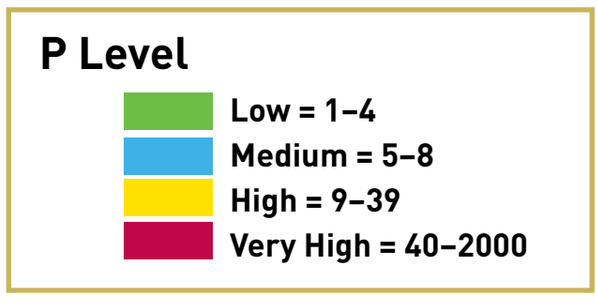
A map which outlines all of the field boundaries in your WFP that you own and/or operate. It is important to work with your Nutrient Management Planner and soil sampler to make sure all of the fields you own/operate are included in your Nutrient Management plan and sampled according to management.

- The Farm Outline Map gives a clear overview of the land included in your NMP.
- Tract numbers are based off of FSA.
- Tracts are differentiated using different outline colors.
- Fields and pastures numbers are labeled inside each field.
- Your included soil sample results correspond with represented tracts and field numbers.

### P LEVEL MAPS

Phosphorus (P) is the key nutrient we focus on in the NYC Watershed as it contributes the greatest to eutrophication of our reservoirs. For this reason, phosphorus management is crucial when developing your plan, and P levels are well represented in your P level Maps.

- Your P level maps illustrate the phosphorus levels in each field.
- P levels are based on the most recent soil samples taken.
- Fields are shaded with hash marks to depict P level amounts.




- The P lbs/ acre for each field are also indicated numerically.
- Fields with low to medium soil test phosphorus levels have a greater likelihood of a crop response if additional P is applied.
- Fields with high and very high soil test phosphorus have an increased risk for movement of P into streams with no additional benefit to crop growth if P is applied.
- For this reason, your Nutrient Management Planner may reduce rates of manure on fields with high P levels or alter timing of application to avoid P runoff and increased buildup of P content.

### SOIL SAMPLE RESULTS

An agronomic soil test is an *INDEX* of nutrient availability, something we can measure that is correlated with a likeliness of a crop response. An agronomic soil test is NOT a measure of the total amount of a nutrient in the soil.

- The probability of crop response to added nutrients is estimated when soil tests are classified as high, medium, or low. These classifications are matched with recommended fertilizer rates.
- Refer to sections 5-9 for more information on understanding and improving your farm's nutrient, fertilizer, and pH balance.

# STEPS TO IMPLEMENT YOUR FARM NUTRIENT MANAGEMENT PLAN

Check off as completed:

☐ 1. Review the soil sample reports and P level maps for your farm (in back pocket of this guide). Note the fields that have high soil phosphorus levels. Fields that have "Very High" P levels (Greater than 40 pounds per acre $P_2O_5$)should receive limited to no manure applications, especially if animals loaf or pasture in these areas, and will be depositing manure there. If applying manure nutrients mechanically or by hand, target applications to fields with lower soil nutrient levels.

☐ 2. Examine your fields to determine where flow paths are and where water may leave the field and enter water courses (see Section 4 – "Field Hydrology"). Determine where manure spreading setbacks should be located (35 feet year round; 100 ft. in winter) and avoid applying manure in these areas if mechanically or hand spreading manure. Limit livestock access to these setback areas to establish a good vegetated buffer.

☐ 3. If piling manure, determine proper siting locations of piles (see Section 2 – "On Farm Waste Management").

☐ 4. If piling manure and not field applying, contact your nutrient management or whole farm planner to determine appropriate options for manure export from farm.

☐ 5. Determine from soil test results if fields/pastures require lime application to manage soil pH for optimum crop growth. Apply lime according to soil test and adjusted for lime ENV (see Section 10 – "Soil pH and Liming") as able.

☐ 6. Determine if commercial fertilizer applications, pest control, compost or additional manure applications might be helpful to achieve crop production goals. (Contact your nutrient management planner for assistance if necessary).

☐ 7. Keep records of manure, compost and fertilizer applications as well as animal grazing (see Section 3 - "Recording Keeping").

☐ 8. Review implementation of your nutrient management plan and any animal waste management issues with your whole farm planner during your Annual Status Review (ASR) meeting. Please share with your planner during that meeting if you are having trouble implementing any part of your plan.



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