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Erosion and Sediment Control

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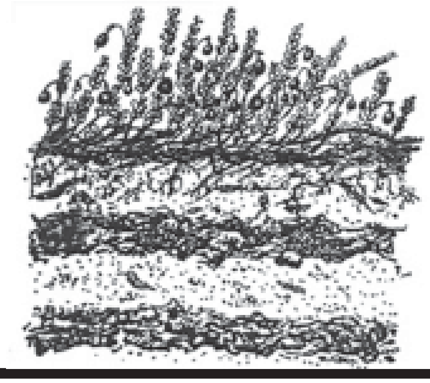

BEST MANAGEMENT PRACTICES GUIDE FOR MASSACHUSETTS CRANBERRY PRODUCTION

Erosion and Sediment Control

Erosion and sedimentation pose problems for soil conservation and water quality maintenance. Erosion control is an important component of non-point pollution prevention programs since soil itself can be both a contaminant and a carrier of other pollutants such as pesticides and nutrients. Under the Massachusetts Wetlands Protection Act, erosion and sediment must be kept to a minimum in order for practices to continue to qualify as Normal Maintenance or Improvement of Land in Agricultural Use. Since cranberries are grown in proximity to sensitive water bodies and wetlands, it is essential that growers use the best practices available to control erosion.

Most cranberry agricultural activities do not give rise to significant levels of off-site erosion. In fact, many of the strategies recommended for reducing erosion and sedimentation are normal farming practices of the cranberry industry. Bogs are typically constructed on nearly level to slightly depressed landscapes, so runoff and erosion are minimized. Secondly, strict control of water flow through the bogs is critical to successful growing and harvesting of cranberries. Water control structures function to control water volume and velocity. Therefore, waterways in cranberry bogs tend to be less subjected to storm-related erosion events. Also, cranberry water systems often include water storage ponds that act as settling ponds that further reduce off-site sediment discharge. Finally, cranberry growing conforms to conservation farming principles in that the soil is not disturbed once the crop is established.

Sources of water and wind eroded sediments associated with cranberry production are generally related to atypical or occasional activities, such as land clearing, new bog construction or renovation, operations associated with sanding (namely excavating and stockpiling of sand resources and sand application), and ditch cleaning and maintenance. In some bogs, especially those with perennial streams flowing through them, stream or ditch bank erosion can pose a concern. This BMP is designed to point out ways to minimize erosion and sediment during these activities. Information is also provided regarding the construction and maintenance of sediment barriers.

Make sure that you are familiar with and in compliance with State and Federal Wetlands Protection regulations.

Erosion and sediment prevention methods - new construction and bog renovation

Disturbing large areas of land carries with it the risk of erosion. Soil erosion can damage water bodies and aquatic life. Small plants and invertebrate animals can be smothered by silt that may also damage the gills of fish. Sediments may also serve to carry pollutants into water. For example, phosphorus is often bound to soil particles at low pH and may be carried with sediment, stimulating algal growth in receiving water bodies. Proper planning for the control of erosion prior to the start of any construction or earthmoving activities will ensure that wetlands and water bodies are protected and that you remain in compliance with the Massachusetts Wetland Protection Act. The Act **requires** that erosion and sediment be minimized as part of the Normal Maintenance or Improvement of Land in Agricultural Use practices.

It is important to formulate an erosion control plan **prior** to the start of any construction activity. The erosion control plan, including planning for where runoff water will go during construction, should be part of your overall project plan. Materials needed for implementing that plan should be on hand or installed prior to earth disturbance. It is vital to have erosion control measures in place prior to substantial rainfalls or storms. For most effective erosion control:

- ✓ Formulate a plan for erosion control
- ✓ Minimize and stabilize disturbed areas
- ✓ Protect disturbed areas from runoff and minimize runoff velocity
- ✓ Prevent sediment from moving off of your site
- ✓ Regularly inspect and maintain erosion and sediment control structures and materials

♦ Pre-construction planning

• Plan for water movement on your site.

If possible, plan to divert water around the site. Soil laden runoff should be kept out of sensitive water bodies. It may be necessary to plan for retention ponds to hold such runoff for sedimentation prior to release. All such plans should be based on handling a large rain event, e.g. 4+ inches in 24 hours.

• Plan dikes with side slopes no greater than 1:1.

While steeper slopes allow for a larger planting area, they are more vulnerable to erosion. Steep dikes will continue to be more difficult to maintain for the life of the planting.

• Plan to install silt fencing and barriers.

• Have all required erosion control materials on site.

♦ Erosion control during construction

• Construct water management and control features first.

Recovery ponds constructed now can act as silt basins. The captured material may be useful later in dike construction. Attempt to divert channeling water around the disturbed area, as common silt barriers are only effective against sheeting runoff across the site.

• Install silt fencing and barriers

Silt fencing should be installed along the down slope property edge. It must be in place before any soil is disturbed. Instructions for constructing silt barriers are found in the last section of this BMP. Silt fences must be inspected after every rainfall and properly maintained to minimize soil movement. These barriers protect water bodies as well as neighbors properties and public ways. MA Department of Environmental Protection requires that 80% of solids be removed from runoff before it reaches a bordering vegetative wetland.

• Disturb as little of the site as possible.

When constructing multiple beds, open up the site progressively. Stabilize the site as you go along. Leave existing vegetation in place elsewhere on the site as much as possible. If you have problems with dust and wind erosion, control by sprinkling water on dry soil or sand. Keep your site neat. This will help to control erosion and will also be looked upon favorably by your neighbors.

• Maintain soil and sand stockpiles properly.

Excavated sand should be stockpiled as far away as possible from water bodies and drainage ways. Soil stockpiles can be stabilized by seeding or mulching. This should be done if stockpiles will remain for more than a week or two. Down gradient silt barriers may also be needed. Some consideration of impact on neighbors should be taken when establishing height and location of stockpiles.

• Avoid loss of soil from roadways during construction.

Dust on roadways can be controlled by sprinkling water. Grass or vegetation should be established on roadways, dike roads, etc. as soon as possible. Placement of coarse gravel in the site roadways at the exits will prevent tracking of soil onto public roadways. For this practice, coarse gravel (2-3 inches) is placed 6 inches deep by 7 feet wide for the final 50 feet of the exit roadway.

• Avoid disturbing soil during adverse weather conditions.

Work during dry seasons. Do not work on the site when the soil is frozen or saturated or during heavy rain or wind storms. When large rain events are predicted, putting a shallow flood over the bed can be protective against erosion losses.

♦ Dike construction and stabilization

• Construction

Embankments should be built no steeper than 1:1. Site the shallower slope on the outside of the dike to minimize off-site erosion. The dike should be built and compacted in layers using fill materials containing no sod, brush, roots, or stumps. Core materials in the dike should be the most pervious materials available. In Southeastern Massachusetts, this will often be compacted glacial till. Dikes should be constructed to a height 1 foot above the normal flood elevation. In order to establish vegetation on dikes or embankments, surface soil must have the capacity to hold adequate water to support plant growth.

• Stabilization

Stabilize dikes and other disturbed areas by seeding to grass or other plants, by mulching, or by placing soil stabilization fabric (geotextile, netting, or burlap). Mulch should be anchored with mesh. Grade 2-3 turf sods have been used successfully for this purpose. Pay particular attention to dike edges, they remain prone to erosion during rainstorms until stabilized. Keep woody plants off of dikes as their roots can destabilize the structure. Avoid ponding (wheel tracks) on top of dikes.

Curlex, a cornstarch netting entwined with aspen excelsior fibers, has been successfully used to stabilize bankings and on-bed ditch edges. Ditches stabilized with Curlex required 60% less cleaning than those left untreated. Erosion blankets are preferable to loose mulch on the bog side of a dike, as mulch may contain weed seeds that will end up in the bed. Curlex is biodegradable, decomposing in 6-8 months. The material must be in good contact with the underlying soil or erosion can occur under the blanket.

Grass is best planted in spring or fall and may benefit from a layer of mulch or netting and periodic watering during establishment. Top dress dikes with 3-4 inches of topsoil prior to seeding. Hydroseeding or gel seeding can be used. Erosion control ‘blankets’, such as Curlex, have been successful in conjunction with grass planting. Studies have shown that germination rate rose from 50-60% to 85-95% when Curlex was used over grass seed. Pre-seeded Curlex is available.

Choose non-weedy species for seeding dikes. Recommended examples include clovers, fescues, and perennial ryegrass. Mixtures of species in the seed mix are preferable to a single species. Fertilize and lime grasses as needed during establishment.

A novel practice for stabilizing embankments with plants is to use wildflower species such as birdsfoot trefoil in conjunction with an erosion blanket. The trefoil blooms before and after the cranberries (supports but does not compete with pollinators) and requires only one mowing per year. For more information, see the reference “Is it time to rethink grass slopes?” at the end of the section.

♦ Flume installation, protection, and stabilization

• Installation

Flumes should be fitted with antiseep collars and driven into native soil if possible. Fill and compact around the culvert to prevent piping (formation of eroded channels). Packing with bentonite or other dense materials may be helpful. Placement of concrete blocks around the flume may also help.

The size of the outlet pipe is important. If it is too small, the culvert may wash out. Size is determined based on the amount of water to be discharged. Consult an engineer or NRCS for this calculation.

Water should be discharged into a stable ditch or channel.

• Protection and stabilization

Use a riprap apron with underlying geotextile at the base of outlet flumes where the velocity of the outflow could cause erosion. The geotextile protects the riprap from undercutting and can be placed directly on leveled soil. A gravel base may be substituted for the fabric. The riprap apron is necessary if capacity flow from the outlet results in the formation plunge pools. These can severely weaken embankments and threaten stability. The riprap apron also prevents scouring at the culvert mouth and prevents gully erosion that could gradually extend upstream.

The riprap structure should be installed early in construction but can be added later. Once installed they should be inspected regularly for channeling. Removal of sediment buildup may be difficult.

Erosion and sediment prevention methods - all beds

♦ Controlling steam bank and ditch bank erosion

A common result of this type of erosion in cranberry systems is the loss of functionality of ditches and canals. Ditches lose drainage capacity due to sedimentation and canals can lose capacity due to bank slumping.

• Manage water to minimize erosion, slumping, and undercutting of bankings.

Stream or ditch bank erosion commonly occurs when saturated, unstable soil materials are subject to high velocity water flow. Reduce the erosive potential of moving water by slowing the flow velocity at the flume.

Lower water levels in ditches to improve slope and bank stability during times of the season when soil is wet. This is especially common in the spring during periods of rain and/or sprinkling for frost. Water levels in ditches should be higher in times of drought. Saturated soil has very little strength; lowering water levels in ditches dries out the soil and reduces slump and failure of sidewalls.

• Use vegetation or other materials to stabilize bankings.

Establish a good stand of grass on dikes. This will stabilize the soil and prevent waterlogging (vegetation facilitates water loss by transpiration).

Try to establish cranberry vines or other vegetation on the sidewalls of ditches. The roots will anchor the soil, increase soil stability, and reduce slumping. Erosion blankets such as Curlex may be used to aid in establishment of vegetation on bankings and in holding the bed edges in place until the cranberry plants are well established.

Apply geofabric or geogrid materials to unstable embankments to increase shear strength and reduce slumping. Extremely unstable sidewalls may be lined with pressure treated lumber.

• Install protective features.

Install energy dispersing or deflecting barriers wherever discharging water flows in direct contact with a ditch sidewall. This will occur where discharging internal flumes are set at right angles to the shore ditch or canal and large volumes of water are being released, e.g. harvest flood.

Add rip rap stone to the down gradient side of flumes to prevent stream or ditch bed scouring. Large irregular stones placed in the stream or ditch bed dissipate the energy of high velocity water exiting the bog. The loss of energy by the water significantly reduces scouring and sediment transport. This practice is regulated under the Massachusetts Wetlands Protection Act - make sure you are in compliance when using rip rap stone.

♦ Sanding

• Stockpile sand responsibly.

The stockpiling of sand should be limited as much as possible. Loss to water and wind erosion is inevitable if sand piles are left in place for long periods of time.

Excavated sand should be stockpiled as far away as possible from water bodies and drainage ways. Down gradient silt barriers may also be needed. All efforts should be made to minimize wind erosion.

Impact on neighbors should be considered when establishing height and location of stockpiles.

• Avoid discharge of sand laden waters.

This is critical when barge sanding. Retain flood water for adequate period to allow settling, usually 5-7 days or longer.

Sand laden water may also be generated following other sanding methods if sand is 'watered-in' by hosing or shallow flooding. Precautions after such practices should be similar to those used when barge sanding.

• Follow practices recommended in the Sanding BMP.

♦ Ditch cleaning

• Take precautions to preserve integrity of stream and ditch bankings.

Be careful not to undercut stream or ditch banks or to dig ditches too deeply during ditch cleaning. Undercutting leads to instability and bank failure.

• Avoid discharge of sediments during ditch cleaning.

If fine textured sediment is being dredged from ditch bottoms, consider using a silt fence to trap sediments before they move offsite.

Cleaning ditches from the point most distant from the flume (moving towards the flume) will enhance settling of sediments.

Allow dredged sediments ample time to drain of excess water before being moved significant distances. Use a sediment barrier as necessary to keep the sediments contained.

Construction and maintenance of sediment barriers

♦ General

Growers should employ all reasonable sediment capture and removal techniques to receive and cleanse waters exiting the bog. Growers should also consider diverting sediment charged water to holding ponds to allow settling of solids. Filter strips or filter booms with hanging cloth may also be effective.

Sediment barriers are necessary if drainage across a disturbed area could deposit sediment into a water body, a wetland, or a neighbors property. They are not needed if the site drains into a tailwater recovery pond or the bog itself. Note: Most sediment barriers are designed to handle sheet erosion only.

- ✓ All sediment barriers should be inspected immediately after any rainfall, at least daily during rainy periods, and if there is any sign of downstream erosion.
- ✓ Sediment must be removed from behind the barrier if it reaches ½ the height of the barrier. If there are signs of undercutting or impounding of large volumes of water behind a sediment barrier, a second barrier should be installed.
- ✓ If the barrier shows signs of decomposition or clogging, it should be replaced promptly.
- ✓ Once the barriers are no longer needed, they should be removed and the remaining sediment should be graded and seeded.
- ✓ Do not install bales or fencing across streams, ditches, or waterways.

♦ BioFence - a novel practice

BioFence biodegradable siltation fencing is a product developed and registered by Environmental Research Corps, based in East Freetown, MA. This product has received an EPA Environmental Technology award. BioFence is designed to replace hay bales and plastic silt fencing in erosion control applications. The product is easy to install and is biodegradable - it can be left in place at project completion.

For further information on this product, call 1-800-793-8526.

♦ Straw or hay bales

This is a temporary and inexpensive sediment barrier consisting of a row of entrenched and anchored straw bales. This structure will intercept and detain small amounts of sediment from disturbed areas and will prevent offsite movement to a limited extent. The velocity of sheet flows will also be decreased.

Contributing drainage area should be less than one acre. These structures are effective for no more than 3 months.

• Planning and installation

Locate the barrier where there will be sediment laden runoff — near the base of the drainage area. Ideally there will be an undisturbed, vegetated area further downslope of the barrier.

- ✓ Dig a trench at least 4 inches deep, removing all grass. Flare ends uphill to increase storage capacity.
- ✓ Place wire-bound or string-tied bales tightly, end to end, in the trench.
- ✓ Anchor each bale with at least 2 stakes or re-bars driven through the bale. Angle stakes to force bales together.

- ✓ Fill gaps by carefully wedging loose straw between bales.
- ✓ Backfill excavated soil against the barrier. Fill to ground level on downslope side and build up 4 inches on upslope side.
- ✓ Loose straw scattered on upslope side will increase effectiveness of barrier.

• Potential problems

These barriers are not effective in areas with high water velocities or volumes.

If improperly constructed, water flow will undercut the barrier and actually increase erosion.

These barriers are effective for approximately three months; less if improperly maintained.

• Maintenance

Inspect after each runoff-producing rainfall and daily during prolonged rainy periods. Check for flow around ends of barrier. Repair damaged bales and under cut areas promptly.

Remove sediment deposits when they reach 1/2 of the height of the barrier.

When the barrier is no longer effective or the project is finished, remove the barrier and dispose of it properly. The remaining sediments should be leveled and vegetated.

♦ Sediment fencing

This is a temporary sediment barrier consisting of filter fabric stretched across and attached to supporting posts and entrenched. Additional, rigid wire fencing may be needed in some areas of the barrier as support. This structure will intercept and detain small amounts of sediment from disturbed areas during construction and reduces runoff velocity down a slope. As with the bale barriers, these structures are designed for sheet runoff only (no channeling). Sediment fences may also be used to catch wind-blown sand.

Contributing drainage area should be less than 1/4 acre per 100 feet of fence; and no more than 1.5 total acres. These structures are effective for approximately 6 months. In addition to their longer effective life, sediment fences trap a much higher percentage of sediments than do straw bales. It is NOT necessary to use straw bales in addition to sediment fencing.

• Planning and installation

Locate the barrier where there will be sediment laden runoff -- but at least 10 feet past the base of the slope in the drainage area to provide sediment storage and access for cleanout. Access must be provided to locations where sediment accumulates and reinforced, stabilized outlets must be in place for emergency overflow. Do not locate where ponding behind the fence will cause property damage or create a safety hazard. The fenceline should be nearly level along its length, but should swing slightly uphill for the last 10-20 feet at each end (approx. 6 inch elevation) to provide storage capacity.

- ✓ Dig a trench 8 inches deep and 4 inches wide or a V-trench.
- ✓ Drive support posts in at least 16 inches, on the downslope side of the trench. Use 4 inch diameter pine, 1.33 lb./linear ft. steel, or 3 inch diameter quality hardwood posts. Steel posts should have projections for fastening fabric. Posts should be placed no more than 6 feet apart; 8 feet if support wire is to be used.
- ✓ Fasten support wire to upslope side of posts. Wire should extend 6 inches into the trench. Use 14 gauge wire with 6-inch mesh.
- ✓ Attach continuous length of filter fabric to upslope side of supports. Avoid joints, especially at the low point of the fence.
- ✓ Extend fabric one foot into trench and backfill with compacted earth or gravel.
- ✓ If large amounts of sediment are expected, a shallow storage area may be excavated upslope of the fence.
- ✓ Provide for safe bypass of storm flow. Set stabilized, reinforced outlet so that no more than 1.5 feet of water is held behind the fence at the lowest point. Set the outlet within the fence with posts no more than 4 feet apart and fabric no more than 1 foot above surface. Install a horizontal brace to hold the fabric. Provide a riprap splash pad 5 feet by 5 feet by 1 foot deep on level grade on the downslope side of the outlet in the fence.

• Potential problems

These barriers are not effective in areas with high water velocities or volumes and will not control runoff for anything deeper than sheet or overland flow.

If improperly constructed, water flow will undercut the barrier and actually increase erosion. The bottom of the fence should be buried at least 8 inches deep and the trench should be backfilled with compacted earth or gravel.

• Maintenance

Inspect after each runoff-producing rainfall and daily during prolonged rainy periods. Check for flow around ends of barrier. Repair as necessary.

Remove sediment deposits to provide adequate storage and remove pressure on the fence but take care not to undermine the fence when removing sediment.

If the fabric tears or decomposes, replace it immediately. If using burlap, replace after no more than 60 days.

When the barrier is no longer effective or the project is finished, remove the barrier and dispose of it properly. The remaining sediments should be leveled and vegetated.

Source materials:

NRCS Fact Sheets. **Straw and hay bale barriers**; **Sediment fences**; **Geotextiles**; **Outlet protection and stabilization**.

Cranberry beds construction planning guide: Erosion control for cranberry bed development. Maine DEP in cooperation with the Cranberry Technical Workgroup.

WSCGA Best Management Practices. **Preventing erosion during cranberry bed construction.**

For further information:

Dike standard. 1980. Natural Resources Conservation Service Practice Standard #356. NRCS-NHCP. Amherst, MA.

Howland, M. A. 1998. **Is it time to rethink grass slopes?** Cranberries August 1998: 16-17.

Howland, M. A. 1997. **Building with erosion blankets from slope to bed.** Cranberries October 1997: 14-15.

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