Conservation Practices

A Conservation Practices is a specific treatment, such as a structural or vegetative measure, or a management technique commonly used to meet specific needs in planning and implementing conservation, for which standards and specifications have been developed.

The **National Handbook of Conservation Practices** (NHCP) establishes NRCS national standards for conservation practices commonly used to improve natural resources with respect to soil, water, air, plants, and animals plus humans (SWAPA+H). Each NRCS State office localizes the Field Office Technical Guide (FOTG) to its geographic area and establishes quality requirements for applying conservation practices within its area of responsibility. These revised local standards are designed to be equal to or more rigorous than the national standard. Conservation practice standards are in section IV of the FOTG.

There are 167 conservation practices listed in the National Handbook of Conservation Practices. The table below summarizes some of the most common practices that can be interpreted from large-scale aerial imagery.

Table 1. Common Conservation Practices (listed alphabetically).

Conservation Practices	
Conservation practice	**Practice description**
Alley Cropping	Trees or shrubs planted in a set or series of single or multiple rows with agronomic,horticultural crops,or forages cultivated in the alleys between the rows of woody plants.
Bedding	Plowing, blading, or otherwise elevating the surface of flat land into a series of broad, low ridges separated by shallow, parallel channels.
Contour Buffer Strips	Narrow Strips of permanent, herbaceous, vegetative cover established across the slope and alternated down the slope with parallel, wider cropped strips.
Contour Farming	Tillage, planting, and other farming operations performed on or near the contour of the field slope.
Contour Orchard/Other Fruit Area	Planting orchards, vineyards, or small fruits so that all cultural operations are done on the contour.
Cross Wind Trap Strips	Herbaceous cover, resistant to wind erosion, established in on or more strips across prevailing wind erosion direction.
Diversion	A channel constructed across the slope with a

	supporting ridge on the lower side.
Field Border	Strip of permanent vegetation established at the edge or around the perimeter of a field.
Filter Strip	Strip or area of herbaceous vegetation, situated between cropland, grazing land, or disturbed land (including forest land) and environmentally sensitive areas.
Grassed Waterway	Natural or constructed, channel shaped or graded, to required dimensions and established with suitable vegetation.
Hedgerow Planting	Establishing a living fence of shrubs or tress in, across, or around a field.
Herbaceous Wind Barriers	Herbaceous vegetation established in rows or narrow strips across the prevailing wind direction.
Hillside Ditch	A channel that has a supporting ridge on the lower side constructed across the slope at definite vertical intervals and gradient, with or without a vegetative barrier.
Irrigation System, Tailwater Recovery	A facility to collect, store, and transport irrigation tailwater for reuse in a farm irrigation distribution system.
Lined Waterway or Outlet	A waterway or outlet having an erosion-resistant lining of concrete, stone, or other permanent material. The lined section extends up the side slopes to a designed depth. The earth above the permanent lining may be vegetated or otherwise protected.
Riparian Forest Buffer	Area of trees and/or shrubs adjacent to and up gradient from water bodies.
Stripcropping (Contour)	Growing row crops, forages, small grains, or fallow in a systematic arrangement of equal width strips on or near the contour of the field slope.
Stripcropping (Cross Wind)	Growing crops, in strips, established across the prevailing wind-erosion direction and arranged so that strips susceptible to wind erosion are alternated with strips having a protective cover that is resistant to wind erosion.
Stripcropping (Field)	Growing crops in a systematic arrangement of strips or bands across the general slope (not on the contour) to reduce water erosion. The crops are arranged so that a strip of grass or a close-growing crop is alternated with a clean-tilled crop or fallow.

Surface Drainage, Field Ditch	A graded ditch for collecting excess water in a field.
Terrace	An earth embankment, a channel, or a combination ridge and channel constructed across the slope.
Tree/Shrub Establishment	To establish woody plants by planting or seeding.
Vegetative Barrier	Permanent strips of stiff, dense vegetation along the general contour of slopes or across concentrated flow areas.
Water and Sediment Control Basin	An earth embankment or a combination ridge and channel generally constructed across the slope and minor watercourses.
Windbreak/Shelterbelt Establishment	Linear plantings of single or multiple rows of trees or shrubs established for environmental purposes.
Source: National Handbook of Conservation Practices	

Conservation Practices

Alley Cropping

Trees or shrubs planted in a set or series of single or multiple rows with agronomic, horticultural crops, or forages cultivated in the alleys between the rows of woody plants.

Alley Cropping

Alley cropping in Dawson County,Texas. Image courtesy of USDA, NRCS.

Alley Cropping

Alley cropping in Grant County, Louisiana. Image courtesy of USDA, NRCS.

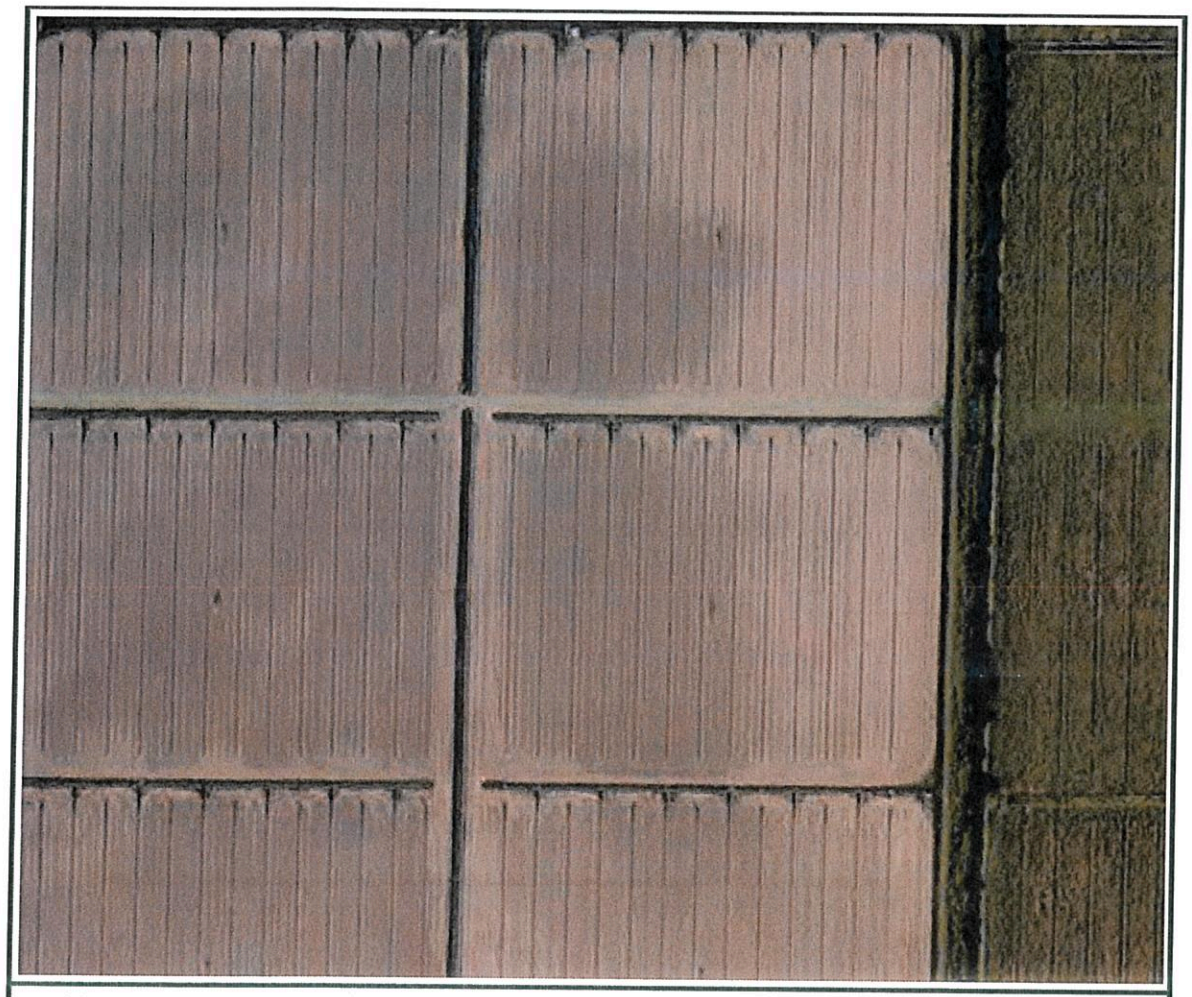
Bedding

Plowing, blading, or otherwise elevating the surface of flat land into a series of broad, low ridges separated by shallow, parallel channels.

Strawberry Beds

Strawberry beds in Hawaii (note the with sugar cane in the background). In this case, the raised beds are covered with black plastic to control weeds and preserve soils moisture. Image courtesy of USDA, NRCS.

Bedding Sugar Cane



Bedding sugar cane in Collier County, Florida. Image courtesy of USDA, NRCS.

Bedding Preparation

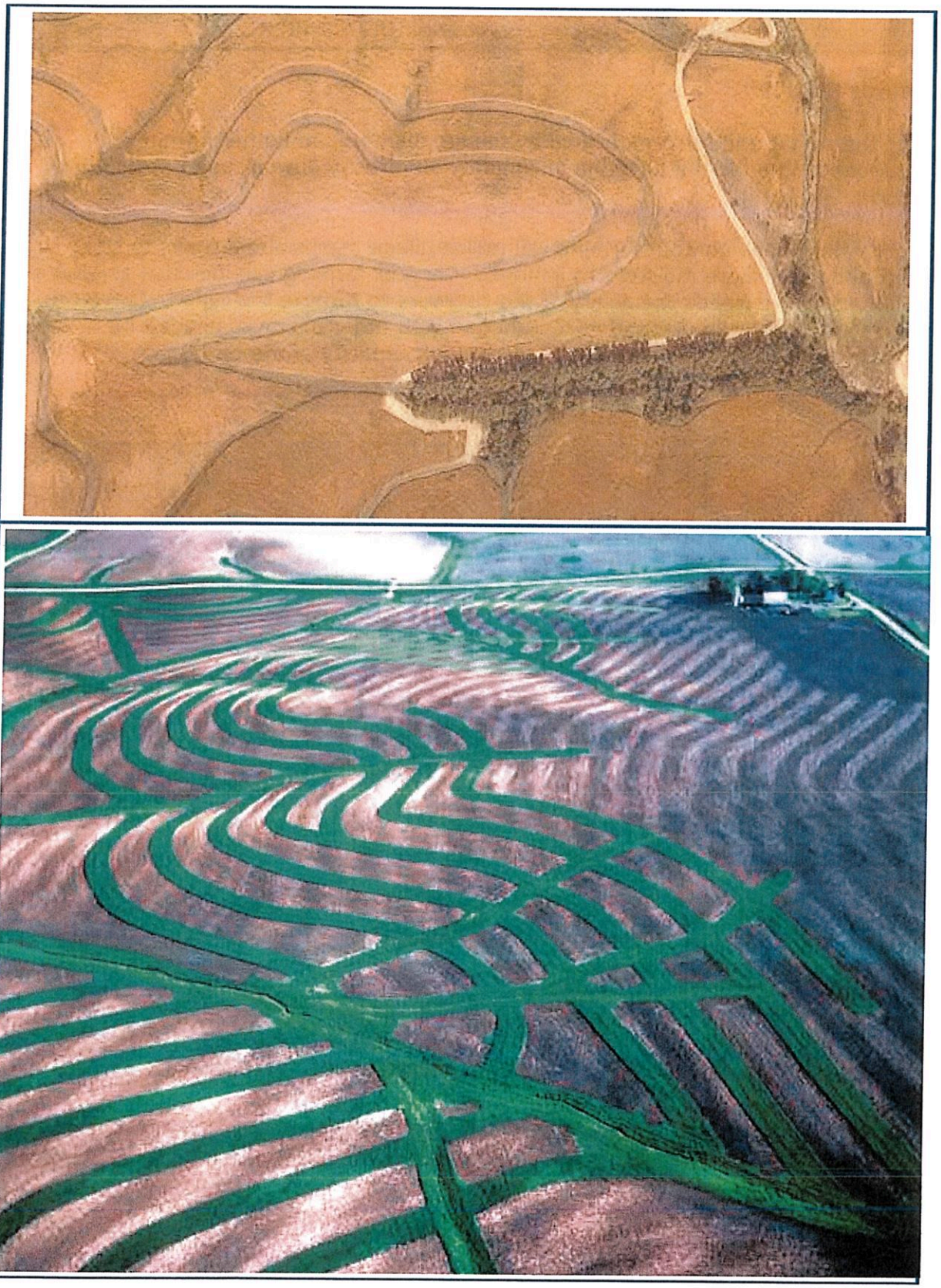
Bedding preparation in Beaufort County, North Carolina. Image courtesy of USDA, NRCS.

Contour Buffer Strips

Contour buffer strips are narrow bands of permanent, herbaceous vegetative cover established across the slope (on the contour) and alternated down the slope with parallel, wider cropped strips. The benefits of farming on the contour with the added protection from the grass strips make contour buffer strips an effective and cost efficient conservation practice.

Contour buffer strips slow runoff water and trap sediment. Consequently, soil erosion is generally reduced significantly by this practice. Sediments, nutrients, pesticides, and other potential pollutants are filtered out as water flows through the grass strips. The grass strips also provide food and cover for wildlife.

Contour Buffer Strips



Contour buffer strips in Iowa. Images courtesy of USDA, NRCS.

Contour Farming

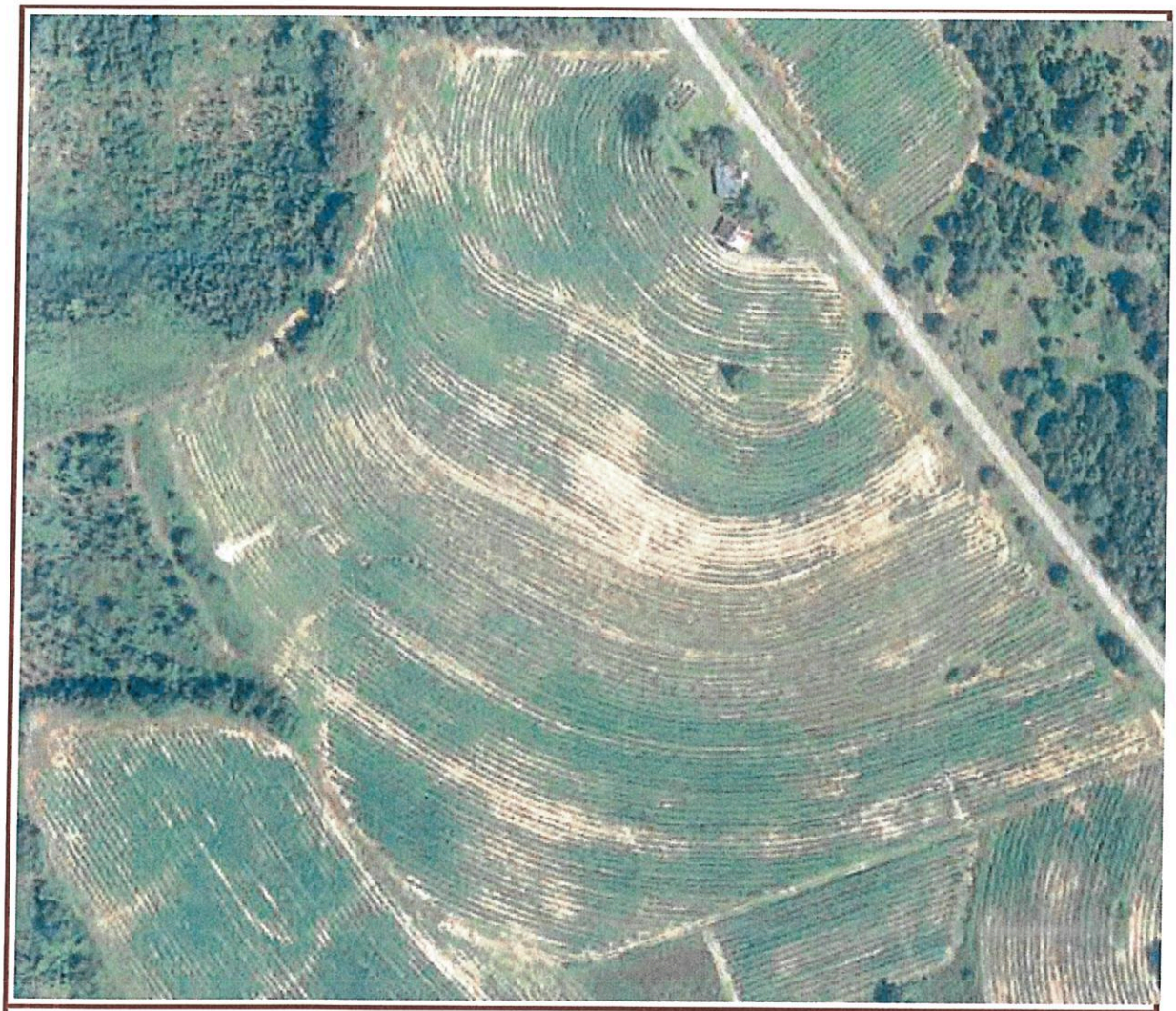
Using the ridges and furrows formed by tillage, planting, and other farming operations to change the direction of runoff from directly downslope to around the hillslope.

Properly designed countour farming will utilize tillage marks and furrows to slow runoff and allow more moisture to infiltrate. Contour farming can increase erosion if rainfall amount exceeds the ability of the contours to remove the runoff. Therefore, this practice is usually planned in conjunction with other practices needed for support in the event runoff exceeds the carrying capacity of the contours.

Contour Stripcropping

Contour stripcropping in Iowa. Image courtesy of USDA, NRCS.

Contour Farming



Contour farming in Bullock County, Alabama. Note the reliance on the ridges and furrows formed by tillage and planting, rather than the use of terrace structures. Image courtesy of USGS.

Contour Orchard/Other Fruit Area

Planting orchards, vineyards, or small fruits so that all cultural operations are done on the contour.

Contour Planted Orchards

Contour planted orchards in Leelanau County, Michigan. Image courtesy of USDA, NAIP.

Contour Planted Orchards

Contour planted orchards in California. Image courtesy of USDA, NRCS.

Cross Wind Trap Strips

Herbaceous cover, resistant to wind erosion, established in one or more strips across prevailing wind erosion direction. Trap strips shall be wide enough to trap saltating soil particles and store wind-borne sediments originating upwind. The

width of each trap strip shall be 15 - 25 feet depending on the effective height of the vegetation or stubble in the strip during periods when wind erosion is expected to occur. The strips shall be located at the windward edge of fields, or immediately upwind from areas to be protected from erosion or deposition, or in recurring patterns interspersed between erosion-susceptible strips.

Cross Wind Trap Strips

Cross Wind Trap Strips in Charleston County, South Carolina. Image courtesy of USDA, NRCS.

Diversion

A channel constructed across the slope with a supporting ridge on the lower side.

Diversions

A series of diversions in a field in Grant County, Kansas. Image courtesy of USDA, NRCS.

Diversions

A series of diversions in a field in Power County, Idaho. Image courtesy of USDA, NRCS.

Field Border

Strip of permanent vegetation established at the edge or around the perimeter of a field.

Field Border

Field border in Chambers County, Alabama. Image courtesy of USDA, NRCS.

Filter Strip

Strip or area of herbaceous vegetation situated between cropland, grazing land, or disturbed land (including forest land) and environmentally sensitive areas.

Filter Strip

Filter strip protecting a small stream in Wright County, Iowa. Image courtesy of USDA, NRCS.

Grass Filter Strip

Grass filter strip in Carroll County, Iowa. Image courtesy of USDA, NRCS.

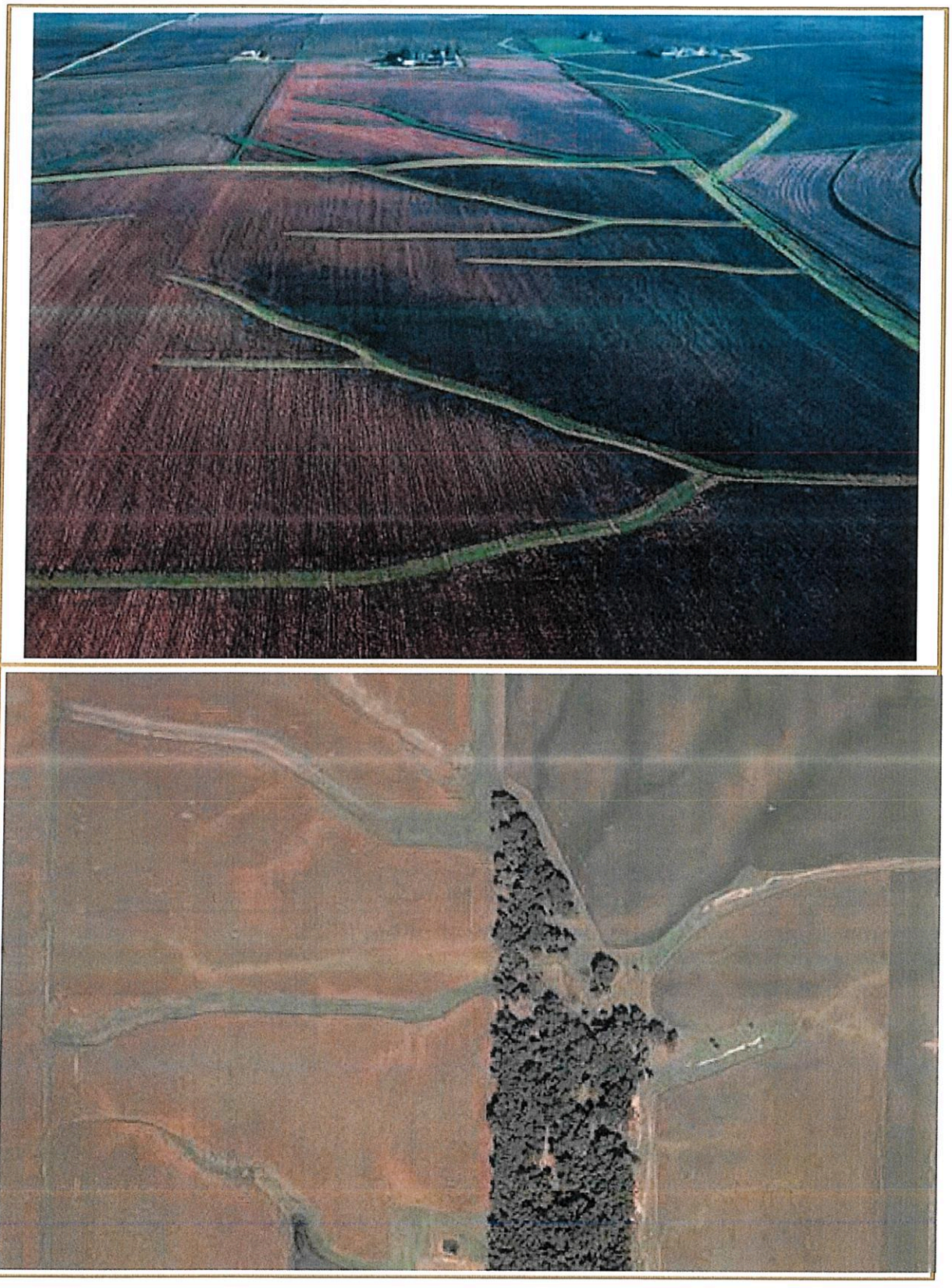
Grassed Waterway

Natural or constructed channel shaped or graded to required dimensions and established with suitable vegetation.

Grassed Waterway

Grassed waterway in southern Missouri. Image courtesy of USDA, NRCS.

Grassed Waterways



Grassed waterways in Iowa (top, oblique image) and in Missouri (bottom, vertical photo). Both images courtesy of USDA, NRCS.

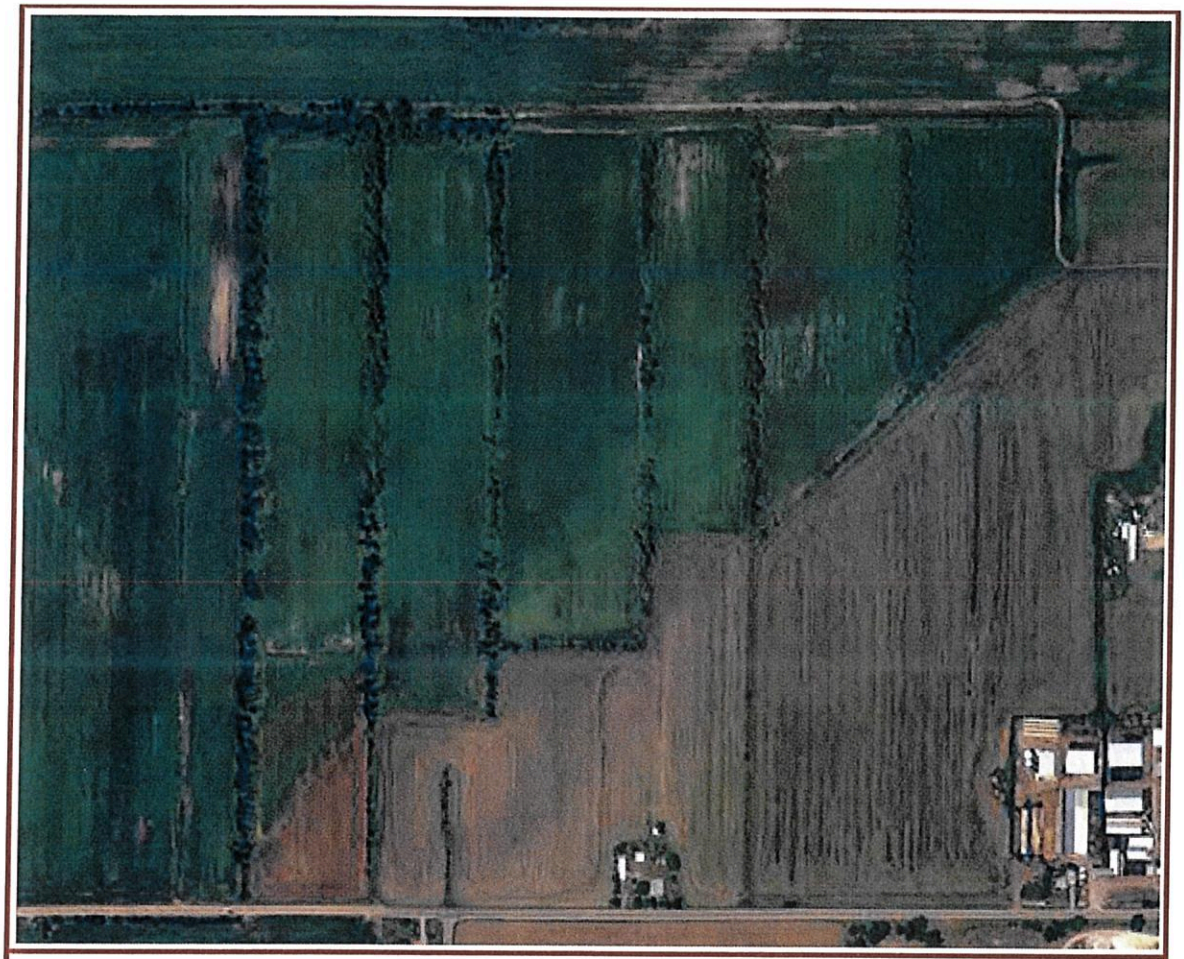
Hedgerow Planting

Establishing a living fence of shrubs or trees in, across, or around a field.

Hedgerow Planting

Hedgerow planting in Iowa. Image courtesy of USDA, NRCS.

Hedgerow Planting



Hedgerow plantings on muck soils in Clinton County, Michigan. Image courtesy of USDA, NAIP.

Herbaceous Wind Barriers

Herbaceous vegetation established in rows or narrow strips across the prevailing wind direction.

Herbaceous Wind Barriers

Herbaceous wind barriers in Richmond County, North Carolina. In this case, there are a series of contour buffer strips that curve across the field following the contours of the land. The straight, east-west-trending herbaceous wind barriers are superimposed on the buffer strips. Image courtesy of USDA, NRCS.

Hillside Ditch

A channel that has a supporting ridge on the lower side constructed across the slope at definite vertical intervals and gradient, with or without a vegetative barrier.

Hillside Ditch

Hillside ditch in Teller County, Colorado. Image courtesy of USDSA, NRCS.

Hillside Ditch

Hillside ditch in Elko County, Nevada. Note how the ditch "hugs" the contour, forming "V's" as it crosses the concentrated flow lines (especially evident in the lower left of the image). Image courtesy of USDSA, NRCS.

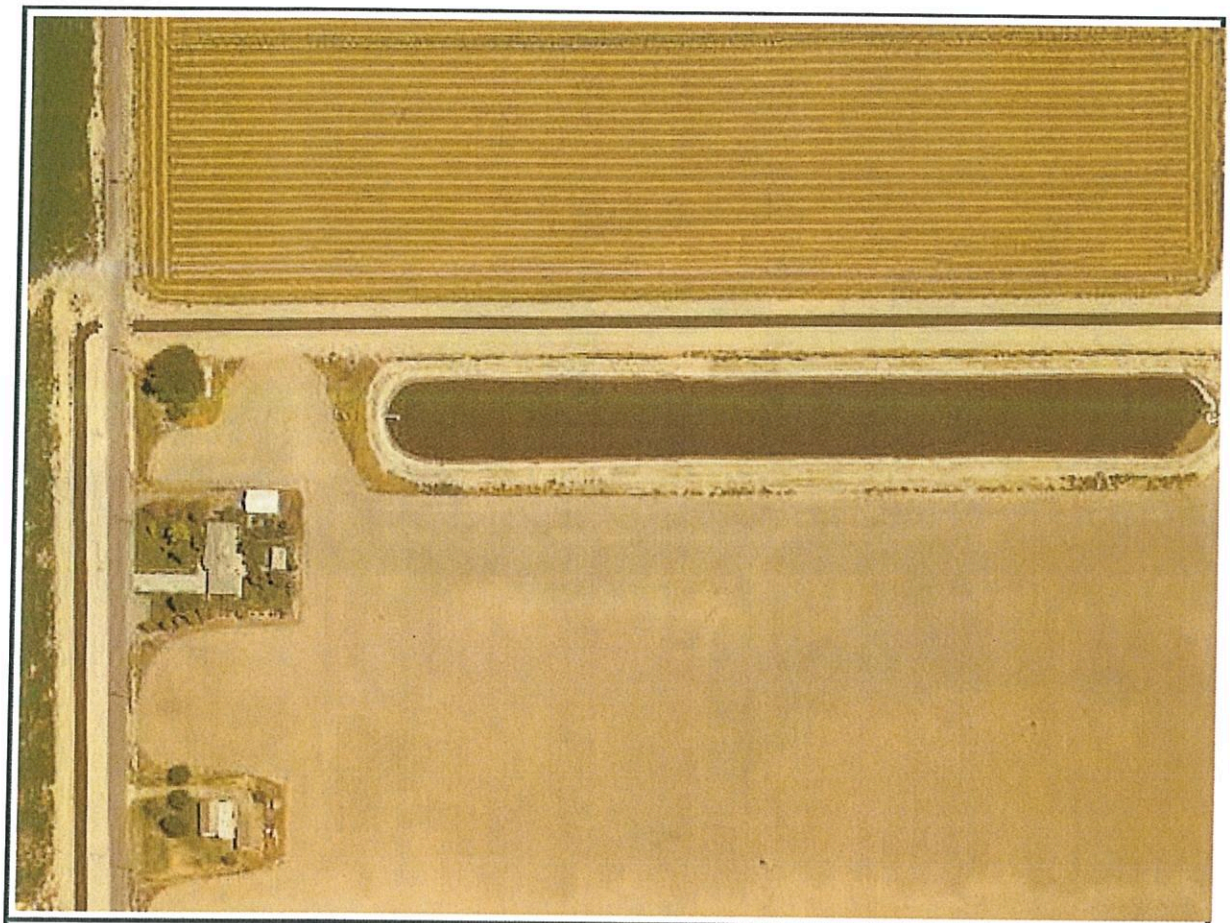
Irrigation System, Tailwater Recovery

A facility to collect, store, and transport irrigation tailwater for reuse in a farm irrigation distribution system. The purpose of the practice is to conserve farm irrigation water supplies and water quality by collecting the water that runs off the field surface for reuse in the farm irrigation system.

Tailwater Recovery

An irrigation tailwater recovery system in California. Note the recovery pond, the pond-outlet sump and the redistribution pump and piping. Image courtesy of USDA, NRCS.

Tailwater Recovery Pond



Irrigation tailwater recovery pond in Stanislaus County, California similar to the one shown above. Image courtesy of USDA, NRCS.

Irrigation Tailwater Recovery

An irrigation tailwater recovery system in Maricopa County, AZ. This image captured the dark field as it was being gravity irrigated. Note the series of evenly-spaced flood gates along the supply channel at the top edge of the field. The tailwater is leaving the field along its bottom edge (note the closely-spaced discharge runs that empty into the return ditch. A pump facility is located in the lower-right of the image on the N-S extension of the return-flow ditch. The returned water is piped (underground) back into the supply channel for re-use. Image courtesy of USDA, NCRS.

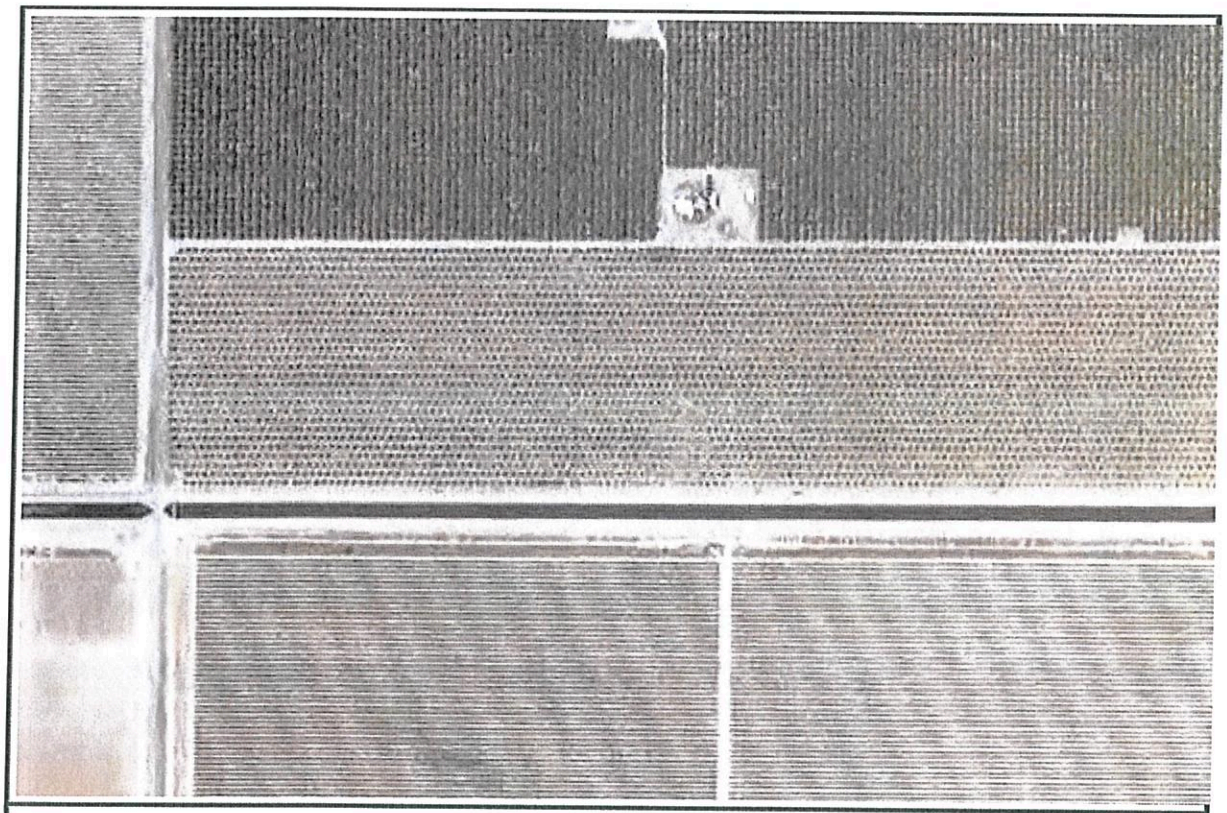
Lined Waterway or Outlet

A waterway or outlet having an erosion-resistant lining of concrete, stone, or other permanent material. The lined section extends up the side slopes to a designed depth. The earth above the permanent lining may be vegetated or otherwise protected.

Lined Waterways

Lined waterways near Albuquerque, New Mexico. Images courtesy of USDA, NRCS.

Lined Waterway

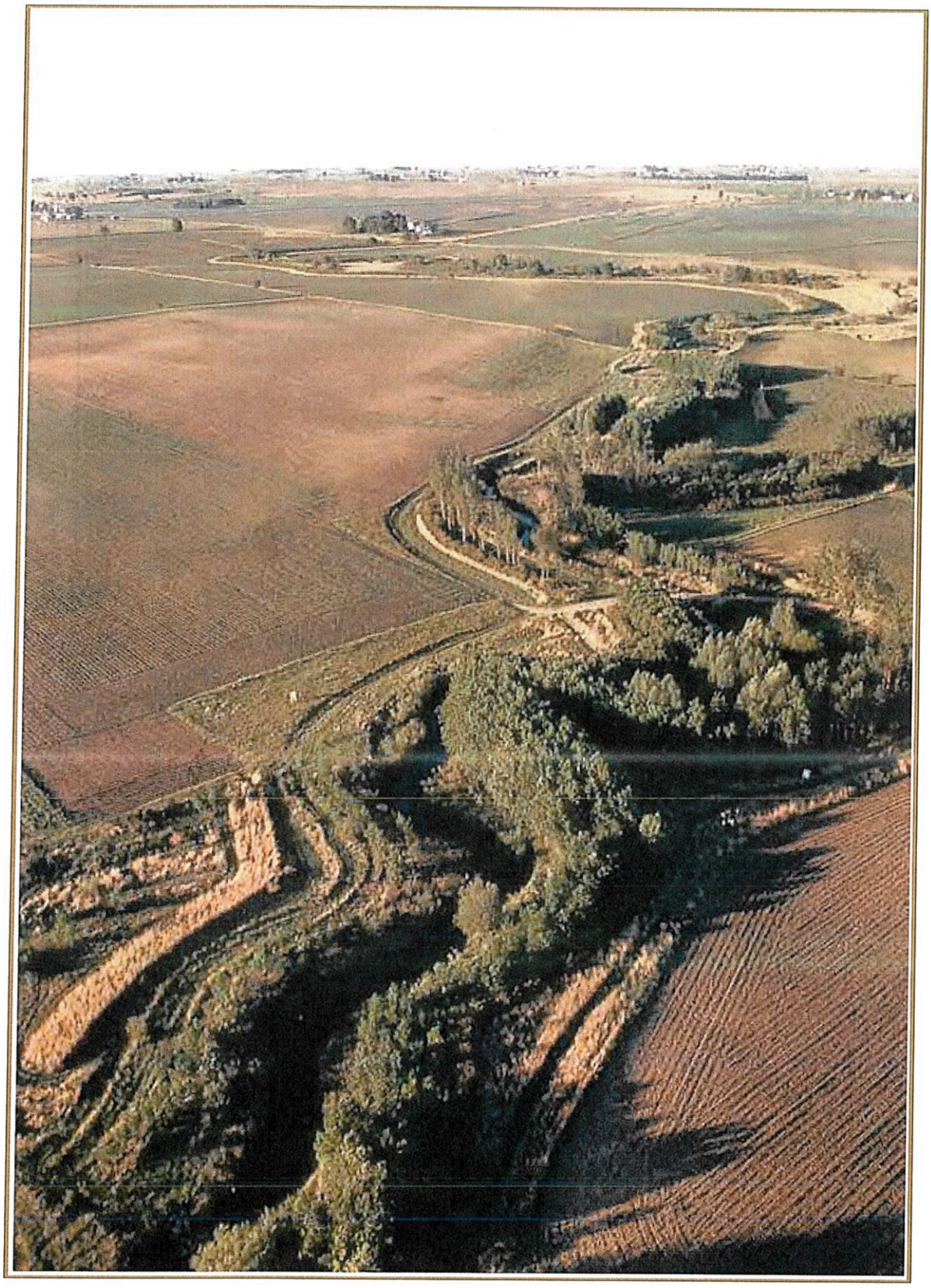


Lined waterway near Fresno, California. Images courtesy of USDA, NRCS.

Riparian Forest Buffer

Area of trees and/or shrubs adjacent to and up gradient from water bodies.

Riparian Forest Buffer



An aerial oblique view of a riparian forest buffer in Iowa. Image courtesy of USDA, NRCS.

Riparian Forest Buffer

Riparian forest buffer in central, Nebraska. Image courtesy of USDA, NRCS.

Stripcropping

Stripcropping involves growing crops in a systematic arrangement of strips across the field to reduce soil erosion (by water or wind), reduce particulate emissions into the air and improve water quality. This practice is used on cropland and certain recreation and wildlife lands where field crops are grown.

The crops are arranged so that a strip of grass or close-growing crop is alternated with a clean tilled strip or a strip with less protective cover. Generally the strip widths are equal across the field. On sloping land where sheet and rill erosion are a concern, the strips are laid out on the contour (contour stripcropping)or across the general slope (field stripcropping). Where wind erosion is a concern, the strips are laid out as close to perpendicular as possible to the prevailing erosive wind direction (cross-wind stripcropping).

Stripcropping is a multi-purpose practice that has one or more of the following effects:

1. Reduced sheet and rill erosion.

2. Reduced wind erosion.

3. Increased infiltration and available soil water.

4. Reduced dust emissions into the air.

5. Improved water quality.

6. Improved visual quality of the landscape.

7. Improved wildlife habitat.

Contour stripcropping involves growing row crops, forages, small grains, or fallow in a systematic arrangement of equal-width strips on or near the contour of the field slope. The crops are arranged so that a strip of grass or close-growing crop is alternated with a clean tilled strip or a strip with less protective cover.

Contour Stripcropping

Contour stripcropping corn (tan) and alfalfa (green) in central Wisconsin. Note the use of grassed waterways to control water erosion in the numerous concentrated flow lines in this field. Image courtesy of USDA, NRCS.

Contour Stripcropping

Contour stripcropping of corn (brown) and alfalfa (green) in Iowa. The use of grassed waterways to control water erosion in the numerous concentrated flow lines in this field is masked to some degree by the overall greenness of the alfalfa. Image courtesy of USDA, NRCS.

Contour Stripcropping

Contour stripcropping in Adams County, Pennsylvania. Image courtesy of USDA, NRCS.

Cross-wind stripcropping involves growing crops in equal-width strips established across the prevailing wind-erosion direction and arranged so that strips susceptible to wind erosion are alternated with strips having a protective cover that is resistant to wind erosion.

Cross-wind Stripcropping

Cross-wind stripcropping in Banner County, Nebraska. By inspecting the form of the concentrated flow line crossing this field diagonally from upper left to bottom center, you can deduce that, in general, the land slopes down to the lower right. Hence, the orientation of the bands of close-grown crop in this field appear to have been arranged across the prevailing wind-erosion direction, NOT across the general slope (differentiating it from field stripcropping) and NOT on the contour (differentiating it from contour stripcropping). Image courtesy of USDA, NRCS.

Field stripcropping involves growing crops in a systematic arrangement of equal-width strips across the general slope (NOT on the contour) to reduce water erosion. The crops are arranged so that a strip of grass or a close-growing crop is alternated with a clean-tilled crop or fallow.

Field Stripcropping

Field stripcropping in Daniels County, Montana. By inspecting the form of the two concentrated flow lines crossing this field, you can deduce that, in general, the land slopes down to the right. Hence, the bands of the close-grown crop have been arranged across the general slope, but not on the contour (differentiating it from contour stripcropping). Image courtesy of USDA. NRCS.

Surface Drainage, Field Ditch

A graded ditch for collecting excess water in a field.

Drainage Ditch

Drainage ditch in Saginaw County, Michigan. Photo courtesy of Randy Schaetzl, MSU.

Drainage Ditches

Drainage ditches in Bay County, Michigan. In this image, the water in the ditches is covered with Duckweed, a floating aquatic plant, that makes the ditches appear a light green color. Image courtesy of USDA, NAIP.

Drainage Ditches

Drainage ditches (arrows) in Clinton County, Michigan. In this leaf-off, spring image, the pattern of the tile drains underlying several of the fields is obvious. The drain tiles discharge to the ditches. Image courtesy of Clinton County, Michigan.

Terrace

An earth embankment, a channel, or a combination ridge and channel constructed across the slope.

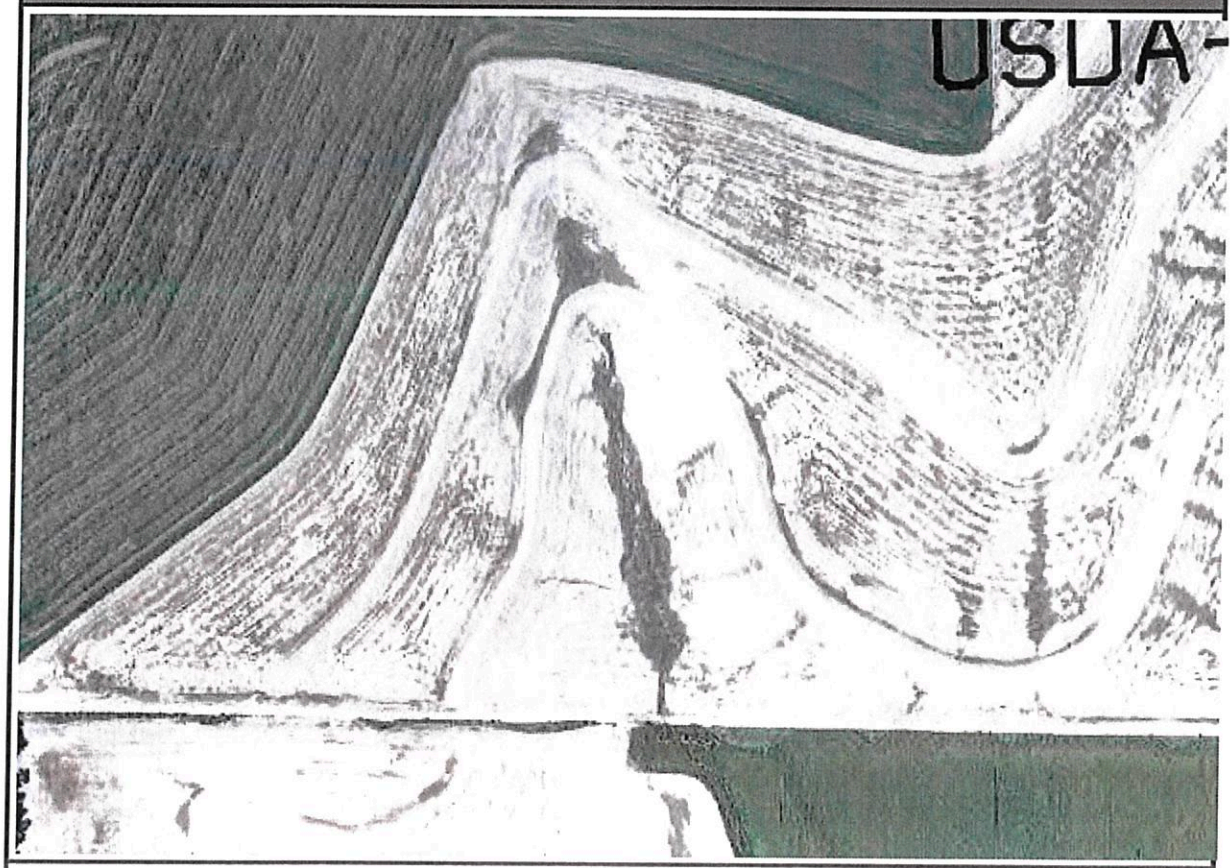
Terraces

Terraces in Shelby County, Iowa. Images courtesy of USDA, NRCS.

Terraces

Terraces in Allen County, Kansas. Image courtesy of USDA, NRCS.

Terraces



Terraces in Smith County, Kansas. Image courtesy of USDA, NRCS.

Tree/Shrub Establishment

Establishment of woody plants by planting or seeding.

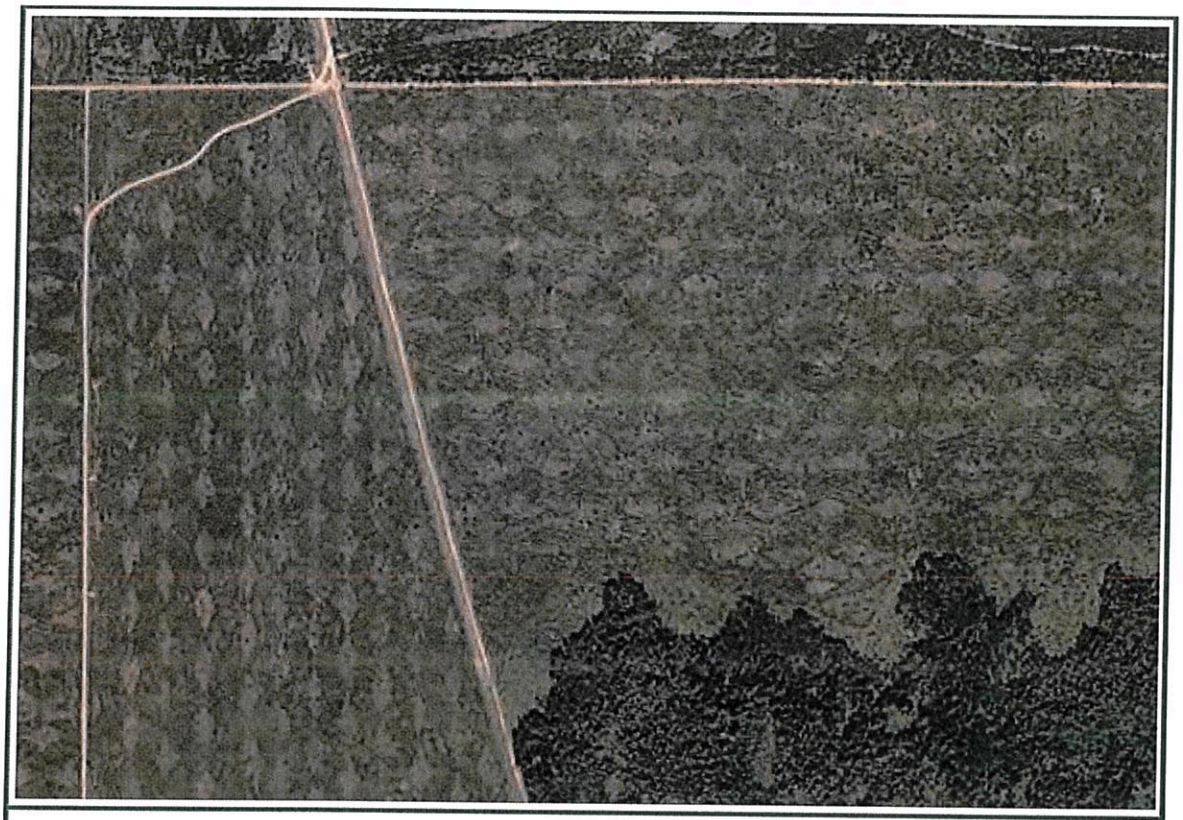
Tree Planting

Tree planting within a riparian area in Kansas. Note the shelter tubes used to protect the seedlings from winter-kill and deer-browse. Image courtesy of USDA, NRCS.

Riparian Zone Restoration

Riparian zone restoration using trees planted in shelter tubes. Image courtesy of USFWS.

Jack Pine Planting



Jack pine planting (for Kirtland warbler habitat) in Oscoda County, Michigan. The diamond shaped openings increase the amount of edge in the stand. Image courtesy of USDA, NAIP.

Tree Establishment

Tree establishment in Chicot County, Arkansas. Image courtesy of USDA, NRCS.

Vegetative Barrier

Permanent strips of stiff, dense vegetation, along the general contour of slopes or across concentrated flow areas.

Vegetative Barrier

Vegetative barrier in Autauga County, Alabama. Image courtesy of USDA, NRCS.

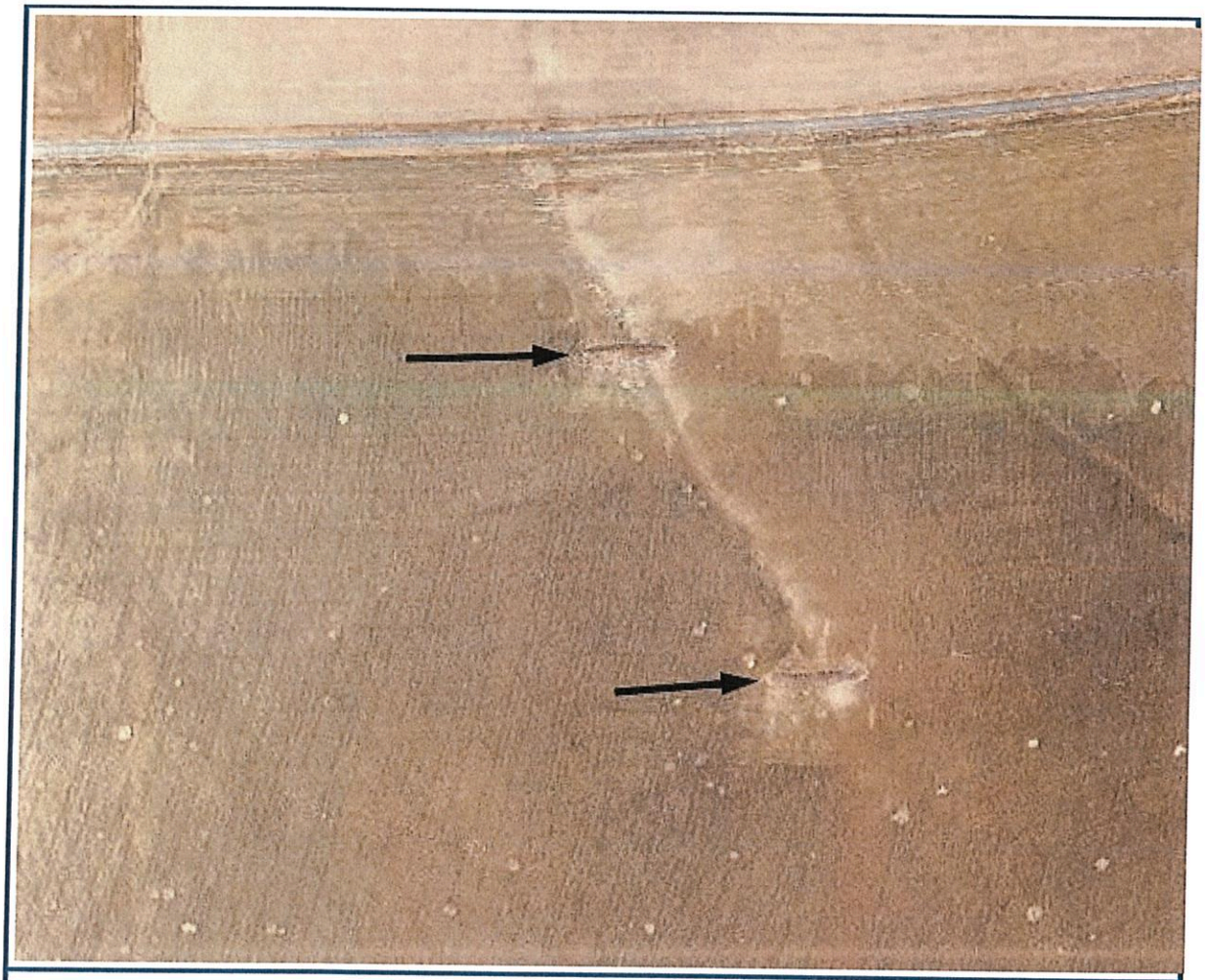
Water and Sediment Control Basin

An earth embankment or a combination ridge and channel, generally constructed across the slope and minor watercourses to form a sediment trap and water detention basin.

Water-sediment Control Structures

Water-sediment control structures (arrows) in Lauderdale County, Tennessee. Note the minor watercourse that is "interrupted" by these structures. The upper (i.e. left) four structures appear to create very narrow basins, but the lower (i.e. right-most) structure clearly impounds a sizable detention basin. Image courtesy of USDA, NRCS.

Water-sediment Control Structures

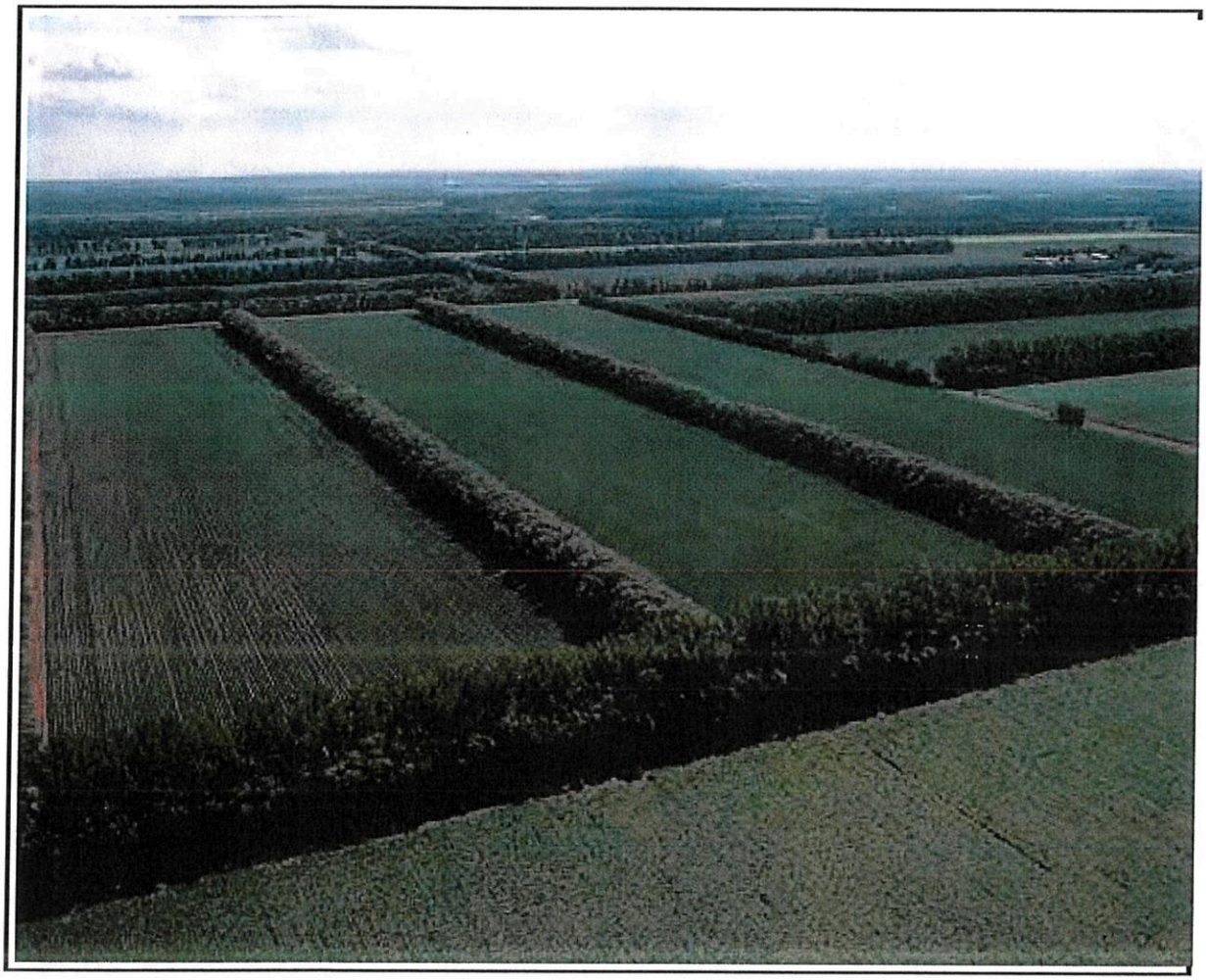


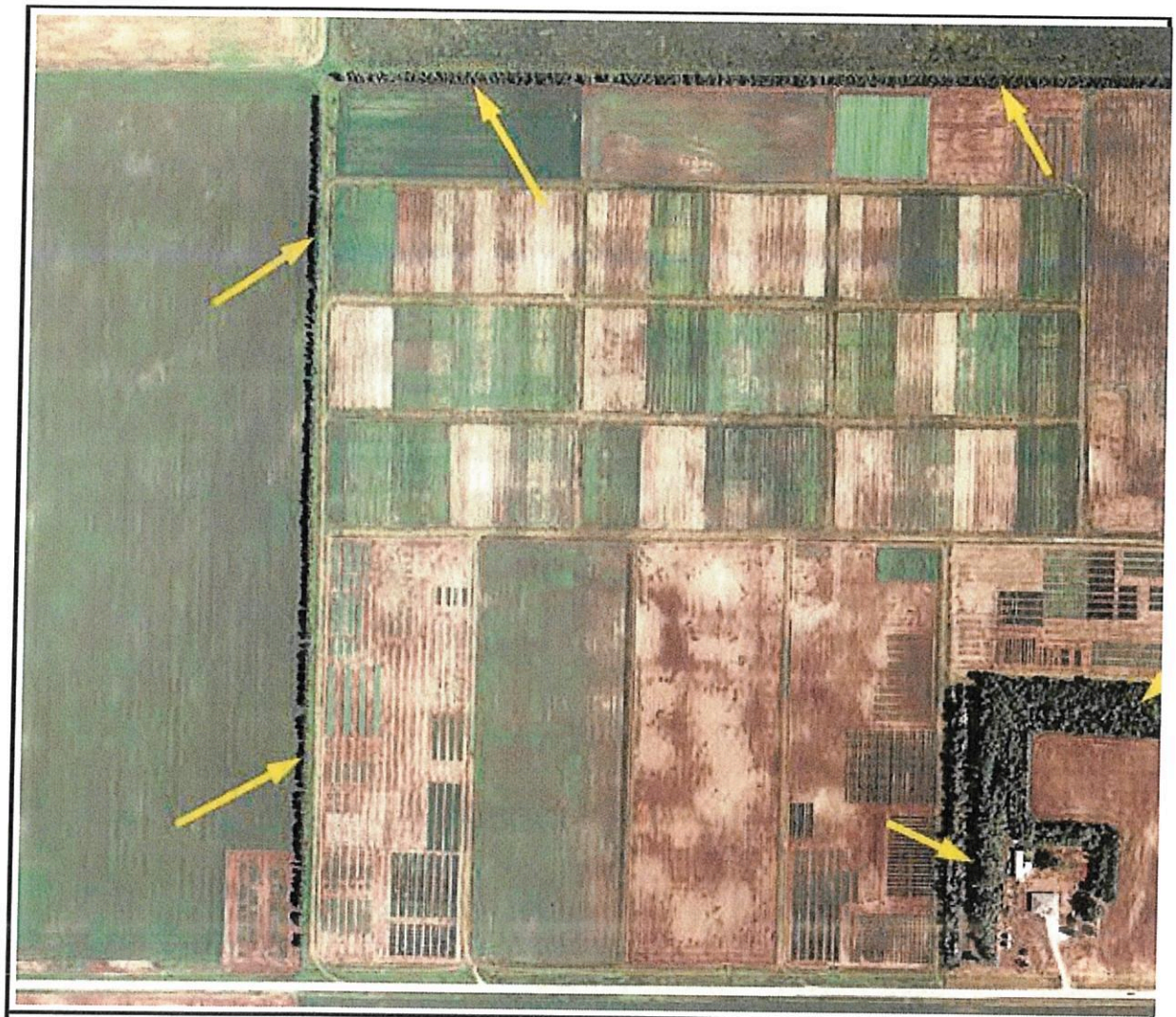
Water-sediment control structures (arrows) in Gilliam County, Oregon. Note the minor watercourse that is "interrupted" by these structures (flow is toward the top of this image). The width of the lighter soil areas immediately up-gradient from the structures indicates how effective they are in creating a sediment trap and water detention basin. Image courtesy of USDA, NRCS.

Windbreak/Shelterbelt Establishment

Linear plantings of single or multiple rows of trees or shrubs established for environmental purposes.

Windbreaks





Windbreaks in North Dakota. Images courtesy of USDA, NRCS.

Windbreaks

Windbreaks on organic soils in Clinton County, Michigan . Note the north-south-only orientation of the windbreaks in this area of predominantly westerly winds. Image courtesy of USDA, NAIP.

Resource Concerns

Resource Concerns are any identified conservation problem that might be used to set quality criteria and treatment needs for a resource management system. NRCS has historically divided major resource concerns into the general categories of, **Soil, Water, Air, Plant or Animal**. In NRI, however, we only deal with **Soil, Water or Plant resource concerns.**

Resource concerns can be identified by the physical features they exhibit. These are any landscape or vegetation characteristics that can be detected through photo interpretation and characterized by consistent photo features. The identification of these physical features on the aerial image indicate a potential for a particular resource concern.

Soil Resource Concerns

Soil Resource Concerns		
Soil Resource Concerns	**Identifiable Physical Features**	**NRI Broad Cover Type**
Sheet and Rill Erosion	Deposition @ toe slopes, Parallel rills	Cropland, Grassland, Scrub-Shrub, CRP
Wind	Blowouts, Classic dunes, Leeward deposition, Buried crops	Cropland, Grassland, Scrub-Shrub, CRP
Concentrated Flow (ephemeral gullies)	Deposition in exposed drainage courses, Lack of crop growth in drainage courses	Cropland, Grassland, Scrub-Shrub, CRP
Classic Gullies	Dendritic pattern, Shadow with depth, Sparse Vegetation	Cropland, Grassland, Scrub-Shrub, CRP, Forest
Streambank	Bare soil, Soil material in waterways, Disturbed vegetation	Grassland, Scrub-Shrub, Forest
Irrigation Induced	Deposition @ end of field, Sediment, High Reflectance	Cropland, Grassland, Hayland, CRP
Contaminants - Chemical	Drilling sites, Farm washing facilities, Bare spots in fields	Cropland, Grassland, Scrub-Shrub, CRP, Forest
Onsite Damage	Buried crops, Sediment in structures or ditches	Cropland, Grassland, Scrub-Shrub, CRP, Forest

Soil Resource Concerns - Dominant Interpretation Characteristics						
Soil Resource	**Size**	**Shape**	**Texture**	**Tone**	**Pattern**	**Site/Association**

Concerns						
Sheet and Rill Erosion		X	X	X		X
Wind		X		X	X	
Concentrated Flow (ephemeral gullies)				X	X	
Classic Gullies	X	X		X	X	
Streambank		X		X		X
Irrigation Induced				X	X	X
Contaminants - Chemical				X		X
Onsite Damage			X	X	X	

Sheet and Rill Erosion

Sheet Erosion

Sheet erosion is the loss of a uniform, but thin, layer of the soil surface from the landscape caused by un-channelized runoff. **Sheet erosion rarely occurs, however, due to the almost immediate riling after precipitation begins.**

Rill Erosion

Rills are **small, shallow (generally less than 2 inches deep), intermittent channels** that are eroded into the soil surface by runoff from most rainfall events. Rills are easily leveled with normal tillage operations, but are considered to be the most predominant form of erosion. Rills are usually parallel to one another and are aligned directly down the steepest local slope.

Gully Erosion

Larger and deeper channels carved by running water (intermittent concentrated flows). There are two types of gullies: **Ephemeral** and **Classic**.

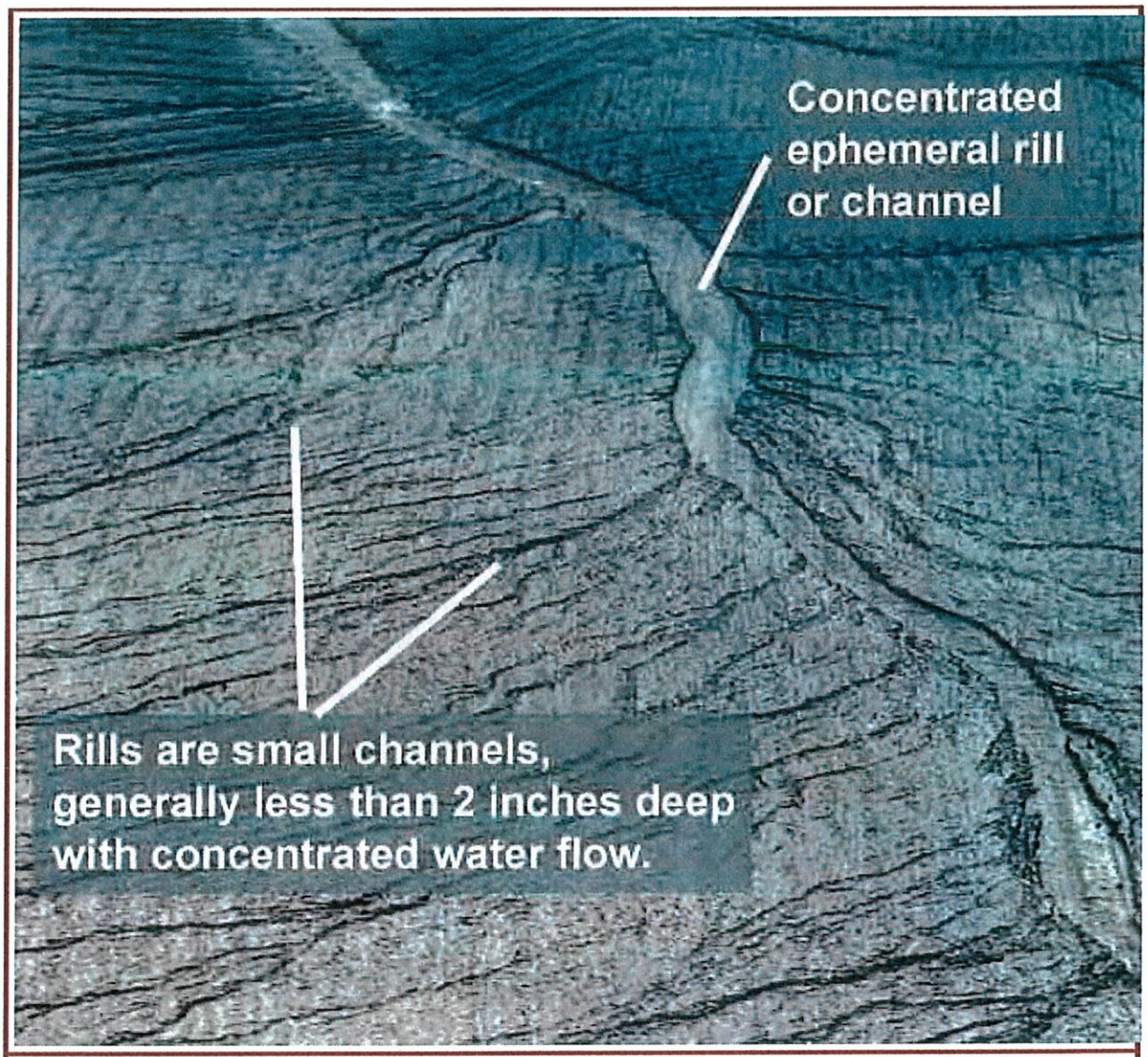
- An **ephemeral gully** is a small, shallow channel eroded by concentrated, but intermittent, runoff flow. Ephemeral gullies **can be leveled by normal tillage**, but will reform again at the same location during following runoff events.

- Classic gullies are deep, well-defined channels created by concentrated, but intermittent, runoff flow both during and immediately following rain events. **Classic gullies are often deeper than 1.5 feet and cannot be leveled by normal tillage operations.**

Rills

Rills are **small, shallow (generally less than 2 inches deep), intermittent channels** that are eroded into the soil surface by runoff from most rainfall events. Rills are usually parallel to one another and are aligned directly down the steepest local slope. Image courtesy of the Agricultural Experiment Station, Oregon State University.

Rills

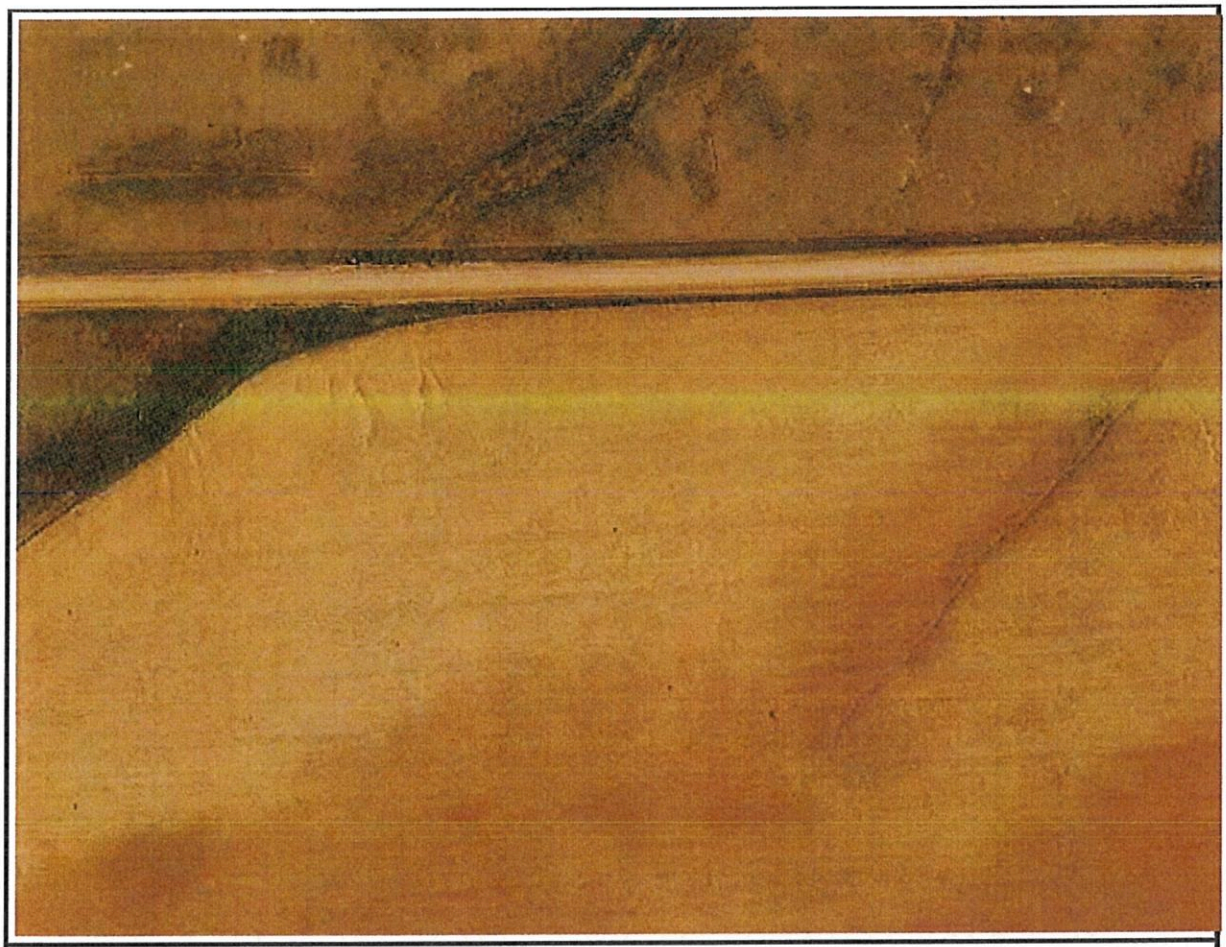


Rills are **small, shallow (generally less than 2 inches deep), intermittent channels** that are eroded into the soil surface by runoff from most rainfall events. Image courtesy of USDA, NRCS.

Rills

The smaller, narrower and shallower concentrated flow lines in this image are rills. The larger, wider and deeper drainage lines are intermittent gullies. All of these erosional channels can be leveled by conventional tillage. Image courtesy of USDA, NRCS.

Rills



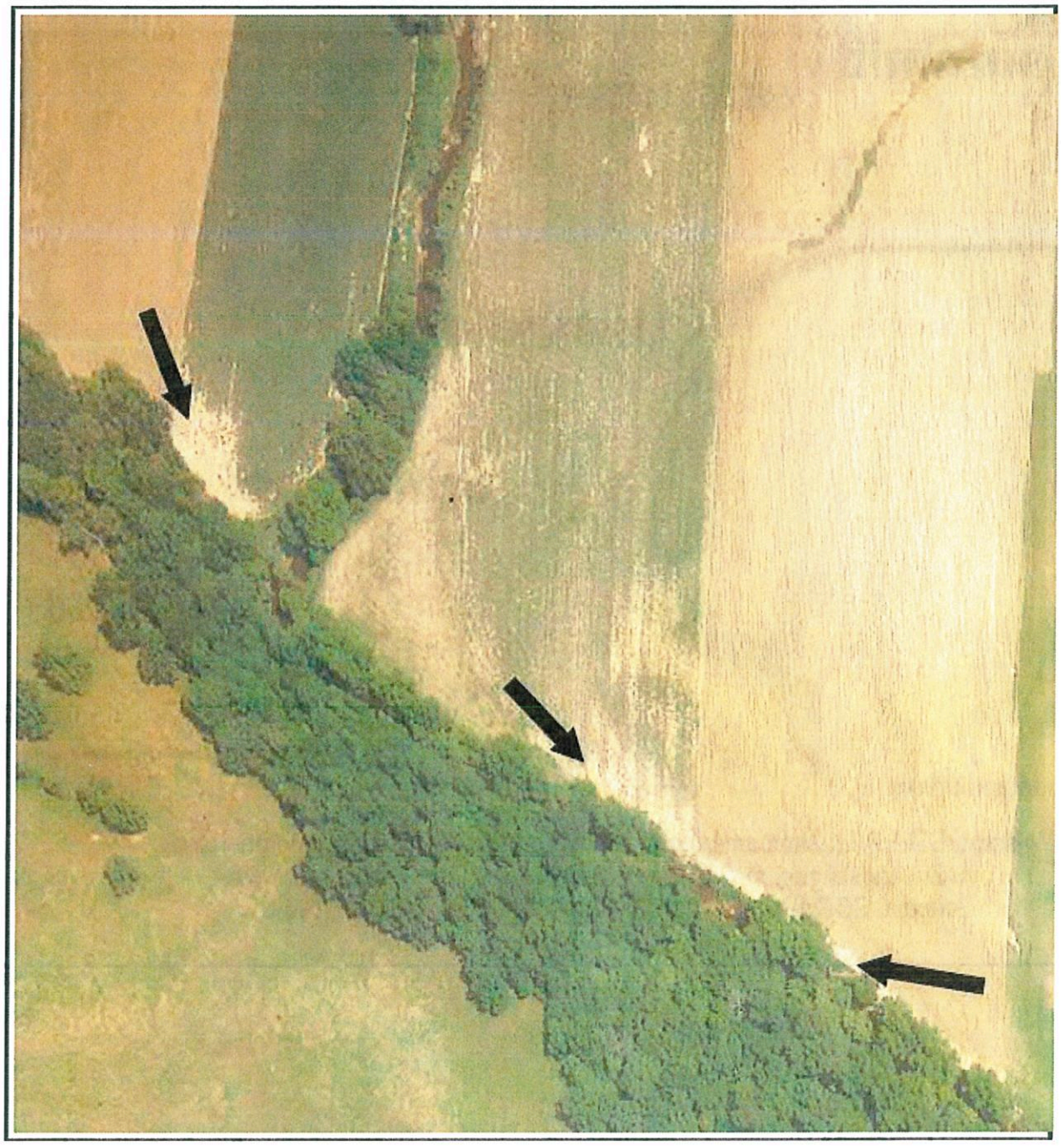
The parallel nature of the erosional features in the field below the road in this image from Adams County, Colorado suggests that they are **Rills** - small, shallow (generally less than 2 inches deep), intermittent channels that are eroded into the soil surface by runoff from most rainfall events. The larger concentrated flow line in the right-center of this image is a good example of an ephemeral gully. Image courtesy of USDA, NRCS.

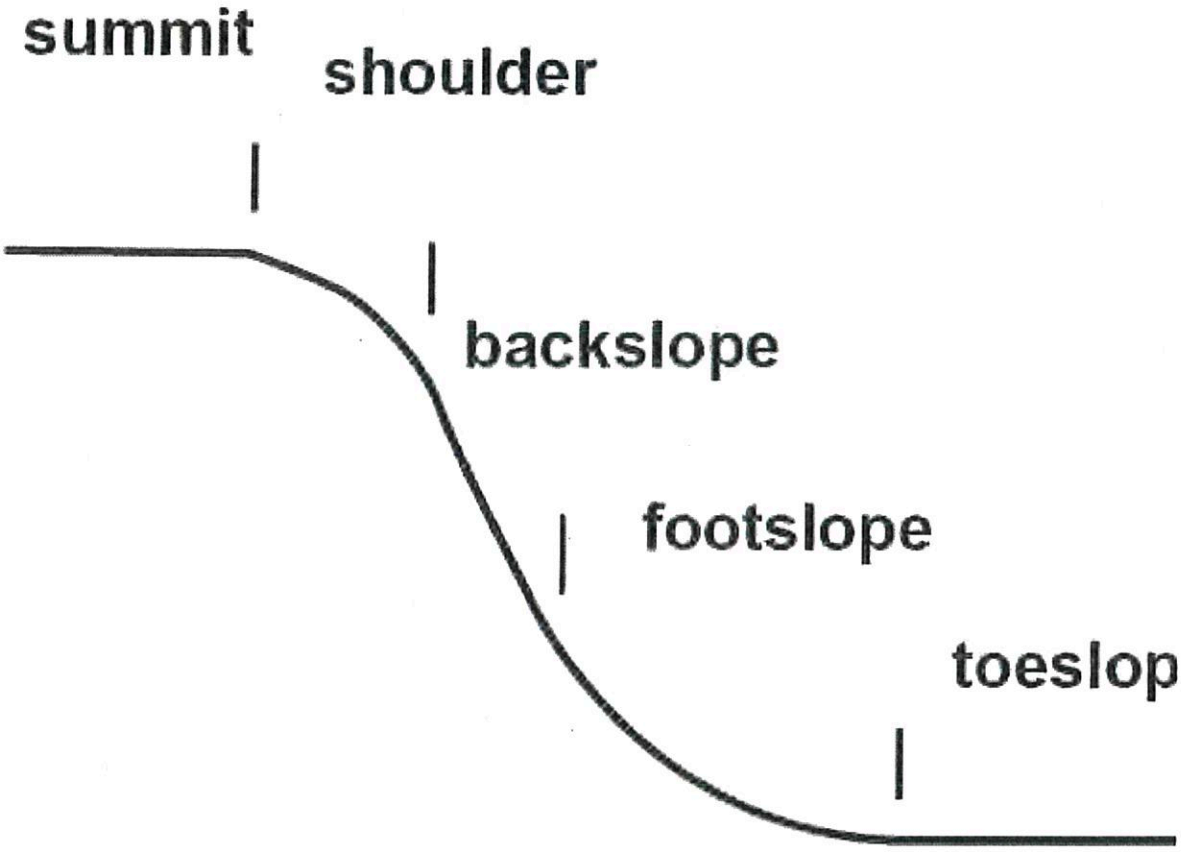
Rills

The parallel nature of the erosional features within the red polygon in this field in Tolland County, Connecticut suggests that they are **Rills** - small, shallow (generally less than 2 inches deep), intermittent channels that are eroded into the soil surface by runoff from most rainfall events. The three larger concentrated flow lines in this image are good examples of ephemeral gullies. Image courtesy of USDA, NRCS.

Sheet and Rill Erosion, ctnd.

Sheet Erosion





Adapted from:

Wysocki, D.A., P.J. Schoeneberger, and H.E. La Garry. 2000. Geomorphology of Soil Landscapes. *In:* Sumner, M.E. (ed.). 2000. Handbook of Soil Science. CRC Press LLC, Boca Raton, FL. ISBN:0-8493-3136-6

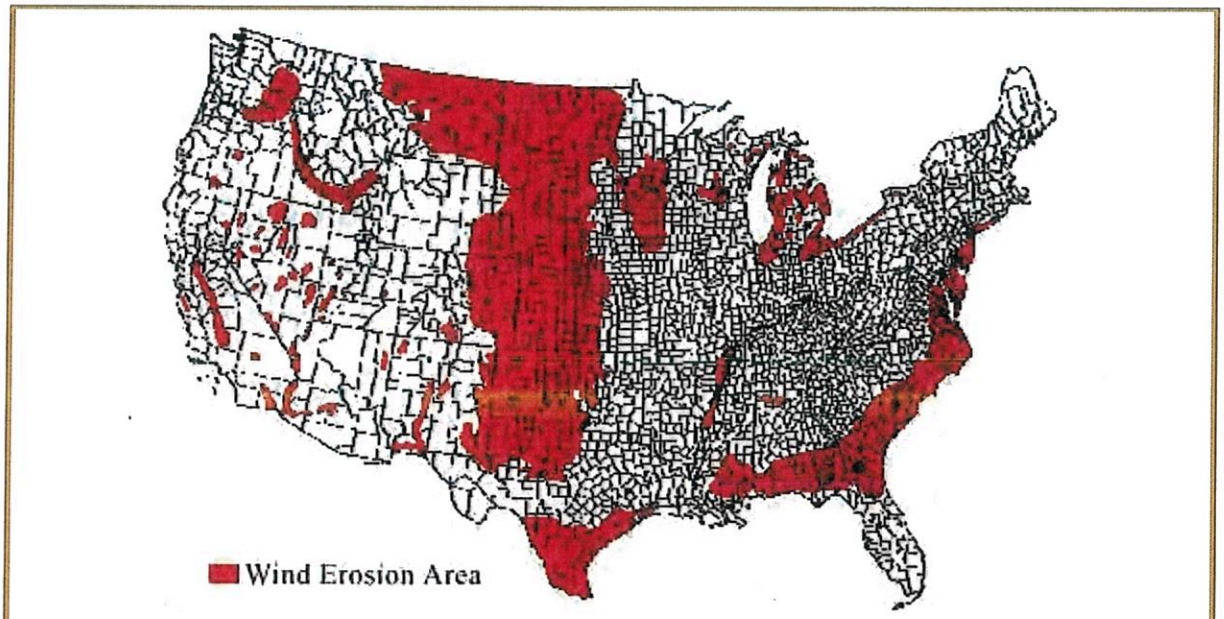
The SHEET EROSION resource concern is often evidenced by the PHYSICAL FEATURE of **Deposition at toe slopes** (see slope name graphic, below). This is well illustrated in this image from Caldwell County, Missouri [arrows]. Both images courtesy of USDA, NRCS.

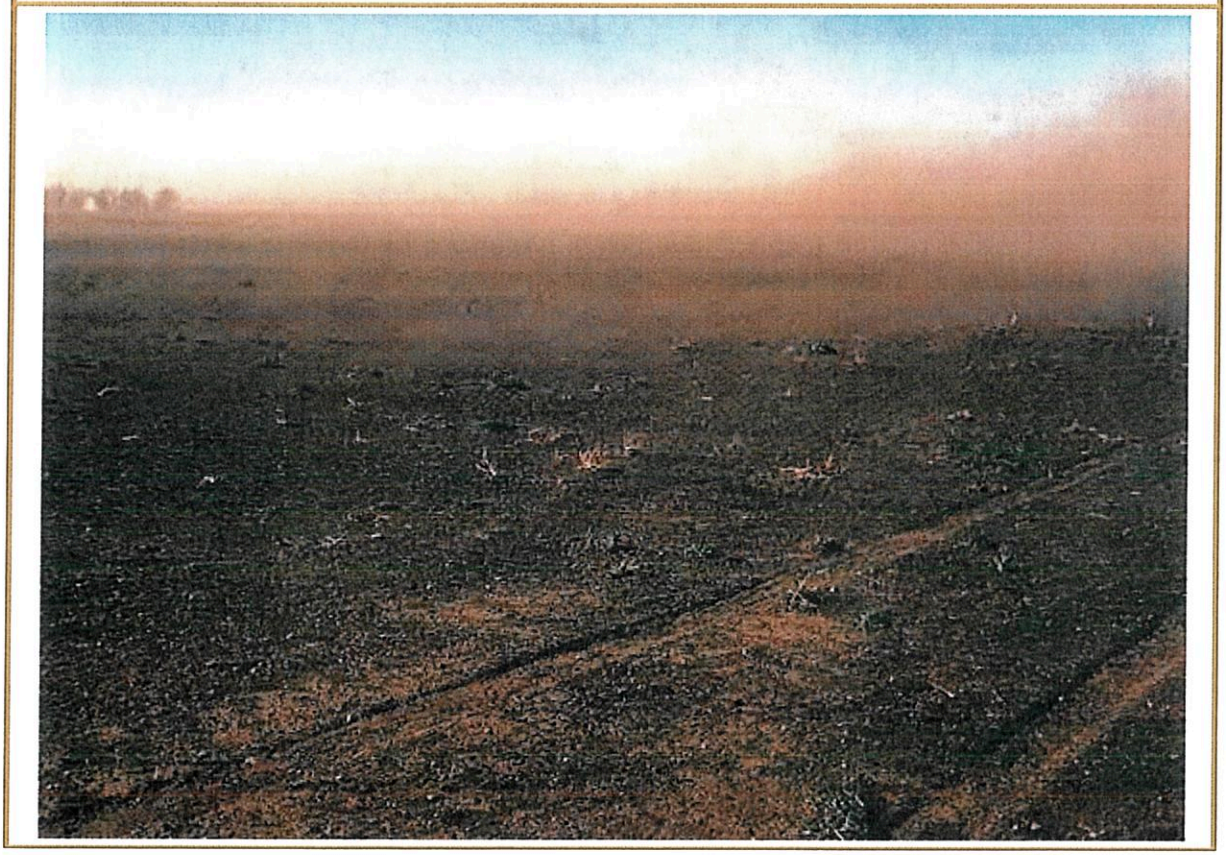
Sheet Erosion

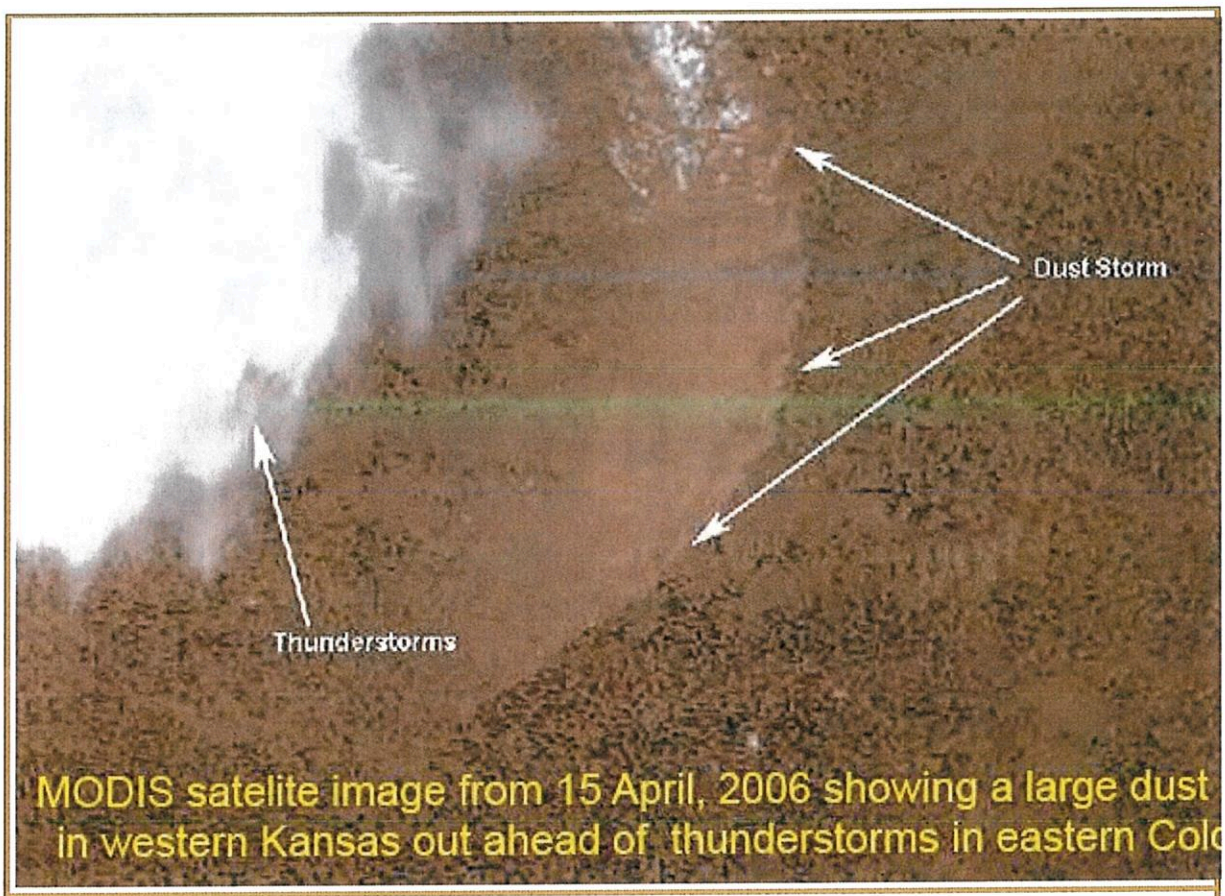
The SHEET EROSION resource concern is often evidenced by the PHYSICAL FEATURE of **Deposition at toe slopes.** This image from Caldwell County, Missouri also exhibits the resource concerns of Concentrated Flow (ephemeral gullies) and Water Contaminants, Turbidity. Image courtesy of USDA, NRCS.

Wind Erosion

Wind Erosion

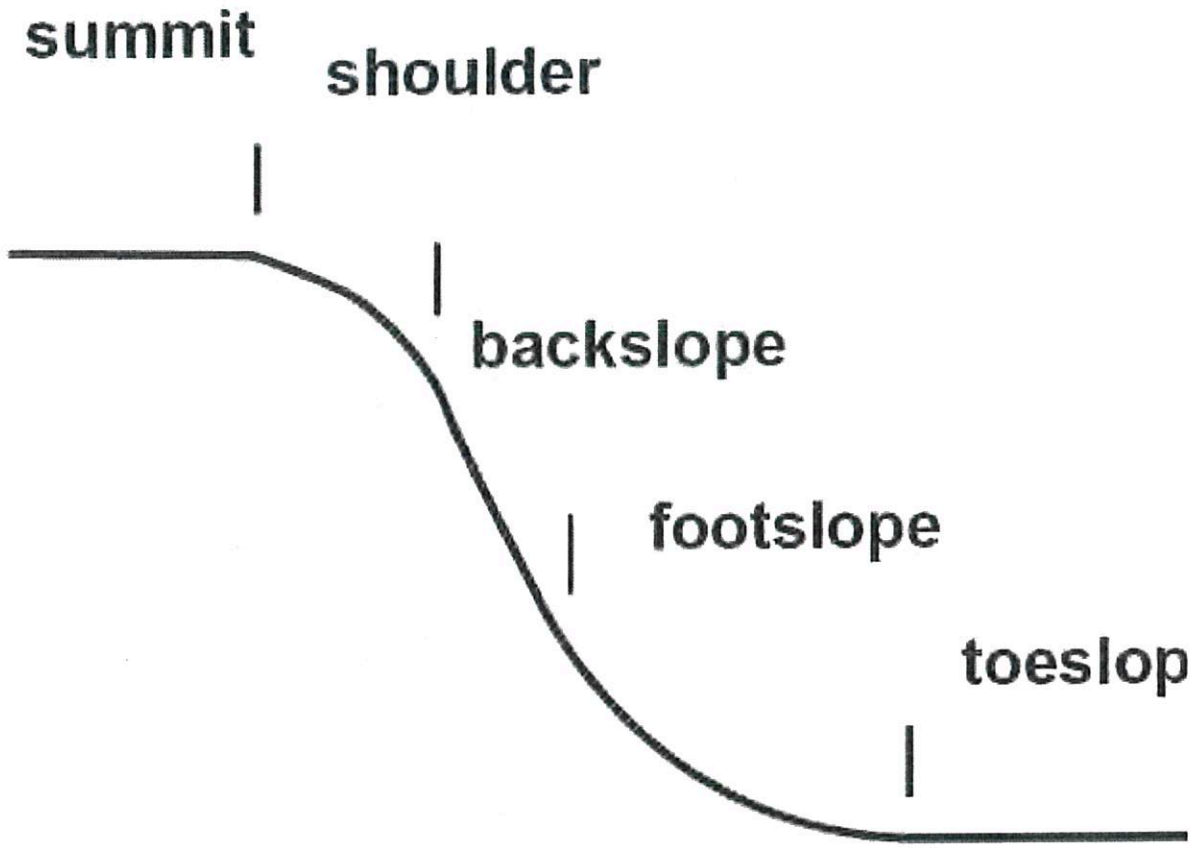

Wind Erosion Area





Most people are familiar with the Dust Bowl crisis of the 1930s, but few are aware that wind erosion continues to be the dominant resource concern on about 73.6 million acres in the US. Wind erosion moderately to severely damages nearly 4.9 million acres every year. According to the 1992 National Resources Inventory, the estimated annual soil loss from wind erosion on non-federal rural land in the United States was 2.5 tons per acre per year. Top image courtesy of USDA, NRCS. Bottom image courtesy of USDA - ARS, Wind Erosion Research Unit.

Wind Erosion



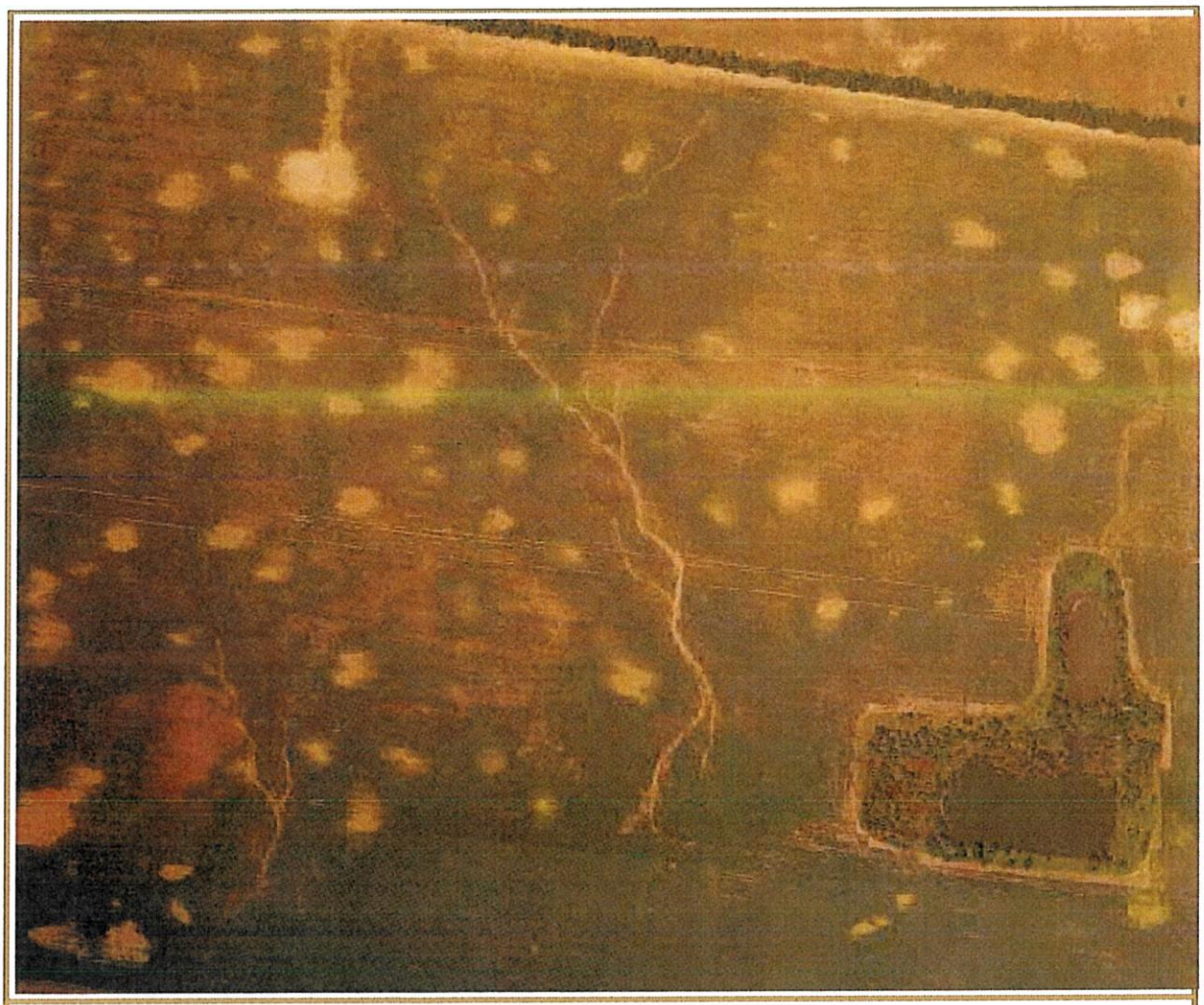
Adapted from:

Wysocki, D.A., P.J. Schoeneberger, and H.E. La Garry. 2000. Geomorphology of Soil Landscapes. *In:* Sumner, M.E. (ed.). 2000. Handbook of Soil Science. CRC Press LLC, Boca Raton, FL. ISBN:0-8493-3136-6

Soil erosion by water is a slope process focused on the shoulder and backslope areas (see slope names, below). Summit erosion is most often associated with WIND EROSION both because of the gentle gradients of the summits and their generally better drainage (dry soils are more prone to wind erosion than moist soils, which are usually associated with the footslope and toeslope positions). These two images (a ground-level view and a low-altitude, aerial oblique view) show the classic landscape pattern of wind erosion problems. Both images courtesy of USDA, NRCS.

Wind Erosion, ctnd.

Wind Erosion

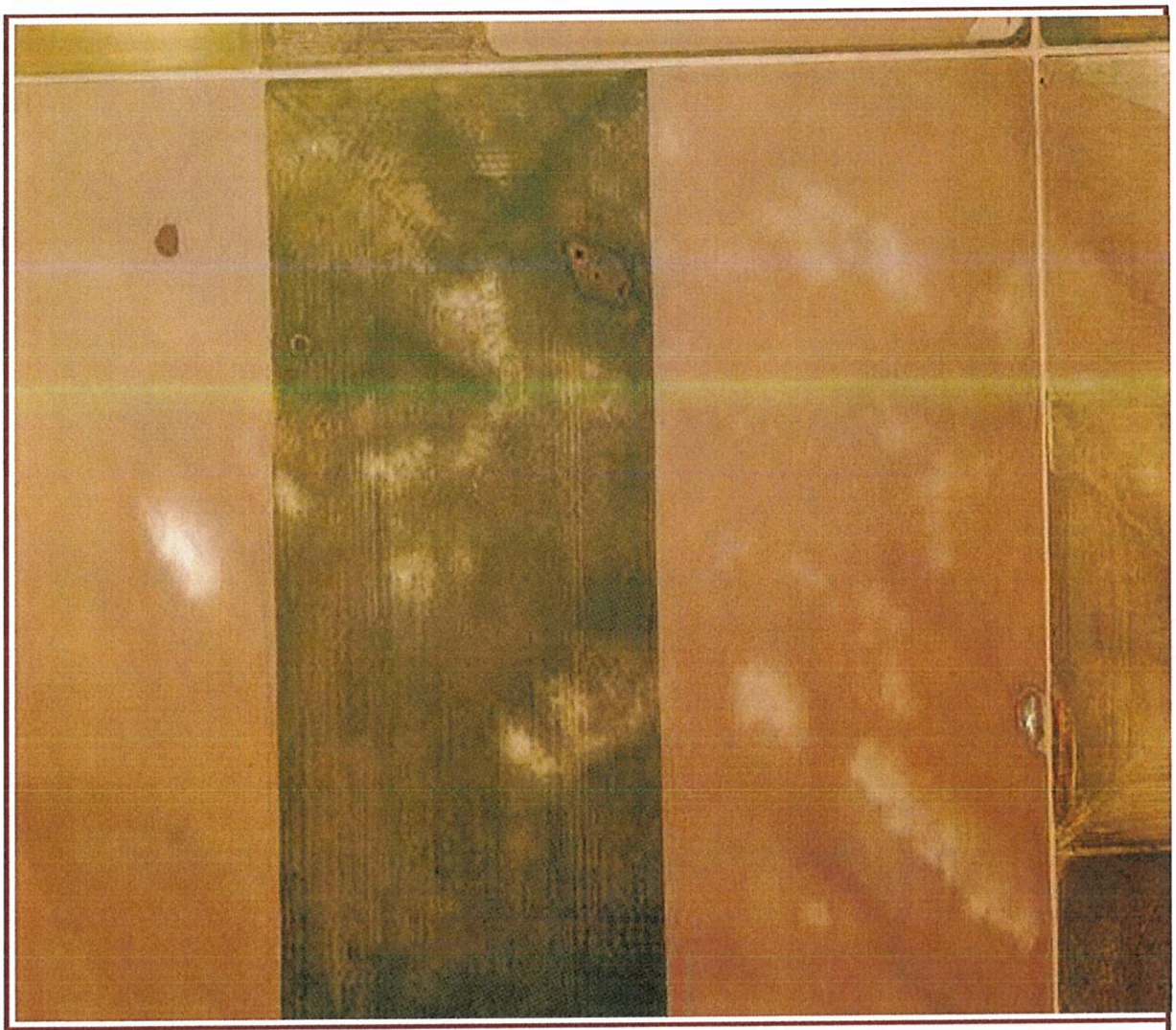


This image from Jim Wells County, Texas shows the patchy pattern typical of summit wind erosion. Be sure the "eroded" patches are on the summits, since toeslope deposits will exhibit a somewhat similar appearance. Image courtesy of USDA, NRCS.

Wind Erosion

This image from Big Stone County, Minnesota exhibits the patchy pattern typical of summit wind erosion. Image courtesy of USDA, NRCS.

Wind Erosion



This image from Logan County, Colorado shows the patchy pattern typical of summit wind erosion. Note how the darker green crop colors and the darker brown soil colors (both associated with footslope and toeslope positions) "confirm" that the light-colored eroded patches are on the summits. Image courtesy of USDA, NRCS.

Wind Erosion

This image from Okanogan County, Washington exhibits the physical feature: **Blowouts** (wind erosion focused on an area lacking vegetation) as an indication of the **Wind Erosion** resource concern. Image courtesy of USDA, NRCS.

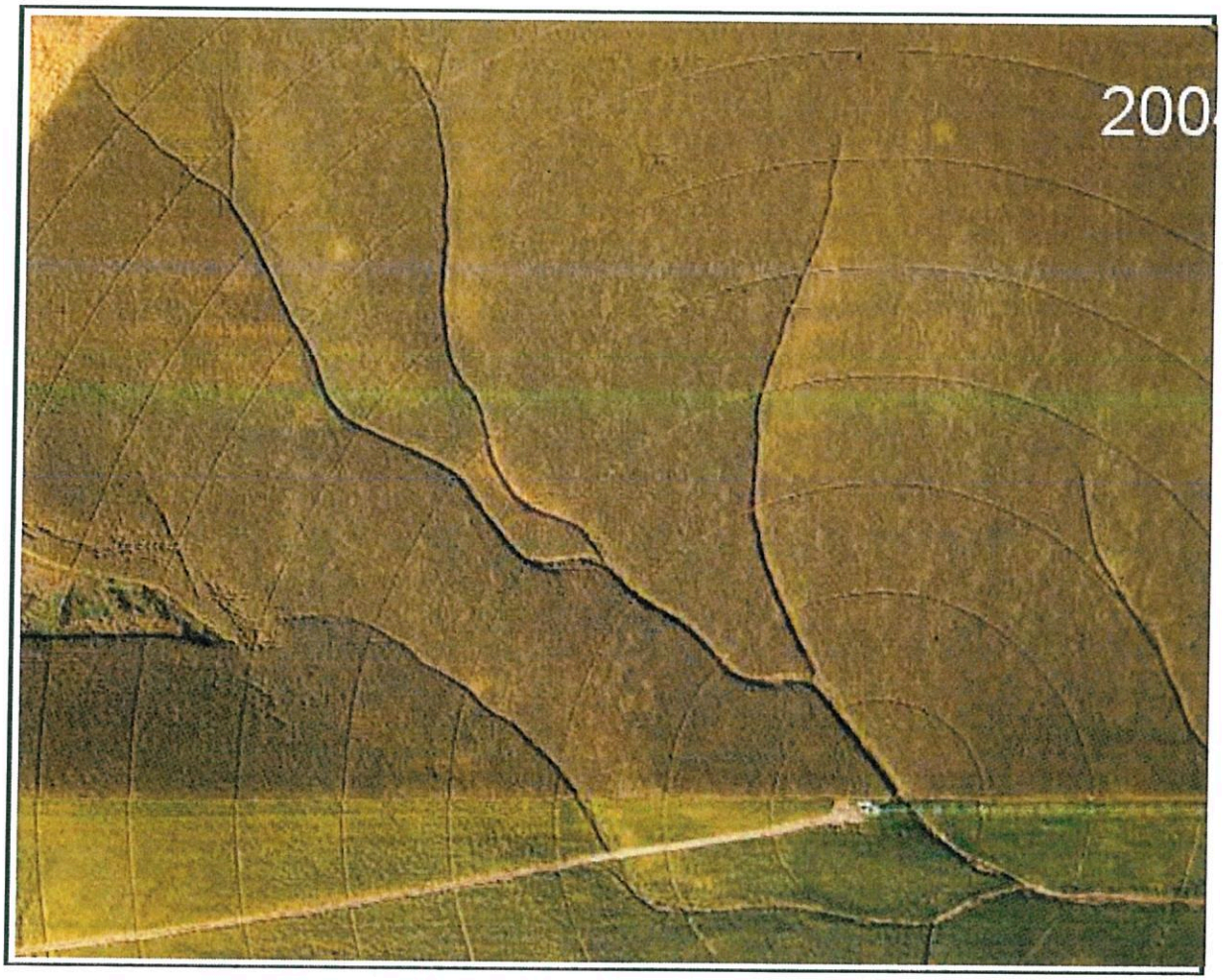
Wind Erosion


Source: NRCS

>**Leeward deposition** is a physical feature indicating a **wind erosion** resource concern. Leeward (i.e., downwind) deposits occur at (1) abrupt slopes (where the wind blows over the top of the slope facet and the slower velocity in the negative space allows the eolian material to "rain out" of the air column); and (2) along abrupt cover changes where open or sparse-covered soil adjoins a denser cover (the roughness of the denser cover slows the wind velocity in the boundary layer, allowing the eolian material to "rain out" of the air column). Aerial image from Adams County, Colorado. All three images courtesy of USDA, NRCS.

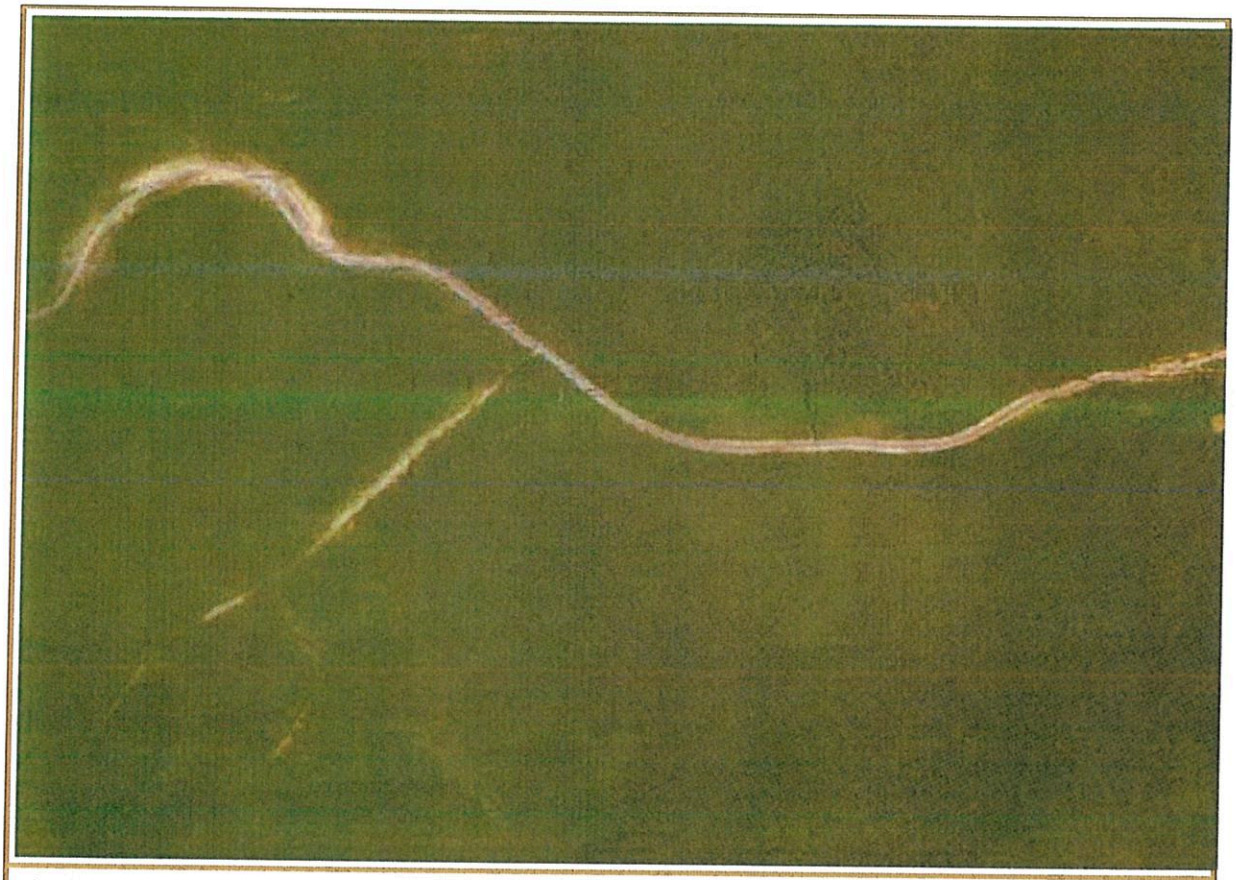
Concentrated Flow (Ephemeral Gullies)

Ephemeral Gullies


200

The ephemeral nature of the gullies shown in this image from Antelope County, Nebraska can be easily confirmed by inspecting the multi-temporal image set. In the 2004 image, the crop shadows make these concentrated flow lines appear very strong, suggesting maybe that they are small classic gullies. BUT, by inspecting the 2006 image (below), it is very obvious that the operator was able to plow and plant directly across these concentrated flow lines - a key attribute of ephemeral gullies. The 2004 image is a good example of the physical feature: **Lack of crop growth in drains** an indicator of the resource concern: **Concentrated flow**. Images courtesy of USDA, NRCS.

Concentrated Flow



This image from Becker County, Minnesota is a good example of the physical feature: **Lack of crop growth in drains**, an indicator of the resource concern: **Concentrated flow**. Images courtesy of USDA, NRCS.

Ephemeral Gullies

This image from Cass County, Missouri is a good example of the physical feature: **Deposition in exposed drains**, an indicator of the resource concern: **Concentrated flow**. The physical feature: **Lack of crop growth in drains** also applies to some of the drainage lines. Images courtesy of USDA, NRCS.

Ephemeral Gullies

This image from Lincoln County, Colorado is a good example of the physical feature: **Deposition in exposed drains** (arrows), an indicator of the resource concern: **Concentrated flow**. The physical feature: **Lack of crop growth in drains** also applies to some of the drainage lines. Images courtesy of USDA, NRCS.

Classic Gullies

Classic Gullies

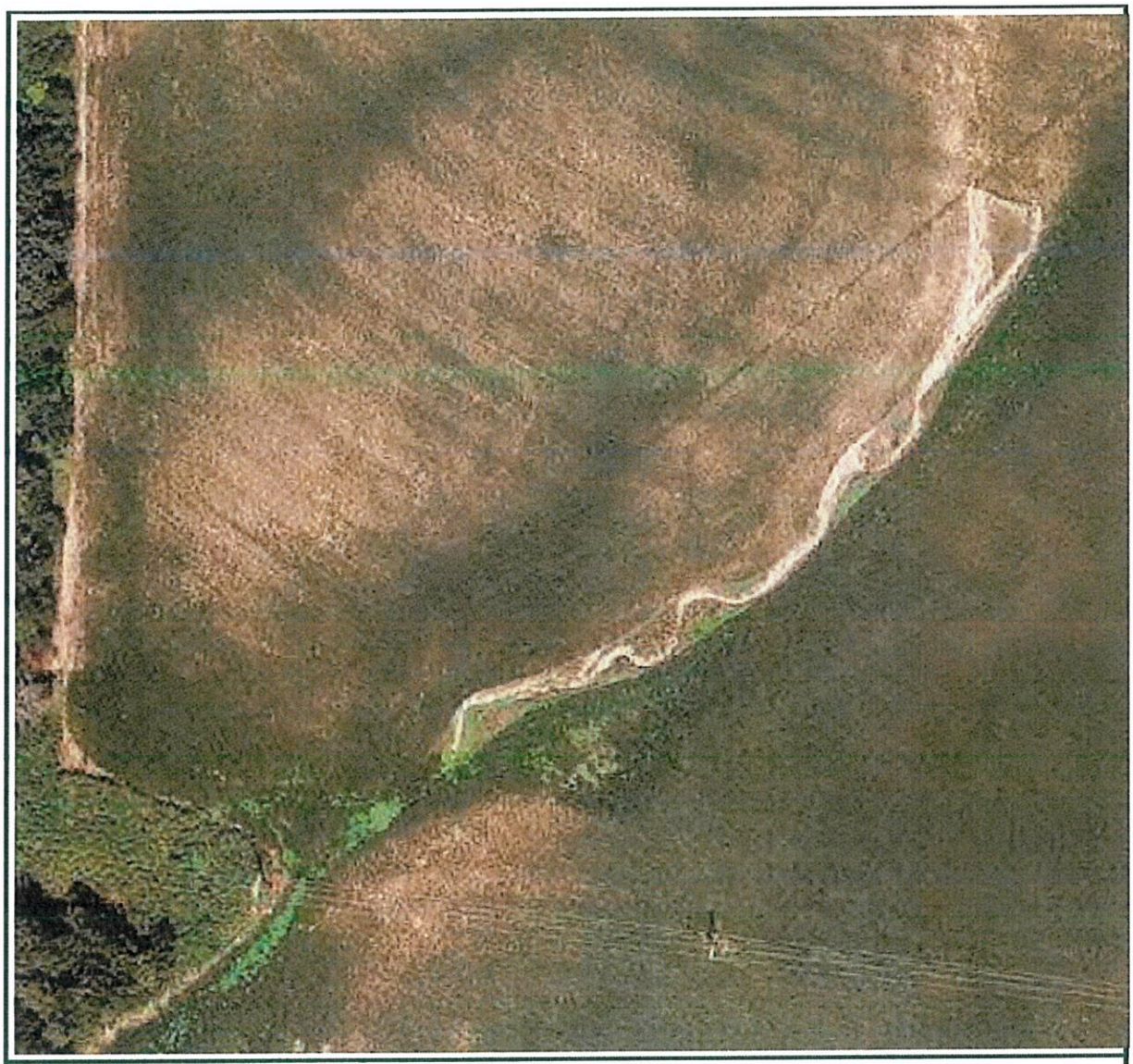

Source: NRCS

Classic gullies are deep, well-defined channels created by concentrated, but intermittent, runoff flow both during and immediately following rain events. **Classic gullies are often deeper than 1.5 feet and cannot be leveled by normal tillage operations.**

Classic Gullies

A **classic gully** in Box Elder County, Utah. The physical features that highlight this resource concern are **Shadows** (indicating its depth) and the fact that plowing/planting operations do not cross this concentrated flow line, but parallel it instead. Image courtesy of USDA, NRCS.

Classic Gully



Concentrated flow lines may produce either ephemeral gullies or classic gullies. The difference is in their depth (and width, to some extent). The use of the multi-temporal image set available for most segments allows the interpreter to observe whether the operator was able to plow/plant across the drainageway in subsequent years. In this example from Dekalb County,Missouri, an earlier image (top) clearly shows a drainageway, but it is not obvious whether it is a classic gully or an ephemeral gully. In the image from two years later (bottom), it is clear that farming operations have "gone around" (rather than over) this gully system. Such evidence supports the classification of this resource concern as a **Classic Gully**. Images courtesy of USDA, NRCS.

Classic Gullies, ctnd.

Classic Gully

>**Classic gullies** are deep, well-defined channels created by concentrated, but intermittent, runoff flow both during and immediately following rain events. **Classic gullies are often deeper than 1.5 feet and cannot be leveled by normal tillage operations.** This image from Caldwell County, Missouri illustrates one of the physical features that helps to identify a classic gully: **the lack of vegetation along its trend**. Image courtesy of USDA, NRCS.

Classic Gully

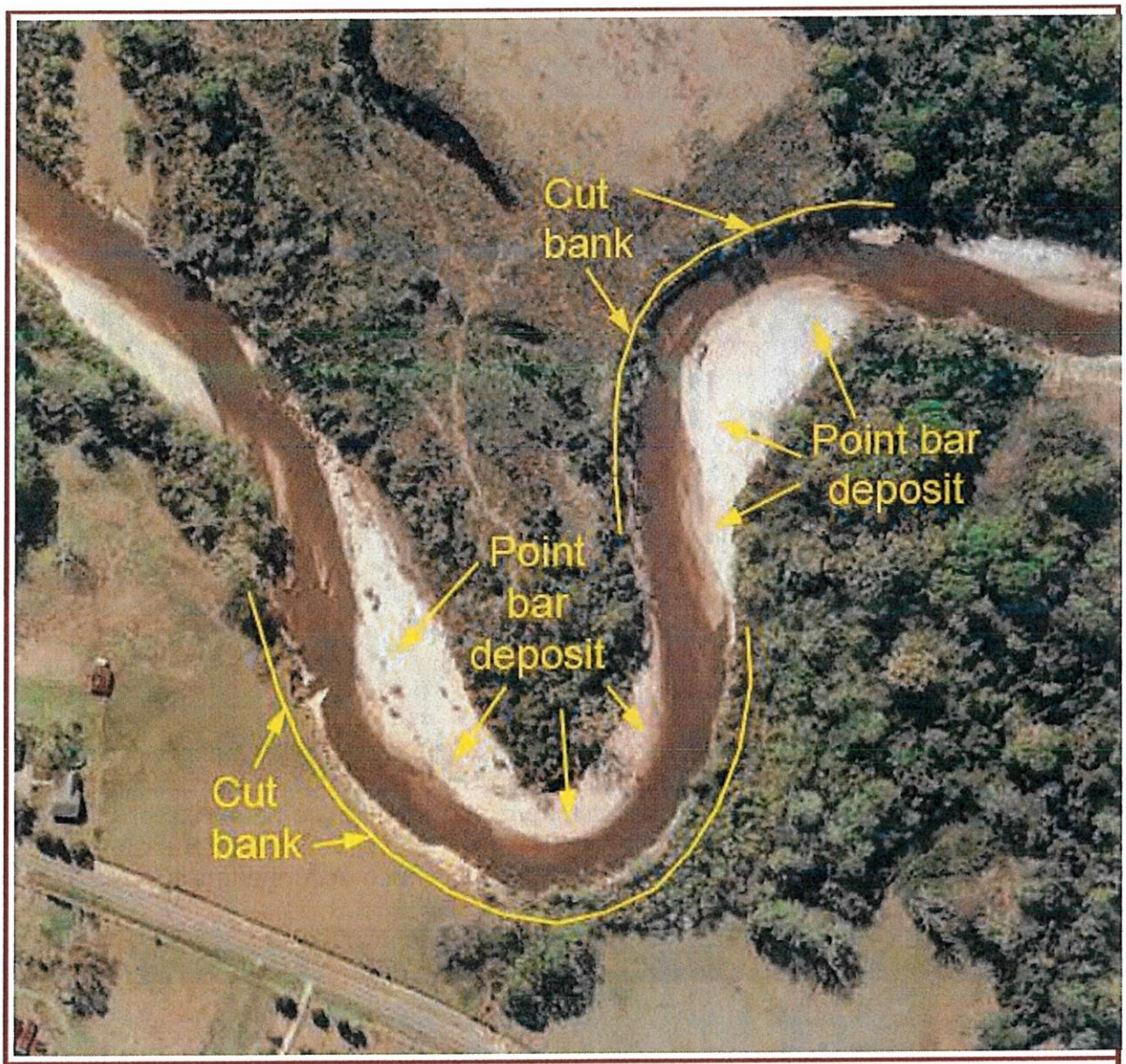
This image from San Benito County, California illustrates two other physical features that help to identify a classic gully: **Dendritic Pattern** and **Distinct, Strong Shadows** due to its depth. Classic gullies are often deeper than 1.5 feet and cannot be leveled by normal tillage operations. Image courtesy of USDA, NRCS.

Classic Gully

These two images illustrate one of the major physical features that helps to identify a classic gully: **distinct, strong shadows** due to its depth. Classic gullies are often deeper than 1.5 feet and cannot be leveled by normal tillage operations. The top image is from Bonneville County, Idaho. The bottom image, from Shelby County, Iowa, also shows another helpful physical feature to identify a classic gully: **the lack of vegetation along its trend**. Both images courtesy of USDA, NRCS.

Streambank Erosion

Streambank Erosion



Concerning the resource concern "Streambank Erosion," keep in mind that within meandering stream channels there is a predictable pattern of erosion **and** deposition. Due to significant differences in flow velocities and trajectories, **erosion** occurs along the **CUT BANK,** which is always on the outside bend of a meander (see annotated image below). **POINT BAR DEPOSITS** always occur along the inside bend of a meander. This image was taken during a low-flow period when the point bar deposits are exposed and the cut bank slope is obvious. During bank-full flows, the point bar will be underwater and the cut-bank slope length will be minimized. Image courtesy of USGS.

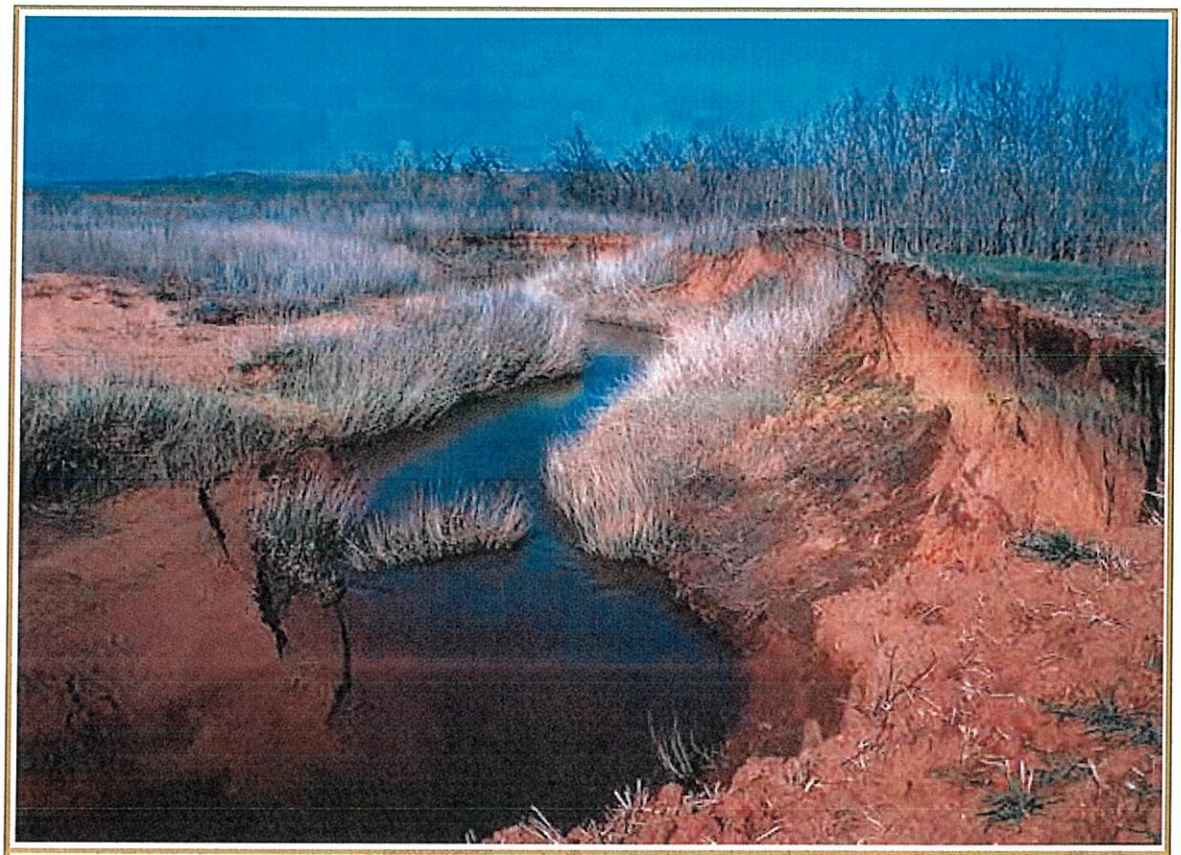
Streambank Erosion

A ground photograph along the Connecticut River illustrating the resource concern **Streambank Erosion**, as highlighted by the physical feature: **Bare Soil**. Note that the **erosion** is along the **CUT BANK**, which occurs along the outside bend of the meander. Image courtesy of USDA, NRCS.

Streambank Erosion

This example of the resource concern **Streambank Erosion**, as highlighted by the **physical feature**: **Bare Soil**, is from Iowa. Note once again, that the **erosion** is along the **CUT BANK**, which occurs along the outside bend of the meander. Image courtesy of USDA, NRCS.

Streambank Erosion



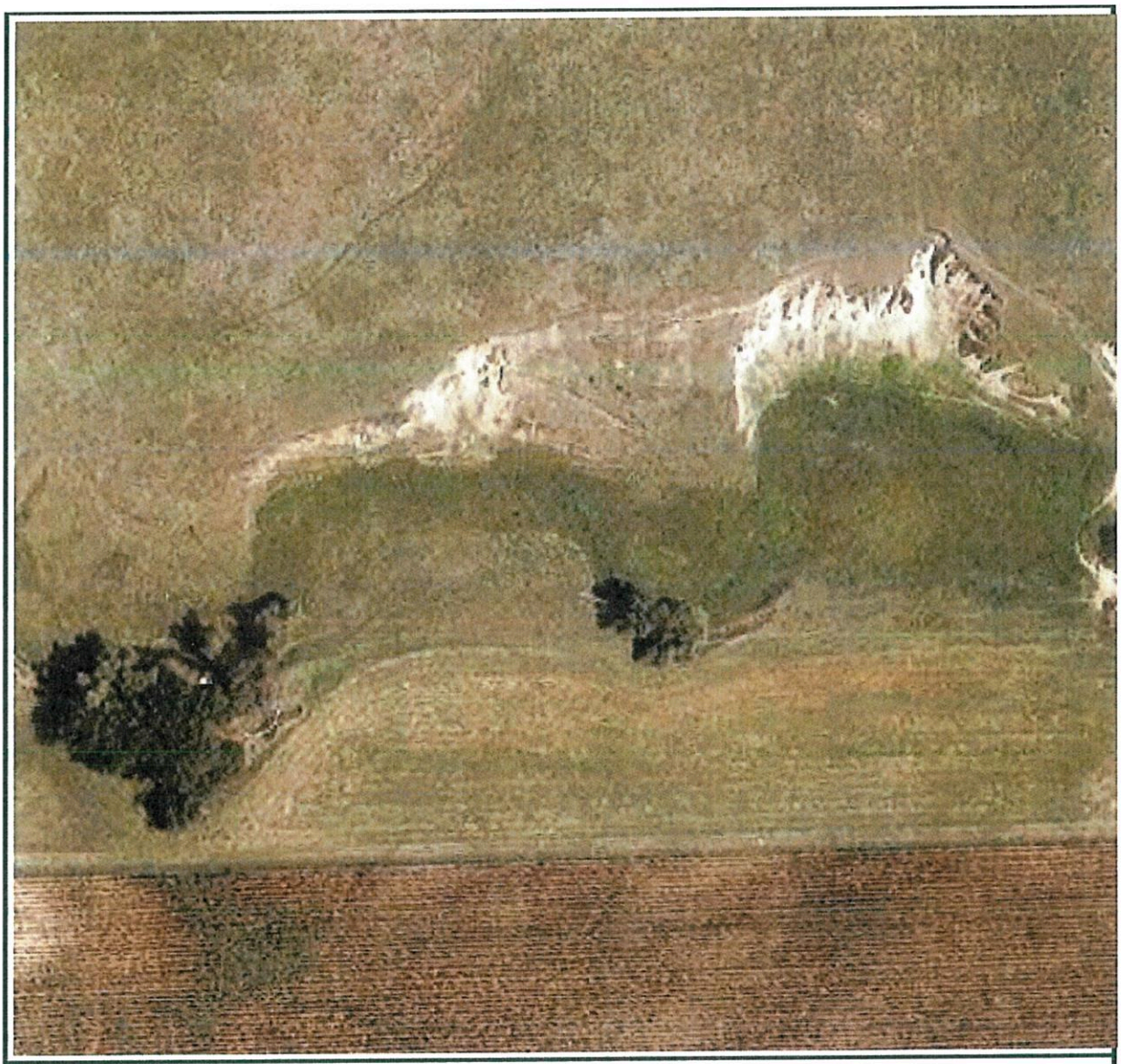
This example of **Streambank Erosion**, as highlighted by the physical feature: **Bare Soil**, is from Oklahoma. Although more difficult to discern in this image, the **erosion** is occurring along the **CUT BANK** on the outside bend of a meander. The **Point Bar deposits** that are **NOT** indicative of streambank erosion are on the inside bend of the meander are well shown in the lower-left corner of this photograph. Image courtesy of USDA, NRCS.

Streambank Erosion, ctnd.

Streambank Erosion

Both of these images from Shelby County, Iowa illustrate the **Streambank Erosion** resource concern, highlighted by the physical feature: **bare soil**. Note that the **streambank erosion** (**CUT BANK)** occurs on the outside bends of the meanders. The top image shows a very narrow, non-vegetated point bar deposit on the inside bend of the meander, while the point bar deposit in the bottom image is almost completely vegetated. Both images courtesy of USDA, NRCS.

Streambank Erosion



This image from Cedar County, Nebraska illustrates the resource concern **Streambank Erosion**, in this case associated with an intermittent stream. Note that the **erosion** occurs along the **CUT BANK,** which is on the outside bends of the meanders. The physical feature that is obvious is **bare soil**. Image courtesy of USDA, NRCS.

Streambank Erosion

The **bare soil** physical feature is well illustrated in this image from Platte County, Wyoming. Since some of these bare soils areas are located on the outside bends of the meanders (i.e., cut banks), the resource concern **Streambank Erosion** is confirmed. Image courtesy of USDA, NRCS.

Streambank Erosion

This image from Choctaw County, Alabama nicely illustrates both the **Cut Bank** on the outside bend of the meander - a bare soil physical feature documenting **Streambank Erosion**, as well as the **Point Bar Deposits** on the inside bend of the meander (**the bare soil associated with the point bar is NOT indicative of streambank erosion**). Image courtesy of USDA, NRCS.

Streambank Erosion

The physical feature originally identified in this image from Lincoln County, Colorado was **Soil Material In The Waterways (documenting Streambank Erosion), but this is NOT correct.** This is an intermittent stream photographed during a low-flow period when the channel contained no water. The "soil in the waterway" is actually the channel bed itself. Image courtesy of USDA, NRCS.

Irrigation Induced Soil Erosion

Irrigation Induced Soil Erosion

One of the best irrigation management practices is to control the frequency, duration and volume of water application in order to not induce runoff (i.e., all the irrigated water infiltrated into the root zone, where the plants could use it). This image from Kalamazoo County, Michigan exhibits the obvious physical feature of **soil deposits at the end of an irrigated** (center pivot) **field**. This feature is suggestive of an **Irrigation Induced Soil Erosion** problem. It may also be that this physical feature is associated with precipitation-induced runoff (**sheet and rill erosion**). Either way, this physical feature helps to identify a resource concern. Image courtesy of USDA, NRCS.

Water Resource Concerns

Water Resource Concerns		
Water Resource Concern	**Identifiable Physical Features**	**NRI Broad Cover Type**
Seeps	White surface deposits, Chlorotic crops, Weeds, Kochia,	Cropland, Hayland, Grassland, Scrub-

	Other tillage	Shrub, CRP
Ponding/Flooding	Drowned crops, Standing water, Debris piles, Sediment, Vegetation change, Tillage exclusions	Cropland, Hayland, Grassland, Scrub-Shrub, CRP
Excess Subsurface Water	Tillage exclusions, Green patches, Yellowing crops	Cropland, Hayland, Grassland, Scrub-Shrub, CRP
Inadequate Outlets	Standing water, Drowned crops, Eroded banks, Headcuts	Cropland, Hayland, Grassland, Scrub-Shrub, CRP, Forest
Water Management, Irrigated	Stressed crops, Drowned crops, Field pattern changes	Cropland, Hayland, Grassland
Restricted Capacity, Lakes/Streams	Turbidity, Silt deltas, Washouts	Cropland, Hayland, Grassland, Scrub-Shrub, CRP
Surface Contaminants, Nutrients/Organics	Algal blooms (color), Yellow or green surface water	Water
Contaminants, Turbidity	Turbidity, Brown surface water, Upland erosion on cropland	Water
Surface Contaminants, Salinity	White crusts along waterways, Salinized drains	Cropland, Hayland, Grassland, Scrub-Shrub, CRP

Water Resource Concerns - Dominant Interpretation Characteristics

Soil Resource Concerns	Size	Shape	Texture	Tone	Pattern	Site/Association
Seeps		X		X	X	X
Ponding/Flooding			X	X	X	X
Excess Subsurface Water				X	X	X
Inadequate Outlets						X
Water Management, Irrigated				X	X	X
Restricted Capacity, Lakes/Streams					X	X
Surface Contaminants, Nutrients/Organics			X	X		
Contaminants,				X	X	X

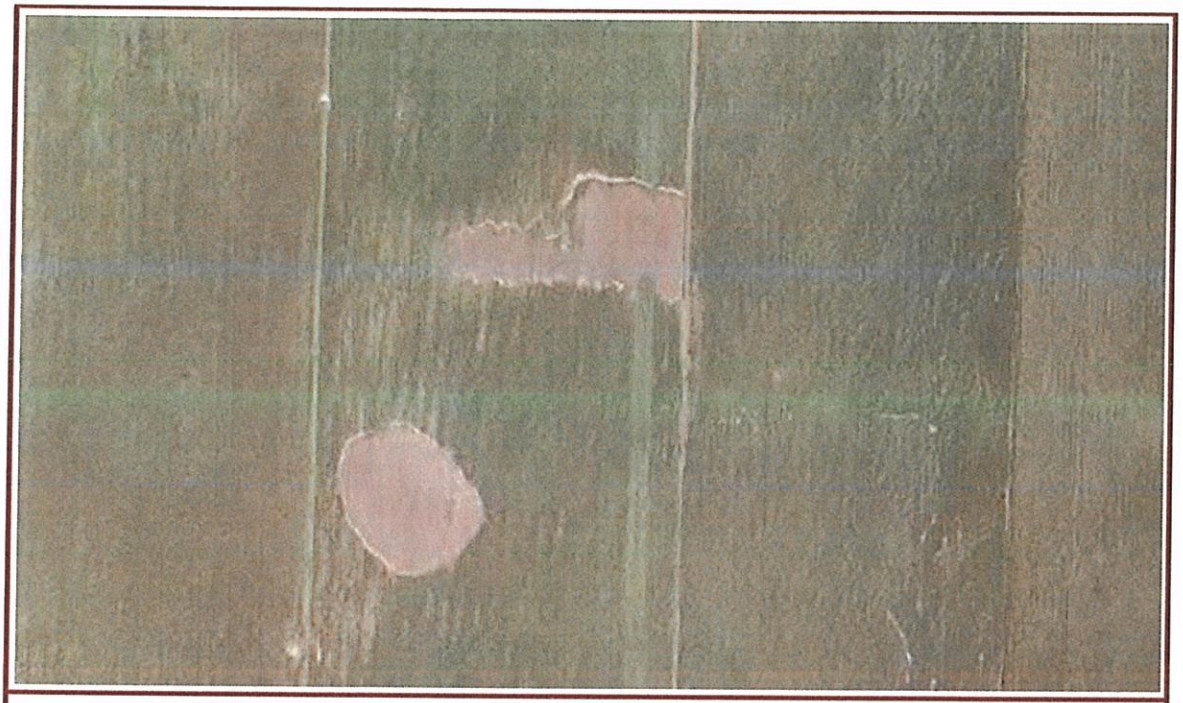
Turbidity						
Surface Contaminants, Salinity				X	X	X

Ponding / Flooding

Ponding and Flooding

Ponding of water typically refers to one or more restricted areas within a field. Short duration ponding is usually caused by frequent and/or intense precipitation events that exceed the infiltration capacity of the soils. Long duration ponding is typically associated with restricted drainage areas (often depressions/swales) within a field. **Flooding**, on the other hand, refers to streams that overflow their banks. As such, flooded fields are always located on the floodplain of a river or stream. Top two images courtesy of USDA, NRCS. Bottom image courtesy of Dave Willis, Agassiz Crop Management, Thief River Falls, MN.

Ponding and Flooding



This image from Iowa shows the physical feature of **standing water in field depressions with debris "rings" evident**. This documents the **Ponding/Flooding** resource concern. Image courtesy of USDA, NRCS.

Ponding and Flooding

The **Ponding/Flooding** resource concern is illustrated in this image from Anoka County, Minnesota by the physical features of **Standing Water, Drowned Crops and Sediment.** Image courtesy of USDA, NRCS.

Ponding and Flooding

The resource concern **Ponding/Flooding** is documented in these images from Calhoun County, Iowa by the physical features of

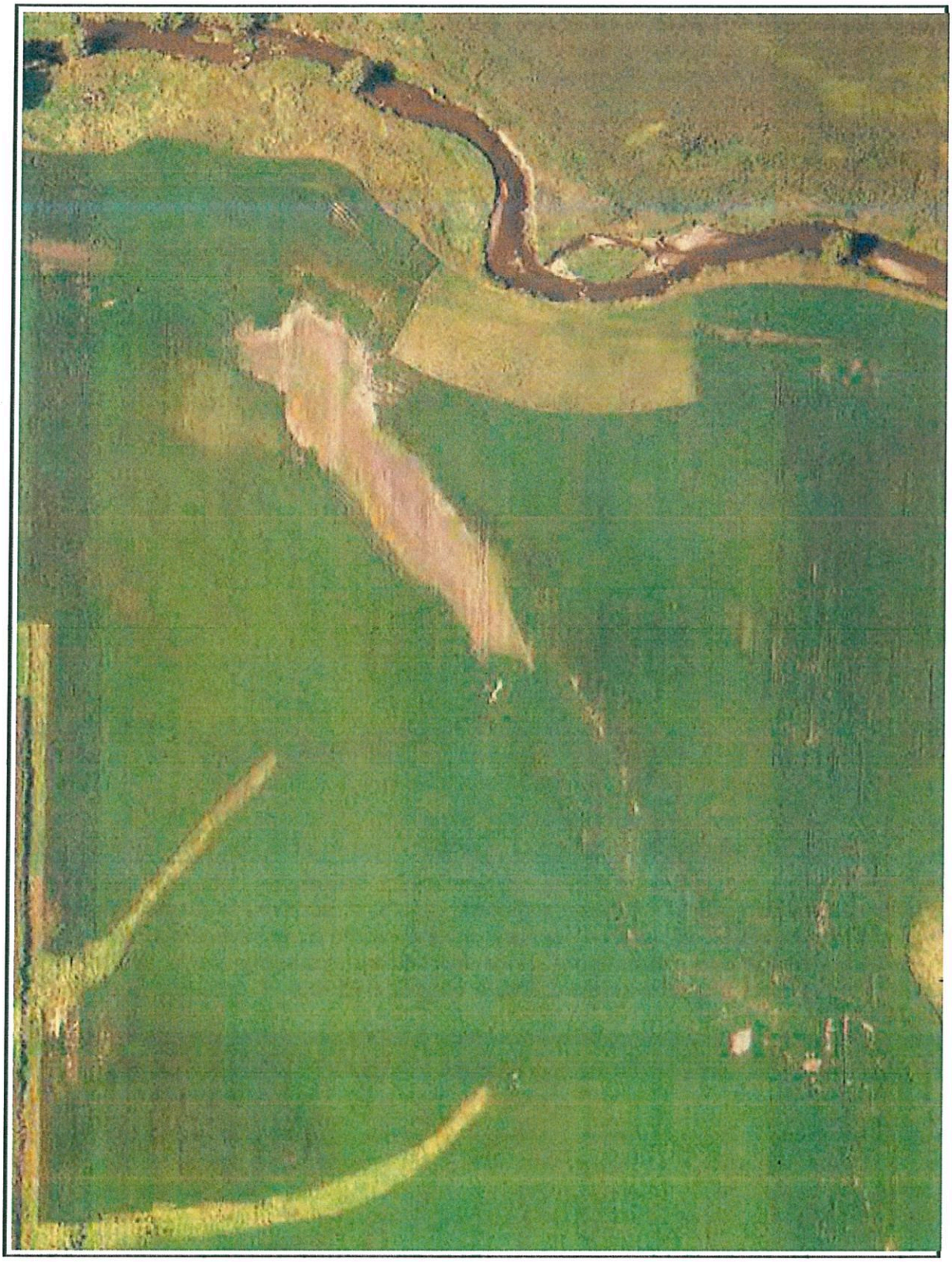
Tillage Exclusion and **Standing Water**. Note the different appearance of the tillage exclusion in wet *vs*. dry years. Images courtesy of USDA, NRCS.

Ponding / Flooding, ctnd.

Ponding and Flooding

Here is an example of a resource concern (**Ponding/Flooding**) being associated with a conservation practice (Water-sediment control structures) in Audrain County, Missouri. These control structures have been constructed across several drainage lines. They were effective in ponding water and settling out sediment as evidenced by the physical features of **drowned crops covered with soil**. Image courtesy of USDA, NRCS.

Ponding and Flooding



This example of the **Ponding/Flooding** resource concern from Boone County, Iowa is evidenced by the physical feature of **drowned crops** (largely non-vegetated area at left center). Image courtesy of USDA, NRCS.

Ponding and Flooding

This example of the **Ponding/Flooding** resource concern from Calhoun County,

Iowa illustrates (in the lower portion of the image) the physical features of **drowned crops, sediment and debris lines**. Image courtesy of USDA, NRCS.

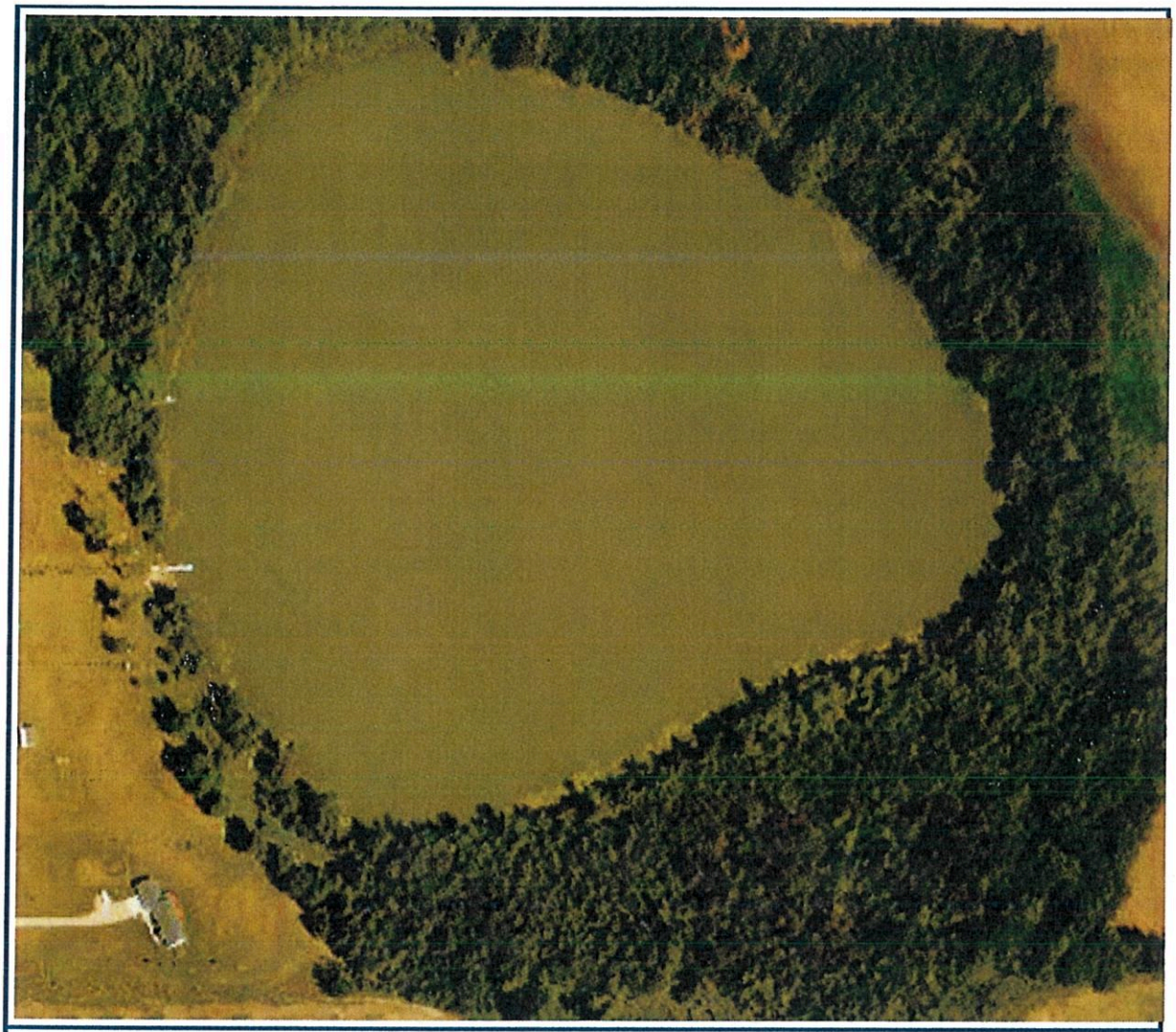
Excess Subsurface Water

Excess Subsurface Water

This image from Dakota County, Minnesota illustrates the physical feature of a **yellowing corn crop in the poorly drained depressions** in this field - evidence of the resource concern of **Excess Subsurface Water**. See also: **Plant Health and Vigor. Image courtesy of USDA, NRCS.**

Surface Contaminants, Nutrients & Organics

Surface Contaminants, Nutrients & Organics



This small lake in Midland County, Michigan exhibits the physical feature of being **bright green due to an algal bloom**. This is evidence of the resource concern: **Surface Contaminants, nutrients and organics**. Image courtesy of USDA, NRCS.

Surface Contaminants, Nutrients & Organics

This green pond in Boone County, Missouri exhibits the physical feature of being **green due to an algal bloom**. This is evidence of the resource concern: **Surface Contaminants, nutrients and organics**. Image courtesy of USDA, NRCS.

Contaminants, Turbidity

Contaminants, Turbidity

This image from Lewis County, Missouri shows the physical feature of a **reddish brown colored river** - distinct evidence of the **Contaminants, turbidity** resource concern. Although this is a legitimate resource concern, **it is NOT associated with the conservation treatment unit (CTU) in the center of this image**. The turbidity in this river is coming from elsewhere in the watershed. With this insight in mind, image interpreters should use this resource concern sparingly and only when the CTU is obviously delivering sediments to the turbid river or lake. Image courtesy of USDA, NRCS.

Contaminants, Turbidity

This image from Howard County, Missouri shows the physical feature of **brown ponds** - distinct evidence of the **Contaminants, turbidity** resource concern. Unlike the circumstance pictured above, at this site the conservation treatment unit (CTU) in the center of this image must be contributing sediment to the ponds, since no other watercourse feeds them (i.e., they are runoff retention ponds). Image courtesy of USDA, NRCS.

Plant Resource Concerns

Plant Resource Concerns		
Plant Resource	**Identifiable Physical Features**	NRI Broad Cover Type

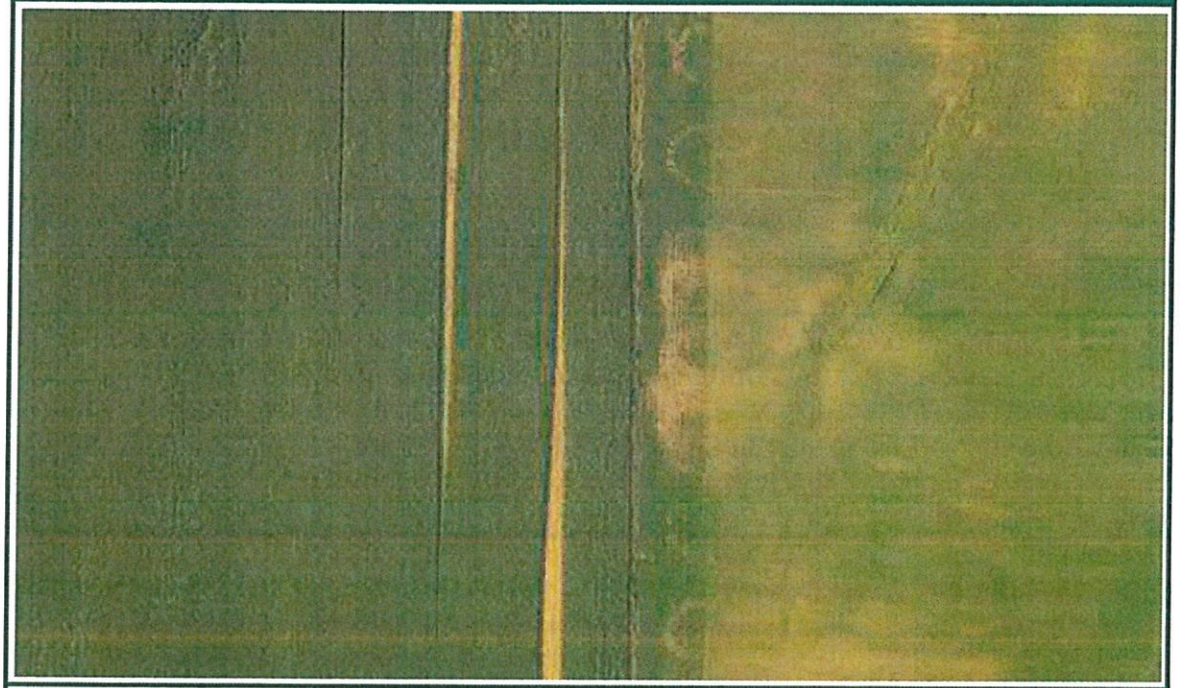
Concerns		
Adapted to Site	Failed planting gaps, Orchard gaps, Tree plantation gaps	Cropland, Hayland, Grassland, CRP, Forest
Health and Vigor	Dead plants (brown color), Yellowing vegetation, Weed monocultures	Cropland, Hayland, Grassland, CRP, Forest
Plant Damaged by Wind	Blowouts (via wind vector), Linear damage patterns in vegetation, Wind deposition	Cropland, Hayland, Grassland, CRP, Forest

Plant Resource Concerns - Dominant Interpretation Characteristics

Soil Resource Concerns	Size	Shape	Texture	Tone	Pattern	Site/Association
Adapted to Site			X		X	X
Health and Vigor			X	X	X	
Plant damaged by Wind			X	X	X	

Adapted to Site

Planter Skips



This image from Butler County, Iowa show the common problem of "**planter skips**." These non-planted physical features result from navigation mistakes

while using a multi-row planter. Foam lines, drag-disk lines and GPS guidance systems can (and should) be used to prevent such mistakes. While not technically a **Plant Adapted To Site** problem, it is a resource concern in that proper management can totally fix this problem (next season). Image courtesy of USDA, NRCS.

Failed Planting

Both of the rectangular planting gaps in this image from Kansas appear to be a **Failed Planting** feature within the **Plant Adapted To Site** resource concern. **They are NOT**. Both of them are **Tillage Exclusions** (hence, their rectangular shape) associated with either **Ponding/Flooding** or **Excess Subsurface Water** resource concerns. Image courtesy of USDA, NRCS.

Orchard Gaps

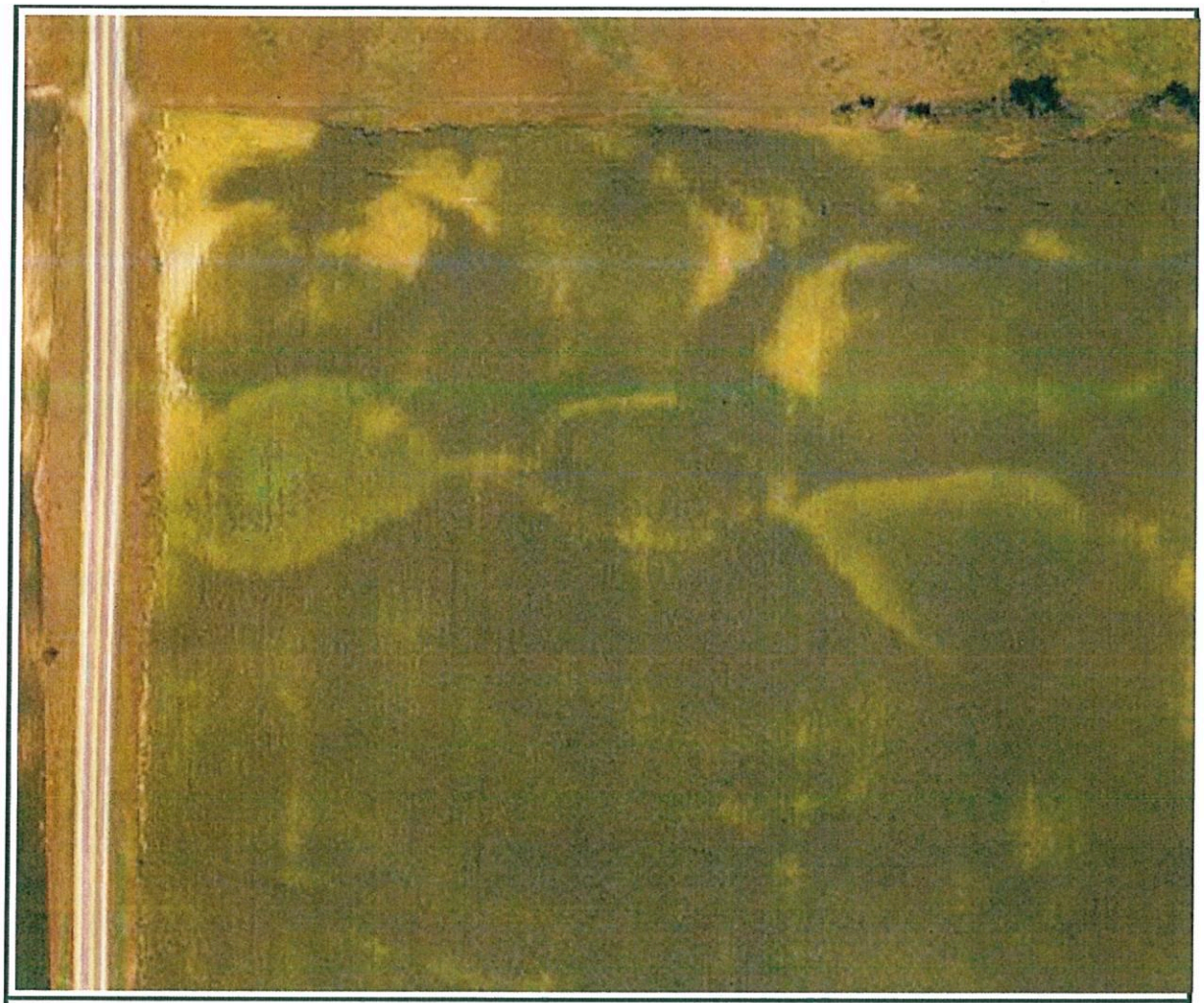
Numerous **orchard gaps** are visible in this image from from Grand Traverse County, Michigan (especially obvious in the orchards along the right side of the image). These are physical features suggesting a **Plant Adapted To Site** resource concern. The causes of these gaps include removals of diseased trees and poorly producing trees. Image courtesy of USDA, NRCS.

Health and Vigor

Health and Vigor

This image from Jasper County, Missouri illustrates the **Plant Health and Vigor** resource concern. The physical feature is **low crop biomass**. Note the pattern of the "thin" parts of the crop canopy - they are all located on the upland swells of this field. The dense biomass portions of the canopy appear to be located in the low swales in the field. Such a pattern is associated with early season drought conditions. The best germination and crop growth occurred in the swale areas due to their greater soil moisture content (in wet times, these same swale areas would drown the crop). Image courtesy of USDA, NRCS.

Health and Vigor



This image from Le Sueur County, Minnesota illustrates the physical feature of a **yellowing corn crop in the somewhat poorly and poorly drained swales** in this field. This physical feature is evidence of two resource concerns: **Plant Health and Vigor**, as well as **Excess Subsurface Water**. Image courtesy of USDA, NRCS.

23. Confined Feeding Operations

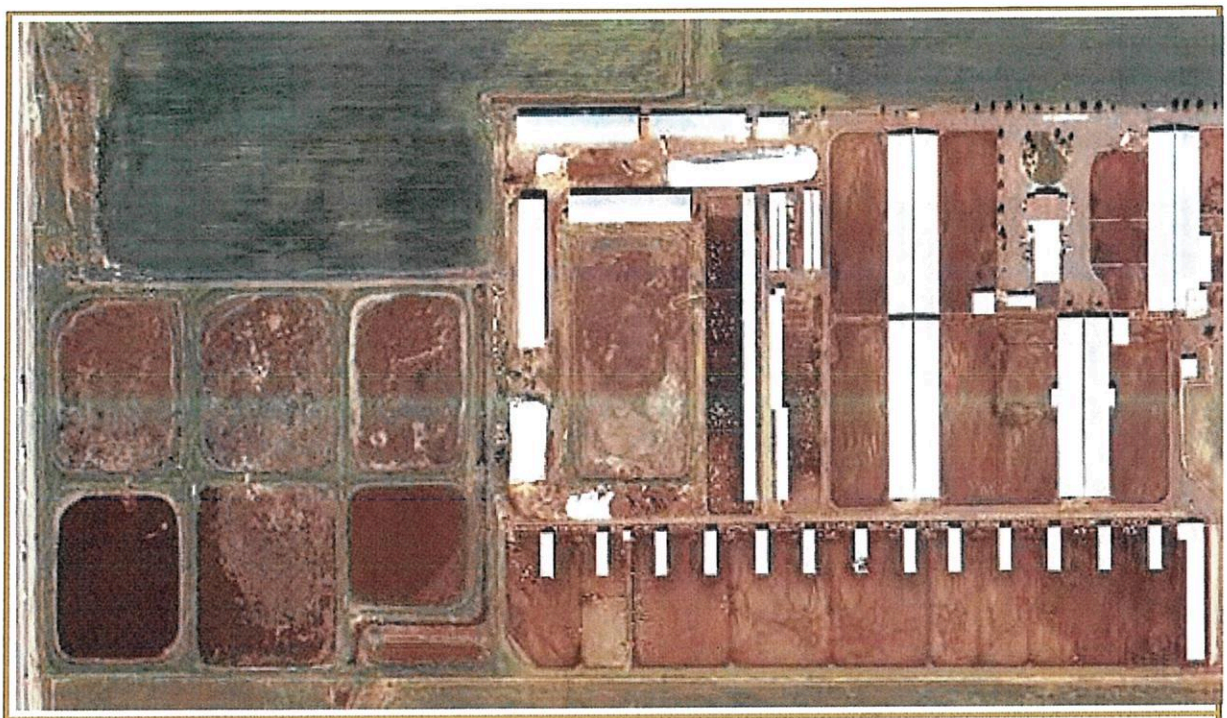
Confined feeding operations, also known as animal feeding operations (AFOs), are farms and ranches where animals are stabled, confined and fed. This category includes the raising of animals in lots, pens, sheds, or buildings. Commercial feedlots are also classified into this category. The central concept of this category is that feed is brought to the animals rather than the animals grazing or otherwise seeking forage in pastures, fields, or on rangeland. Associated components of this category include shipping corrals and other temporary holding facilities.

Beef cattle operations generally include several large barns, several long pole barns, groups of silos or ground bunkers, small rectangular fenced areas and, possibly, extensive pasture fields nearby. Dairy operations have similar building infrastructure. Hog farms are also similar, but have fewer barns and usually have numerous small "hog houses" arranged in a geometric pattern near the barn. Poultry farms typically utilize long, rectangular, one-story pole buildings to house the poultry, each of which usually has one or more small, cylindrical grain silos attached at one end to support the mechanized feed-handling and distribution system.

Commercial Feedlot

Large beef-cattle feedlot in Kansas. Image courtesy of USDA, NRCS.

Commercial Feedlot



Large beef-cattle feedlot in Stanislaus County, California. Image courtesy of USGS.

Dairy Farm

Large dairy farm in Clinton County, Michigan. Note the "breeze-way" corridors connecting the stall galleries with the milking parlors. Image courtesy of USDA, NAIP.

Dairy Farm

Medium-size dairy farm in Iowa. Note the "breeze-way" corridors connecting the stall galleries with the milking parlors. Image courtesy of USDA, NRCS.

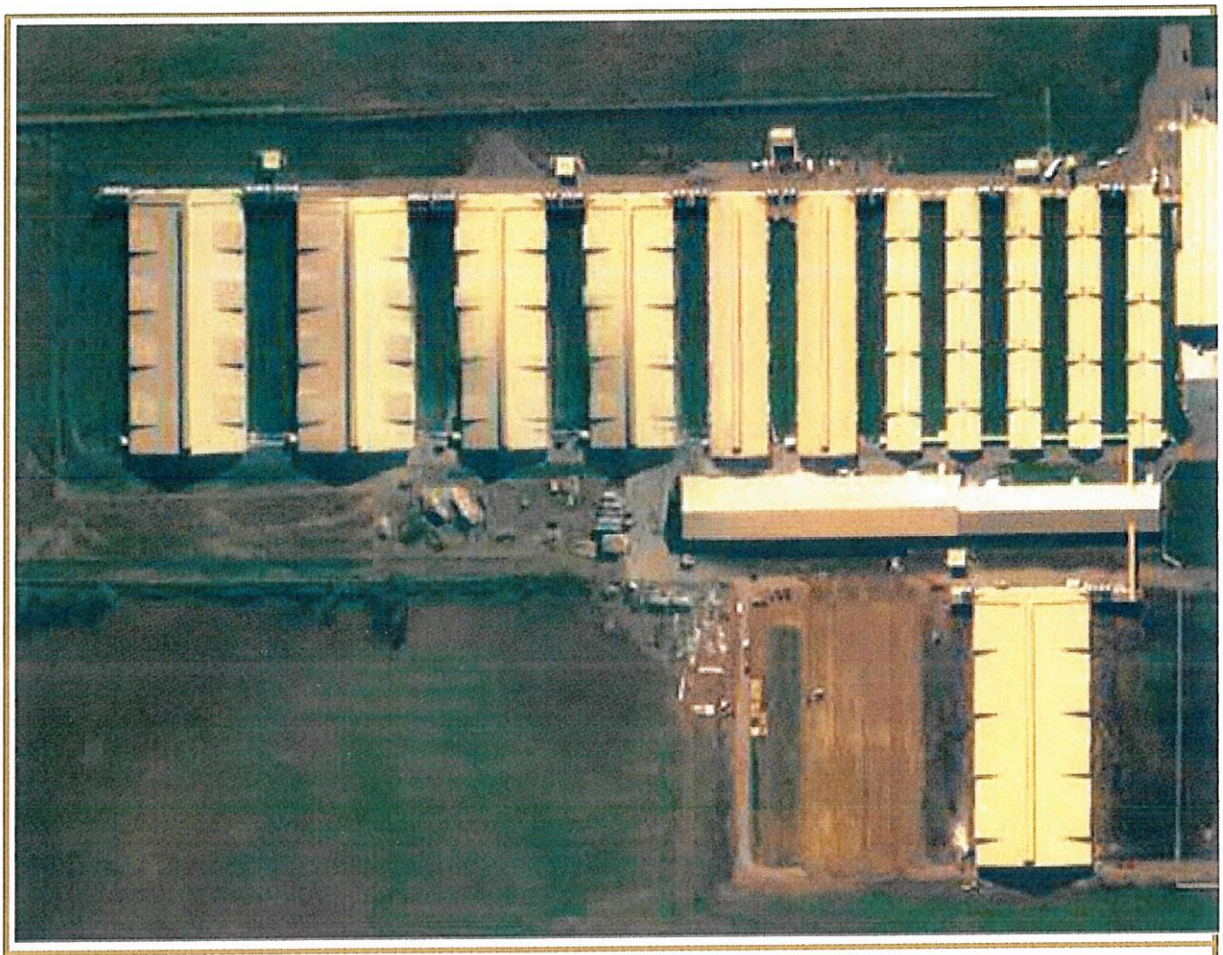
Swine farm in Michigan.

The circular feature at the right-center is a liquid-waste storage pit. Image courtesy of USGS.

Swine Farm in North Carolina

In this large facility, there are two grain bins per building - either for capacity or to facilitate the various rations used in modern swine production. Note the size of the liquid-waste storage pit. Image courtesy of USDA, NRCS.

Poultry Operation



Very large poultry operation in Ionia County, Michigan. Note the grain bins attached to most buildings and the ventilation dormers. Image courtesy of USDA NAIP.