NATURAL RESOURCES CONSERVATION SERVICE
MONTANA CONSERVATION PRACTICE STANDARD

IRRIGATION WATER MANAGEMENT (ACRE)

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, **tribal,** 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.

NOTE: This type of font **(AaBbCcDdEe 123..)** indicates NRCS National Standards.
This type of font (AaBbCcDdEe 123..) indicates Montana Supplement.

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 **consumptive use,** available water-holding capacity of the soil for the crop rooting depth, management allowed soil water depletion, irrigation efficiency and water table contribution **and any soil and chemical limitations**.

- 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 **periods. Crop growth periods can be found in National Engineering Handbook (NEH), Part 652, Irrigation Guide, Pages 3-2 and 3-5.**

When water supplies are estimated to be insufficient to meet even the critical crop growth **period**, 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. **Furrow erosion shall be minimized by proven alternatives such as, but not limited to; application of Polyacrylamide (PAM), mulching, minimum till, no-till, land shaping, or flow reductions.**

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 **(runoff)** and that minimize transport of nutrients and chemicals to groundwater **(deep percolation).**

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, **tribal,** 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. **This can be accomplished by any properly designed sprinkler system where the soil condition at or near the surface is kept in a moist (not dry) state at least 20% of the time.**

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.

The use of the USDA-NRCS Energy Estimator Energy Consumption Awareness Tool can be used for documenting reduction of energy http://ipat.sc.egov.usda.gov/.

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.
- **Long-term evaluation of economic costs for construction and energy usage should be made when comparing alternatives.**
- 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 **and across property lines.**
- 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.
- **Consider testing for Electrical Conductivity (EC) and Sodium Adsorption Rate (SAR) where water is suspected of high salt content. Refer to NEH, Part 652, Chapter 13.**
- 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.
- **Consider timing of irrigation with respect to precipitation events and expected runoff. When irrigated area includes a Vegetated Treatment Area (VTA) for wastewater. VTA should not be irrigated during a wet cycle or predicted storm event.**

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