Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

IRRIGATION WATER MANAGEMENT

CODE 449

(ac)

DEFINITION

The process of determining and controlling the volume, frequency, and application rate of irrigation water.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve irrigation water use efficiency
- Minimize irrigation-induced soil erosion
- Protect surface and ground water quality
- Manage salts in the crop root zone
- Manage air, soil, or plant microclimate
- Improve poor plant productivity and health
- Reduce energy use

CONDITIONS WHERE PRACTICE APPLIES

This practice is applicable to all currently irrigated lands.

CRITERIA

General Criteria Applicable to All Purposes

Develop an irrigation water management (IWM) plan that defines when irrigation is needed (timing) and the amount and rate of water to apply for each irrigation event.

Base the timing of irrigation on one or more of the following methods:

- Evapotranspiration of the crop, using appropriate crop coefficients and reference evapotranspiration data,
- Soil moisture monitoring,
- Computerized irrigation scheduling, utilizing local real-time climate data, soil, and crop growth characteristics (e.g., remote telemetry data systems coupled with cloud-based irrigation scheduling using the soil-water balance method),
- Plant monitoring (e.g., leaf water potential or leaf/canopy temperature measurements).

Base the volume (depth) of water needed for each irrigation event on the following that are relevant to a crop or field:

- Available water-holding capacity of the soil for the crop rooting depth,
- Management allowed soil water depletion,

- Current soil moisture status,
- Current crop/forage growth stage,
- Distribution uniformity of the irrigation event,
- Water table contribution,
- Computerized irrigation scheduling recommendation.

For variable rate irrigation systems, such as center pivots, in addition, base the amount and application rate of irrigation water on spatially identified field parameters such as variations in past yield data, soils, crop growth, topography, or computerized irrigation scheduling recommendations.

When irrigation water is not available on demand, such as when it is provided by an irrigation district, use the planned availability as a factor to determine the timing of the irrigation event. Adjust irrigation amounts appropriately to account for the periodic availability of water. In all situations where water is limited, ensure that the IWM plan will meet critical crop growth stages.

In locations where rain is expected during the growing season, and where a soil-water balance is calculated, include measurements from an onsite rain gauge, interpolated predictions based on local weather stations, rain gauges, or other accurate method for determining local rainfall for the area under irrigation.

For surface irrigation, apply irrigation water at a rate that achieves an acceptable distribution uniformity and minimizes irrigation-induced erosion.

Additional Criteria for the Protection of Surface and Ground Water Quality

Plan the rate and volume of irrigation water to minimize the transport of sediment, nutrients, and chemicals to surface waters and ground water by—

- Controlling the rate of water application to limit the transport of nutrients and chemicals through the soil profile to ground water.
- Ensuring that the volume and rate of application does not result in damaging irrigation-induced erosion and/or contaminated runoff and offsite transport.

Where the topography is steep enough to cause erosive flow velocities, provide permanent soil cover, increased crop residue, and/or use polyacrylamide according to NRCS Conservation Practice Standard (CPS) Anionic Polyacrylamide (PAM) Application (Code 450) in lieu of or in combination with structural measures to control erosion.

Do not conduct fertigation or chemigation operations if rainfall that may produce runoff or deep percolation is expected. Limit the application rate and volume of water to the amount necessary to apply the chemicals or nutrients to the soil depth recommended by the manufacturer. Limit the application of chemicals or nutrients to the minimum length of time required to deliver and flush the pipelines. Ensure that the irrigation and water delivery systems are equipped with properly designed and functioning valves and other components necessary to prevent backflows of nutrients or pesticides into the water sources. Base the timing and application of nutrients and/or pesticides on the criteria in NRCS CPS Nutrient Management (Code 590) and Pest Management Conservation System (Code 595), respectively.

Additional Criteria for Managing Salts in the Crop Root Zone

Ensure the irrigation application volume is sufficient to provide an appropriate salt balance in the soil profile. Base the determination of the required water volume on the leaching procedure contained in NRCS National Engineering Handbook (NEH) (Title 210), Part 623, Chapter 2, “Irrigation Water Requirements,” and 210-NEH, Part 652, “Irrigation Guide,” Chapters 3 and 13.

Additional Criteria for Managing Air, Soil, or Plant Microclimate

To provide protection from heat or cold, ensure that the irrigation system can apply the required rate of water as determined by the methodology contained in 210-NEH-623-2.

Additional Criteria for Reduced Energy Use

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

Calculate the reduction of energy use as the average annual or seasonal energy reduction compared to previous operating conditions.

CONSIDERATIONS

Consider the following when planning irrigation water management:

- Increased crop residue left on the field will reduce the potential for irrigation-induced erosion, increase the infiltration of water into the soil, and reduce evaporation from the soil surface.
- There is a potential for spray drift and odors when applying agricultural and municipal waste waters. Time irrigation based on prevailing winds to reduce this potential. In areas of high visibility, consider irrigating at night.
- The development of detailed topographic soil maps and the identification of environmentally sensitive areas can help with the development of site-specific irrigation plans that better meet crop needs while minimizing adverse environmental impacts.
- Plan the location of end guns so that overspray will not reach public roads or other unintended locations.
- Periodic inspection of irrigated areas for the presence of pesticides, animal wastes, or other contaminants prior to irrigation can allow these problems to be addressed before they cause a water quality problem.
- The quality of irrigation water can adversely affect crops and soils. Testing and assessment of irrigation water can help to address adverse impacts of the water on crop quality, plant development, and soil properties such as crusting, pH, permeability, salinity, and structure.
- Avoid operating heavy equipment on wet soils to minimize soil compaction.
- To reduce the potential for ground water contamination, schedule salt leaching events to coincide with low levels of residual soil nutrients and pesticides.
- Manage water so it does not drift or come in direct contact with surrounding electrical lines, supplies, devices, controls, or components that could cause loss of electrical power or the creation of an electrical safety hazard to humans or animals.
- Consider how the interruption of power to irrigation systems from load control, interruptible power schedules, repair and maintenance downtime, and harvest downtime may change the plans for irrigation water management.
- The use of new technologies for data collection such as drones, advanced imaging technology, remote sensing technology, yield monitoring, and data logging to calculate water use can lead to more efficient water application.
- The use of energy saving technologies, such as low energy precision application irrigation and use of alternative energy sources can result in significant energy saving versus conventional methods.
- Crop species selection in situations where drought or water deficits are recurrent.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to the requirements of this standard. As a minimum, include in the plans and specifications—

- A plan view showing the layout of the irrigation system including irrigated areas, planned crops, soils, pipelines, and location and installation information for any moisture sensors, rainfall gauges, or other sensing equipment.

- Methods to be used to measure or determine the flow rate and volume of the irrigation applications.
- Documentation of the scientific method used for scheduling the timing and amount of irrigation applications.
- The seasonal or annual planned water application volumes by crop.
- The management allowable depletion and depth of the managed crop root zone for each crop.
- An estimate of the irrigation system distribution uniformity, based on testing, evaluation, or observation.
- The specific soil moisture monitoring objectives if soil moisture sensors are used. Indicate how data from the soil moisture sensor locations and depths will be considered to make field-wide irrigation decisions.
- Information on how to recognize irrigation-induced erosion and how to mitigate it.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance (O&M) plan for the operator. As a minimum, include in the O&M plan:

- Record keeping documents to be used by the operator to record irrigation water management activities.
- Requirements for recording each irrigation event, including the amount or depth of water applied, duration of the event, and the date of application.
- Requirements for recording the methods used for determining the timing and amount of irrigation events.
- Requirements for recording other pertinent data used to implement the irrigation water management plan.
- Reference other O&M plans for the irrigation equipment and water delivery systems used.

REFERENCES

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