NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

IRRIGATION WATER MANAGEMENT

(Ac.)

CODE 449

DEFINITION

The process of determining and controlling the volume, frequency and application rate of irrigation water in a planned, efficient manner.

PURPOSE

This practice may be applied as part of a resource management system to achieve one or more of the following purposes:

- Manage soil moisture to promote desired crop response
- Optimize use of available water supplies
- Minimize irrigation induced soil erosion
- Decrease non-point source pollution of surface and groundwater resources
- Manage salts in the crop root zone
- Manage air, soil, or plant micro-climate
- Proper and safe chemigation or fertigation
- Improve air quality by managing soil moisture to reduce particulate matter movement
- Reduce energy use

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable to all irrigated lands.

An irrigation system adapted for site conditions (soil, slope, crop grown, climate, water quantity and quality, air quality, etc.) must be available and capable of efficiently applying water to meet the intended purpose(s).

CRITERIA

General Criteria Applicable to All Purposes

Irrigation water shall be applied in accordance with federal, state, and local rules, laws, and regulations. Water shall not be applied in excess of the needs to meet the intended purpose.

Measurement and determination of flow rate is a critical component of irrigation water management and shall be a part of all irrigation water management purposes.

The irrigator or decision-maker must possess the knowledge, skills, and capabilities of management coupled with a properly designed, efficient and functioning irrigation system to reasonably achieve the purposes of irrigation water management.

An “Irrigation Water Management Plan” shall be developed to assist the irrigator or decision-maker in the proper management and application of irrigation water.

Irrigator Skills and Capabilities. Proper irrigation scheduling, in both timing and amount, control of runoff, minimizing deep percolation, and the uniform application of water are of primary concern. The irrigator or decision-maker shall possess or obtain the knowledge and capability to accomplish the purposes which include:

A. General

1. How to determine when irrigation water should be applied, based on the rate of water used by crops and on the stages of plant growth and/or soil moisture monitoring.

2. How to determine the amount of water required for each irrigation, including any leaching needs.
3. How to recognize and control erosion caused by irrigation.
4. How to measure or determine the uniformity of application of an irrigation.
5. How to perform system maintenance to assure efficient operation.
6. Knowledge of "where the water goes" after it is applied considering soil surface and subsurface conditions, soil intake rates and permeability, crop root zones, and available water holding capacity.
7. How to manage salinity and shallow water tables through water management.
8. The capability to control the irrigation delivery.

B. Surface Systems

1. The relationship between advance rate, time of opportunity, intake rate, and other aspects of distribution uniformity and the amount of water infiltrated.
2. How to determine and control the amount of irrigation runoff.
3. How to adjust stream size, adjust irrigation time, or employ techniques such as "surge irrigation" to compensate for seasonal changes in intake rate or to improve efficiency of application.

C. Subsurface Systems

1. How to balance the relationship between water tables, leaching needs, and irrigation water requirements.
2. The relationship between the location of the subsurface system to normal farming operations.
3. How to locate and space the system to achieve uniformity of water application.
4. How to accomplish crop germination in arid climates and during dry periods.

D. Pressurized Systems

1. How to adjust the application rate and/or duration to apply the required amount of water.
2. How to recognize and control runoff.
3. How to identify and improve uniformity of water application.
4. How to account for surface storage due to residue and field slope in situations where sprinkler application rate exceeds soil intake rate.
5. How to identify and manage for weather conditions that adversely impact irrigation efficiency and uniformity of application.

System Capability. The irrigation system must be capable of applying water uniformly and efficiently and must provide the irrigator with adequate control over water application.

Additional Criteria to Manage Soil Moisture to Promote Desired Crop Response

The following principles shall be applied for various crop growth stages:

- The volume of water needed for each irrigation shall be based on plant available water-holding capacity of the soil for the crop rooting depth, management allowed soil water depletion, irrigation efficiency and water table contribution.
- The irrigation frequency shall be based on the volume of irrigation water needed and/or available to the crop, the rate of crop evapotranspiration, and effective precipitation.
- The application rate shall be based on the volume of water to be applied, the frequency of irrigation applications, soil infiltration and permeability characteristics, and the capacity of the irrigation system.

Appropriate field adjustments shall be made for seasonal variations and field variability.

Additional Criteria to Optimize Use of Water Supplies

Limited irrigation water supplies shall be managed to meet critical crop growth stages.

When water supplies are estimated to be insufficient to meet even the critical crop growth stage, the irrigator or decision-maker shall modify plant populations, crop and variety selection, and/or irrigated acres to match available or anticipated water supplies.

Additional Criteria to Minimize Irrigation-Induced Soil Erosion

Application rates shall be consistent with local field conditions for long-term productivity of the soil.

Additional Criteria to Decrease Non-Point Source Pollution of Surface and Groundwater Resources

Water application shall be at rates that minimize transport of sediment, nutrients, and chemicals to surface waters and that minimize transport of nutrients and chemicals to groundwater.

Additional Criteria to Manage Salts in the Crop Root Zone

The irrigation application volume shall be increased by the amount required to maintain an appropriate salt balance in the soil profile.

The requirement shall be based on the leaching procedure contained in NRCS National Engineering Handbook (NEH) Part 623, Chapter 2, Irrigation Water Requirements, and NEH, Part 652, National Irrigation Guide, Chapters 3 and 13.

Additional Criteria to Manage Air, Soil, or Plant Micro-Climate

The irrigation system shall have the capacity to apply the required rate of water for cold or heat protection as determined by the methodology contained in NEH Part 623, Chapter 2, Irrigation Water Requirements.

Additional Criteria for Proper and Safe Chemigation or Fertigation

Chemigation or fertigation shall be done in accordance with all local, state and federal laws.

The scheduling of nutrient and chemical application should coincide with the irrigation cycle in a manner that will not cause excess leaching of nutrients or chemicals below the root zone to the groundwater or to cause excess runoff to surface waters.

Chemigation or fertigation should not be applied if rainfall is imminent. Application of chemicals or nutrients will be limited to the minimum length of time required to deliver them and flush the pipelines. Irrigation application amount shall be limited to the amount necessary to apply the chemicals or nutrients to the soil depth recommended by label. The timing and rate of application shall be based on the pest, herbicide, or nutrient management plan.

The irrigation and delivery system shall be equipped with properly designed and operating valves and components to prevent backflows into the water source(s) and/or contamination of groundwater, surface water, or the soil.

Additional Criteria to Reduce Particulate Matter Movement

Sprinkler irrigation water shall be applied at a rate and frequency sufficient to reduce the wind erodibility index (I Factor) of the soil by one class.

Additional Criteria Applicable to Reduce Energy Use

Provide analysis to demonstrate reduction of energy use from practice implementation.

Reduction of energy use is calculated as average annual or seasonal energy reduction compared to previous operating conditions.

CONSIDERATIONS

The following items should be considered when planning irrigation water management:

- Consideration should be given to managing precipitation effectiveness, crop residues, and reducing system losses.
- Consider potential for spray drift and odors when applying agricultural and municipal waste waters. Timing of irrigation should be based on prevailing winds to reduce odor. In areas of high visibility, irrigating at night should be considered.
- Consider potential for overspray from end guns onto public roads.

- Equipment modifications and/or soil amendments such as polyacrylamides and mulches should be considered to decrease erosion.
- Consider the quality of water and the potential impact to crop quality and plant development.
- Quality of irrigation water should be considered relative to its potential effect on the soil's physical and chemical properties, such as soil crusting, pH, permeability, salinity, and structure.
- Avoid traffic on wet soils to minimize soil compaction.
- Consider the effects that irrigation water has on wetlands, water related wildlife habitats, riparian areas, cultural resources, and recreation opportunities.
- Management of nutrients and pesticides.
- Schedule salt leaching events to coincide with low residual soil nutrients and pesticides.
- Water should be managed in such a manner as to not drift or come in direct contact with surrounding electrical lines, supplies, devices, controls, or components that would cause shorts in the same or the creation of an electrical safety hazard to humans or animals.
- Consideration should be given to electrical load control/interruptible power schedules, repair and maintenance downtime, and harvest downtime.
- Consider improving the irrigation system to increase distribution uniformity or application efficiency of irrigation water applications.

PLANS AND SPECIFICATIONS

Application of this standard may include job sheets or similar documents that specify the applicable requirements, system operations, and components necessary for applying and maintaining the practice to achieve its intended purpose(s).

OPERATION AND MAINTENANCE

The operation and maintenance (O&M) aspects applicable to this standard consist of evaluating available field soil moisture, changes in crop evapotranspiration rates and changes in soil intake rates and adjusting the volume, application rate, or frequency of water application to achieve the intended purpose(s). Other necessary O&M items are addressed in the physical component standards considered companions to this standard.

REFERENCES

USDA-NRCS National Engineering Handbook, Part 623, Chapter 2, Irrigation Water Requirements.

USDA-NRCS, National Engineering Handbook, Part 652, National Irrigation Guide

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FILTER STRIP

(Ac.)

CODE 393

DEFINITION

A strip or area of herbaceous vegetation that removes contaminants from overland flow.

PURPOSE

- Reduce suspended solids and associated contaminants in runoff.
- Reduce dissolved contaminant loadings in runoff.
- Reduce suspended solids and associated contaminants in irrigation tailwater.

CONDITIONS WHERE PRACTICE APPLIES

Filter strips are established where environmentally-sensitive areas need to be protected from sediment, other suspended solids and dissolved contaminants in runoff; in areas situated below cropland, grazing land, or disturbed land (including forest land); and in areas where permanent vegetative establishment is needed to enhance wildlife and beneficial insects, or maintain or enhance watershed function.

This practice applies when planned as part of a conservation management system.

CRITERIA

General Criteria Applicable to All Purposes

Filter strips shall be designated as vegetated areas to treat runoff and are not part of the adjacent cropland rotation.

Overland flow entering the filter strip shall be uniform sheet flow. Concentrated flow shall be dispersed before entering the filter strip.

State listed noxious weeds will not be established in the filter strip and will be controlled if present. Filter strips shall not be used as a travel lane for equipment or livestock.

Filter strip establishment shall comply with local, state and federal regulations.

Additional criteria to reduce sediment, particulate organics and sediment-adsorbed contaminant loadings in runoff

Filter strip flow length shall be determined based on field slope percent and length, and filter strip slope percent, erosion rate, amount and particle size distribution of sediment delivered to the filter strip, density and height of the filter strip vegetation, and runoff volume associated with erosion producing events. The minimum flow length for this purpose shall be 20 feet.

Filter strip location requirements:

- The filter strip shall be located along the downslope edge of a field or disturbed area. To the extent practical it shall be placed on the approximate contour. Variation in placement on the contour should not exceed a 0.5% longitudinal (perpendicular to the flow length) gradient.
- The drainage area above the filter strip shall have greater than 1% but less than 10% slopes.
- The filter strip will be designed to have a 10-year life span, following the procedure in the Agronomy Technical Note No. 2 (Using RUSLE2 for the Design and Predicted Effectiveness of Vegetative Filter Strips (VFS) for Sediment), based on the sediment delivery in RUSLE2 to the upper

edge of the filter strip and ratio of the filter strip flow length to the length of the flow path from the contributing area.

- The ratio of the drainage area to the filter strip area shall be less than 70:1 in regions with RUSLE-R factor values 0-35, 60:1 in regions with RUSLE-R factor values 35-175, and 50:1 in regions with RUSLE-R factor values of more than 175.
- The average annual sheet and rill erosion rate above the filter strip shall be less than 10 tons per acre per year

Vegetation. The filter strip shall be established to permanent herbaceous vegetation.

Species selected shall be:

- able to withstand partial burial from sediment deposition and
- tolerant of herbicides used on the area that contributes runoff to the filter strip.

Species selected shall have stiff stems and a high stem density near the ground surface.

Species selected for seeding or planting shall be suited to current site conditions and intended uses. Selected species will have the capacity to achieve adequate density and vigor within an appropriate period to stabilize the site sufficiently to permit suited uses with ordinary management activities.

Species, rates of seeding or planting, minimum quality of planting stock, such as PLS or stem caliper, and method of establishment shall be specified before application. Only viable, high quality seed or planting stock will be used.

Site preparation and seeding or planting shall be done at a time and in a manner that best ensures survival and growth of the selected species. What constitutes successful establishment, e.g. minimum percent ground/canopy cover, percent survival, stand density, etc. shall be specified before application.

Planting dates shall be scheduled during periods when soil moisture is adequate for germination and/or establishment.

The minimum seeding and stem density shall be equivalent to a high quality grass hay seeding rate for the climate area or the density of vegetation selected in RUSLE2 to determine trapping efficiency, whichever is the higher seeding rate.

Additional Criteria to Reduce Dissolved Contaminants in Runoff

The criteria given in "Additional criteria to reduce sediment, particulate organics and sediment adsorbed contaminant loadings in runoff" for location, drainage area and vegetation characteristics also apply to this purpose.

Filter strip flow length required to reduce dissolved contaminants in runoff shall be based on management objectives, contaminants of concern, and the volume of runoff from the filter strip's drainage area compared with the filter strip's area and infiltration capacity.

The flow length determined for this purpose shall be in addition to the flow length determined for reducing sediment, particulate organics and sediment-adsorbed contaminant loadings in runoff.

The minimum flow length for this purpose shall be 30 feet.

Additional Criteria to Serve as Zone 3 of a Riparian Forest Buffer, Practice Code 391

Except for the location requirements, the criteria given in **"Additional criteria to reduce sediment, particulate organics and sediment adsorbed contaminant loadings in runoff"** also apply to this purpose.

If concentrated flows entering Zone 3 are greater than the filter strip's ability to disperse them, other means of dispersal, such as spreading devices, must be incorporated.

Additional Criteria to Reduce Sediment, Particulate Organics and Sediment-adsorbed Contaminant Loadings in Surface Irrigation Tailwater

Filter strip vegetation may be a small grain or other suitable annual with a plant spacing that does not exceed 4 inches.

Filter strips shall be established early enough prior to the irrigation season so that the vegetation can withstand sediment deposition from the first irrigation.

The flow length shall be based on management objectives with a minimum flow length of 20 feet.

Additional Criteria to Restore, Create or Enhance Herbaceous Habitat for Wildlife and Beneficial Insects

If this purpose is intended in combination with one or more of the previous purposes, then the minimum criteria for the previous purpose(s) must be met.

Additional filter strip flow length devoted to this purpose must be added to the length required for the other purpose(s).

Any addition to the flow length for wildlife or beneficial insects shall be added to the downhill slope of the filter strip.

Vegetation to enhance wildlife may be added to that portion of the filter strip devoted to other purposes to the extent they do not detract from its primary functions.

Plant species selected for this purpose shall be for permanent vegetation adapted to the wildlife or beneficial insect population(s) targeted.

If this is the only purpose, filter strip width and length shall be based on requirements of the targeted wildlife or insects. Density of the vegetative stand established for this purpose shall consider targeted wildlife habitat requirements and encourage plant diversity. Dispersed woody vegetation may be used to the extent it does not interfere with herbaceous vegetative growth, or operation and maintenance of the filter strip.

The filter strip shall not be mowed during the nesting season of the target wildlife.

Livestock and vehicular traffic in the filter strip shall be excluded during the nesting season of the target species.

Additional Criteria to Maintain or Enhance Watershed Functions and Values

Filter strips shall be strategically located to enhance connectivity of corridors and non-cultivated patches of vegetation within the watershed.

Filter strips shall be strategically located to enhance aesthetics of the watershed.

Plant species selected for this purpose shall be for establishment of permanent vegetation.

CONSIDERATIONS

Filter strips should be strategically located to reduce runoff, and increase infiltration and ground water recharge throughout the watershed.

Filter strip width (flow length) can be increased as necessary to accommodate harvest and maintenance equipment.

Filters strips with the leading edge on the contour will function better than those with a gradient along the leading edge.

Seeding rates that establish a higher stem density than the normal density for a high quality grass hay crop will be more effective in trapping and treating contaminants.

Creating, Restoring or Enhancing Herbaceous Habitat for Wildlife and Beneficial Insects and Pollinators. Filter strips are often the only break in the monotony of intensively-cropped areas. The wildlife and pollinator benefits of this herbaceous cover can be enhanced by:

- Increasing the width beyond the minimum required, and planting this additional area to species that can provide food and cover for wildlife and pollinators. This additional width should be added on the downslope side of the filter strip.
- Adding herbaceous plant species to the filter strip seeding mix that are beneficial to wildlife and pollinators and be compatible for one of the listed purposes. Changing the seeding mix should not detract from the purpose for which the filter strip was established.
- Filter strips for the single purposes of wildlife/beneficial insect habitat or to enhance watershed function should be strategically located to intercept contaminants thereby enhancing air and water quality.

To avoid damage to the filter strip consider using vegetation that is somewhat tolerant to herbicides used in the up-slope crop rotation.

Consider using this practice to enhance the conservation of declining species of wildlife,

including those that are threatened or endangered.

Consider using this practice to protect National Register listed or eligible (significant) archaeological and traditional cultural properties from potential damaging contaminants.

Select grass species that sequester more carbon. Increasing the width of filter strip will increase the potential for carbon sequestration.

PLANS AND SPECIFICATIONS

Based on this standard, plans and specifications shall be prepared for each specific field site where a filter strip will be installed. A plan includes information about the location, construction sequence, vegetation establishment, and management and maintenance requirements.

Specifications shall include:

a) Length, width, and slope of the filter strip to accomplish the planned purpose (length refers to flow length across the filter strip).

b) Species selection and seeding or sprigging rates to accomplish the planned purpose

c) Planting dates, care and handling of the seed to ensure that planted materials have an acceptable rate of survival

d) A statement that only viable, high quality and regionally adapted seed will be used

e) Site preparation sufficient to establish and grow selected species

OPERATION AND MAINTENANCE

For the purposes of filtering contaminants, permanent filter strip vegetative plantings should be harvested as appropriate to encourage dense growth, maintain an upright growth habit and remove nutrients and other contaminants that are contained in the plant tissue.

Control undesired weed species, especially state-listed noxious weeds.

Prescribed burning may be used to manage and maintain the filter strip when an approved burn plan has been developed.

Inspect the filter strip after storm events and repair any gullies that have formed, remove unevenly deposited sediment accumulation that will disrupt sheet flow, reseed disturbed areas and take other measures to prevent concentrated flow through the filter strip.

Apply supplemental nutrients as needed to maintain the desired species composition and stand density of the filter strip.

To maintain or restore the filter strip's function, periodically regrade the filter strip area when sediment deposition at the filter strip-field interface jeopardizes its function, and then reestablish the filter strip vegetation, if needed. If wildlife habitat is a purpose, destruction of vegetation within the portion of the strip devoted to that purpose should be minimized by regrading only to the extent needed to remove sediment and fill concentrated flow areas.

Grazing shall not be permitted in the filter strip unless a controlled grazing system is being implemented. Grazing will be permitted under a controlled grazing system only when soil moisture conditions support livestock traffic without excessive compaction.

REFERENCES

Dillaha, T.A., J.H. Sherrard, and D. Lee. 1986. Long-Term Effectiveness and Maintenance of Vegetative Filter Strips. VPI-VWRRC Bulletin 153.

Dillaha, T.A., and J.C. Hayes. 1991. A Procedure for the Design of Vegetative Filter Strips: Final Report Prepared for U.S. Soil Conservation Service.

Foster, G.R. Revised Universal Soil Loss Equation, Version 2 (RUSLE2) Science Documentation (In Draft). USDA-ARS, Washington, DC. 2005.

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture. Agriculture Handbook 703.

NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

FIELD BORDER

(Ac.)

CODE 386

DEFINITION

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

PURPOSE

This practice may be applied to accomplish one or more of the following:

- Reduce erosion from wind and water
- Protect soil and water quality
- Manage pest populations
- Provide wildlife food and cover
- Increase carbon storage
- Improve air quality

CONDITIONS WHERE PRACTICE APPLIES

This practice is applied around the perimeter of fields. Its use can support or connect other buffer practices within and between fields. This practice may also apply to recreation land or other land uses where agronomic crops including forages are grown.

CRITERIA

General Criteria Applicable to All Purposes

Field borders shall be established around the field edges to the extent needed to meet the resource needs and producer objectives. Minimum field border widths shall be based on local design criteria specific to the purpose or purposes for installing the practice.

The field borders shall be established to adapted species of permanent grass, legumes and/or shrubs that accomplish the design objective and do not function as host for diseases of the field crop.

Plants selected for field borders will have the physical characteristics necessary to control wind and water erosion to tolerable levels on the field border area.

Species must be adapted to local soil, ecological sites and climatic conditions, be easily established, long-lived, and manageable. Care will be taken when selecting plants to avoid invasive species. Species shall be in conformance with the respective Major Land Resource Area (MLRA) Vegetative Guide in Section II of the Field Office Technical Guide.

Seedbed preparation, seeding rates, dates, depths, fertility requirements, and planting methods will be consistent with approved local criteria and site conditions.

Ephemeral gullies and rills present in the planned border area will be eliminated as part of seedbed preparation. If present, ephemeral gullies and rills located immediately upslope from the planned border area need to be treated to ensure more of a sheet flow into the planned border area.

Additional Criteria to Reduce Erosion from Wind and Water

Field border establishment, in conjunction with other practices, will be timed so that the soil will be adequately protected during the critical erosion period(s).

Establish stiff-stemmed, upright grasses, grass/legumes or forbs to trap wind- or water-borne soil particles.

The amount of surface and/or canopy cover needed from the field border shall be determined using current approved water and

wind erosion prediction technology. Calculations shall account for the effects of other practices in the management system.

Wind Erosion Reduction. Locate borders to provide a stable area on the windward edge of the field as determined by prevailing wind direction data.

Minimum height of grass or forbs shall be one foot during the critical erosion period.

Water Erosion Reduction. Locate borders to eliminate sloping end rows, headlands, and other areas where concentrated water flows will enter or exit the field.

Orient plant rows as closely as possible to perpendicular to sheet flow direction.

Additional Criteria to Protect Soil and Water Quality

Do not burn the field border if the main goal of the field border is to protect soil or water quality.

Reducing Runoff and Increasing Infiltration. Locate borders around the perimeter of the field, or as a minimum, install borders to eliminate sloping end rows, headlands and other areas where concentrated water flows will enter or exit the field.

Water Quality – Adsorbed, Dissolved and Suspended Contaminants. As a minimum, locate field borders along the edge(s) of the field where runoff enters or leaves the field. The minimum width for this purpose shall be 30 feet and have a vegetation stem density/retardance of moderate to high (e.g. equivalent to a good stand of wheat).

Design border widths to comply with all applicable State and local regulations regarding manure and chemical application setbacks.

Reducing Soil Compaction from Equipment Parking and Traffic. Border widths will be designed to accommodate equipment turning, parking, loading/unloading equipment, grain harvest operations, etc.

Additional Criteria to Manage Pest Populations

Provide a Harbor for Beneficial organisms (e.g. insects, mites, etc.). Include appropriate plants that attract beneficial organisms that prey on target pests.

Mowing, harvesting, pesticide applications and other disturbance activities will be scheduled to accommodate life cycle requirements of the beneficial organisms.

Provide a Habitat to Cause Pests to Congregate. Select plants for the field border that attract pests (e.g. alfalfa strips planted to lure lygus bugs away from a cotton crop).

Additional Criteria to Provide Wildlife Food and Cover

Establish plant species that provide wildlife food and cover for the target wildlife species.

Schedule mowing, harvest, weed control, and other management activities within the field border to accommodate reproduction and other life cycle requirements of target wildlife species.

Vegetative successional state shall be maintained to accommodate target wildlife species requirements.

When wildlife is a concern, a lower percent groundcover than would be needed if protecting soil and water quality was the only goal is acceptable as long as the soil resource concern is also adequately addressed (i.e. no excessive soil loss). This may be achieved by simply increasing the field border width.

Additional Criteria to Increase Carbon Storage

Establish plant species that will produce adequate above- and below-ground biomass for the site (i.e. a positive soil conditioning index).

Maximize the width and length of the herbaceous border to fit the site and increase total biomass production.

Do not burn if the main goal of the field border is carbon storage.

Do not disturb the roots of the established vegetation with tillage.

Additional Criteria to Improve Air Quality

Establish plant species with morphological characteristics that optimize interception and adhesion of airborne particulates. Select

plants with persistent roots and residue that stabilize soil aggregates and capture airborne soil particles.

Establish species resistant to damage from equipment traffic.

CONSIDERATIONS

Consider planting field borders around the entire field, not just on the field edges where water enters or leaves the field, for maximizing multiple resource protection.

Establishing a narrow strip of stiff-stemmed upright grass at the crop/field border interface can increase soil particle trapping efficiency of the field border.

Native plants are best suited for wildlife habitat enhancement and provide other ecological benefits where adapted to site conditions and when consistent with producer objectives.

Include native plants that provide diverse pollen and nectar sources to encourage local pollinator populations.

Use field borders as corridors to connect existing or planned habitat blocks.

Prescribed burning, strip disking, or selective herbicide applications are management tools that can be used to maintain suitable habitat for specifically desired wildlife species.

Overseed the field border with legumes for increased plant diversity, soil quality, and wildlife benefits.

Waterbars or berms may be needed to breakup or redirect concentrated water flow within the borders.

In selecting plant species to establish in the field border, among other items, consider the plant's tolerance to:

- Sediment deposition and chemicals planned for application
- Drought in arid areas or where evapotranspiration can potentially exceed precipitation during the field border's active growing period(s)
- Equipment traffic

Design border widths to match the required field application setback widths for easier management (i.e. land-use and management changes occur in the same location).

Establish plant species that will have the desired visual effects and that will not interfere with field operations or field border maintenance.

Consider the amount of shading that the field border or portions of the field border may experience and select species for those locations accordingly.

The use of native perennial plant species as opposed to annual species provides a longer period of resource protection.

Consider installing a contour buffer system, No Till practice or other conservation practices on adjacent upland areas to reduce surface runoff and excessive sedimentation of field borders.

This practice occurs in areas where there is a higher likelihood of cultural artifacts. Determine if installation of this practice has the potential to affect cultural resources and avoid areas if possible. Document any specific considerations for cultural resources in the design docket and the Practice Requirements worksheet.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the Criteria included in this Standard. Specifications shall describe the requirements for applying this practice to meet the intended purpose. Record practice specifications on the Field Border 386, Conservation Practice Job Sheet. The following components shall be included for recording this specification:

- Field Border widths and lengths based on local design criteria.
- Field Border location(s) within the field(s) or farm boundary.
- Species to be used and the location and planting density of the species used.
- Site preparation requirements.
- Timing of planting and planting method.
- Liming or fertilizer requirements.
- Operation and maintenance requirements.

OPERATION AND MAINTENANCE

Field borders require careful management and maintenance for performance and longevity. The following O&M activities will be planned and applied as needed:

- Repair storm damage
- Remove sediment from above or within the field border when accumulated sediment either alters the function of the field border or threatens the degradation of the planted species' survival
- Shut off sprayers and raise tillage equipment to avoid damage to field borders
- Shape and reseed border areas damaged by animals, chemicals, tillage, or equipment traffic
- Maintain desired vegetative communities and plant vigor by liming, fertilizing, mowing, disking, or burning and controlling noxious weeds to sustain effectiveness of the border
- Repair and reseed ephemeral gullies and rills that develop in the border
- Minimally invasive tillage (e.g. paraplowing) may be performed in rare cases where compaction and vehicle traffic have degraded the field border function. The purpose of the tillage is strictly to decrease bulk density and increase infiltration rates so as to provide a better media for reestablishment of vegetation and field border function
- Maintenance activities that result in disturbance of vegetation should not be conducted during the nesting season of grass nesting birds
- Avoid vehicle traffic when soil moisture conditions are saturated

REFERENCES

K. G. Renard, G. R. Foster, G. A. Weesies, K. D. K. McCool and D. C. Yoder. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), Agricultural Handbook Number 703.

Revised Universal Soil Loss Equation Version 2 (RUSLE2) website (checked Sept 2011): http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm

REDUCING SILT IN YOUR IRRIGATION DRAIN WATER

A HANDBOOK ON

BEST MANAGEMENT PRACTICES

FOR THE IMPERIAL COUNTY SILT TMDLs

By Al Kalin – Consultant

Imperial County Farm Bureau Voluntary TMDL Compliance Program
April 9, 2003, 4th Revision

The Regional Water Quality Control Board's first Total Maximum Daily Load, (TMDL), directed at the Imperial Valley farmers, is the Silt TMDL. It mandates that farmers will be required to reduce the amount of silt leaving their fields enough so that the amount of silt entering the Salton Sea is reduced by 50%.

To achieve this goal growers can either deal directly with the Regional Water Quality Control Board or they can choose to join the Imperial County Farm Bureau's Voluntary TMDL Compliance Program, designed to facilitate the implementation of the Silt TMDL and provide assistance to farmers who have joined the program.

A turbidity meter, which measures how much sediment is suspended in the water, can be used to see what degree of clarity is acceptable and what degree of clarity is not acceptable. The Imperial County Farm Bureau's Voluntary TMDL Compliance Program Director has meters available for loan and can instruct growers on their proper use

Growers will find that many of the farming practices they use today will reduce the amount of silt leaving their fields. The key is to determine which combination of erosion conservation practices are the most economical and beneficial to accomplish the job. Those practices that reduce that amount of silt in the drain water are called Best Management Practices or BMPs, for short.

All growers should keep a running log or diary of what they are doing for each field to reduce the amount of silt leaving a field in the drain water. Dates, methods used, photographs, and actual turbidity meter readings are important to show that progress is being made.

SLOW IS THE ONLY WAY TO GO!

The key to the reduction of silt leaving the field is to keep the velocity of drain water below the magic speed at which soil particles are picked up and put into suspension by the speed of the water. The faster the water flows, the more silt it will carry in suspension.

The important thing to remember is that once the silt is in suspension, and the drain water is muddy, it becomes almost impossible to improve the situation until that muddy water has left the field. If you keep the drain water moving slow from the very start, it becomes much simpler to manage.

Experience has shown that if the drain water velocity is kept below 6/10 of a foot per second, (36 feet per minute), the water will pick up little, if any clay or silt, and will remain clear.

IMPORTANT BMPs

In most cases, one single BMP is not enough to reduce the silt leaving a field. Instead, many different BMPs, working together are usually required to reduce the sediment suspended in the drain water.

Drain Box

The Imperial Irrigation District requires a drain box on most valley fields so that drainage water leaving the field can be measured as it drops in elevation from the farmer's field to the IID drain ditch. Although this simple device is designed to transfer water to different levels while allowing it to be measured, it also becomes one of the best tools that farmers can use to reduce silt in their drains.

By regulating the sill or grade board of the drain box, soil erosion can be minimized. In many instances farmers will find that the soil around their drain box has been eroded over the years because the height of the sill is not adjusted properly. In many situations the elevation can be significantly higher, especially when anticipated tailwater flows will not reach elevations that will cause crop damage.

A new injection molded plastic drain box with a steel frame is currently available that reduces the cost of installation. The whole box weighs less than 50 pounds and is easily handled by one person however care must be taken to keep the area around the box free of dry weeds since the plastic material will burn.

Wider Drain Box

If the current drain box is broken and needs to be replaced the grower should consider replacing it with a much wider 42” version. The major cost of replacing a drain box is labor, so the extra dollars spent for a wide version does not change the total cost that much.

A wide drain box allows more water to be removed from the field without having to lower the level of the drain box sill. Other BMPs may deliver the drainwater to the drop box slowly but if the opening is narrow, the water builds up in height and the velocity near the drain box increases. If the drain box is checked up too high the beds or crops near the drain box may become submerged.

Wide Pan Ditch

The bottom of a pan ditch is usually the width made by a grader blade, (12-14 feet), and level from side to side so that drain water flows evenly across its width. Because of its width, a pan ditch is able to carry a much larger quantity of water at a slower speed and with less depth. For vegetable growers, who need to enter a field soon after irrigating to harvest, a pan ditch has the added benefit of drying much faster than a deep V-ditch.

In most cases, a wide pan ditch can replace a deep V-ditch for the same amount of labor and do a much better job of moving drain water off the field at a slower velocity without the water becoming muddy.

A wide pan ditch in conjunction with a wide drain box are two of the best tools available to reduce silt in the drainwater.

Deep Drains and Deep Reverse Grade Drains

Deep Drain Before Irrigation

Deep Drain Blocked While Irrigating

Many fields east of Brawley and Calipatria have very deep drain ditches. Drain water moves from the field into the drains through concrete drop boxes or plastic spills. Some of the deeper versions are designed to flow in the opposite direction of the natural side-fall of the field.

Although this type of field drain is very efficient in removing drain water from the field it can create many problems when trying to satisfy the requirements of the Silt TMDL.

The first point of erosion is where the irrigation water exits the end of the furrow, or area planted to crop, and travels straight for 20 to 50 feet across the lower end

of the field to the drain. The sill boards in the concrete drain box should be adjusted while the field is being irrigated so the water can tell the irrigator what the proper level is. Ideally, when adjusted correctly, the water should be backed up to where the water exits the furrow or planted crop. Care must be taken that the crop is not submerged and that water will not stand when the field is finished irrigating.

In many cases this 20 to 50 foot strip of land between the end of the furrows and the drain is bare of any growth. In some situations planting this bare area with a grass will greatly reduce soil erosion. Any grass that is planted should be mowed and baled before it is allowed to go to seed. Rye grass, wheat, or oats would be good choices for planting on the end of sugar beet or alfalfa fields and the baled grass would make excellent feed for horses or calves. The grass should not be allowed to become too rank or it may back the water up into the field. On sandier fields bermuda grass may start growing naturally at the lower end of the fields.

The second point of erosion is where the water dumps into the drain ditch and begins flowing towards the final drain box that empties the field drain ditch into the Imperial Irrigation District's drain ditch.

In some cases plastic sheeting is used as a spillway to dump water from the field into the drain. This usually causes heavy erosion because the water picks up speed as it travels across the plastics sheeting. A layer of fiber mat material over the plastic sheeting may slow down the water enough to stop the erosion if the differences in elevations are not too great.

Where concrete drain boxes are used to dump water from the field level to the drain ditch level, erosion occurs as the water exits the concrete pipe and drops a distance into the drain ditch causing large, round washes. If control structures were installed in the deep drains at the proper intervals, determined by the side fall of the field, it would allow the drains to remain full of water during irrigation. The pipes from the drop boxes would then be submerged by the water, which should help reduce turbulence and erosion. Each control structure including the final drain box would need a self starting siphon to slowly drain the drain ditch over a 24 hour period after the irrigation was completed.
It's important that the final drain box, which dumps into the district drain, is adjusted to the correct level. Many of the deep drains are far deeper than they need to be and have become even deeper over the years. With the sill board set correctly, and water left to stand in the drains for a few days after each irrigation, the drains may slowly fill up with silt to the proper levels.

Self-Starting Siphon in Installed In Grade Board

Self-Starting Siphon Installed In Drain Box

Drain Water Ditch Checks

Drain water ditch checks are small temporary or permanent dams placed in a ditch to control the flow.

When the side-fall of a field is too steep to allow drain water to run slowly, drain water ditch checks can be added to back up the water, slow it down, and reduce erosion.

These small dams can be made from concrete, plastic covered earth, metal, wood, or whatever works the best for the grower.

New, labor saving products, woven from straw and other fibers, are being produced in the Imperial Valley by Greenfix America for erosion control in highway construction and landscaping. The company's fiber logs work very well as drain water ditch checks and can be installed very quickly by staking them to the contour of the drain ditch. Just as a "speed bump" in a shopping center slows the traffic, so do these logs slow the water in a drain ditch.

Lined Spillways to Drain Water Into Drain Ditches

Small spillways, usually made from plastic sheeting are then used where the water drops from the small V-ditch down to the lower level of the main drain ditch. Lining the spillway with slick plastic sheeting only speeds up the water and means even more erosion may occur when the water hits the bottom of the drain ditch.

Instead of plastic sheeting, if the spillway is lined with woven fiber mat, like produced by Greenfix America, the water velocity is reduced by the coarse texture of the woven fiber mat and much less erosion occurs.

Maintaining the Proper Grade

While doing the groundwork for a new crop, growers should check the levels on the tail end of their fields. Many times low spots develop, particularly close to the drain box, and a slight touch-up with a laser land leveler plus resetting the height of the sill board on the drain box will do wonders to reduce the amount of erosion that occurs in the new crop.

Draining Water Across the End of a Field (No Drain Ditch)

If the borders are eliminated on the last 50 feet or so of the field, and the crop is maintained to the end of the field, the drain water from the upper lands can be used to irrigate the crop at the ends of the adjacent lower lands.

The growing crop acts as a barrier to slow down the velocity of the water and crystal clear water is usually the end result when this method of drainage is used.

This method will not work if there is too much side slope on the field or where water standing in the lower portion of the field for too long a period may harm the crop or rise too high in the furrows and submerge the plants.

Filter Strips

The bed that crops are planted on must end before they reach the end of the field so cultivation and harvesting equipment can turn. In addition, the lower ends of hay fields, irrigated with borders, may die out from heavy traffic and compaction caused by the harvesting equipment.

This is where a filter strip works well, with or without a drain ditch, to reduce the velocity of the drain water. On sandy fields, different types of grasses will automatically replace the alfalfa on the lower ends of fields and act as a filter strip.

For crops planted on beds, natural occurring grassy weeds or light plantings of grasses such as wheat or rye grass will create a very good buffer to reduce the velocity of the drain water. Care should be taken to select the proper plant to use for the filter strip so that it does not become a weed that is difficult to control in the crop being grown.

For hay crops, the planted filter strips should be harvested separately so as not to contaminate the quality of the crop being grown. Even in hot weather when rye or wheat filter strips die out, the roots left in the soil will help prevent erosion until the process can be repeated in the fall.

Sprinkler Irrigation, Drip Irrigation, and Level Basin Irrigation

High amounts of erosion usually occur during the first irrigation when a new crop is being germinated on recently worked soil.

When a moveable sprinkler irrigation system is used to germinate the crop no drainwater is produced. A level basin irrigation system as well as a drip irrigation system also produces no drain water and growers need to understand that these can be considered as the ultimate BMP.

Planting In The Mulch

Planting a crop such as wheat in the mulch is an excellent BMP. The Imperial Irrigation District does not allow any drain water to leave the field during the mulching irrigation. After the soil is mulched the seed is planted below the mulch and into the mud where it germinates without further irrigation. By the time the first irrigation is needed the plant will have grown to almost a foot high with a well-developed root system which reduces erosion. In addition the solid stand of the crop will act like a filter strip to slow down the water and reduce soil movement.

Pump-back Systems

Pump-back systems, which return drain water back to the irrigation ditch, will reduce the amount of silt leaving the field because a portion of the water is being recycled and used over. This too, can be listed as a very useful BMP but it comes with an added expense of labor and fuel required to pump the water back to the irrigation ditch.

Polyacrylamides (PAMs)

Polyacrylamides, or PAMs for short, are group of polymer compounds, relatively new to farming, that show great promise in reducing silt during irrigation where no other method is effective.

The material works by either keeping the silt particles from becoming suspended in the drain water or allow suspended silt particles to settle out rapidly when applied to drainwater.

PAMs can be mixed with the irrigation water or sprayed on the drain water as it leaves the field. The estimated cost of using the material is between $2 and $6 per acre for each irrigation.
PAMs should be considered for higher value crops on very steep ground where the drainwater exiting the furrows is already too muddy.

For more information about the use of PAMs, and the availability of the material in the Imperial Valley, growers can contact the Imperial County Farm Bureau's Voluntary TMDL Compliance Program Director or Farm Consultant for more information.

Gopher Ditch

Unique to this area, a gopher ditch keeps a gopher from burrowing out of the field and directly into a deep drain thus stopping washouts and a tremendous loss of soil. Many times a deep drain or even the Alamo or New River may run next to a field with only a road separating the two. If a gopher burrows out of the field, under the road, and into the deep drain, irrigation water may cause terrible washouts. By digging a deep V-ditch along the edge of the field an extra barrier is created to keep the water contained should the gopher burrow out of the field. Instead of the burrow exiting in the deep drain or one of the rivers it comes out in the gopher ditch which allows the irrigator to see the washout, contain it in the gopher ditch, and repair it before serious damage is done. Care must be taken to keep the gopher ditch as weed free as possible or the weeds may attract gophers as a food source.

Fine Tuning

Already growers are inventing new ways to reduce the amount of silt that leaves a field. One grower has successfully used small lines of planted wheat across the bottom of a pan ditch as well as in front of a drop box to slow down the water leaving the field. With a positive attitude and innovative thinking, just about anything is possible.

The BMPs listed above are only a small portion of what can be used to reduce the amount of silt leaving the fields. Whatever a grower can think of that works for that particular field, can also be considered a BMP whether or not its use is recognized.

The Last Guy on the Totem Pole

Even if all of the key BMP's are implemented, the success of whether or not there is a reduction of silt during an irrigation will depend on the last guy on the totem pole and the one that gets paid the least….**the IRRIGATOR**.

The grower should use every possible means to re-educated the irrigator so that he understands what is trying to be accomplished and that he has the grower's backing to accomplish the task. A TMDL Training Video, in Spanish with English subtitles, is available from the Farm Bureau to help explain why TMDLs are necessary and what the irrigator can do to make the program a success.

APPENDIX

Imperial County Farm Bureau Voluntary TMDL Compliance Program

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Web Site

www.ivtmdl.com

A new web site has been developed to help growers more easily comply with the Silt TMDL. After registering on the website, growers can easily input all the information about their fields in a secure mode. That information will then automatically be uploaded to the main database of the Imperial County Farm Bureau's Voluntary TMDL Compliance Program and ultimately transferred to the Regional Water Quality Control Board.

This should save countless hours of time for both the grower and the staff of the Imperial County Farm Bureau Voluntary TMDL Compliance Program.

The new website will also have current information about the TMDL process, information on BMPs, and many other kinds of information to keep growers appraised of what is happening with the TMDL.

List of Suppliers

Concrete Drain Boxes

Ryerson Concrete Products
802 East Main Street
El Centro, CA 92243
(760) 352-4341

Plastic Drain Boxes

Elms Equipment Rentals, Inc.
1676 Main Street
Brawley, CA 92227
(760) 344-3780

Fiber Mats and Fiber Logs

Greenfix America
6547 Lyerly Rd.
Calipatria, CA 92233
(760) 348-7600

Drainbox Installation and Repair

Clayton's Drain Tile Maintenance
1619 River Drive
Brawley, CA 92227
(760) 344-2183

Elms Equipment Rentals, Inc.
1644 E. Jones Road
Brawley, CA 92227
(760) 351-1911

Tile Maintenance Company
5300 Kalin Road
Brawley, CA 92227
(760) 344-2550