

# WHOLE FARM CONSERVATION **BEST PRACTICES** MANUAL



Development of this Whole Farm Conservation Best Practices Manual was led by the Conservation Learning Group at Iowa State University Extension and Outreach.

The Conservation Learning Group is a collaborative team that strives to advance training, outreach, and research across land uses and production systems to increase overall sustainability of agricultural and natural systems for multiple generations to come.

#### **Conservation systems summit participants:**

Iowa State University Extension and Outreach

United States Department of Agriculture–Natural Resources Conservation Service

United States Department of Agriculture–Agricultural Research Service

Practical Farmers of Iowa

Iowa Soybean Association

Iowa Agriculture Water Alliance

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# SCIENCE + SUPPORT = **SOUND STEWARDSHIP**

Improving water quality, soil health, and wildlife habitat while remaining productive and profitable is the focus of many conservation efforts in Iowa. There has been extensive education and outreach programming to increase awareness of whole farm water quality, soil health, and wildlife habitat practices. Confidence in practice selection and management is essential for moving from awareness to implementation. However, recommendations for practice selection and management have varied depending on the organization providing advice, leading to uncertainty among farmers and landowners.

In 2019, the Conservation Learning Group brought together a group of leading scientists and technical specialists in Iowa for a series of four conservation systems summits to **build consensus on the best management recommendations** for farmers and landowners getting started with conservation and water quality practices. This manual is the final product of those summits—a one-stop shop intended to help select and incorporate the in-field and edge-of-field conservation practices most appropriate to the decision maker's land and preferences.

This Whole Farm Conservation Best Practices Manual complements the United States Department of Agriculture–Natural Resources Conservation Service's conservation planning process. Foundational to the conservation planning process is decision makers understanding their resources, wider natural resource concerns and opportunities, and the broad effects of their land management choices. This manual provides a science-based framework to support decision makers in the conservation planning process and in adopting sound conservation practices on the land.

# Conservation Practices at a Glance

| Practice          | ABILITY TO ADDRESS RESOURCE CONCERN |            |                         |                   |            |         |            |
|-------------------|-------------------------------------|------------|-------------------------|-------------------|------------|---------|------------|
|                   | Soil Health                         |            | Nutrient Loss Reduction |                   |            | Habitat |            |
|                   | Impact                              | Confidence | Nitrogen Impact         | Phosphorus Impact | Confidence | Impact  | Confidence |
| Cover Crops       |                                     |            |                         |                   |            |         |            |
| No-tillage        |                                     |            |                         |                   |            |         |            |
| Strip-tillage     |                                     |            |                         |                   |            |         |            |
| N Management      |                                     |            |                         |                   |            |         |            |
| P Management      |                                     |            |                         |                   |            |         |            |
| Diverse Rotations |                                     |            |                         |                   |            |         |            |

## LEGEND



**Strong**



**Moderate**



**Weak**



**No Impact**

**Anecdotal Evidence**

**Multiple Studies**

**Scientific Consensus**



| Practice                        | ABILITY TO ADDRESS RESOURCE CONCERN |            |                         |                   |            |         |            |
|---------------------------------|-------------------------------------|------------|-------------------------|-------------------|------------|---------|------------|
|                                 | Soil Health                         |            | Nutrient Loss Reduction |                   |            | Habitat |            |
|                                 | Impact                              | Confidence | Nitrogen Impact         | Phosphorus Impact | Confidence | Impact  | Confidence |
| Wetlands                        |                                     | ✓✓         |                         |                   | ✓✓✓        |         | ✓✓✓        |
| Multipurpose Oxbows             |                                     | ✓✓         |                         |                   | ✓✓✓        |         | ✓✓✓        |
| Saturated Buffers               |                                     | ✓✓         |                         |                   | ✓✓✓        |         | ✓✓✓        |
| Bioreactors                     |                                     | ✓✓         |                         |                   | ✓✓✓        |         | ✓✓✓        |
| Field Buffers                   |                                     | ✓✓✓        |                         |                   | ✓✓         |         | ✓✓✓        |
| Controlled Drainage             |                                     | ✓✓         |                         |                   | ✓          |         | ✓✓         |
| Terraces                        |                                     | ✓✓✓        |                         |                   | ✓✓         |         | ✓✓✓        |
| Ponds                           |                                     | ✓✓         |                         |                   | ✓          |         | ✓✓✓        |
| Water/Sediment Control Basins   |                                     | ✓✓         |                         |                   | ✓✓✓        |         | ✓✓✓        |
| Grassed Waterways               |                                     | ✓✓✓        |                         |                   | ✓✓         |         | ✓✓✓        |
| Strategically Placed Perennials |                                     | ✓✓         |                         |                   | ✓✓         |         | ✓✓✓        |
| Prairie Strips                  |                                     | ✓✓✓        |                         |                   | ✓✓         |         | ✓✓✓        |
| Windbreaks                      |                                     | ✓✓         |                         |                   | ✓✓         |         | ✓✓✓        |
| Riparian Forest Buffers         |                                     | ✓✓✓        |                         |                   | ✓✓✓        |         | ✓✓✓        |
| Bottomland Timber Establishment |                                     | ✓✓✓        |                         |                   | ✓✓✓        |         | ✓✓✓        |

\* Soil health improvement occurs within the practice footprint. However, no improvement is measured in the rest of the field.

# Potential habitat impact if pollinator habitat is installed above the practice.

## LEGEND



**Strong**



**Moderate**



**Weak**



**No Impact**

✓ **Anecdotal Evidence**

✓✓ **Multiple Studies**

✓✓✓ **Scientific Consensus**





# In-Field Conservation Practices That Work

This section includes:



**Tillage Management**



**Cover Crops**



**Diverse Rotations**

Iowa farmers constantly seek to lower production costs, protect the environment, and conserve natural resources. Adopting conservation practices works hand-in-hand with paying attention to the basics of production efficiency to achieve all three of these goals.

Conservation agriculture improves crop yields and supports the long-term environmental and financial sustainability of farming. The guidelines in this section are built upon the principles of conservation agriculture:

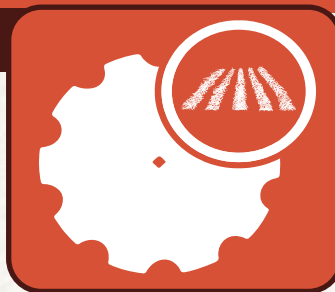
- ✓ Maintain soil cover
- ✓ Maximize living roots in soil
- ✓ Minimize soil disturbance
- ✓ Increase the diversity of plant species

These principles of conservation agriculture support Iowa's commitment to reduce nutrient loading through the Iowa Nutrient Reduction Strategy, developed as part of the 2008 Gulf of Mexico Hypoxia Action Plan. This comprehensive plan calls for the reduction of total nitrogen and phosphorus loadings to the Gulf of Mexico by 45 percent over the coming decades, achieved through a combination of strategically implemented practices, both in-field and edge-of-field, and high rates of conservation practice adoption statewide.

## Cropping Systems for Conservation

Incorporating conservation practices in the field begins with the choices you make about crops, rotation, tillage, fertilization, and pest management. Conservation agriculture employs a cropping-systems approach that builds soil organic matter and soil structure, controls soil erosion, and conserves soil water, reducing the loss of nutrients and soil to surface and ground water. It enhances the long-term productivity of soil and maximizes economic returns.

Iowa farmers have traditionally used one of three cropping systems: the corn-soybean rotation, two years of corn followed by one year of soybean (corn-corn-soybean), and continuous corn, usually with full-width tillage of all fields. Conservation-minded Iowa farmers consider incorporating three major conservation practices in their fields: switching to no-tillage or strip-tillage, planting cover crops, and incorporating small grains into their crop rotations.



### No-tillage and Strip-tillage

Full-width tillage, disturbing of the soil surface in preparation for spring planting, leaves Iowa's productive topsoil and its rich nutrients vulnerable to erosion by wind and water. No-tillage and strip-tillage systems better protect the soil from erosion by minimizing soil surface disturbance.

In a **no-tillage** system, crops are sown into undisturbed soil with plant residue on the surface. In Iowa, no-tillage is recommended for planting soybean following corn, for planting corn following soybean on well-drained soils, and for any rotation on moderately sloped fields.

In a **strip-tillage** system, more than two-thirds of the row width is left undisturbed, and the remaining strip is tilled to create a seedbed for spring planting. In Iowa, strip-tillage is recommended for corn production in north central and central Iowa on poorly drained soils and low-sloped fields.

Consult the tillage management decision tools on pages 42 and 43 to determine whether no-tillage or strip-tillage best suits your field and cropping system.

### KEY PLANTER SETTINGS WITH NO-TILLAGE AND STRIP-TILLAGE

- **Ensure adequate weight and down pressure** on the toolbar.



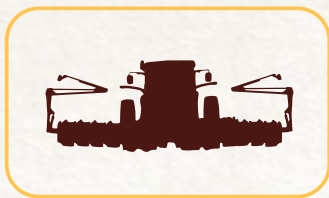
50 to 100 pounds of down pressure  
Best for drier conditions and firm fields



Reduce down pressure to avoid sidewall compaction  
Best for wetter conditions and loose seedbeds

- **Ensure adequate closing-wheel tension** to successfully close the seed furrow and provide good seed-to-soil contact.
- **Shift the planter row unit 3 to 4 inches** off the previous year's corn rows in no-tillage systems.
- **Adjust row cleaners** to move residue out of the row space with minimal soil disturbance and to avoid trenching.





## Planting and Harvesting

Planting into a no-tillage or strip-tillage system requires following the same fundamental principles that maximize production efficiency in a full-width tillage system:

- Wait for conducive field conditions with a soil temperature at 50°F and rising. At a soil temperature of 50°F or warmer, there is robust seed germination and vigorous seedling emergence, growth, and establishment.
- Avoid wet conditions that are conducive to excessive soil compaction, particularly with no-tillage as remediation can be more difficult.
- When planting corn into corn residue, fall strip-tillage is preferred over spring strip-tillage, and should be delayed in the fall as late as possible. Typically, “refreshing” fall strip-tillage strips prior to planting is not needed. If spring strip-tillage is required, soil conditions must be suitable, and strip-tillage should be done at least one week before planting. Real time kinematics (RTK) guidance systems may allow for easier direct planting into the tilled zone, but are not necessary for success.
- At harvest, use controlled traffic paths, and ensure uniform residue distribution across the harvest width. For no-tillage, avoid using a chopping corn head or stalk chopper.



## Fertilizing

No-tillage and strip-tillage systems do not require an increase in the total nitrogen applied for optimal crop yields. For no-tillage corn, using a split application with 20 to 30 pounds of nitrogen per acre at planting increases the potential for success.

The phosphorus and potassium fertility program under a no-tillage or strip-tillage system is similar to that for full-width tillage:

- Take composite soil samples for each zone or grid sample, and use the soil test analysis as the basis for nutrient application. In a strip-tillage system, the composite soil sample should include soil cores from between and within the strip zones.
- Knifed-in phosphorus (as compared to broadcast) does not increase crop yield, but does reduce losses to surface water.
- Starter fertilizer may be beneficial in a no-tillage system.





## Managing Pests and Disease

Seedling and foliar diseases may be more prevalent for pathogens that overwinter on crop residue in no-tillage and strip-tillage systems, so scout fields more frequently. Properly timed fall or spring herbicide programs will control winter annual weeds. Row cleaners in no-tillage and strip-tillage systems may create increased weed pressure when the equipment moves residue and soil away from the seedbed, especially when pre-emergence herbicides are applied prior to planting. No-tillage and strip-tillage systems reduce soil surface evaporation, allowing for better activation of certain herbicides.



# Tillage Management Guide



Use controlled traffic to minimize compaction.



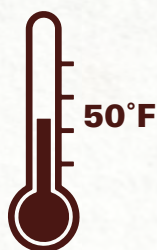
Ensure residue is evenly spread across the harvest width.



Base soil fertility program on composite soil samples from uniform management zones and grid samples.



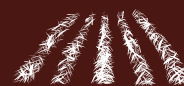
Follow proper maintenance and planter setup for optimum performance. Pay particular attention to row-unit down pressure, seeding depth, and closing-wheel tension.



Select corn and soybean planting dates based on ideal planting conditions (50°F soil temperatures and rising, suitable soil moisture).



Scout fields more frequently for insects and diseases (consult Iowa State field agronomist or private agronomist for assistance).



For strip-tillage, take soil cores from within and between strips.

## P&K

Injection of phosphorus and potassium reduces risk for loss and does not affect productivity compared to broadcast.

Starter phosphorus and potassium may be beneficial.

## Tillage Residue Management at a Glance

The table to the right summarizes common tillage management methods for corn and soybean rotations and assigns a relative success rate along with a level of confidence based on published research.

**Success with tillage residue management is defined by your ability to meet both row crop production and conservation goals.**

|  | Success Rate | Confidence |
|--|--------------|------------|
| Controlled traffic to minimize soil compaction         |              |            |
| Comparable profitability to full tillage on most soils |              |            |
| Fertility program managed similarly to other systems   |              |            |
| Scouting early and often                               |              |            |

## LEGEND



Strong



Moderate



Weak



No Impact



Anecdotal Evidence

Multiple Studies



Scientific Consensus





**Cover crops** are plant species, such as oats and cereal rye, planted to reduce soil erosion, improve soil health, and provide water quality benefits during the months of the year when crops are not actively growing on farmland. Utilizing cover crops improves soil health by:

- ✓ Improving soil structure.
- ✓ Reducing soil compaction.
- ✓ Protecting the soil surface.

Cover crops are seeded in the fall, either before or after harvest. They are not harvested as grains, but can be grazed or harvested as forage. Cover crops go hand-in-hand with no-tillage and strip-tillage.

Cover crop choices and seeding specifications vary depending on crop rotation and preferences. The cover crop decision tools on pages 44 through 47 will help you choose and manage the most appropriate cover crops for your situation.

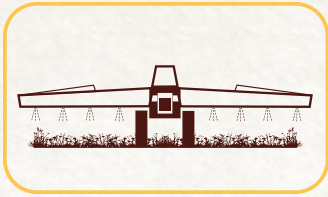
Seeding a winter cereal grain cover crop ahead of corn and soybean does not require any drastic changes in corn or soybean management practices.



### Plant Cover Crops in the Fall

- Aerial and overseeded cover crops do not interfere with harvest. Aerial overseeding a cereal grain in a corn-soybean rotation between August 20 and September 10 offers an expanded season to establish the cover crop. The recommended aerial seeding rate is 60 pounds per acre for oats and 45 pounds per acre for cereal rye.
- Drilling immediately after harvest is also an option for winter cereal grains and oats. Harvest corn and soybean as soon as possible if you're planning for drilled cover crop seeding. Choose corn and soybean maturities that are within the well-adapted range for your area. Drill winter cereal grains at the seeding rate of 45 pounds per acre, ideally before October 15 and no later than November 1. Drill oats as a cover crop before September 15 at the seeding rate of 60 pounds per acre.
- Timely rainfall is critical for cover crop germination, especially for aerial or overseeded cover crops.





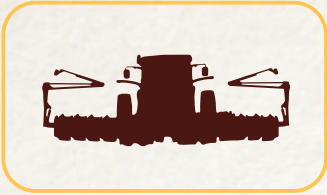
## Terminate Cover Crops in the Spring

- Cover crops that survive the winter must be terminated in the spring ahead of planting, to avoid affecting corn and soybean crop yields. With corn, terminate the cover crop before it is 8 inches tall, or 10 to 14 days before planting corn. With soybean, terminate the cover crop before it is 12 inches tall, or 3 to 7 days before planting soybean. If spring weather conditions are abnormally dry, terminate cover crops earlier than otherwise recommended.
- Terminate cover crops using glyphosate. Use the full label rate, and apply when days are warmer than 60°F and nights are above 40°F to increase effectiveness. Avoid using high amounts of ammonium sulfate or urea ammonium nitrate tank-mixed with the glyphosate. Always read and follow herbicide label instructions.

### SPRING TILLAGE OF A COVER CROP

**Spring tillage of cover crop residue is not recommended.** Tillage of cover crops that have been recently terminated, with minimal root decomposition, results in a rough seedbed. This creates a non-uniform seed depth and crop emergence.





## Spring Planting After the Cover Crop

Planting corn or soybean after a cover crop requires minimal change. Follow best management practices for the corn or soybean crop, and the fundamental principles that maximize production efficiency:

- Plant based on soil conditions, but realize that suitable soil conditions may be a day or two later than without cover crops.
- Wait for conducive field conditions with a soil temperature at least 50°F and rising. At a soil temperature of 50°F or warmer, there is robust seed germination, and vigorous seedling emergence, growth, and establishment.

### KEY PLANTER SETTINGS WITH A COVER CROP

- **Ensure adequate weight and down pressure** on the toolbar to attain desired planting depth. Check seed depth frequently as planting conditions change.



50 to 100 pounds of down pressure  
Best for drier conditions and firm fields



Reduce down pressure to avoid sidewall compaction  
Best for wetter conditions and loose seedbeds

- **Ensure adequate closing-wheel tension** to successfully close the seed furrow and provide good seed-to-soil contact.
- **Adjust row cleaners** to move residue out of the row space while leaving the soil undisturbed, using caution to avoid cover crops wrapping around the cleaners.



## NITROGEN MANAGEMENT WITH A COVER CROP

- **Move nitrogen application to the spring** close to the time of corn planting.
- **Starter fertilizers may be beneficial** to minimize impact of nitrogen immobilization due to cover crop root and residue decomposition.
- There is **no need to adjust nitrogen rates** following winter cereal-grain cover crops.



### Spring Management After the Cover Crop

- With corn following a winter cereal-grain cover crop, there is no need to change the nitrogen rate; however, wait to apply nitrogen fertilizer until after cover crop termination, to avoid the cover crop taking up the nitrogen. Starter fertilizer with 20 to 30 pounds of nitrogen per acre may be beneficial for corn following a cereal-grain cover crop.
- Corn and soybean fertility programs may need to be adjusted when adding a cover crop to the system, but many practices remain the same. The timing of phosphorus and potassium does not need to be adjusted. Apply manure based on developed manure management plans and according to best management practices; the growing cover crop will take up nutrients from the applied manure. Disturbance from manure application may be detrimental to some cover crop stands depending on the type of manure applicator injectors or disc covers used.
- Cereal-grain cover crops are typically tolerant of residual herbicides. Scout corn and soybean fields more frequently for insect and disease pressure, especially in a corn field following an overwintering cover crop.

## MANURE APPLICATION WITH A COVER CROP

















- **Apply following manure management plan** or Iowa State University recommendations.
- Manure application may be detrimental to cover crop stands, especially injected manure. Low-disturbance injection methods will reduce impact of manure application on cover crops.
- Cover crops are a good option for their ability to **uptake manure nutrients** that could otherwise be lost.

# Cover Crop Management at a Glance

The tables that follow summarize common cover crop species and management practices used in corn-soybean rotations, and assign a relative success rate along with a level of confidence based on published research. Success rate with cover crops is defined by a combination of reliable emergence, biomass accumulation, and ease of termination that enables the decision maker to meet both row crop production and conservation goals.











## Species

Success is defined by the ability of the species to accumulate biomass for desired cover crop benefits in corn-soybean rotations.

| Species      | Success Rate  | Confidence  |
|--------------|---|---|
| Oats         |    |    |
| Cereal rye   |    |    |
| Winter wheat |  |  |
| Vetches      |  |  |
| Clovers      |  |  |
| Rapeseed     |  |  |
| Turnips      |  |  |
| Radishes     |  |  |

## Seeding Method/Timing

Success is defined by reliable, uniform germination and growth of cereal grain cover crops to accumulate desired biomass.

| Seeding Method/Timing        | Success Rate  | Confidence  |
|------------------------------|---|---|
| Interseed                    |    |    |
| Overseed (aerial)            |    |    |
| Overseed (broadcast)         |  |  |
| Drill                        |  |  |
| Broadcast with incorporation |  |  |

## LEGEND



Strong



Moderate



Weak



No Impact

 Anecdotal Evidence









 Multiple Studies

 Scientific Consensus









## Termination Method

Success is defined by the ability to easily terminate an overwintering cover crop ahead of corn or soybean production.

| Termination Method | Success Rate  | Confidence  |
|--------------------|---|---|
| Mow                |  |  |
| Herbicide          |  |  |
| Crimper roll       |  |  |
| Tillage            |  |  |















## Nitrogen Management

Success is defined by the ability to manage nitrogen following a cereal grain cover crop without negative impact to the following corn crop.

| Nitrogen Management        | Success Rate  | Confidence  |
|----------------------------|---|---|
| No change in total N rate  |  |  |
| Starter nitrogen           |  |  |
| Split nitrogen application |  |  |







## Termination Timing

Success is defined by the ability to easily terminate an overwintering cover crop ahead of corn or soybean production to achieve row crop and conservation goals.

| Termination Timing       | Success Rate  | Confidence  |
|--------------------------|---|---|
| >14 days before corn     |  |  |
| 7-14 days before corn    |  |  |
| 0-7 days before corn     |  |  |
| >14 days before soybean  |  |  |
| 7-14 days before soybean |  |  |
| 0-7 days before soybean  |  |  |
| 0-7 days after soybean   |  |  |

## Crop Management

Success is defined by the ability to manage corn and soybean crops without yield penalty following a cover crop.

| Crop Management                      | Success Rate  | Confidence  |
|--------------------------------------|---|---|
| Use of well-adapted maturities       |  |  |
| Properly maintained/adjusted planter |  |  |
| Scouting early and often             |  |  |

# Cover Crop Management Guide



**Spring termination ahead of:**



**Corn**

10 to 14 days prior to planting or before 8 inches tall



**Soybean**

3 to 7 days prior to planting or before 12 inches tall

**Nitrogen management for corn following cereal rye:**



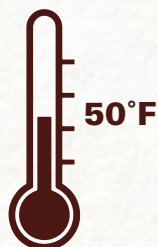
Move nitrogen application to the spring after cover crop termination.



Starter fertilizers may be beneficial to minimize impact of nitrogen immobilization due to cover crop root and residue decomposition.



No need to adjust total nitrogen rates following winter cereal-grain cover crops.



Select corn and soybean planting dates based on ideal planting conditions (50°F soil temperatures and rising, suitable soil moisture).



Follow proper maintenance and planter setup for optimum performance. Pay particular attention to row-unit down pressure, seeding depth, and closing-wheel tension.



Choose corn and soybean maturities that are within the well-adapted range for your area.



Scout fields with cover crops more frequently for insects and diseases (consult Iowa State field agronomist or private agronomist for assistance).





Crop rotations use different crop species on the same piece of land from one year to the next. A typical crop rotation system in Iowa is the corn-soybean rotation. A diverse crop rotation adds small grains, forage crops, or other summer annuals into a more traditional cropping system.

In Iowa, a common diverse rotation would include a year of winter small grain interseeded with red clover following a crop of soybean. A more diverse rotation would include two to three years of alfalfa or legume-grass mixtures managed for hay production or grazing.

Diverse crop rotations are a key component in achieving the principles of conservation agriculture, improving cropping systems by:

- ✓ Protecting the soil surface.
- ✓ Enriching the soil with additional organic matter and diverse biological activity.
- ✓ Controlling soil erosion.
- ✓ Maximizing the resilience of corn-based cropping systems to weather extremes and pest pressure.
- ✓ Reducing greenhouse gas emissions.
- ✓ Possibly decreasing application amounts for nitrogen and phosphorus by reducing the loss of these nutrients.

### SPRING SEEDING CONSIDERATIONS

**Oats are the most reliable spring small grain** in northern Iowa. Winter cereals have the potential to winter kill at northern locations.

Establishing a diverse crop rotation begins with planting a winter small grain—wheat, rye, or triticale—after the soybean harvest, by October 1 in northern Iowa and October 15 in southern Iowa. Another option is to plant a spring small grain—oats, wheat, triticale, or barley—the following spring.

Winter small grains can also be frost-seeded with red clover, or followed with a cover crop after harvest. Typically, spring small grains in Iowa can be sown alone, or companion-seeded with legumes such as alfalfa or red clover.



## Some Guidelines for Incorporating Small Grains:

- Avoid using variety not stated (VNS) seed for winter or spring small grains intended for grain harvest. Rather, plant seed of named varieties, tested for germination and weed seeds.
- Oats, drilled in spring, are more reliable than winter small grains north of Interstate 80, due to the potential for winterkill. Winter small grains are more successful south of Interstate 80, drilled before October 15.
- Plant oats at a seeding rate of 80 to 90 pounds pure live seed per acre. Plant winter small grains at a rate of 60 to 70 pounds pure live seed per acre with an adequate level of soil test phosphorus. Soil phosphorus is important for winter survival of small grains.

## NITROGEN MANAGEMENT WITH DIVERSE ROTATIONS

Account for nitrogen fixation legumes in the following crop.

**Apply 30 to 40 pounds of nitrogen per acre** to optimize small grain production.

- The extended soil surface cover by perennials like alfalfa or a legume-grass mixture in a diverse crop rotation reduces the loss of nitrogen and phosphorus. However, crop removal of phosphorus is greater with hay than with corn or soybean grain.
- Frost-seed red clover into winter small grains during the spring freeze-thaw period at 10 to 12 pounds per acre. Clip red clover and weeds one month after small-grain and straw harvest.
- In general, diverse crop rotations disrupt and potentially reduce disease pressure and insect cycles. However, consider applying a fungicide to control head blight of winter small grains and rust on oats.
- Increase seed quality with post-harvest aeration of small grains.
- Test wheat, rye, barley, and hulled oats for levels of vomitoxin before feeding to livestock.

Consult the diverse rotations decision tools on pages 48 through 51 for guidance in establishing a rotation that suits your location, cropping system, and preferences.

## TILLAGE MANAGEMENT WITH DIVERSE ROTATIONS

**Use no-tillage** for seeding small grains into corn or soybean residue.






**Plant no-tillage** corn or soybean into small grains or alfalfa, unless wildlife holes are problematic.



## Rotation

This table summarizes common crop rotations and assigns a relative success rate along with a level of confidence based on published research.









**Success is defined by the rotation's ability to meet both row crop and conservation goals.**

| Rotation  | Success Rate  | Confidence |
|---|---|------------|
| Continuous corn                                   |  | ✓✓✓        |
| Corn – soybean                                    |  | ✓✓✓        |
| Corn – soybean – small grain/red clover (3 years) |  | ✓✓✓        |
| Corn – soybean – small grain/alfalfa (5+ years)   |  | ✓✓✓        |
| #Energy crops                                     |  | ✓✓         |

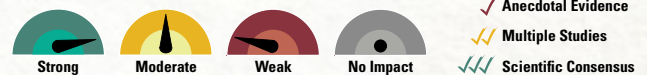
## Crop Management

This table summarizes common crop management practices in relation to the use of extended rotations and assigns a relative success rate along with a level of confidence based on published research.

**Success is defined by reliable crop growth to meet crop rotation and conservation goals.**

| Crop Management   | Success Rate  | Confidence  |
|---|---|---|
| Applying a reduced nitrogen rate to crop following legume |  |  |
| Planting winter cereal grains in southern Iowa            |  |  |
| Producing oats in northern Iowa                           |  |  |
| Scouting early and often                                  |  |  |

**LEGEND**







# Edge-of-Field Conservation Practices that Work

Edge-of-field conservation practices are designed to improve water quality by reducing the movement of either nitrogen or phosphorus, but rarely both. This is due to the way in which nitrogen and phosphorus move with water. Nitrogen, especially the nitrate-nitrogen form, is readily soluble in water. Nitrate-nitrogen is typically lost through leaching and found dissolved in subsurface and tile drainage water. Many edge-of-field practices for nitrate-nitrogen reduction focus on capturing tile drainage water and reducing the amount of dissolved nitrate-nitrogen.

Phosphorus, however, is typically bound to soil particles. When erosion occurs, the bound phosphorus is transported with sediment in surface runoff. Most edge-of-field practices for reducing phosphorus loss focus on reducing erosion or capturing sediment in surface runoff. For this reason, the edge-of-field conservation practices and decision trees in this manual are divided into two sections, Nitrogen Reduction Practices and Phosphorus Reduction Practices.

## A COMMITMENT TO CONSERVATION

Iowa has made a commitment to **reduce nutrient loading in the state's waterways** through the Iowa Nutrient Reduction Strategy, developed as part of the 2008 Gulf of Mexico Hypoxia Action Plan. This calls for the reduction of nutrient loadings to the Gulf of Mexico by 45 percent over the coming decades.



## Edge-of-Field Conservation Practices that Work: Nitrogen Reduction Practices

This section includes:



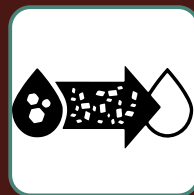
**Wetlands**



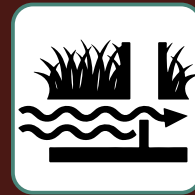
**Multipurpose  
Oxbows**



**Saturated  
Buffers**



**Bioreactors**



**Controlled  
Drainage**

In addition to incorporating conservation practices in the field, many Iowa farmers are adopting edge-of-field practices that help to significantly improve water quality in the state by managing the loss of nitrogen from cropland.

Approximately 50 percent of Iowa cropland has subsurface drainage, based on United States Department of Agriculture Census of Agriculture data from 2012 and 2017. While this subsurface drainage makes it possible to farm previously wet soils, the drainage system also carries dissolved nitrogen from farm fields to the streams, rivers, lakes, wetlands, and other surface waters of the state.

Excess nitrogen in surface water leads to local, regional, and national-level alterations to aquatic ecosystems resulting in decreased water clarity, increased algal growth, and oxygen deficiencies that cause fish kills and reduce biotic diversity. Excess nitrogen also harms potable water supplies. Nitrate-nitrogen concentrations above the 10 mg/L  $\text{NO}_3\text{-N}$  drinking-water standard established by the United States Environmental Protection Agency are not uncommon in Iowa in surface waters and groundwater.

Edge-of-field practices that address nitrogen loss can significantly reduce the amount of nitrate-nitrogen that leaves subsurface drainage networks. On average, nitrate-nitrogen is reduced by:

- ✓ 52 percent with water quality enhancement wetlands.
- ✓ 42 percent with multipurpose oxbows.
- ✓ 53 percent with saturated buffers.
- ✓ 43 percent with bioreactors.
- ✓ 32 percent with controlled drainage.

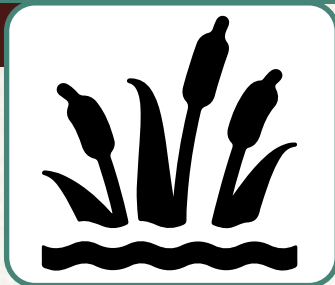


While nitrogen reduction edge-of-field practices have the potential to remove large amounts of nitrate-nitrogen from subsurface water, there is no one practice that works well at all sites. A combination of appropriate practice implementation and high adoption rates is needed to meet the nitrogen reduction goals of the Iowa Nutrient Reduction Strategy.

This section is intended to help you determine which nitrogen reduction edge-of-field practice is best suited for your needs—a sort of “office chair” suitability analysis to help determine the appropriate practice for a given location. The nitrogen reduction edge-of-field decision tools on pages 53 through 54 guide you through the process of determining whether edge-of-field practices will work at your site and help identify the most appropriate edge-of-field practice. Practice-specific decision tools follow on pages 55 through 59.





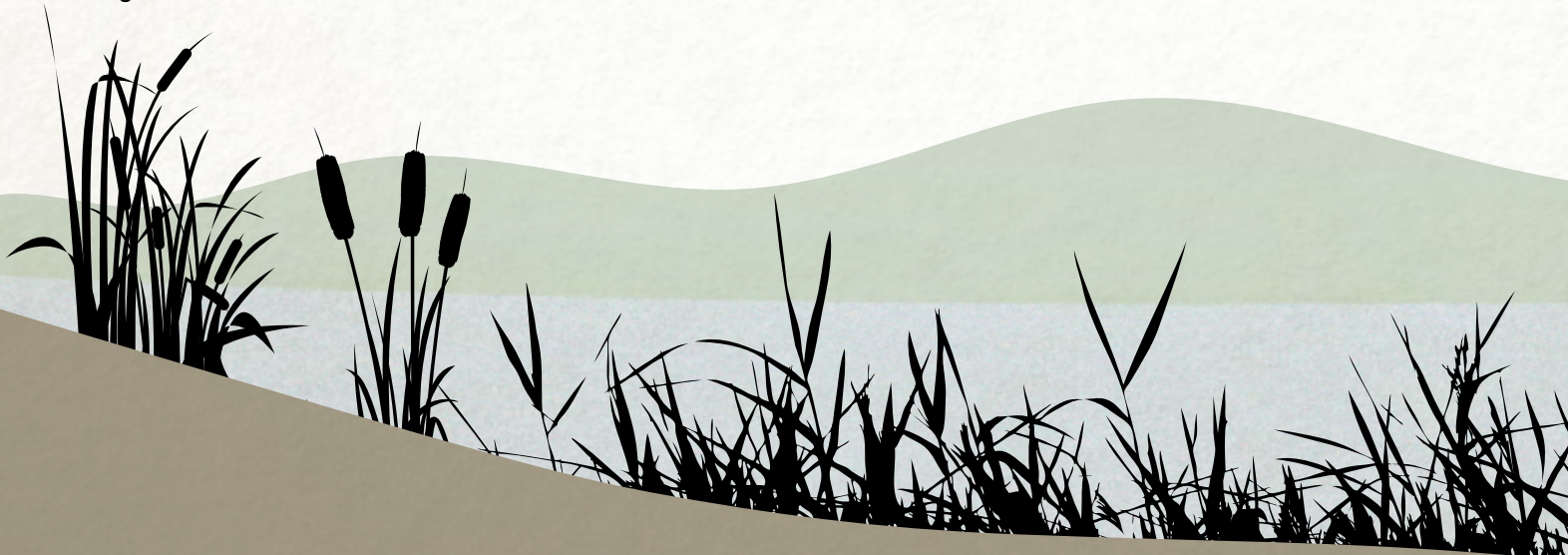


Several types of wetlands can be used in agricultural settings, depending on your goals. **If the primary goal of a wetland is to improve water quality**, water quality enhancement wetlands help to remove nitrogen through conversion of nitrate-nitrogen to nitrogen gas by microbial activity and through plant uptake. Ideally, water quality enhancement wetlands should have a pool footprint greater than or equal to 1 percent of the watershed area to be treated. The topography of the site should allow for a drop in elevation from the tile outflow to the surface of the standing water in the wetland to prevent backflow of water into the tile drain system.

Additional land is needed to allow a diverse buffer of wetland vegetation to develop around the shallow water pool. If the wetland footprint is in an area that could experience high sediment flow, a sedimentation basin or other structure will need to be considered. It is also important that water quality enhancement wetlands remain fish-free to reduce sediment disturbance and prevent unwanted loss of sediment, phosphorus, and nitrogen from the system.

**If the primary goal is to provide additional wetland habitat**, identifying low-profitability wet zones within the field can reveal locations that could be planted in perennial wetland vegetation.

Some must-have pieces of information for determining if a wetland could be a suitable edge-of-field practice for the site include a soils map, profitability maps, and knowledge of relationships to district infrastructure if the site is in a drainage district.



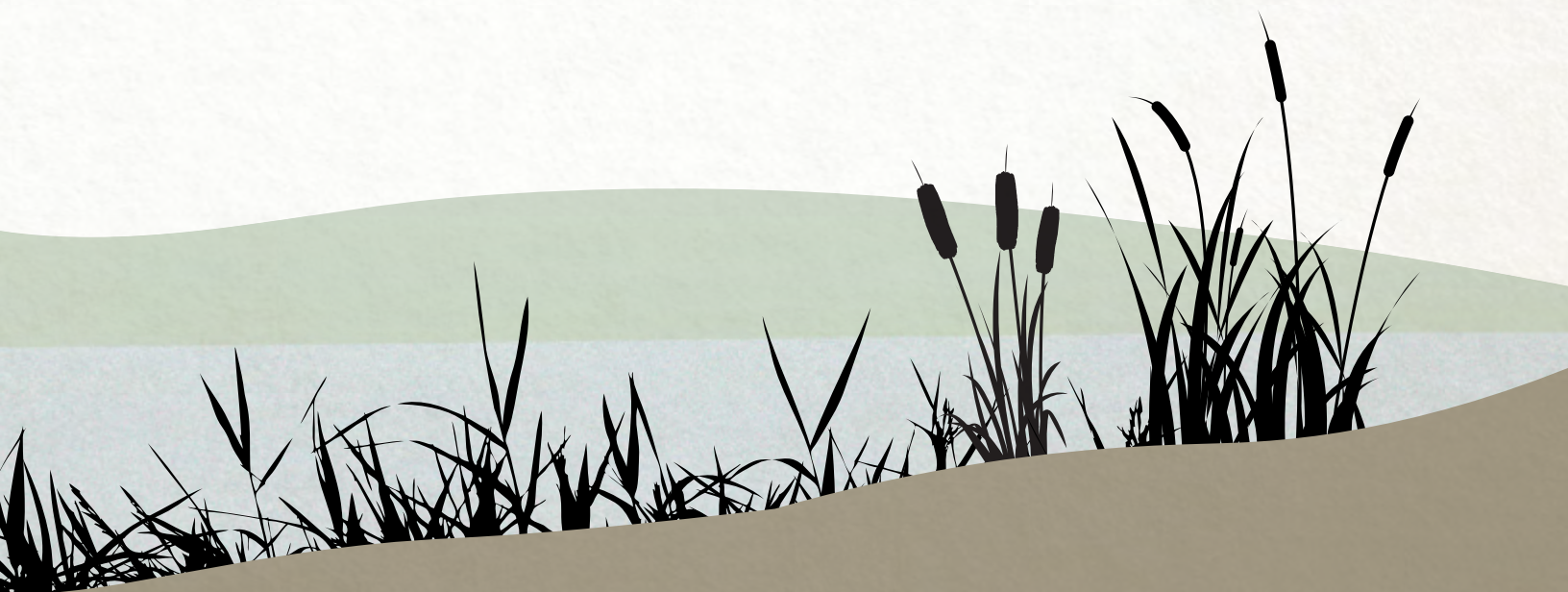




Multipurpose oxbows are **restored wetlands located adjacent to a stream or river that receive tile drainage water** and function to both reduce nitrate and provide aquatic habitat. Oxbow wetlands are old stream channel bends that have been cut off from the main stream channel over time either through channelization or natural processes.

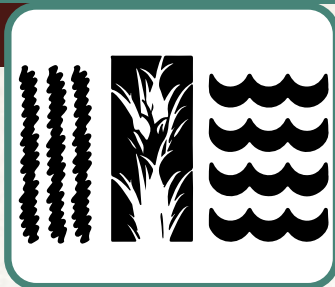
Ideally, multipurpose oxbow restorations should be situated in the floodplain in an area along the stream that does not exhibit any signs of channel instability, such as steep banks, bank sloughing, or bank undercuts. The multipurpose oxbow will also need to be in a site that has the topography to allow for a drop in elevation from the tile outflow to the surface of the standing water to prevent backflow of water into the tile drainage system. The basin footprint should be 1 to 2 percent the size of the drainage area to allow for optimum nitrate reduction. Multipurpose oxbows improve water quality through the conversion of nitrate-nitrogen to nitrogen gas by microbial activity. In addition to nitrate reduction and habitat, multipurpose oxbows can also provide flood water storage.

Some must-have pieces of information for determining if a multipurpose oxbow could be suitable for your site are historic aerial photos, a topographic map, and a drainage map.





## Saturated Buffers



Saturated buffers are established near streams or ditches by diverting the existing tile drainage outflow so that **water passes through the subsurface of a vegetated buffer prior to entering a waterway**. Saturated buffers help to remove nitrogen through conversion of nitrate-nitrogen to nitrogen gas by microbial activity, as well as through plant uptake. In addition to improving water quality, saturated buffers also can enhance stream- and ditch-side habitat.

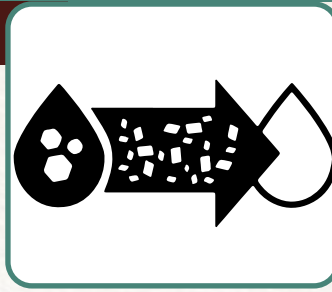
For this practice, it is beneficial to have a clay base layer to prevent undesired movement of water that could result in subsurface water bypassing the saturated buffer. Sites with open surface intakes in the drainage system are not ideal, as the soil and residue that may get into the drainage system via the surface intake could interfere with the movement of water into the saturated buffer. If surface intakes are present, additional precautions will be needed to reduce sediment flow into the saturated buffer.

Trees, both existing and newly planted, are an option within saturated buffers. If there are existing trees within the footprint of the saturated buffer, take extra care in setting distribution lines. Work to identify and remove aggressively rooting species, such as boxelder, willow, silver maple, and cottonwood, within 20 feet of the distribution lines. If tree seedlings are to be established within a saturated riparian forest buffer, space seedlings at least 20 feet from distribution lines and control structures and avoid establishing aggressively rooting species.

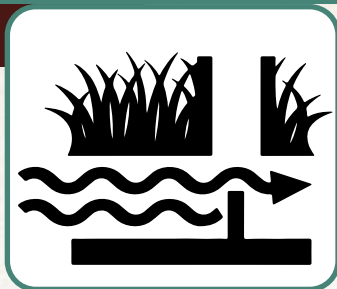
Use the [USDA's Saturated Buffer Viewer](https://acpfdata.gis.iastate.edu/ACPF/satbuff/) (<https://acpfdata.gis.iastate.edu/ACPF/satbuff/>) to determine if a saturated buffer would work on your site.







Bioreactors treat water from subsurface drainage systems by **diverting tile flow into an excavated trench filled with woodchips**. The woodchips provide carbon and attachment surfaces for microbial communities that convert nitrate-nitrogen to nitrogen gas. Ideally, bioreactors need relatively consistent tile flow to maintain saturated conditions in the bioreactor. Bioreactors cannot be placed in areas where surface flows may cause ponding of water on top of the bioreactor. It is important to keep the bioreactor footprint out of highly trafficked areas to prevent the compaction of woodchips within the trench. The presence of surface intakes requires additional consideration.



Controlled drainage uses existing tile drainage coupled with additional water control structures to help hold subsurface water in place when full drainage isn't needed and to prevent the loss of nitrogen through tile drain outflows. Water control structures are managed so that **subsurface water is drawn down** during periods of field work, such as during planting and harvesting. The **subsurface water level is then raised** outside of the growing season and after crop establishment.

Some must-have pieces of information for determining whether controlled drainage will work for your site include a drainage map, a topographic map, and a soils map. It is also helpful to have an understanding of your goals and your willingness and ability to manage such a system.





## Edge-of-Field Conservation Practices that Work: Phosphorus Reduction Practices

This section includes:



**Terraces**



**Ponds**



**Water and Sediment  
Control Basins**



**Grassed  
Waterways**



**Prairie Strips**



**Windbreaks**



**Riparian  
Forest Buffers**



**Bottomland Timber  
Establishment**

In addition to incorporating conservation practices in the field, many Iowa farmers are adopting edge-of-field practices that help to significantly improve water quality in the state by managing the loss of phosphorus from cropland.

Much of the phosphorus lost to Iowa waterways is bound to sediment that has been eroded from agricultural areas or streambanks. Approximately 70 percent of total phosphorus lost to streams near cropland is associated with surface runoff carrying sediment-bound phosphorus. As sediment is eroded from fields, it carries phosphorus to streams, rivers, lakes, wetlands, and other surface waters of the state.

Excess phosphorus and sediment in surface waters leads to local, regional, and national-level alterations to aquatic ecosystems resulting in decreased water clarity, increased algal growth, and oxygen deficiencies that cause fish kills and reduce biotic diversity. Unlike nitrate-nitrogen, no phosphorus drinking water standards exist.

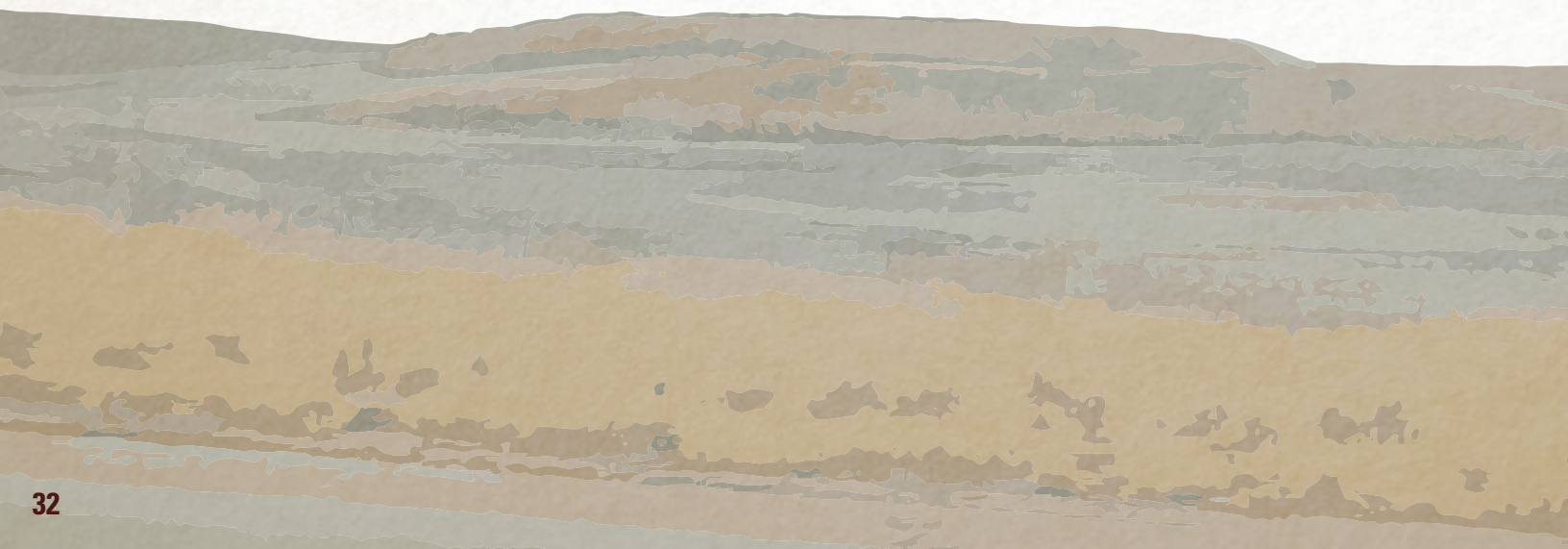
Edge-of-field practices that address phosphorus loss can significantly reduce the amount of sediment-bound phosphorus that is lost with surface runoff. On average, phosphorus is reduced by:

- ✓ 77 percent with terraces.
- ✓ 85 percent with ponds.
- ✓ 85 percent with water and sediment control basins (WASCOBs).
- ✓ Variable removal rates with grassed waterways.
- ✓ 90 percent with prairie strips.

The Iowa Nutrient Reduction Strategy does not currently contain numerical values for phosphorus reduction for windbreaks, riparian forest buffers, and bottomland timber establishment.

While phosphorus reduction edge-of-field practices have the potential to remove large amounts of phosphorus from surface runoff, there is no one practice that works well at all sites. Topography and slope of row crop acres play a large role in where erosion occurs in the field and inform which edge-of-field practice is best suited to that location. A combination of appropriate practice implementation and high adoption rates is needed to meet the phosphorus reduction goals of the Iowa Nutrient Reduction Strategy.

This section is intended to help you determine which phosphorus reduction edge-of-field practice is best suited for your needs—a sort of “office chair” suitability analysis to help determine the appropriate practice for a given location. The phosphorus reduction edge-of-field decision tools on pages 60 through 61 guide you through the process of determining whether edge-of-field practices will work at your site and help identify the most appropriate edge-of-field practice. Practice-specific decision tools follow on pages 62 through 71.

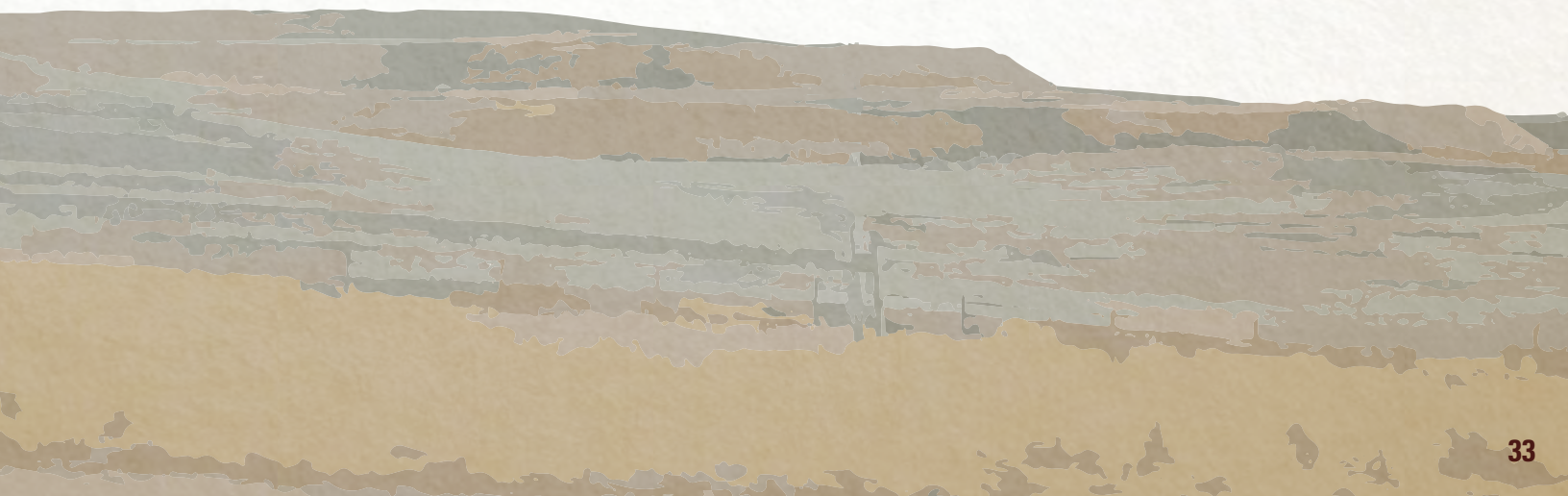




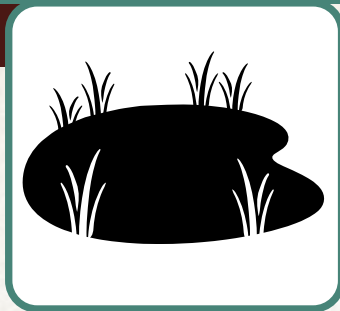


Terraces are earthen embankments located in sloped landscapes that are situated parallel to one another and typically follow the contour of the field. Terraces are designed to reduce sheet and rill erosion through rerouting of water and subsequent reduction in surface runoff speed. Terraces can also lead to improved water infiltration and better conservation of soil moisture. By reducing erosion, the amount of sediment-bound phosphorus lost from the field is also reduced. Terraces have the added benefits of improving farm operations on sloped land, and, when terrace embankments are planted with native vegetation, creating wildlife habitat. Consider using terraces in combination with other in-field and edge-of-field erosion reducing practices.

Some must-have pieces of information for determining whether terraces will work for the site include a topographic map and a soils map.





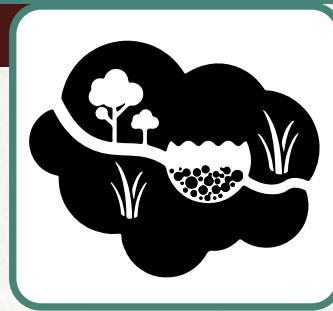


Farm ponds are created using earthen embankments to dam an area or by excavating a pit to store water. To adequately collect surface runoff from upslope, the watershed area draining to the pond should be 10 to 20 times larger than the surface area of the pond. Farm ponds can help reduce sediment-bound phosphorus loss by storing sediment in the basin, as well as by reducing the erosive force of surface runoff downhill or downstream of the pond. Farm ponds can have added benefits such as providing fish and wildlife habitat, acting as a water source for livestock, and promoting groundwater recharge.

Some must-have pieces of information for determining whether a pond will work for your site include a topographic map and a soils map.





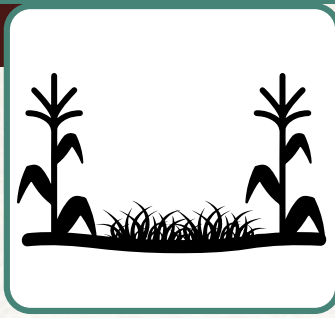


Water and sediment control basins (WASCOBs) are created in irregularly sloped areas by constructing an earthen embankment perpendicular to the land slope in an area prone to gully formation or across an existing drainageway experiencing erosion. WASCOBs act to store water after rain events, trapping sediment and sediment-bound phosphorus lost from upslope areas and preventing erosion downslope by reducing downstream runoff. WASCOBs are not designed for long-term water storage like farm ponds. After construction, any area not farmed will need to have vegetation established. Consider using WASCOBs in combination with other in-field or edge-of-field erosion reducing practices, including additional WASCOBs.

Some must-have pieces of information for determining whether WASCOBs will work for your site include a topographic map and a soils map. It is also helpful to consider your willingness to remove accumulated sediment to maintain WASCOB functionality.







Grassed waterways are constructed or modified natural channels in gently sloping areas that are graded to slow the flow of surface water to a non-erosive speed, helping to reduce gully erosion. The channel is planted with perennial vegetation and maintained so that no areas of bare soil exist. The vegetation helps to reduce the flow of water while also capturing sediment and sediment-bound phosphorus. To maintain effectiveness, grassed waterways should not be used as a lane for heavy equipment or have extensive livestock traffic. Consider using grassed waterways in combination with other in-field and edge-of-field erosion reducing practices.

Some must-have pieces of information for determining whether grassed waterways will work for your site include a topographic map and a soils map.





## Prairie Strips

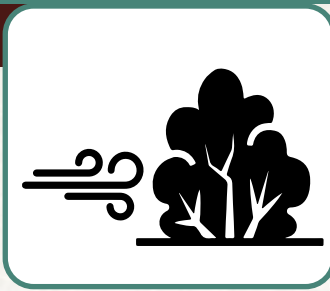


Prairie species have stiff stems and deep roots that slow down water, allow it to infiltrate, and filter out sediment and nutrients. Patches of native perennial vegetation create valuable habitat for a wide variety of birds, insects, and mammals. Prairie strips can be placed around the edge of a field, within the field, alongside or perpendicular to waterways, and in terrace channels. To provide erosion control, improved water quality, and wildlife habitat, **a minimum of 10 percent of the field should be converted to prairie**. Prairie strips should have a minimum width of 30 feet and be spaced at intervals that work with your farming equipment.

Prairie flowers and grasses take time to establish, typically requiring two to three seasons of establishment management. Annual and perennial weeds grow quickly and can outcompete prairie plants in the first two growing seasons. Mowing prairie is an essential management practice that must be done during the first year whenever the height of the vegetation reaches 12 inches. Mower height should be set to 4 to 8 inches.





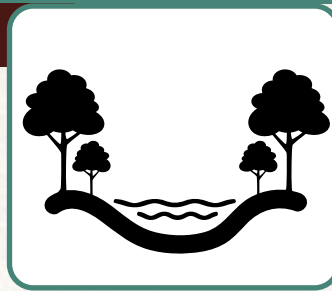


Windbreaks are linear plantings of trees and shrubs designed to provide economic, environmental, and community benefits. Windbreaks are also referred to as shelterbelts. The primary purpose of windbreaks is to **slow the wind, creating more beneficial conditions for soils, crops, livestock, and people.**

Windbreaks also provide shade and alternative shelter for livestock, visual screening, aesthetics, recreational opportunities, and wood and nontimber forest products (commodities obtained from the forest that do not incorporate harvesting trees, e.g., tree nuts, maple syrup, mushrooms, decorative elements for arrangements and wreaths).

Windbreaks have also been recognized for their value in providing ecosystem services, which often extend beyond the farm. Benefits include enhancement of biodiversity, wildlife habitat, carbon storage, pollinator habitat, and soil and water quality protection. Individual management goals will influence windbreak design and species composition.



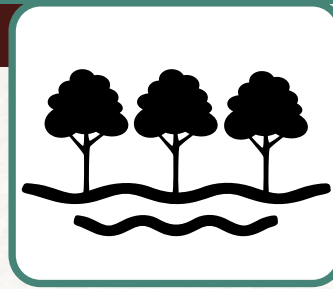


Riparian forest buffers are areas adjacent to a stream, lake, or wetland that **contain a combination of trees, shrubs, and other perennial plants** managed differently from the surrounding landscape to provide conservation benefits. Riparian forest buffers can also be managed to produce a harvestable crop from trees and shrubs. Riparian forest buffers can deliver a number of benefits including:

- Filtering of nutrients, sediments, pesticides, and animal waste from agricultural lands
- Stabilizing eroding streambanks
- Trapping sediment, nutrients, and woody material during flooding
- Mitigating downstream flood damage
- Providing aquatic and terrestrial wildlife habitat and travel corridors
- Providing recreational opportunities and aesthetics
- Diversifying landowner income







Bottomland timber establishment involves planting stands of trees and shrubs on designated bottomland or floodplain areas. Compared to riparian forest buffers, this practice is applicable to larger floodplain systems that extend at least 180 feet from the stream, and are located within the 100-year floodplain.

Bottomland timber establishment restores and enhances the natural beneficial functions of floodplains by controlling erosion and reducing floodplain scour. This practice also encourages nutrient and sediment trapping during overbank flows, slowing and storing floodwaters to mitigate in-field and downstream flooding. Additionally, this practice encourages nitrate removal through denitrification and vegetative uptake, promotes carbon sequestration, restores wildlife habitat, and provides recreational opportunities and income diversification for landowners.





# SCIENCE + SUPPORT = **SOUND STEWARDSHIP**

## Decision Tools for Conservation

**Decision tools** are important step-by-step guides in the process of decision making and risk analysis. Being visual in nature, decision tools are readily comprehensible and applicable.

The decision tools that follow clearly illustrate the choices, risks, objectives, and information needs involved in the implementation of conservation practices. Further, these decision tools visually illustrate possible alternatives, probabilities and outcomes, providing clarity to the decision making process.

The conservation decision tools that follow are based on research and experience to help **decision makers (farmers and landowners)** predict future outcomes and to support rational decision making when implementing conservation and water quality practices for the first time.

The sections that follow include decision tools for in-field and edge-of-field conservation practices.

**N** This icon represents practices that are effective for **nitrogen reduction**.

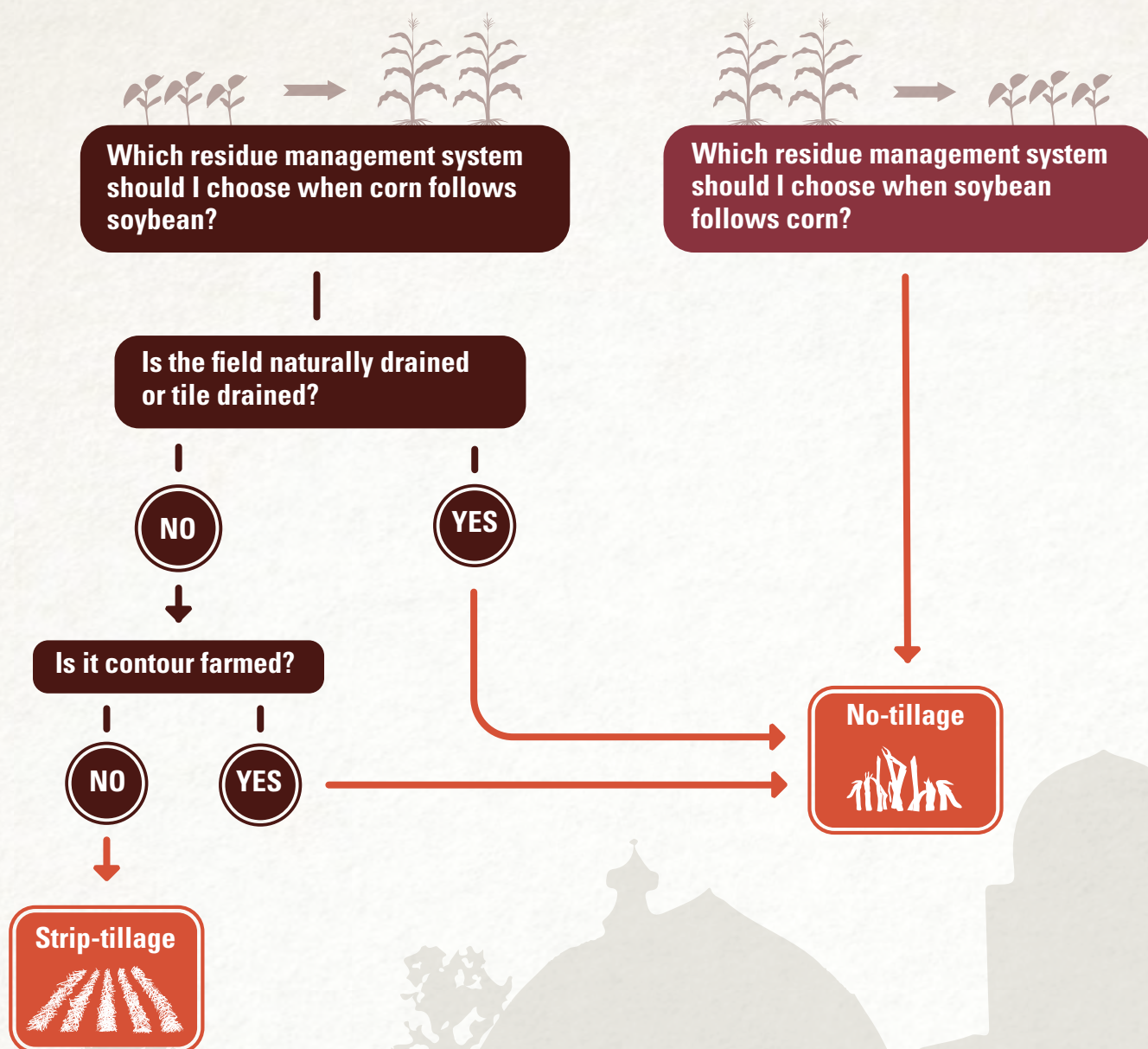
**P** This icon represents practices that are effective for **phosphorus reduction**.

Decision tools can also be used by **conservation professionals** to help guide clients in implementing a variety of practices on their farms. Decision tools designed specifically for conservation professionals, primarily focused on edge-of-field practices, can be found in the Decision Tools for Conservation Professionals Addendum at [www.conservationlearninggroup.org](http://www.conservationlearninggroup.org).



# Tillage Management

## Corn Soybean Rotation



**Attend a conservation field day to learn more!**

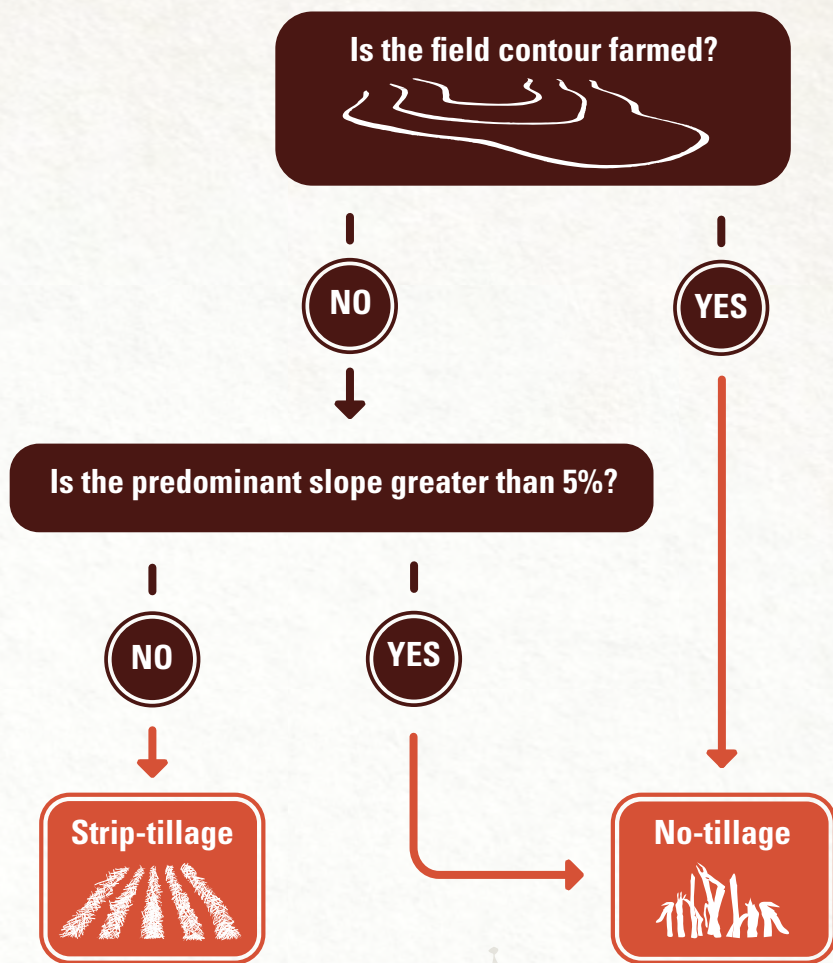
Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





# Tillage Management

## Corn Following Corn



**Attend a conservation field day to learn more!**

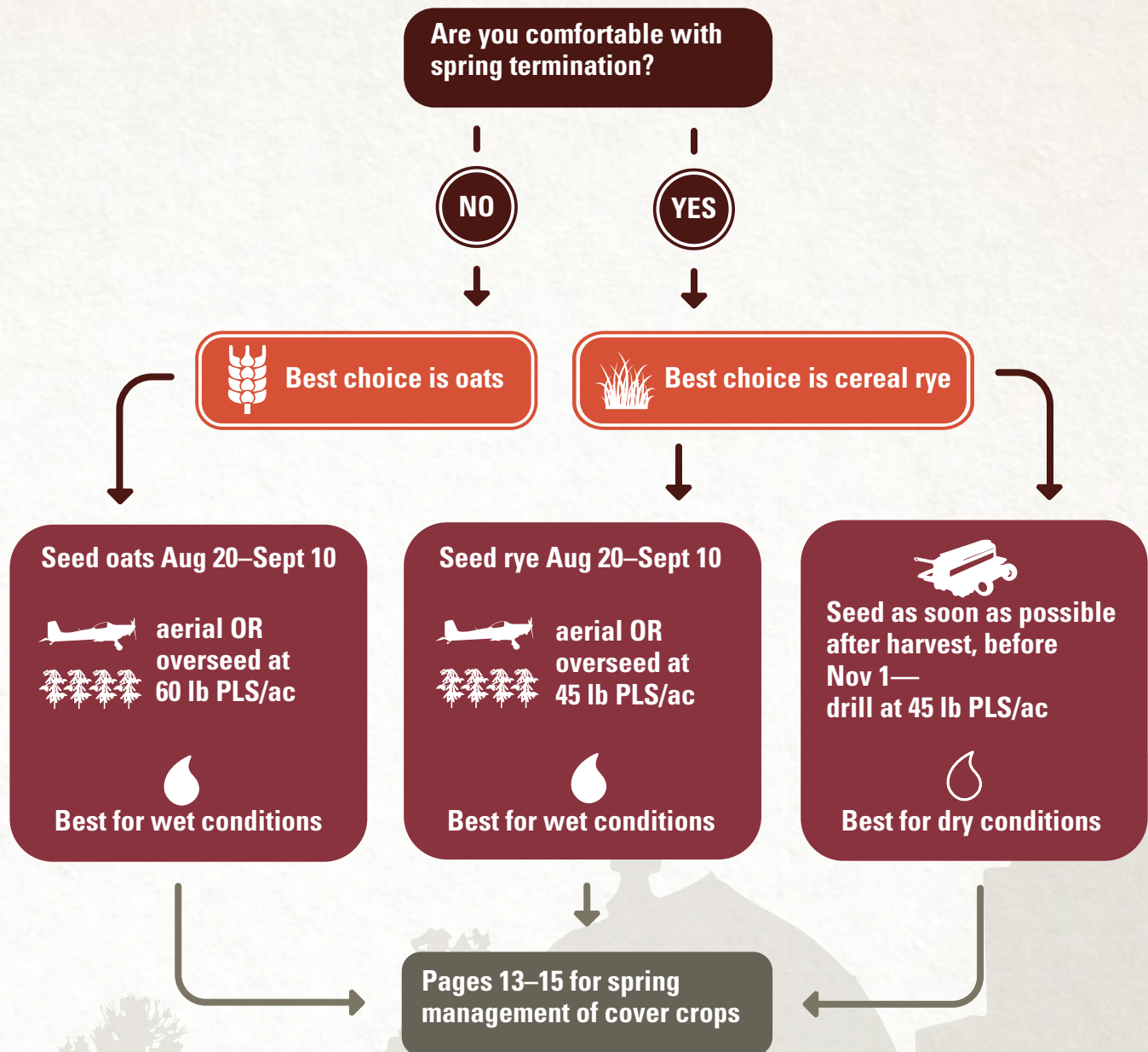
Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



**Attend a conservation field day to learn more!**

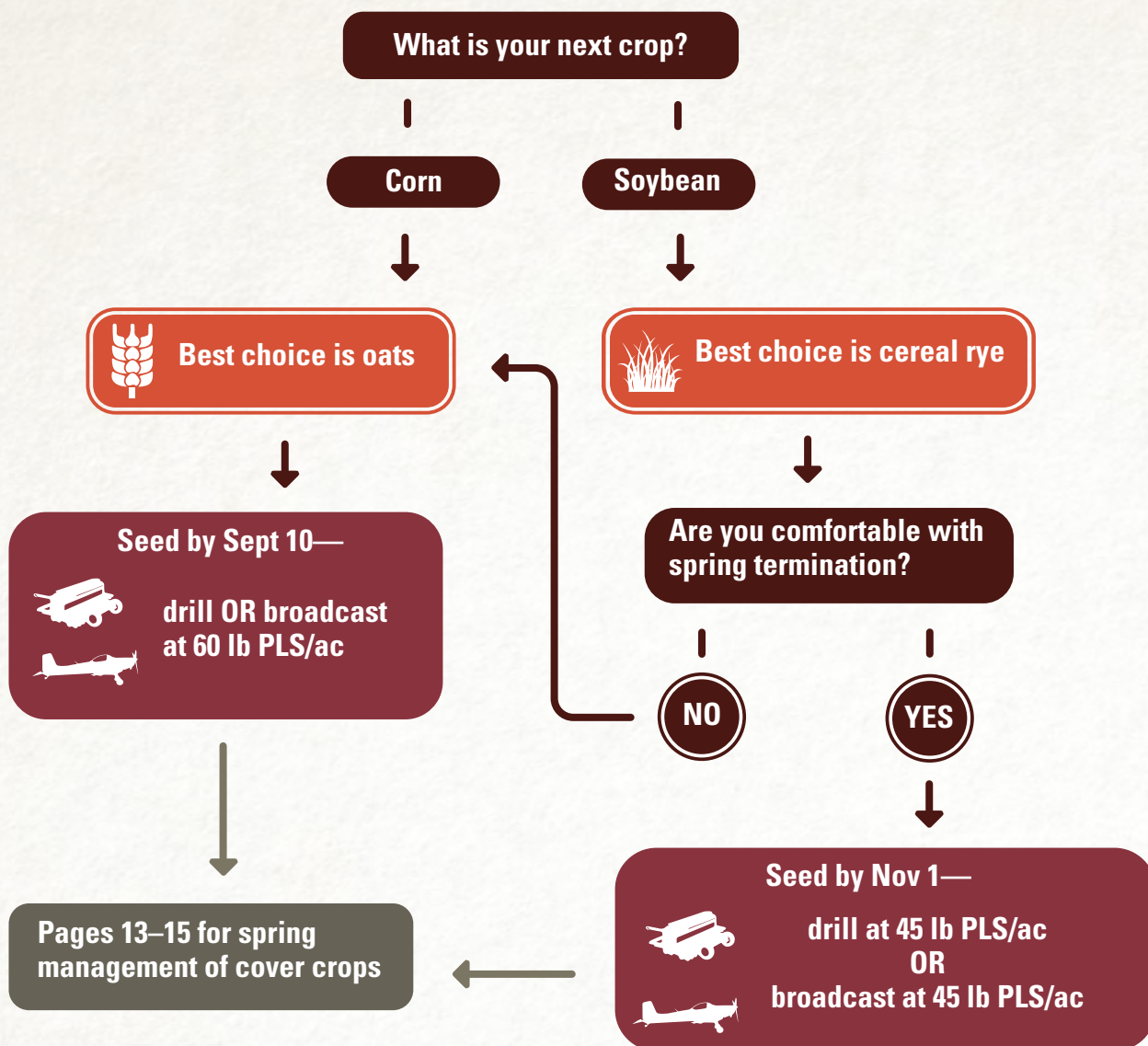
Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



**Attend a conservation field day to learn more!**

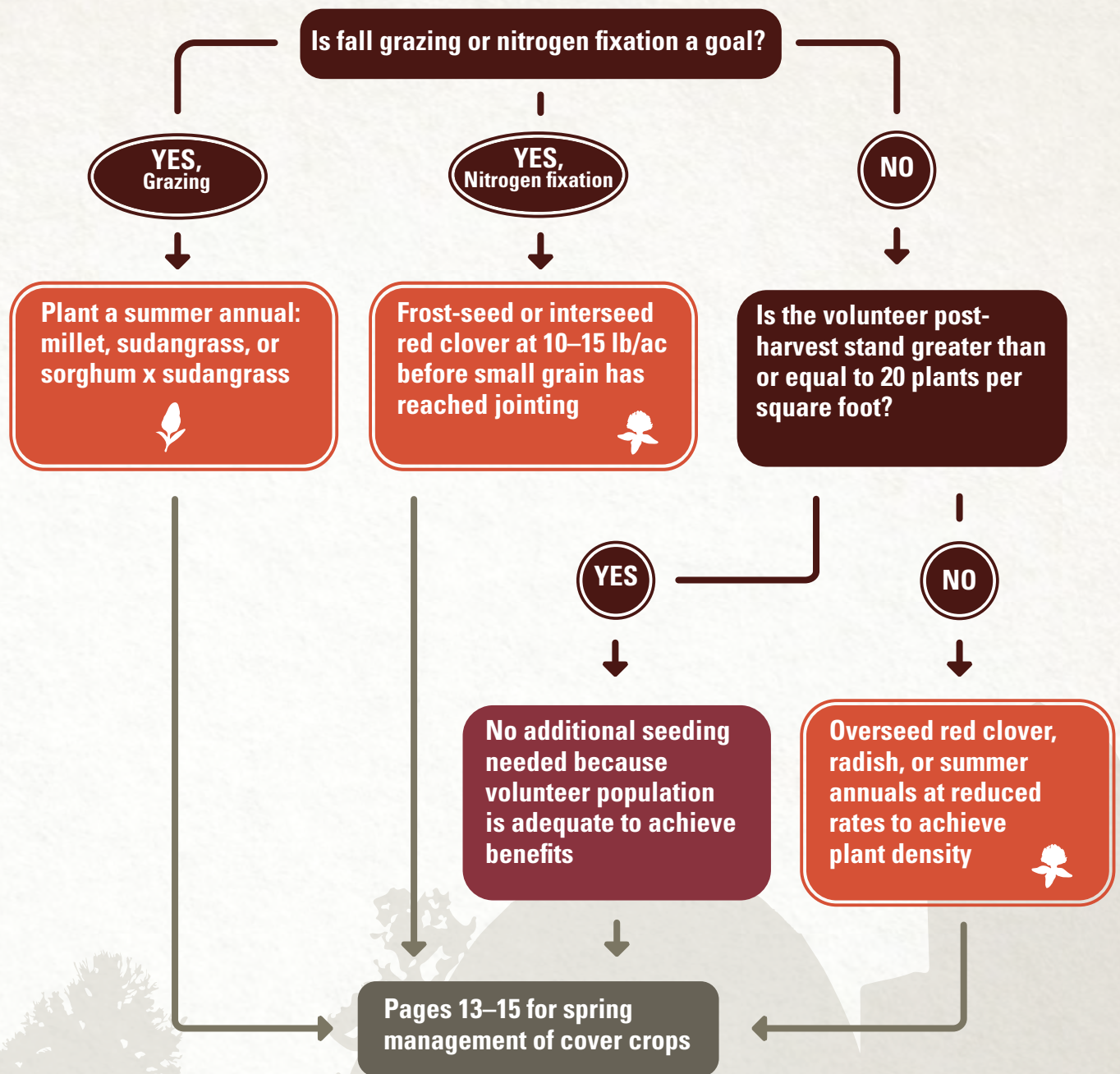
Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





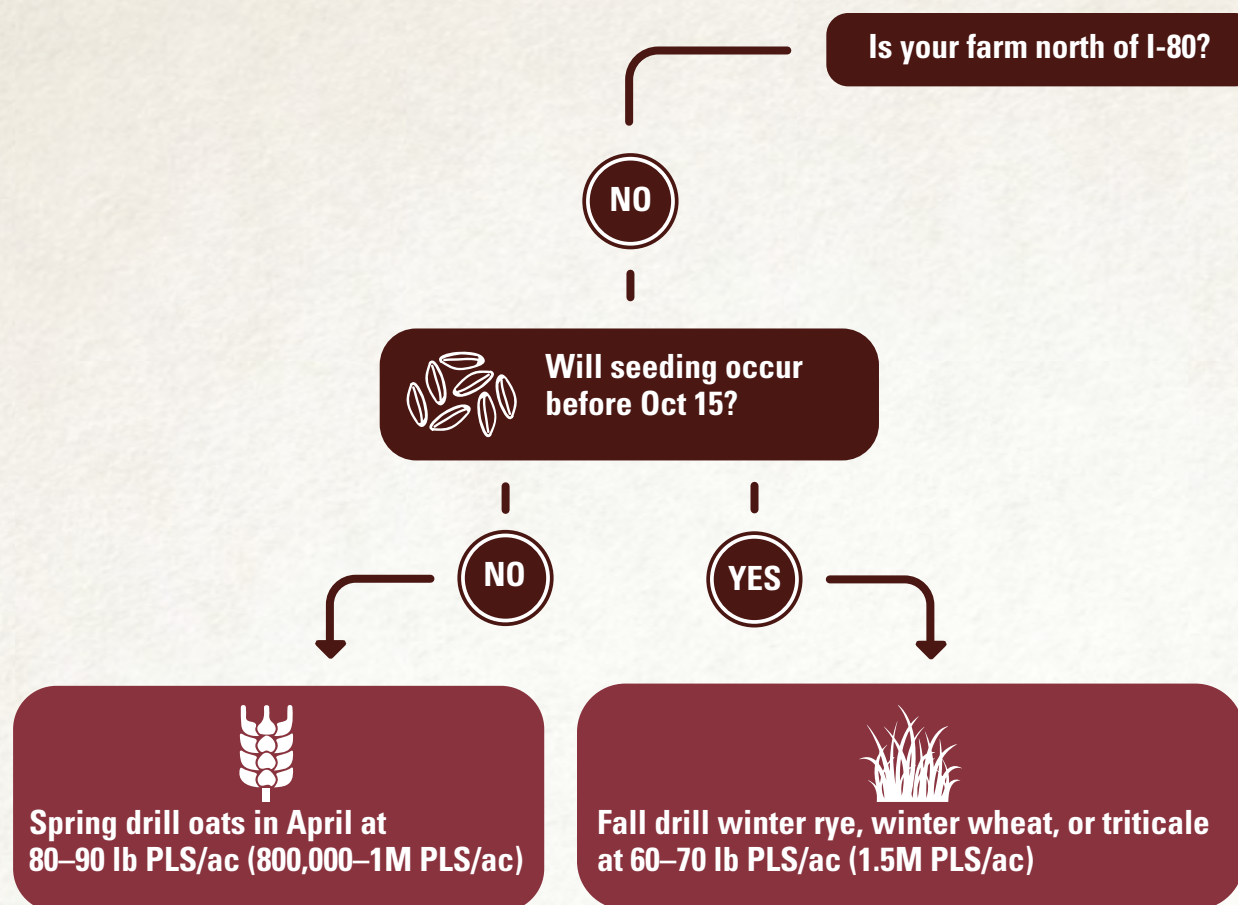
# Cover Crop Selection and Management

## After Small Grains Before Corn



**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



Interested in extending beyond the corn-soybean-small grain rotation?

NO

YES

Page 47 for seeding a cover crop following small grains

**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



YES

What is this year's crop?

Corn

Soybean



Spring drill oats at 80–90 lb PLS/ac  
(800,000–1M PLS/ac)



Spring drill oats in April at  
80–90 lb PLS/ac (800,00–1M PLS/ac)



Fall drill winter rye, winter  
wheat, or triticale by Oct 1 at  
60–70 lb PLS/ac (1.5M PLS/ac)

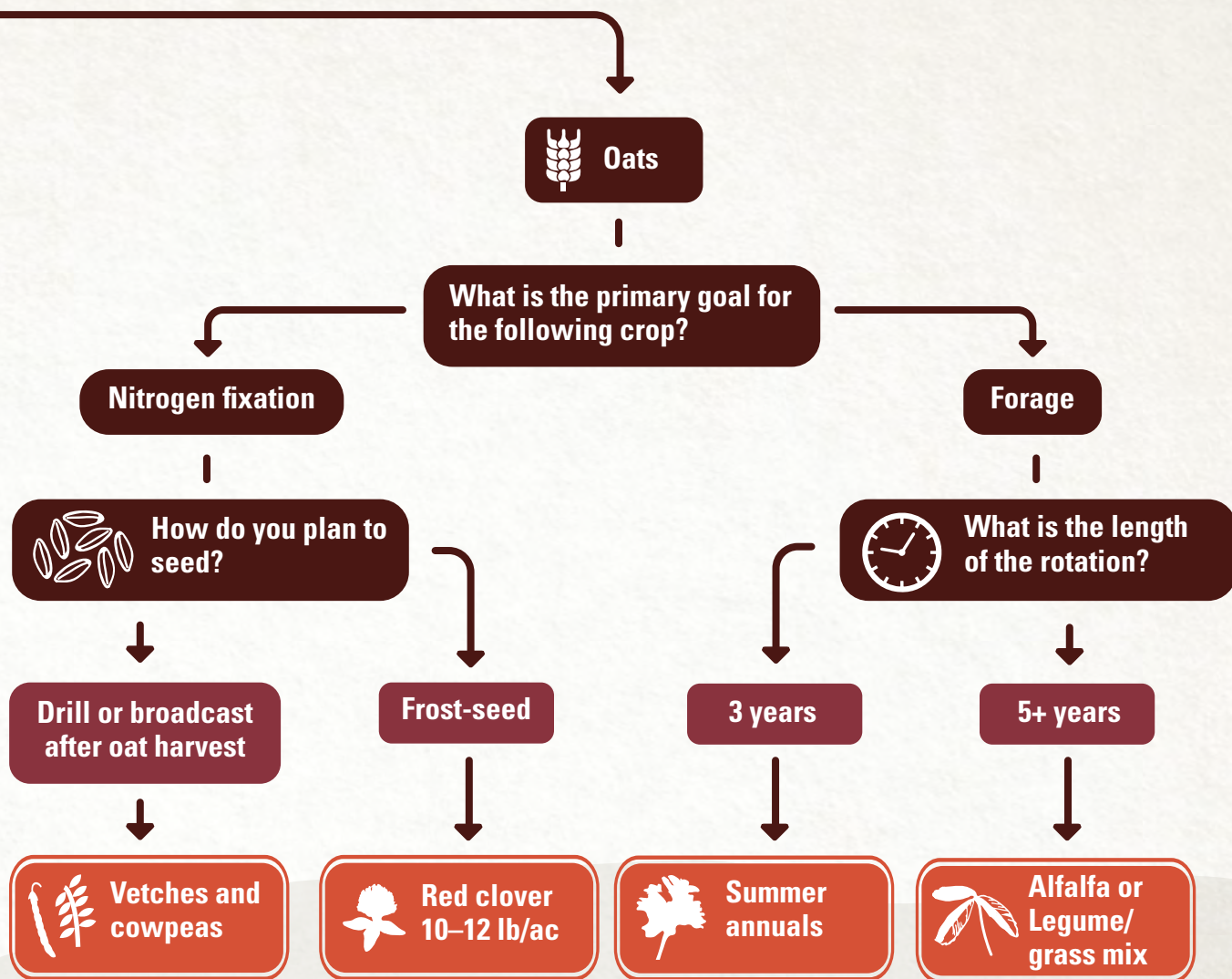
Pages 50 and 51 for  
5-year rotations



**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





## Helpful information for edge-of-field decision tools

It is helpful to gather background information prior to using the following edge-of-field decision tools, but collecting all the information suggested is not essential for using the tool. Ideally, the background information includes aerial photos/imagery, drainage maps (with surface inlets if present), topographic maps, soil survey information, a conservation plan, awareness of your goals, long-term site plans, profitability maps, knowledge of existing utilities, and any existing water-quality data. See the Resources section on pages 74 through 77 for information on how to find maps and aerial photos online. If you are working with a conservation technical assistance provider, additional background information includes a watershed plan and any Agricultural Conservation Planning Framework (ACPF) information for the watershed, LiDAR maps, land-use and land-cover information for the surrounding watershed, and stream and river water quality monitoring data.

The edge-of-field decision tools that follow are designed for **decision makers (farmers and landowners)**.



This icon represents practices that are effective for **nitrogen reduction**.



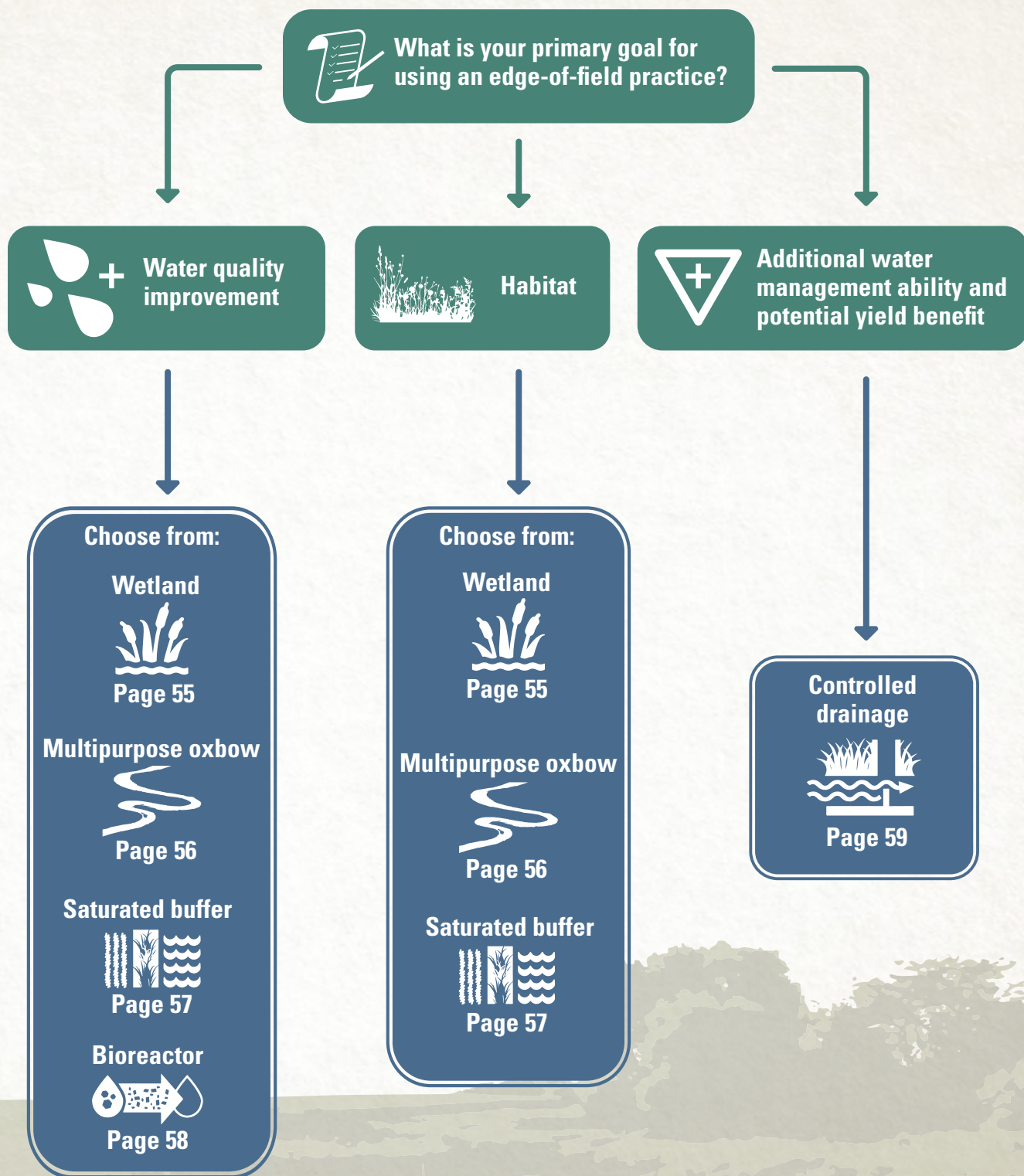
This icon represents practices that are effective for **phosphorus reduction**.

Decision tools can also be used by **conservation professionals** to help guide clients in implementing a variety of practices on their farms. Edge-of-field decision tools designed specifically for conservation professionals can be found in the Decision Tools for Conservation Professionals Addendum at [www.conservationlearninggroup.org](http://www.conservationlearninggroup.org).





# Could Nitrogen Reduction Edge-of-Field Practices Work for You?

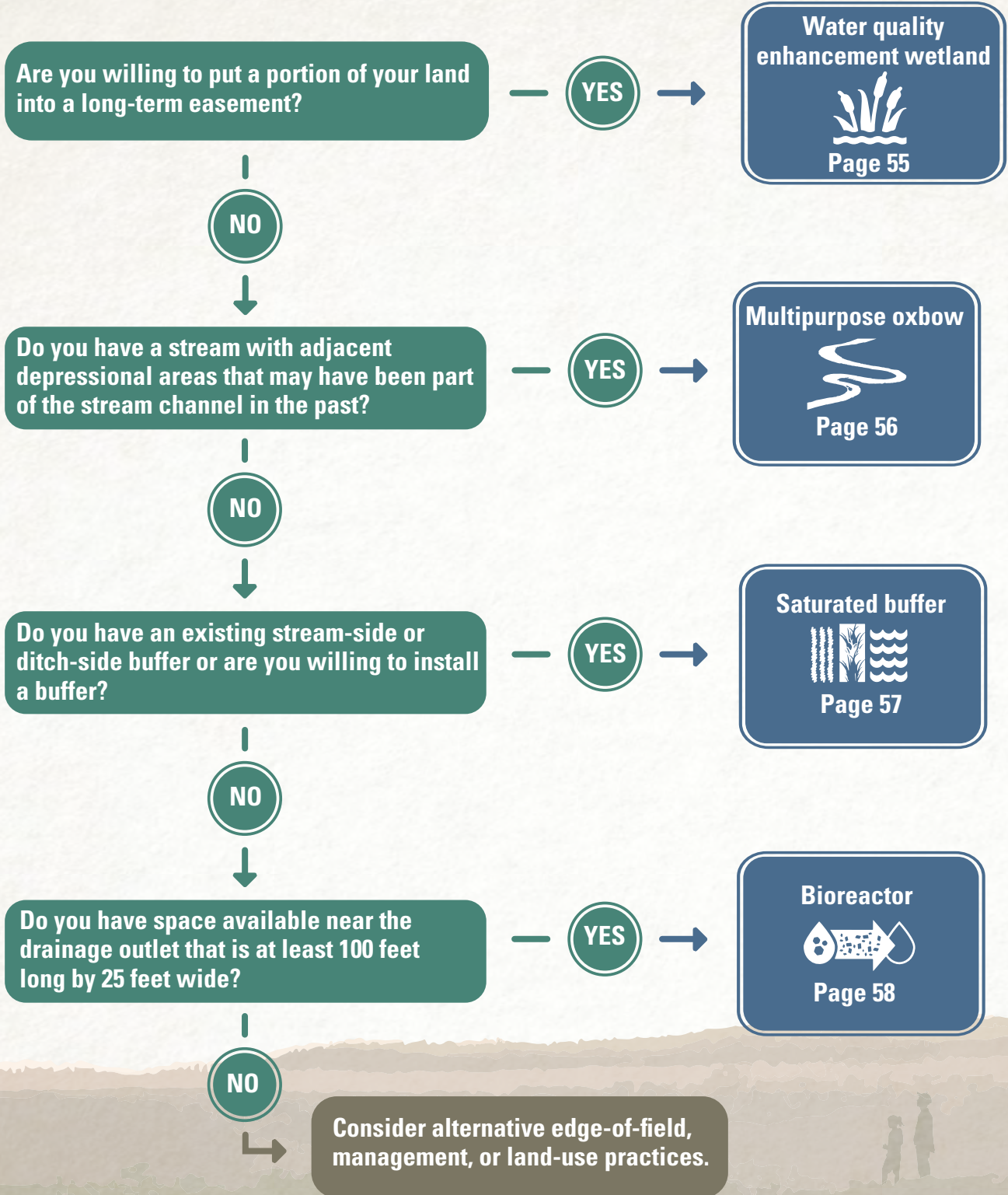


**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



# Choosing the Right Nitrogen Reduction Edge-of-Field Practice for Water Quality Improvement



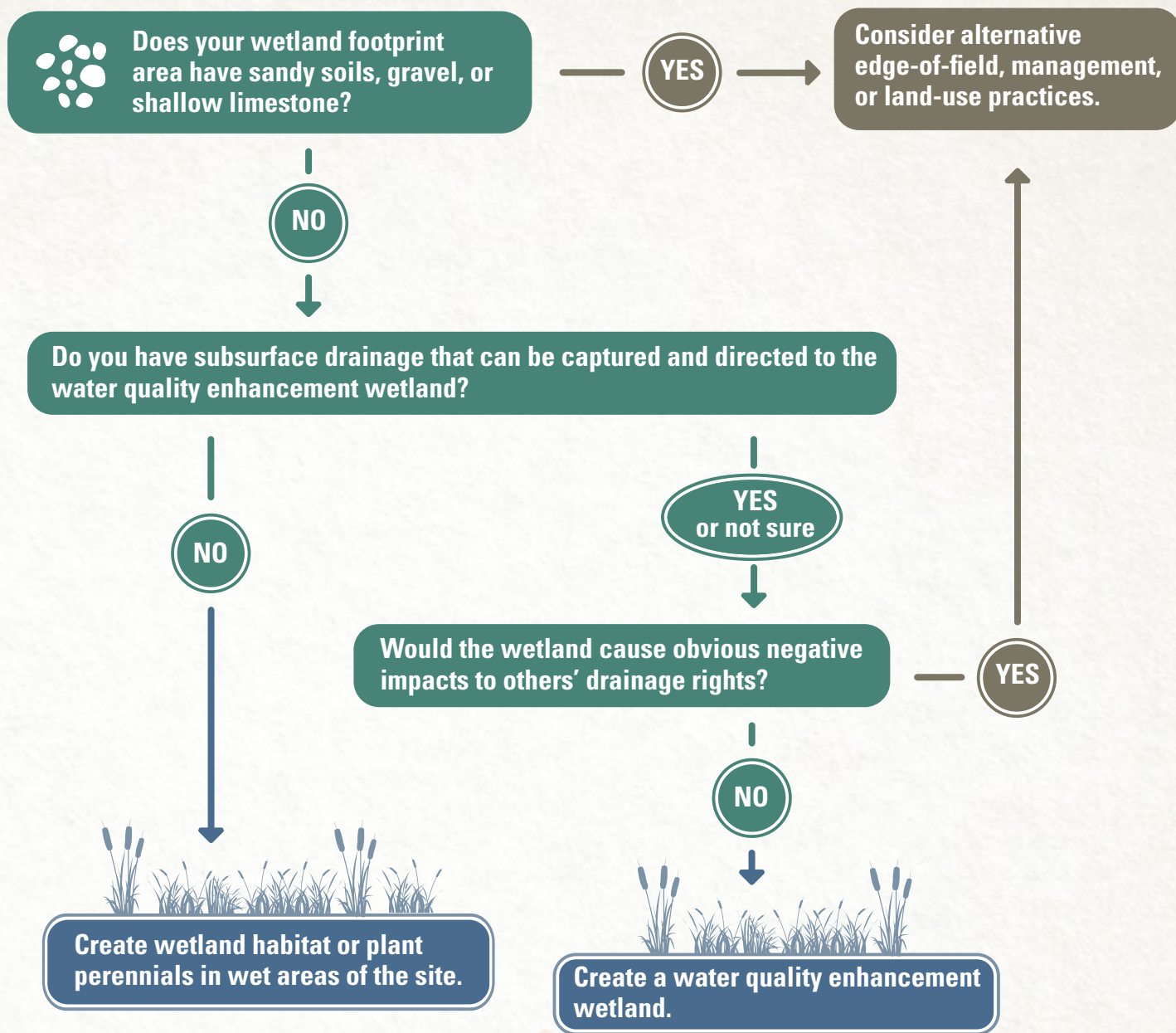
**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





# Is a Water Quality Enhancement Wetland Right for You?

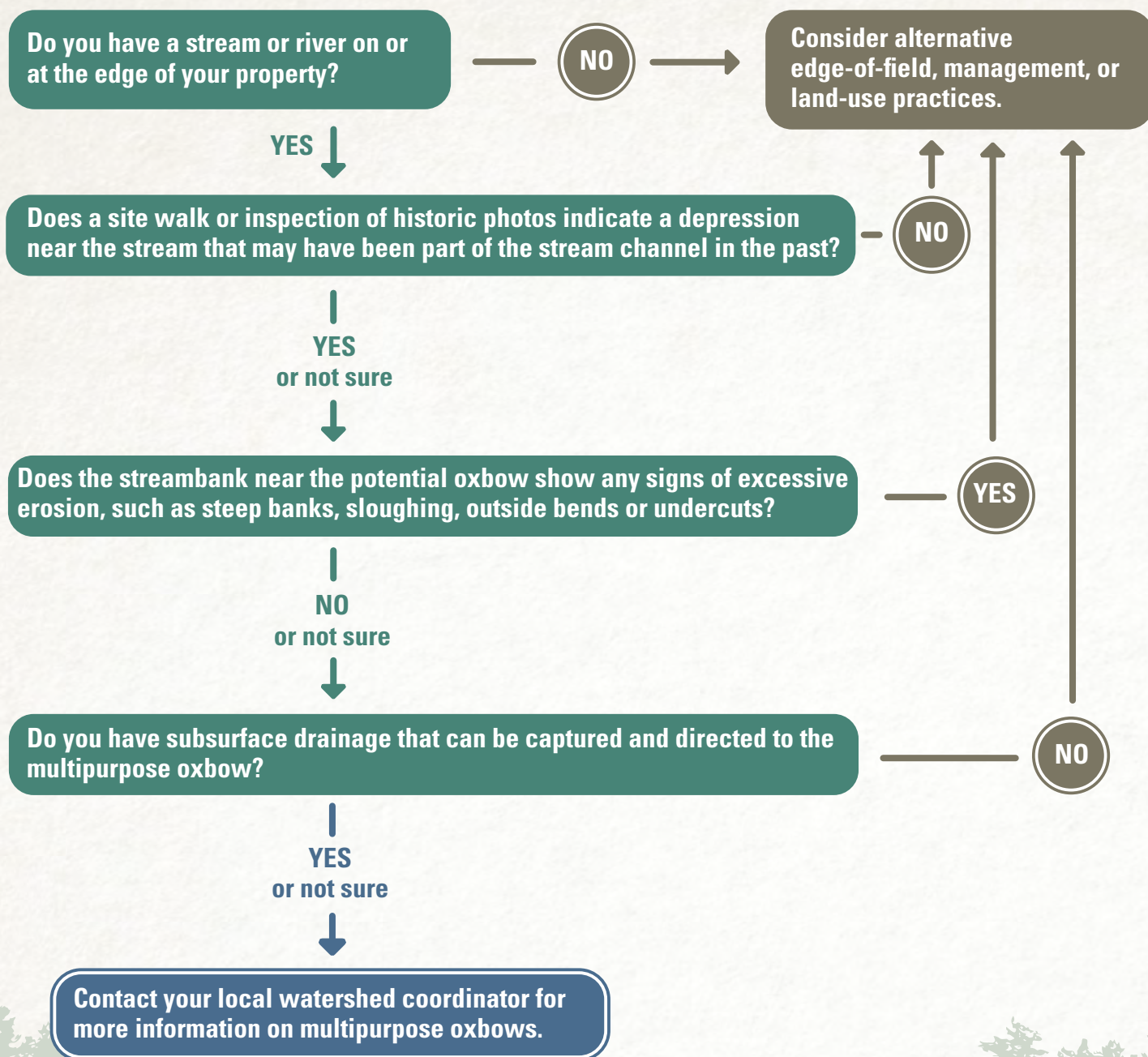


## Attend a conservation field day to learn more!

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



# Is a Multipurpose Oxbow Right for You?



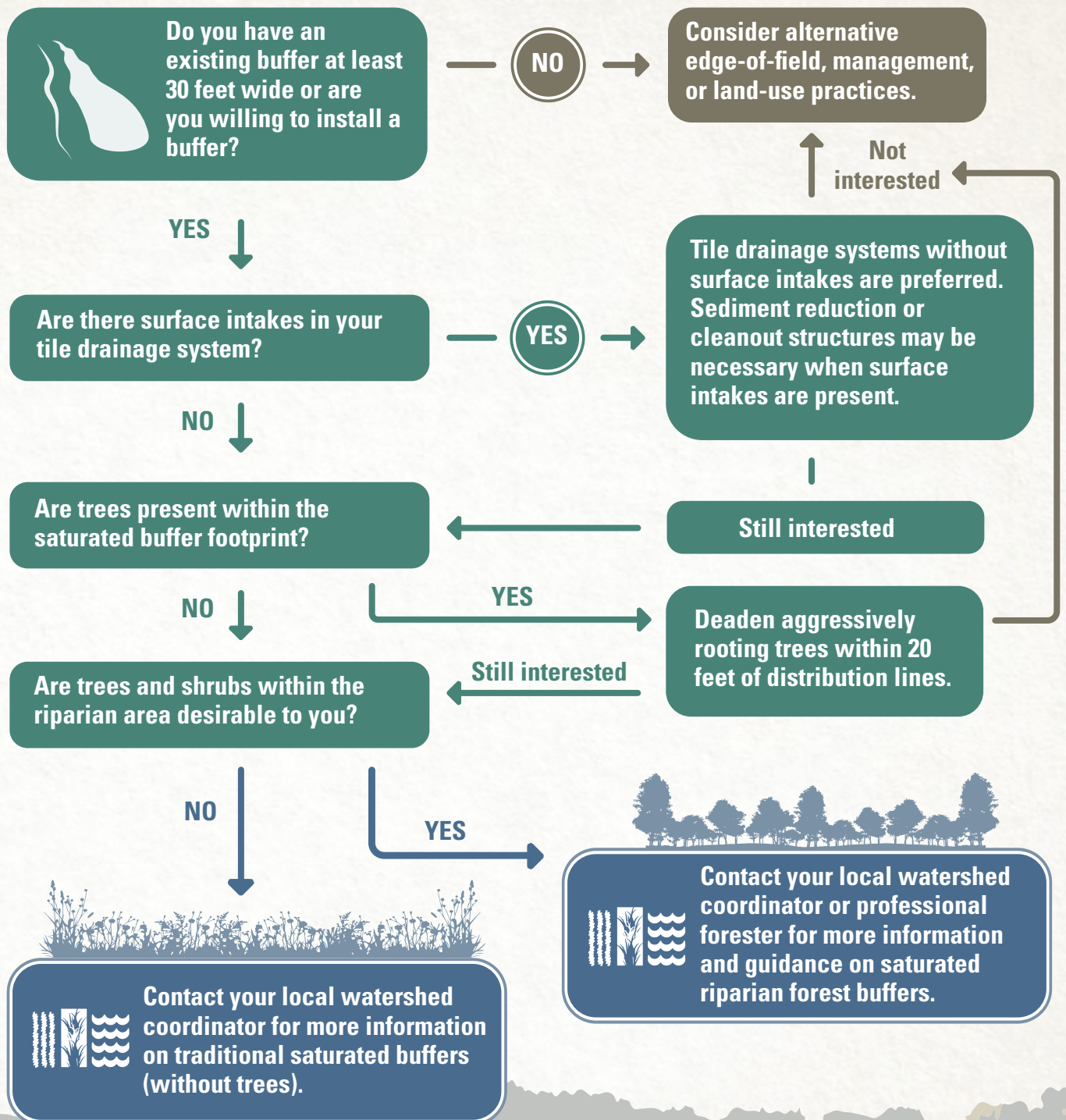
**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





# Is a Saturated Buffer Right for You?

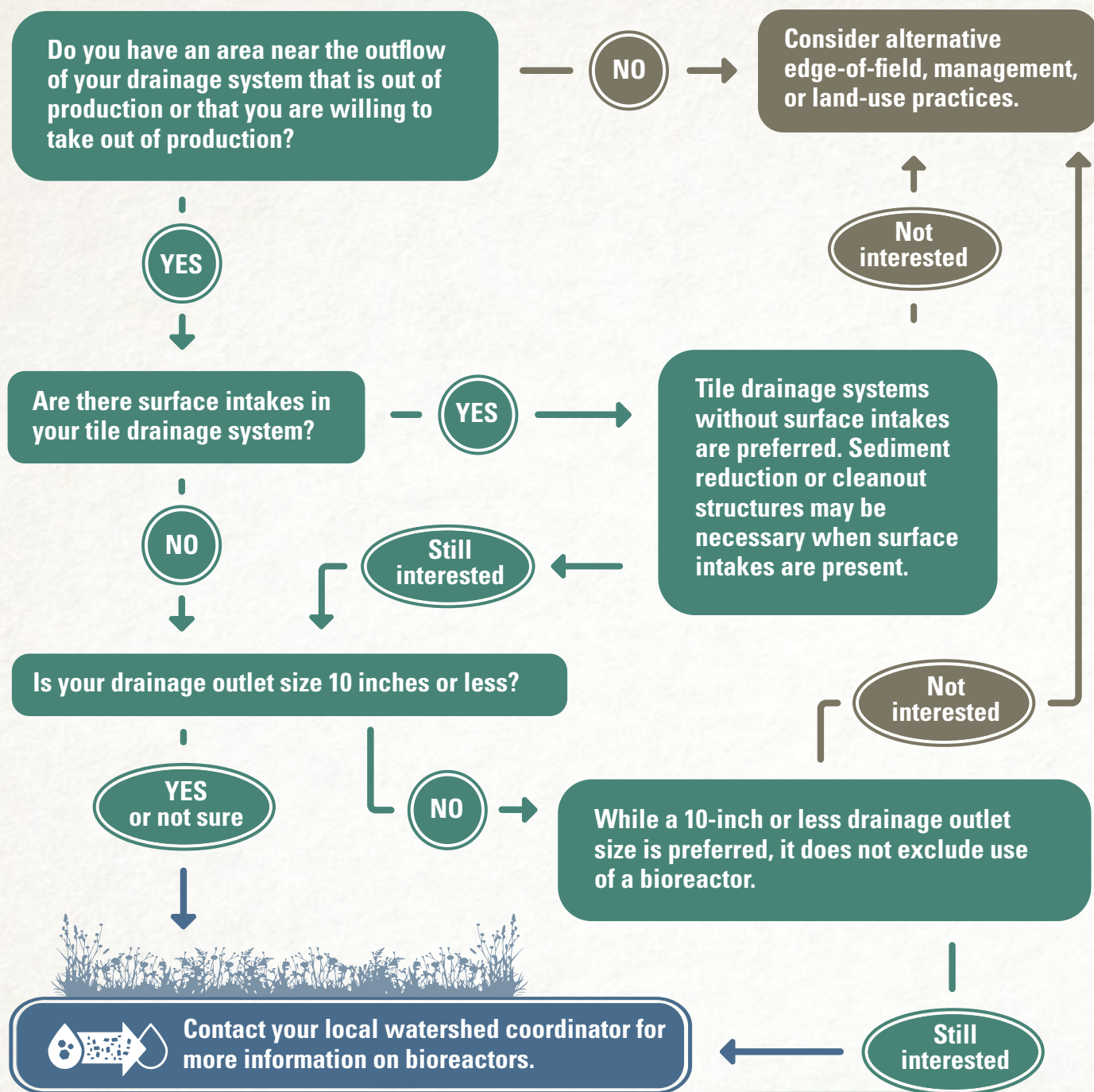


**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



# Is a Bioreactor Right for You?



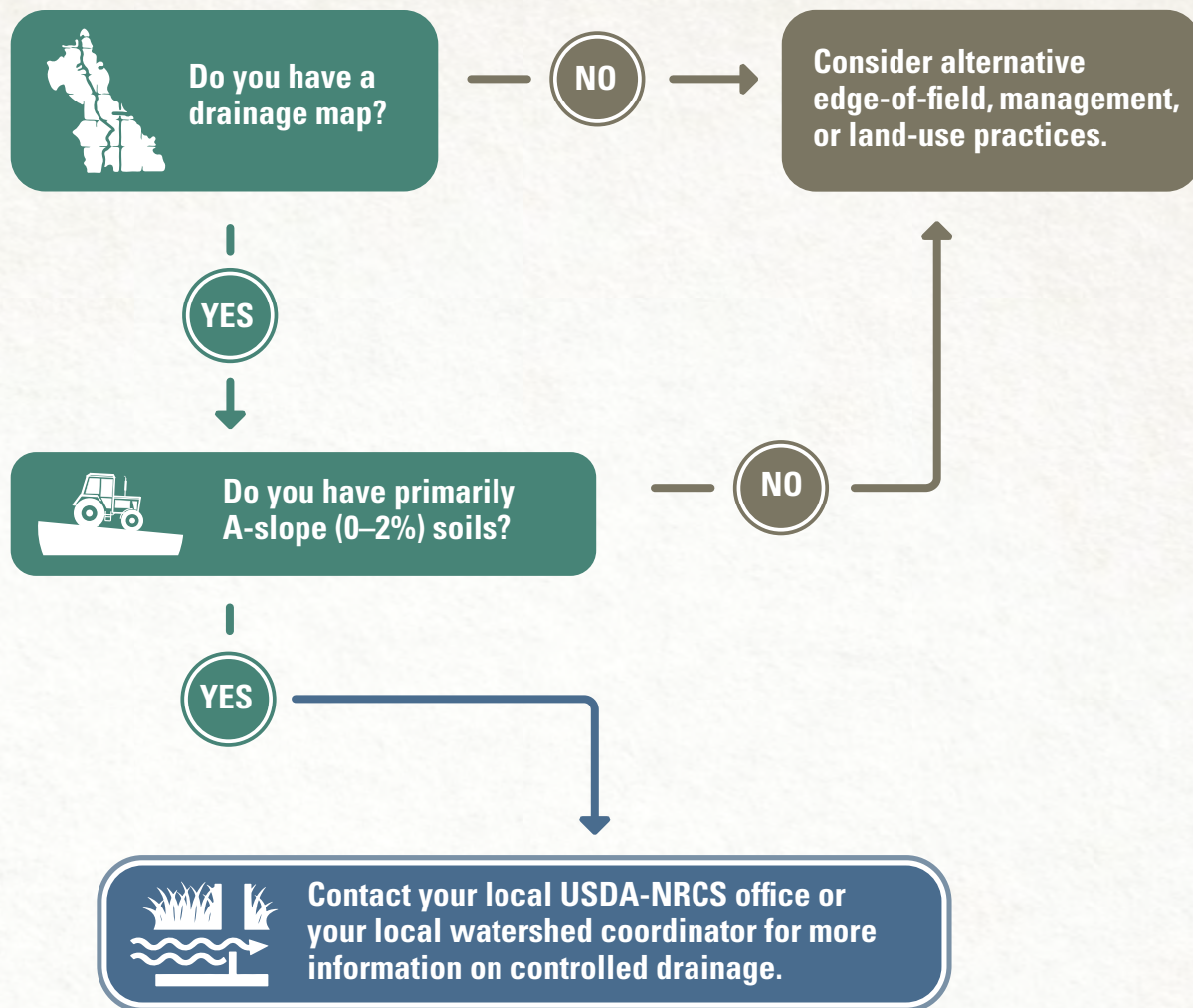
**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





## Is Controlled Drainage Right for You?



**Attend a conservation field day to learn more!**

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# Could Phosphorus Reduction Edge-of-Field Practices Work for You?



What is your primary goal for using an edge-of-field practice?



Water quality improvement



Erosion control

Choose from:

Terraces



Page 62

Prairie strips



Page 66

Ponds



Page 63

Riparian forest buffers



Page 70

Water and sediment control basins



Page 64

Bottomland timber establishment



Page 71

Grassed waterways



Page 65

Choose from:

Terraces



Page 62

Prairie strips



Page 66

Ponds



Page 63

Windbreaks



Page 68

Water and sediment control basins



Page 64

Riparian forest buffers



Page 70

Grassed waterways



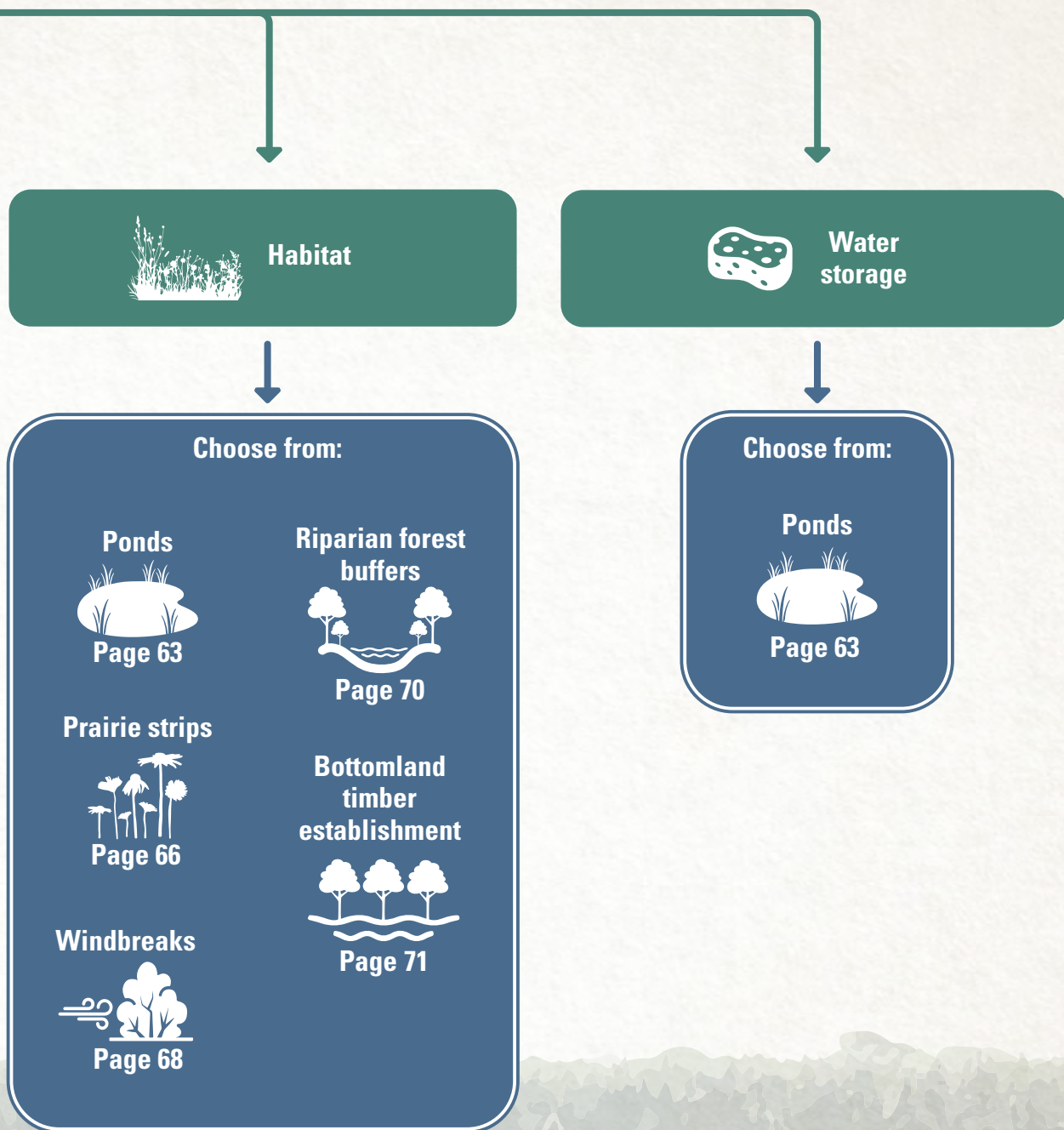
Page 65

Bottomland timber establishment



Page 71



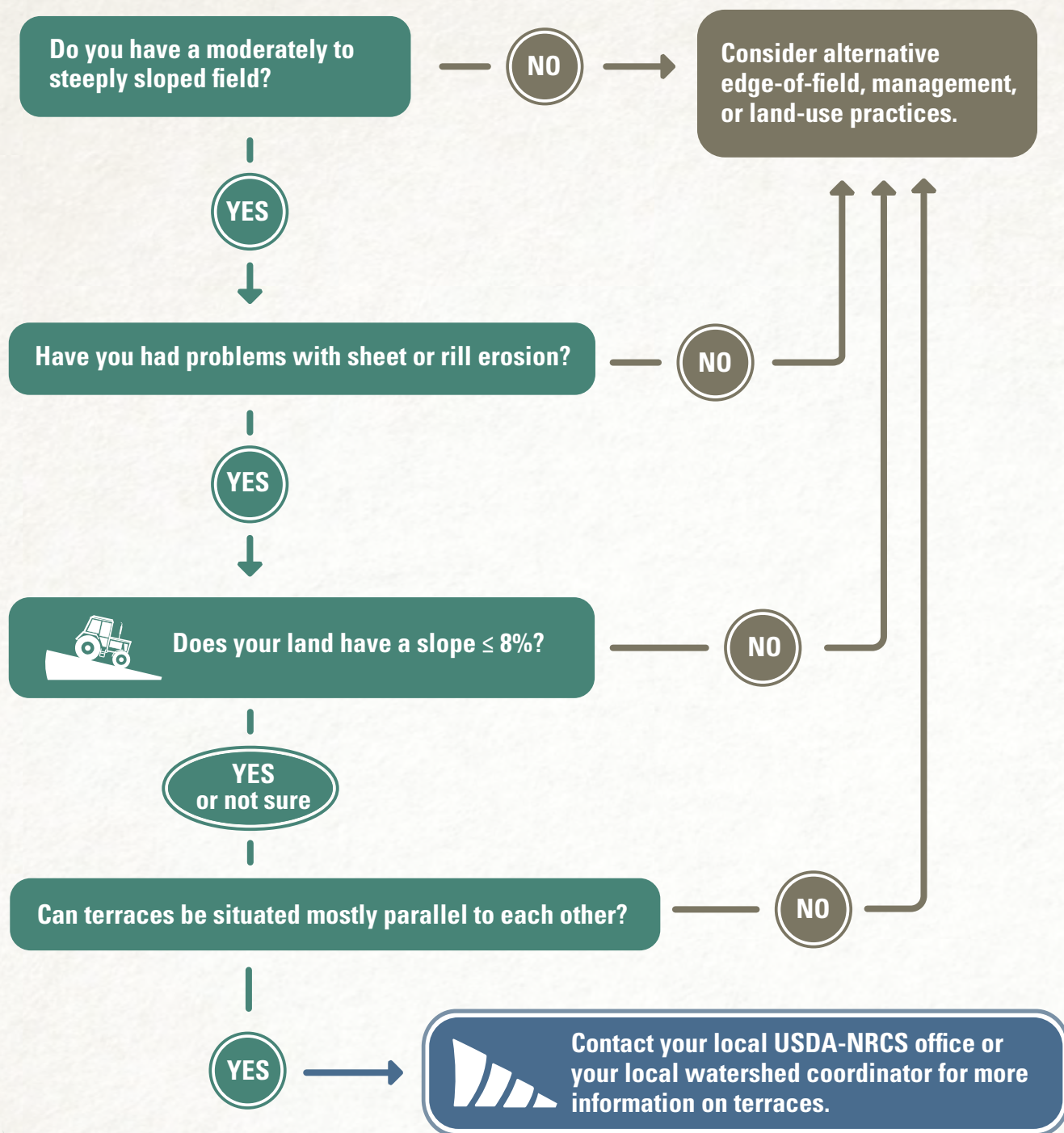


**Attend a conservation field day to learn more!**

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## Are Terraces Right for You?

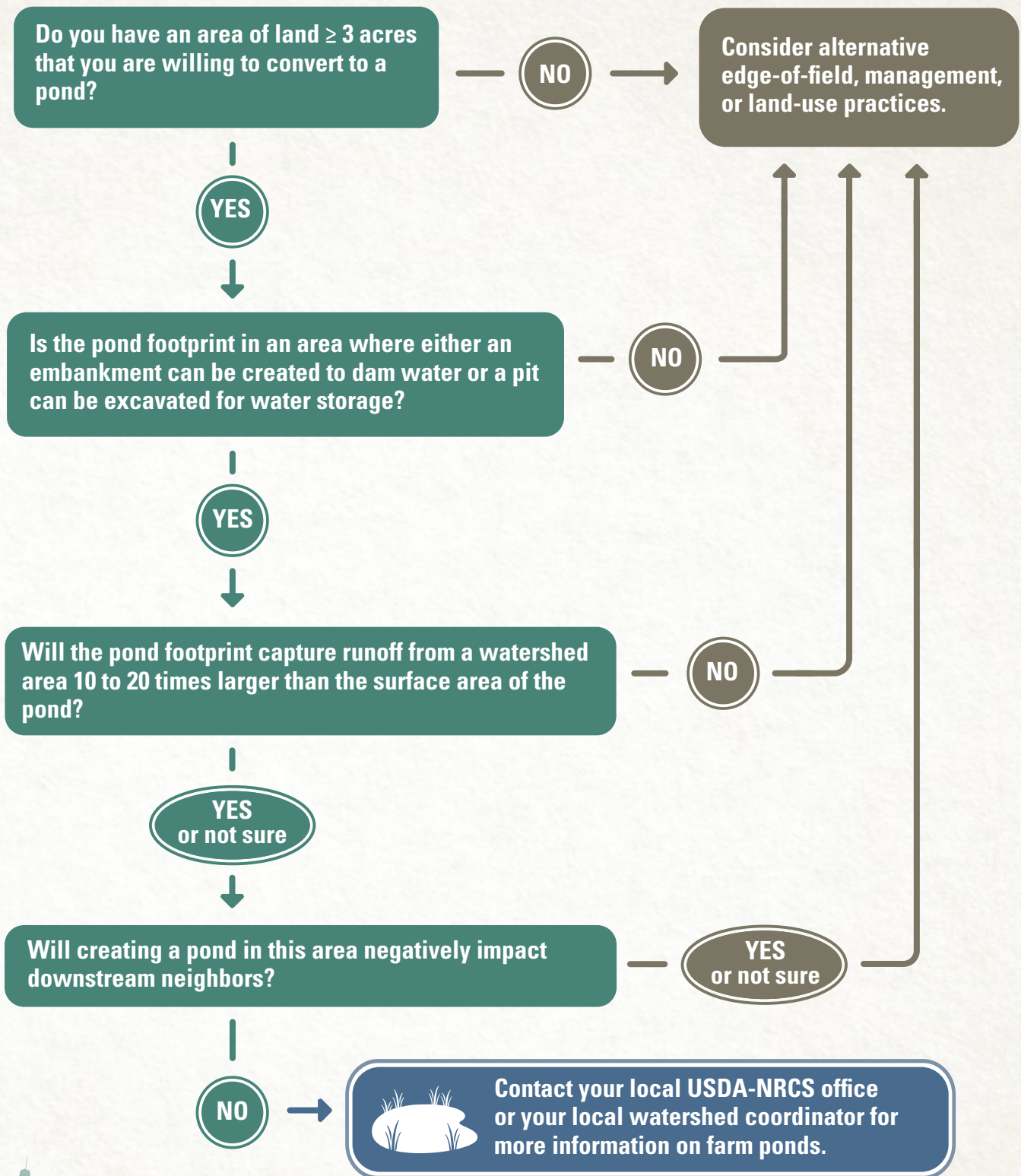


### Attend a conservation field day to learn more!

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



# Is a Pond Right for You?

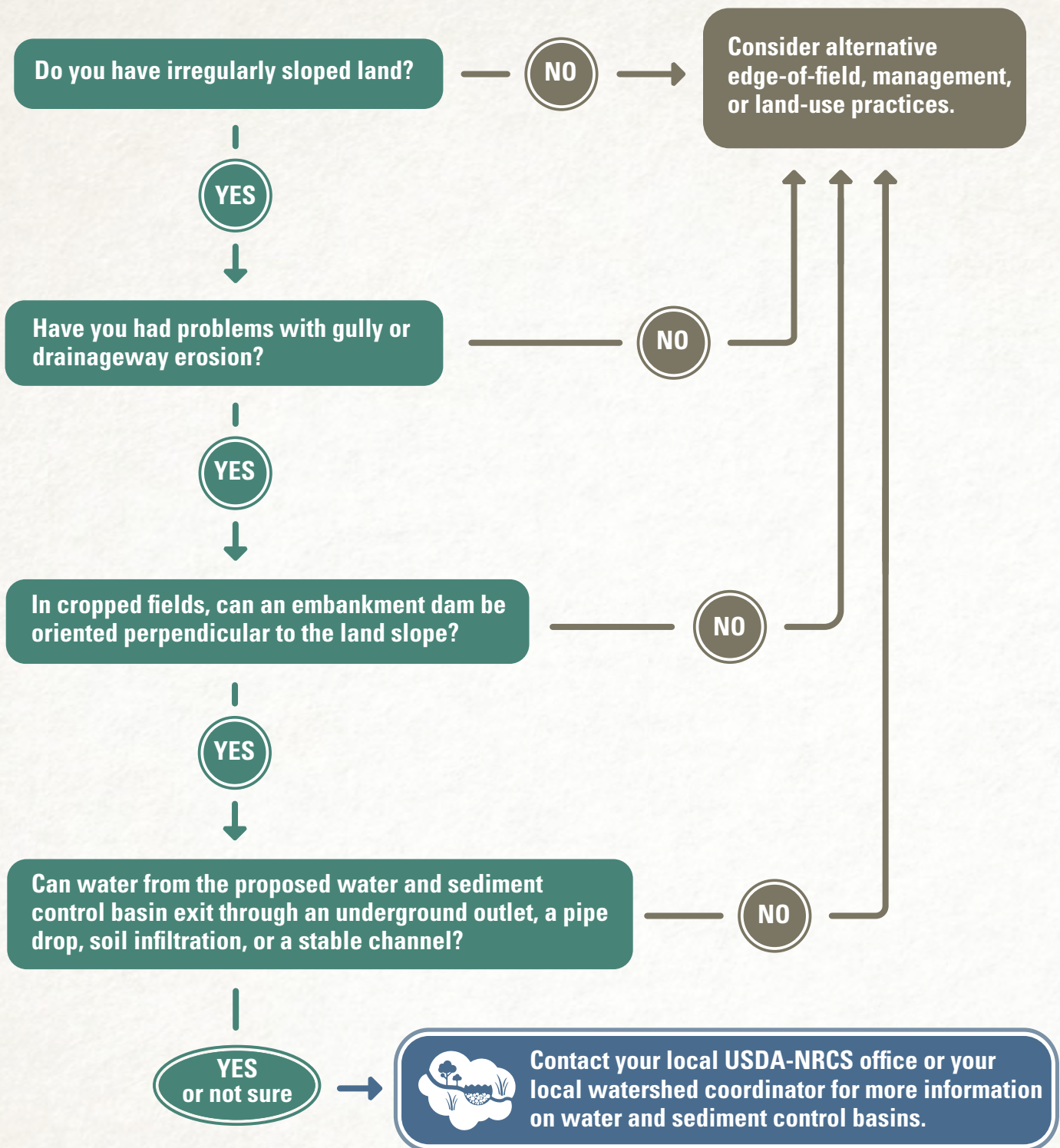


**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



# Is a Water and Sediment Control Basin Right for You?



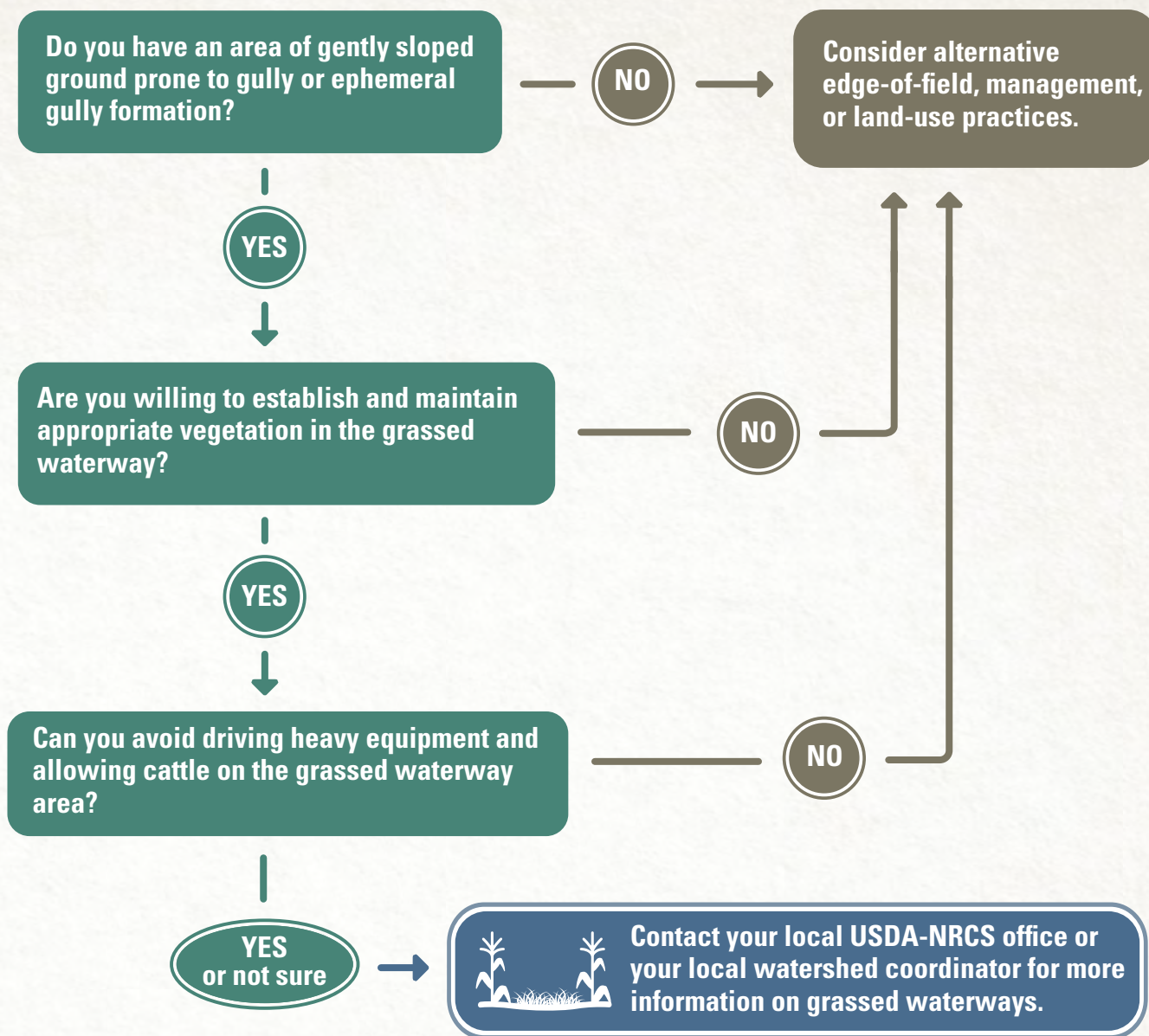
**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





## Is a Grassed Waterway Right for You?



**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.



# Are Prairie Strips Right for You?

Are reducing soil erosion, nitrate and phosphorus loss,  
AND providing wildlife habitat your primary goals?

YES



Are you willing to convert 5–10%  
of your field to prairie?

YES



Are you committed to mowing for the  
first two years to minimize weeds?

YES



Are you willing to farm around  
prairie strips?

YES



Plant prairie strips, 30 feet or wider,  
through the field. Space at a distance  
conductive to your farm equipment.



Plant on the contour  
for slopes  $\geq 5\%$ .

NO

NO

NO

Consider alternative  
edge-of-field, management,  
or land-use practices.

Plant prairie strips around the perimeter of  
field, on end rows, or in a terrace channel.

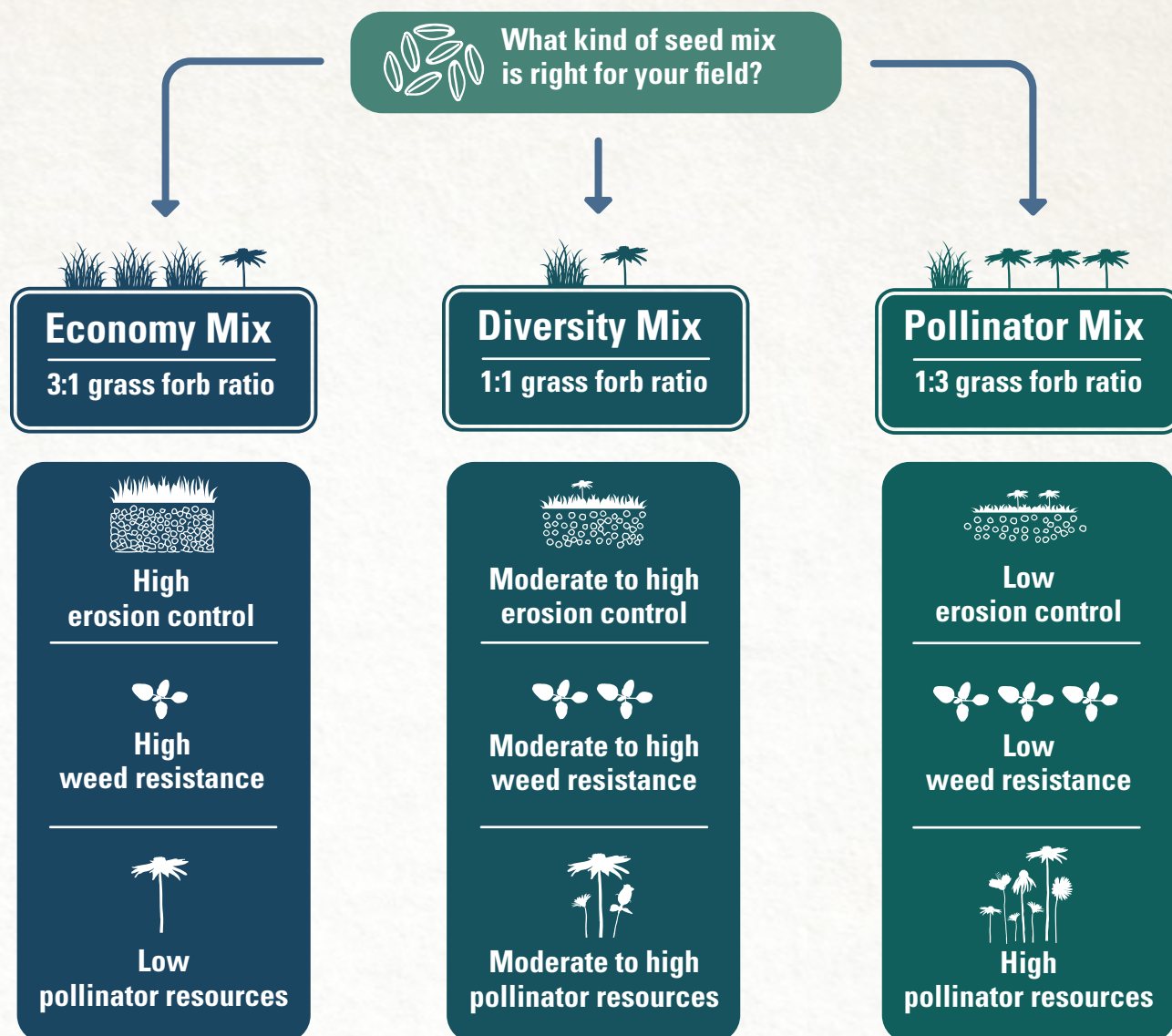
Contact your local USDA-NRCS office for  
more information on prairie strips.



Attend a conservation field day to learn more!

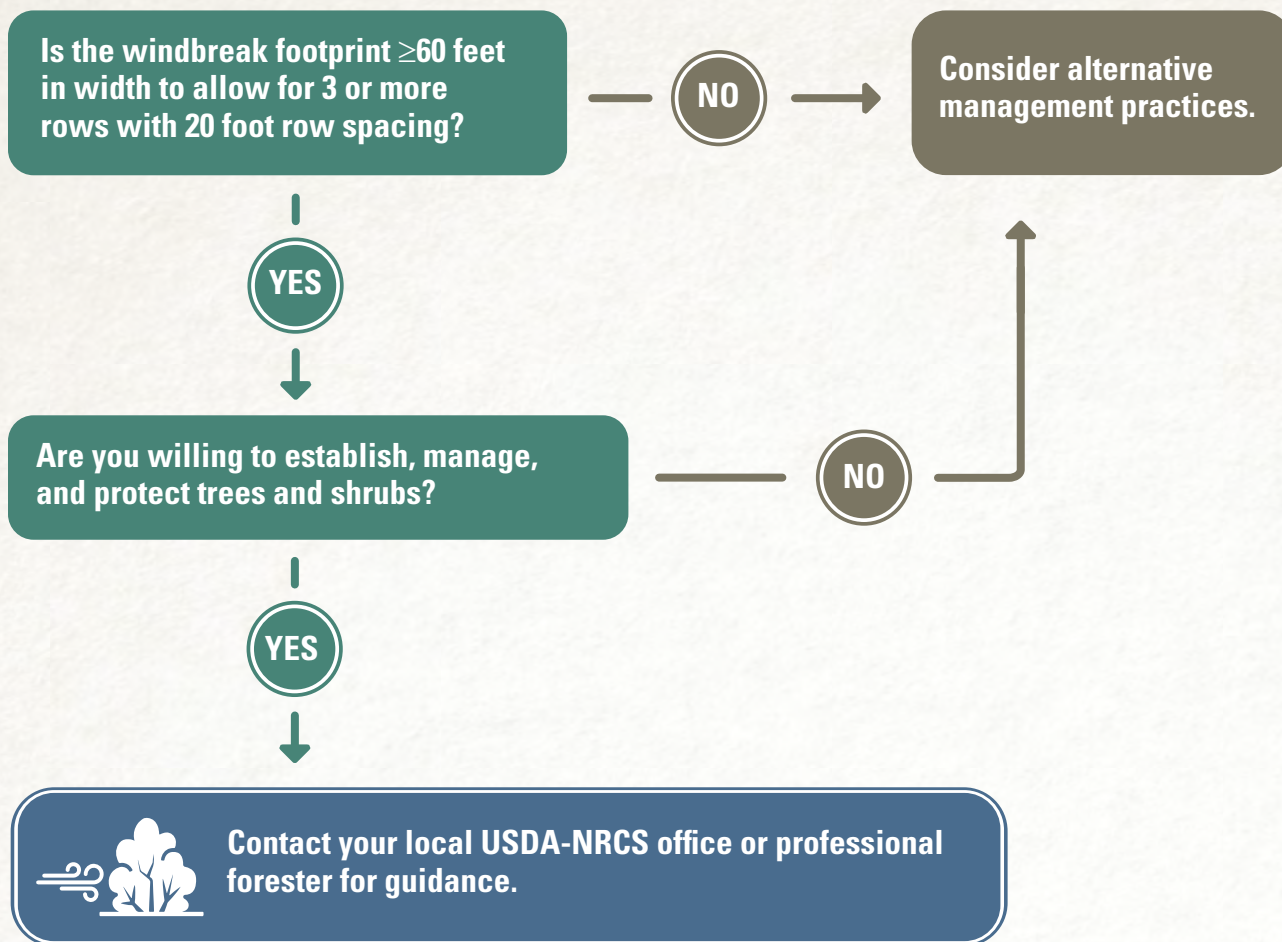
Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University  
Extension and Outreach, or USDA-NRCS for field days near you.







## Is a Windbreak Right for You?



### Attend a conservation field day to learn more!

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





What is your primary goal for planting trees and shrubs on your site?

Homestead, livestock, and field protection

Wildlife habitat and diversified income



Moderately dry site conditions

**Conifers:** Eastern redcedar, Norway spruce, Eastern white pine, arborvitae

**Hardwoods:** red oak, black oak, black walnut, hackberry



Moderately wet site conditions

**Conifers:** Eastern redcedar, bald cypress, tamarack

**Hardwoods:** bur oak, swamp white oak, hackberry, Kentucky coffeetree, river birch



Moderately dry site conditions

**Conifers:** Eastern redcedar, Norway spruce, Eastern white pine, arborvitae

**Hardwoods:** bur oak, red oak, hackberry, black cherry

**Shrubs:** American plum, chokeberry, hazelnut, paw paw, gray dogwood



Moderately wet site conditions

**Conifers:** Eastern redcedar, bald cypress, tamarack

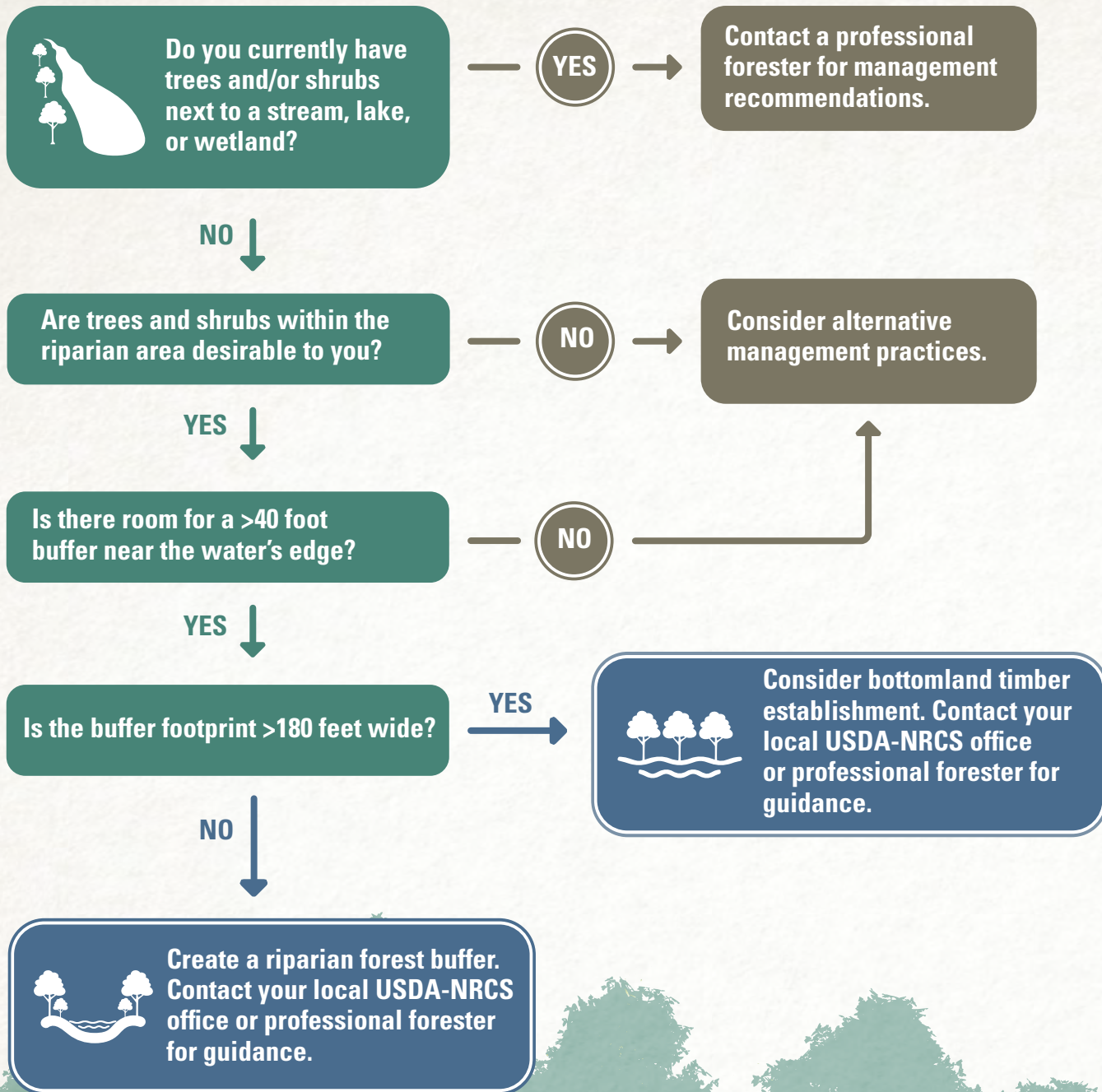
**Hardwoods:** swamp white oak, pin oak, pecan, shellbark hickory, sycamore

**Shrubs:** buttonbush, elderberry, red-osier dogwood, serviceberry

Note that these lists are not all-inclusive, and simply intended to show the diversity of potential species. Consult with a professional forester for site-specific species recommendations. Visit <https://naturalresources.extension.iastate.edu/contacts/forestry> to locate a professional forester or forestry contractor near you.



# Is a Riparian Forest Buffer Right for You?



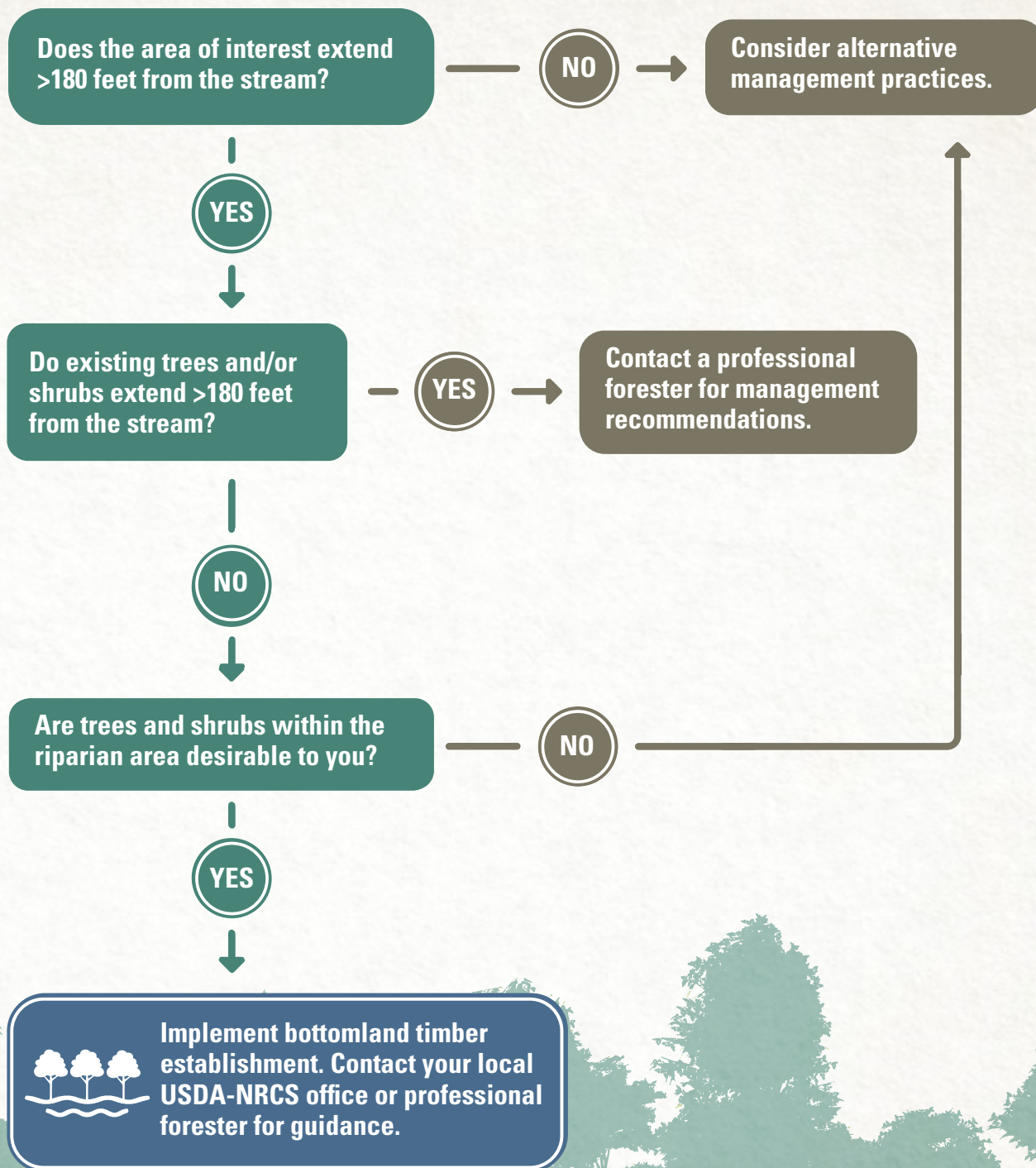
**Attend a conservation field day to learn more!**

Contact Iowa Learning Farms, Practical Farmers of Iowa, Iowa State University Extension and Outreach, or USDA-NRCS for field days near you.





# Is Bottomland Timber Establishment Right for You?



**Attend a conservation field day to learn more!**

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# Glossary

**A-slope soils** Nearly level soils that have an angle of 0 to 2 percent from the soil surface to the horizon.

**ACPF** Agricultural Conservation Planning Framework, a planning tool that uses field boundary, land use, elevation, and soil data to determine suitable locations for in-field and edge-of-field conservation practices within hydrologic units of the Midwest.

**Aerial seeding** Technique for sowing seeds by broadcasting them from a plane or helicopter.

**Backflow** Undesirable flow of water in the opposite direction from what is intended.

**Broadcast seeding** Technique for sowing seeds across a field by either scattering the seed by hand or mechanically, commonly using broadcast fertilizer spreaders or aerial applicators. This might occur into a standing crop or following crop harvest.

**Cereal rye** Cool season annual small-grain crop.

**Composite soil sample** Thoroughly mixed soil sample consisting of several cores taken from a particular field at a specific soil depth for analysis.

**Conservation plan** Natural resources management strategy for an individual farm.

**Control structure** Structure installed in line with a drainage pipe to raise, lower, or divert the flow of water from subsurface drainage.

**Controlled traffic** Conservation practice that minimizes or controls wheel traffic paths from one field operation to the next, to limit soil compaction.

**Coulter** Vertically mounted, circular blade that cuts crop residue and disturbs soil ahead of a planter row unit.

**Cover crop** A plant species that is seeded in fall, either before or after harvest, to manage soil erosion and take up nutrients to reduce nutrient losses. It is not intended for grain harvest, but can be grazed or harvested as forage.

**Denitrification** Microbial process that converts nitrate to nitrogen gas.

**Disease pressure** Level of prevalence and severity of disease.

**Distribution line** Tile drainage pipe that dispenses water to a desired location, such as a saturated buffer.

**Diverse rotation** Cropping system that has more crop diversity than the primary corn and soybean rotation.

**Down pressure** Amount of force transferred from one point to another point, often referred to as force from a planter toolbar to an individual row unit.

**Drainage map** Map that identifies the location of tile drainage lines within individual fields or a drainage district.

**Drainage rights** Legal ability of landowners to divert water from agricultural fields to areas of lower elevation either on or off their property.

**Drainage tile** Clay or concrete pipe segments, or perforated plastic pipe, buried under agricultural land to move excess water out of the soil.

**Drill seeding** Mechanical means of creating soil furrows at planting and metering seed into the furrows at a uniform rate.

**Easement** Portion of land set aside for a specific purpose.

**Edge-of-field practice** Structural practice located at the edge of an agricultural field.

**Ephemeral gully erosion** Removal and transport of soil from natural drainageways or flow paths in a field. Ephemeral gullies are small enough to be smoothed over by tillage but are likely to keep re-forming.

**Fall tillage** Soil tillage in the fall that leaves the field rough and requires a spring finishing pass to create a smooth and clod-free seedbed.

**Frost-seeding** Practice of seeding a crop species in late winter when the soil surface is going through frequent (often daily) freeze-thaw cycles that help to incorporate seed.

**Full-width tillage** Tillage that disturbs 100 percent of the soil surface in preparation for planting.

**Gully erosion** Removal and transport of soil from natural drainageways or flow paths in a field. If left unchecked, drastic changes to the slope of the drainageway may occur and permanent ditches can form.



**Habitat** Environment in which animals, plants, and other organisms live, eat, or breed.

**Herbicide** A chemical that kills plants, intended for weed control.

**Hydrologic unit** Area of land that drains to a common point.

**Interseeding** A form of early season broadcast seeding directly into an existing crop stand when it is 6 to 8 inches tall.

**No-tillage** Agricultural practice where crops are grown in undisturbed soil and plant residue at the surface.

**LiDAR** Light Detection And Ranging, a surveying method that uses laser light reflected off the land surface to form an elevation map.

**Nutrient load** Amount of a nutrient lost from a given area over a defined period of time.

**Nutrient stratification** The natural occurrence of nutrients, such as phosphorus and potassium, in layers or bands of different concentrations in the soil.

**Overseeding** A form of broadcast seeding directly into an existing crop stand without incorporating the seed.

**Overwintering** The process of a crop species surviving freezing winter conditions.

**Pathogen** A bacterium, virus, or other microorganism that causes disease.

**Pest** An organism (plant or animal) that causes damage to field crops.

**Pesticide** Any substance or mixture of substances used to repel, kill, or prevent pests.

**Post-harvest aeration** Blowing air through stored grain to reduce the rate of grain deterioration.

**Potable water** Water that is fit for human consumption.

**Practice footprint** The space or area of land that an edge-of-field practice occupies.

**Pure Live Seed (PLS)** The percentage of viable seed that has the potential to germinate within a measured one-pound weight of any seed lot. Seeding rates are based on Pure Live Seed expressed in pounds per acre.

**Rill erosion** Removal and transport of soil due to concentrated water flow paths.

**Row cleaner** Toolbar-mounted adjustable equipment for clearing crop residue away from the intended seedbed.

**Sedimentation basin** Water-holding structure that slows the flow of water and allows soil particles to settle out of the water column.

**Seeding rate** Amount of seed required at planting to achieve optimum yield goals.

**Sheet erosion** Removal and transport of a thin layer of soil due to surface runoff occurring over a large area.

**Soil organic matter** The organic component of soil that includes plant and animal residue at various stages of decomposition, biomass of soil microorganisms, and substances produced by plant roots and other soil organisms.

**Soil erosion** The detachment and transport of soil at the land surface by water, ice, wind, and gravity.

**Soil sampling** Collecting soil cores at specific soil depths from the field for analysis.

**Starter fertilizer** Fertilizer applied near the seed at planting to supply readily available nutrients to seeds before the plant root system develops.

**Stream bank sloughing** Erosion of soil down a stream bank toward or into the stream channel.

**Strip-tillage** A system with less than one-third of the row width tilled to create a seedbed. The strip-tillage system leaves more than two-thirds of the row width undisturbed between tillage zones.

**Strip freshening** Second tillage pass to prepare fall strip-tillage strips for warming before planting.

**Subsurface tile drainage** In-field, below-ground drainage tiles or pipes that convey excess water in the soil profile away from agricultural land.

**Surface intake** Surface drain that allows surface runoff to be diverted into a subsurface tile drainage line.

**Unstable stream bank** Stream bank that is prone to erosion or sloughing.

**Vomitoxins** A family of mycotoxins, also known as deoxynivalenol (DON), that infect wheat, barley, oat, rice, and corn.



# Resources

## Strip-Tillage and No-Tillage

[Iowa Learning Farms Soil Conservation Resource Page:](#)

<https://www.iowalearningfarms.org/conservation-station>

Al-Kaisi, M. (2012, February 13). [Strip-tillage concept and management](#). Retrieved from Iowa State University Extension and Outreach website:

<https://crops.extension.iastate.edu/cropnews/2012/02/strip-tillage-concept-and-management>

DeJong-Hughes, J., & Vetsch, J. (2018). [On-farm comparison: Conservation tillage systems](#). Retrieved from University of Minnesota Extension website:

<https://extension.umn.edu/soil-management-and-health/farm-comparison-conservation-tillage-systems>

[Iowa Soybean Association Replicated Strip Trial Database:](#)

<https://www.iasoybeans.com/research/results/replicated-strip-trials>

Nowatzki, J., Endres, G., & DeJong-Hughes, J. (2017, June). [Strip-till for field crop production](#) (Publication AE 1370). North Dakota State Extension Service and University of Minnesota Extension. Retrieved from:

<https://ag.ndsu.edu/publications/crops/strip-till-for-field-crop-production/>

Mallarino, A., & Sawyer, J. (2016, December). [Take a good soil sample to help make good fertilization decisions](#) (Publication CROP 3108). Retrieved from Iowa State University Extension and Outreach website:

<https://store.extension.iastate.edu/product/Take-a-Good-Soil-Sample-to-Help-Make-Good-Fertilization-Decisions>

[USDA-NRCS Residue and Tillage Management Iowa Job Sheet:](#)

[https://www.nrcs.usda.gov/wps/PA\\_NRCSConsumption/download/?cid=nrcseprd1291431&ext=pdf](https://www.nrcs.usda.gov/wps/PA_NRCSConsumption/download/?cid=nrcseprd1291431&ext=pdf)

## Cover Crops

[Iowa Learning Farms Cover Crop Resources and Research:](#)

<https://iowalearningfarms.org/cover-crops>

[Practical Farmers of Iowa Farmer-Led Research on Cover Crops:](#)

<https://practicalfarmers.org/research>

Basche, A., Roesch-McNally, G., Clay, R., & Miguez, F. (2016, June). [Iowa Cover Crop Resource Guide](#).

Retrieved from Iowa State University Extension and Outreach website:

<https://store.extension.iastate.edu/product/Iowa-Cover-Crop-Resource-Guide>

Sustainable Agriculture Research and Education. (2012). Crop rotation with cover crops. [Managing cover crops profitably](#). Third Edition. SARE USDA. Retrieved from:

<https://sare.org/Learning-Center/Books/Managing-Cover-Crops-Profitably-3rd-Edition/Text-Version/Crop-Rotation-with-Cover-Crop>

[USDA-NRCS Cover Crop Iowa Job Sheet:](#)

[https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcseprd985818.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcseprd985818.pdf)



## Crop Rotations

[Practical Farmers of Iowa Farmer-Led Research on Small Grains:](#)

<https://practicalfarmers.org/research>

Baldwin, K. B. (2006). [Crop rotations on organic farms](#) (AG-659W-05. E06-45788). Center for Environmental Farming Systems, North Carolina Agricultural & Technical State University. Retrieved from:

<https://carolinafarmstewards.org/wp-content/uploads/2012/12/7-CEFS-Crop-Rotation-on-Organic-Farms.pdf>

Klinkenborg, V. (2012, November 3). [Did farmers of the past know more than we do?](#) *New York Times*. Retrieved from:

<https://www.nytimes.com/2012/11/04/opinion/sunday/crop-rotation-and-the-future-of-farming.html>

Ohde, N. (2016, April 7). [Five reasons why diverse crop rotations are good for Iowa](#). Retrieved from Practical Farmers of Iowa website:

<https://practicalfarmers.org/2016/04/5-reasons-why-diverse-crop-rotations-are-good-for-iowa>

[USDA-NRCS Conservation Crop Rotation Iowa Job Sheet:](#)

[https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_005649.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_005649.pdf)

## Whole Farm Economics

[Ag Decision Maker:](#) An agricultural economics and business website:

<https://extension.iastate.edu/agdm>

Duffy, M. (2012, August). [Value of soil erosion to the land owner](#) (A1-75). Retrieved from Iowa State University Extension and Outreach website:

<https://extension.iastate.edu/agdm/crops/html/a1-75.html>



## Edge-of-Field Practices

Baker, J.L., Melvin, S.W., Lemke, D.W., Lawlor, P.A., Crumpton, W.G., & Helmers, M.J. (2004, March). Subsurface drainage in Iowa and the water quality benefits and problem. In R. Cooke, Ed., *Drainage VIII: Proceedings of the Eighth International Symposium*, Sacramento, California, USA (Publication No. 701P0304, pp. 39-50). American Society of Agricultural Engineers.

Christianson, L.E., Frankenberger, J., Hay, C., Helmers, M.J., & Sands, G. (2016). [\*Ten ways to reduce nitrogen loads from drained cropland in the Midwest\*](#) (Pub. C1400). University of Illinois Extension. Retrieved from: <http://draindrop.cropsci.illinois.edu/index.php/i-drop-impact/ten-ways-to-reduce-nitrogen-loads-from-drained-cropland-in-the-midwest/>

### [Directory of Professional Foresters and Forestry Contractors](#)

<https://naturalresources.extension.iastate.edu/contacts/forestry>

Frankenberger, J., Kladvik, E., Sands, G., Jaynes, D., Fausey, N., Helmers, M., Brown, L. (2006). [\*Drainage water management for the Midwest: Questions and answers about drainage water management for the Midwest\*](#) (WQ-44). Retrieved from Purdue University Extension website:

<http://extension.purdue.edu/extmedia/WQ/WQ-44.pdf>

Iowa State University [Prairie & Tree Planting Tool](#)

<https://pt2.nrem.iastate.edu/>

Jaynes, D., Reinhart, B., Hay, C., Isenhardt, T., Jacquemin, S., Kjaersgaard, J., Utt, N. (2018). [\*Questions and answers about saturated buffers for the Midwest\*](#) (ABE-160). Retrieved from Purdue University Extension website:

<http://extension.purdue.edu/extmedia/ABE/ABE-160.pdf>

STRIPS Team. (2017, June). [Prairie strips: small changes, big impacts](#). (Publication AE 3610). Retrieved from Iowa State University Extension and Outreach website:

<https://store.extension.iastate.edu/product/Prairie-Strips-Small-Changes-Big-Impacts>

### [USDA-ACPF Watershed Database Saturated Buffer Viewing:](#)

<https://acpfdata.gis.iastate.edu/ACPF/satbuff/>

### [USDA-NRCS Contour Buffer Strips Iowa Job Sheet:](#)

[https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/nrcs142p2\\_006620.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_006620.pdf)

[USDA-NRCS. \(2012, February\). Drainage Water Management](#). Retrieved from:

[https://www.nrcs.usda.gov/Internet/FSE\\_DOCUMENTS/stelprdb1076966.pdf](https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1076966.pdf)

## Iowa Learning Farms Conservation Webinar Series

### [Webinar archive](#)

<https://www.iowalearningfarms.org/webinars>



## Iowa Nutrient Reduction Strategy

Iowa Department of Agriculture and Land Stewardship, Iowa Department of Natural Resources, Iowa State University College of Agriculture and Life Sciences. (2013). [\*Iowa Nutrient Reduction Strategy: A science and technology-based framework to assess and reduce nutrients to Iowa waters and the Gulf of Mexico.\*](#)

Retrieved from:

<https://nutrientstrategy.iastate.edu/sites/default/files/documents/NRSfull-130529.pdf>

[Tracking the Iowa Nutrient Reduction Strategy](#)

<https://nrtracking.cals.iastate.edu/>

## Map Resources

[Iowa Geographic Map Server](#)

<https://ortho.gis.iastate.edu>

### LiDAR Maps

Open a Map Layer in ArcGIS Web App -> Elevation Maps -> Shaded Relief

### US Topographic Maps

Open a Map Layer in ArcGIS Web App -> Elevation Maps -> USGS Topographic

### Summer Aerial Photos

Open a Map Layer in ArcGIS Web App -> Summer Orthophotos 2004-2017

### Spring Aerial Photos

Open a Map Layer in ArcGIS Web App -> Spring Orthophotos 2004-2018

### Land Use Land Cover

Open a Map Layer in ArcGIS Web App -> 2002 IDNR Landcover

[USDA-NRCS Web Soil Survey \(Soil Survey information\):](#)

<https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx>

[Multi-Resolution Land Characteristics Consortium \(National Land Cover Database\):](#)

<https://mrlc.gov/data>









