USDA
NATURAL RESOURCES
CONSERVATION SERVICE

DELAWARE CONSERVATION
PRACTICE STANDARD

IRRIGATION WATER MANAGEMENT

CODE 449
(Reported by Acres)

DEFINITION

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

PURPOSES

This practice may be applied for one or more of the following purposes:

1. To manage soil moisture to promote desired crop response.
2. To optimize use of available water supplies.
3. To minimize irrigation induced soil erosion.
4. To decrease non-point source pollution of surface and groundwater resources.
5. To manage salts in the crop root zone.
6. To manage air, soil, or plant micro-climate.
7. To properly and safely manage chemigation or fertigation.
8. To improve air quality by managing soil moisture to reduce particulate matter movement.

CONDITIONS WHERE PRACTICE APPLIES

1. This practice is applicable to all irrigated lands.
2. An irrigation system adapted for site conditions must be available and capable of efficiently applying water to meet the intended purpose(s).

CONSIDERATIONS

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

1. Managing precipitation effectiveness, crop residues, and reducing system losses.
2. Potential for spray drift and odors when applying agricultural 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. This standard does not cover the application of municipal waste.
3. Potential for overspray from end guns onto public roads.
4. 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.
5. The quality of irrigation water and the potential impact to crop quality and plant development, and the potential effect on the soil's physical and chemical properties, such as soil crusting, pH, permeability, salinity, and structure.
6. Avoid traffic on wet soils to minimize soil compaction.
7. The effects that irrigation water has on wetlands, water related wildlife habitats, riparian areas, cultural resources, and

recreation opportunities.

8. Management of nutrients and pesticides.

9. Schedule salt leaching events to coincide with low residual soil nutrients and pesticides.

10. Electrical load control/interruptible power schedules, repair and maintenance downtime, and harvest downtime.

CRITERIA

Criteria Applicable to All Purposes

Irrigation water shall be applied in accordance with federal, state, and local 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. A pressure gauge shall be installed on the system in accordance with the manufacturer's recommendations.

System manufacturers must provide irrigation system's operation and maintenance requirements to assure efficient operation.

Applications of irrigation water shall be based on completing a NRCS approved plant irrigation water scheduler checkbook, spreadsheet or output from a computer irrigation scheduler software that details the status of available plant water and the management allowable depletion (MAD) that will trigger an irrigation event. This scheduler utilizes soil moisture readings taken by mechanical or electrical soil moisture monitoring devices, recording evapo-transpiration (ET) rates, irrigation, and or rainfall additions.

Irrigation water rates and amounts required for each irrigation event shall be determined to adequately replenish the root zone without exceeding the soil's water holding capacity. Plant available water will be determined by an on-site evaluation of soil textures in the soil profile and managed for profile depth not to exceed 18 inches. (See Table 1) Management allowed depletion will not exceed 50% of plant available water without measures to mitigate plant stress.

Table 1: Available Water Capacity by Soil Texture

Textural Class	Available Water Capacity	
	Inches/Inches of Depth in Profile	Inches/Foot of Depth in Profile
Coarse Sand	0.021 - 0.0625	0.25 - 0.75
Fine Sand	0.063 - 0.083	0.75 - 1.00
Loamy Sand	0.092 - 0.1	1.10 - 1.20
Sandy Loam	0.104 - 0.117	1.25 - 1.40
Fine Sandy Loam	0.125 - 0.167	1.5 - 2.0
Silt Loam	0.167 - 0.208	2.00 - 2.50
Silty Clay Loam	0.15 - 0.167	1.80 - 2.00
Silty Clay	0.125 - 0.142	1.50 - 1.70
Clay	0.1 - 0.125	1.20 - 1.5

The decision to irrigate must be based on completing NRCS approved daily water budget spreadsheet or water management software and referencing the mechanical or electrical soil moisture monitoring devices used to monitor soil moisture depletion.

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.

Water applications should be at rates that do not exceed the tolerable soil loss value (T), which shall be determined using the current approved erosion prediction technology.

Irrigation Skills and Capabilities. The decision-maker must possess the following 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.

1. How to determine when and the amount of irrigation water that 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 recognize and control runoff and erosion caused by irrigation;

3. 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;

4. The irrigation system operator should be aware of and consider the benefits of surface storage due to crop residue and field slope in situations where sprinkler application rate exceeds soil intake rate or where water supplies are limited;

5. How to identify system problems that reduce uniformity of water application;

6. How to perform system maintenance to assure efficient operation;

7. How to manage salinity and shallow water tables through water management;

8. The capability to control the irrigation delivery;

9. How to manage the operation of the irrigation system considering weather conditions that adversely impact irrigation efficiency and uniformity of application, such as high winds that diminish application uniformity.

An irrigation water management plan shall be developed to assist the decision-maker in the proper management and application of irrigation water.

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.

1. The irrigation system manufacturer will provide a system curve, a system chart or a system table that shows the estimated irrigation depth in inches based on a timer, chart, or table setting. The time required in hours to complete a full rotation or one complete pass over the irrigated field must be provided.

2. The irrigation water management plan will account for management that can positively impact water conservation. (i.e. residue management, planter ridges in fields where slope is a concern, and soil roughness)

3. Monitor and record data from the Delaware Environmental Observing System (DEOS) (http://www.deos.udel.edu/) weather sites and local weather channels for humidity, wind, and temperature forecasts that adversely impact irrigation efficiency and uniformity of application.

Additional Criteria to Optimize Use of Water Supplies

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

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

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 the National Engineering Handbook (NEH), Part 652, chapters 3 and 13.

Additional Criteria for Proper and Safe Chemigation or Fertigation

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

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.

Note: Specific cost-sharing programs or other funding sources may dictate criteria in addition to, or more restrictive than, those specified in this standard.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice. Documentation shall be in accordance with the section "Supporting Data and Documentation" in this standard.

Application of this standard shall include preparation of an irrigation water management plan that specifies the applicable requirements, system operations, and components necessary for applying and maintaining the practice to achieve its intended purpose(s). As appropriate, the plan should include sections on the following:

1. Farm and field information – producer, farm, tract and field/s numbers and boundaries, planned rotation, consultant, and plan date;

2. Objectives of the producer, which includes one of the purposes of the standard;

3. Irrigation system map, showing the reaches of irrigation system and the location of soil moisture monitoring stations;

4. Soils map and soil profile description of dominant soil series;

5. Past irrigation history;

6. Water supply source and well yield if available;

7. Results of soil and irrigation water testing, if available.

8. Provide well permit number and supporting data (drill logs, depth to groundwater, depth of well, location and type of pump, etc.), if available;

9. Identify the type of budget and soil moisture devices that will be utilized;

10. When available, the system design will be referenced in the irrigation water management report and will include information on the system design pressure, flow quantity (in gallons per minute), and a system curve. When the system is new or has been re-tipped, the tip or nozzle specification chart shall be provided in an appendix to the IWM report.

11. If applicable a statement that irrigation system uniformity was determined by the University of Delaware, Cooperative Extension, and a report given to NRCS.

OPERATION AND MAINTENANCE

The producer/client is responsible for the operation and maintenance of the practice. Operation and maintenance activities address the following:

1. Evaluating available field soil moisture;

2. Changes in crop evaportranspiration rates and soil intake rates and adjusting the volume, application rate, or frequency of water application to achieve the intended purpose(s);

3. Perform system operation and management as addressed in the system's manual.

Recordkeeping

Participating producer must maintain records to allow the certifying individual to document plan implementation. As applicable, records include:

All systems

1. Show pumping capacity and water quantity determination on all systems.

2. Statement of how the system flow rate was determined.

3. Records to show how system uniformity of application was measured, if applicable.

4. Provide a written statement annually detailing the findings of a visual inspection performed during operation, to determine that components are properly functioning, including but not limited to pressure gages, flow meter, and backflow preventer.

5. Documentation on how the plant available water determination was made based on soil profile information and crop rooting depth.

6. Written documentation of a Daily Irrigation Balance Sheet this includes a report of the plant available water status, including all rainfall and irrigation amounts. Show documentation of M.A.D. for crop grown when determining irrigation events.

7. Each irrigation event must reference the mechanical or electrical soil moisture monitoring devices and measurements or readings used to monitor moisture depletion. Other methods to consider as supportive, but not required are qualitative measurements that include soil method and visual plant signs of incipient wilting used to evaluate soil moisture.

8. Visual inspection statement.

SUPPORTING DATA AND DOCUMENTATION

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Location of the practice on the conservation map.

2. Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom.

3. A copy of the signed irrigation water management plan.

REFERENCES

1. USDA, Natural Resources Conservation Service, National Engineering Handbook (NEH), Part 650 Engineering Field Handbook, Chapter 15, “Irrigation”.

2. USDA, Natural Resources Conservation Service, National Engineering Handbook (NEH), Part 652, Irrigation Guide.