Delaware Nutrient Management Program

DELAWARE CONSERVATION PRACTICE STANDARD

# IRRIGATION

(Reported as inches of water per acre applied)

## DEFINITION

Irrigation is the practice of applying water to the soil to meet crop water demand. Irrigation can also be used as a way of recycling or reusing treated effluent from municipalities, processing facilities and animal production operations.

## PURPOSES

This standard provides guidance for all businesses engaged in or providing services for the application of supplemental water to irrigate agricultural crops. Irrigating crops allows growers to:

1. Achieve consistent, high yields by fully meeting crop water demand during the growing season, especially when rainfall and soil moisture levels are not sufficient to meet crop needs.
2. Better utilize nutrients from fertilizers and animal wastes by insuring crop yield goals (and therefore nutrient removal amounts) have been achieved.
3. Enhance grain marketing opportunities and farm profits by producing consistent crop yields thus allowing lower risk contracting, and the contracting of a greater percentage of the expected yield.
4. Establish new plantings by promoting germination and early crop growth.

## CONDITIONS WHERE PRACTICE APPLIES

This practice applies to production areas that are well suited for irrigation including well drain soils with an adequate surface water supply from a ditch, pond, or lake, or groundwater supply from one or more wells with a water allocation permit. In general, good water quality – including pH - is required to attain yield goals and to prevent irrigation equipment degradation over time. When using surface waters as the source for irrigating vegetables grown for direct consumption, water quality monitoring needs to include testing for pathogens that can lead to food borne illness, or testing for other water quality indicators like *E. coli.*

## CONSIDERATIONS

This practice applies on lands where soils and topography are suitable for irrigation of crops and an adequate supply of suitable quality water is available to meet crop demand during the growing season. The sprinkler method of water application is suited to most crops, irrigable lands, and climatic conditions where irrigated agriculture is feasible.

Any person or business using irrigation or designing an irrigation system to supplement rainfall to meet crop water needs should consider:

1. the economics of irrigation in terms of the cost of system hardware and installation including wells, pumps and underground distribution lines,

2. the potential environmental impacts with irrigation including potential runoff and leaching of nutrients,

3. the application of fertilizers (fertigation) and pesticides (chemigation) including the timing and metering of these chemicals into the irrigation water supply, and

4. the capacity of a water source throughout the growing season.

When irrigating with processed wastewater, consideration must be given to drift, especially

from overhead sprinkler irrigation systems. Depending on the operating permit issued by Delaware Department of Natural Resources and Environmental Control (DNREC) to the wastewater provider, drift may not be allowed, and special low drift nozzles or other system configurations and hardware to reduce drift may be required. Wind conditions should be considered when timing wastewater applications, not only to mitigate drift but also to limit the impact of odors emanating from the irrigation water.

Nutrients applied when using wastewater cannot not exceed agronomic rates and must be accounted for prior to commercial fertilizer recommendations as determined and reported in a Delaware Department of Agricultural approved Nutrient Management Plan and in an irrigation plan developed to NRCS standards.

This standard does not include criteria for mini- or micro-sprinkler systems, which are covered by NRCS Conservation Practice Standard, Irrigation System, Microirrigation (441). This standard also does not address sub-surface irrigation practices or systems.

## CRITERIA

### General Criteria Applicable to All Purposes

#### *Irrigation System Designing and Configuration of Irrigation Systems*

The criteria for the design of components not addressed in NRCS practice standards shall be consistent with sound engineering principles. Each sprinkler discharge system must be designed as an integral part of an overall plan for conservation land use and treatment within the intended purpose(s) based on the capabilities of the land and the needs of the operator. The selected system shall be based on a site evaluation, expected operating conditions, and verification that soils and topography are suitable for the intended purpose(s).

Depth of Application. Net depth of application shall meet criteria for the intended purpose, not exceeding the available soil water holding capacity and meeting the land user's management plan for the intended purpose.

Capacity. The sprinkler irrigation system shall be designed with adequate capacity to accomplish the primary purpose(s) of the system.

Design Application Rate. Rates shall be selected such that runoff, translocation, and unplanned deep percolation are minimized. Additional conservation measures, such as furrow diking, dammer diking, in-furrow chiseling, and conservation tillage or residue management shall be applied as needed and appropriate.

Distribution Patterns, Nozzle Spacing and Height. A combination of sprinkler spacing, nozzle size, and operating pressure determines the design application rate and distribution parameters that need to be selected. Coefficient of Uniformity (CU) data or Distribution Uniformity (DU) shall be used in selecting sprinkler spacing, nozzle size, and operating pressure. Definitions of each of these uniformity values can be found in the NRCS National Engineering Handbook, Part 652, and Irrigation Guide.

Distribution Lines. The design of main lines, submains, and supply lines shall insure that required water quantities can be conveyed to all operating lateral lines at required pressures. For detailed criteria, see NRCS Conservation Practice Standard, Irrigation Pipeline (430).

Pump and Power Unit. Where required, pump and power units shall be adequate to efficiently operate the sprinkler system at design capacity and total dynamic head. For detailed criteria, see NRCS Conservation Practice Standard, Pumping Plant (533).

Management Plan. An Irrigation Water Management Plan, meeting NRCS Conservation Practice Standard, Irrigation Water Management (449), shall be developed for this practice, unless the purpose of the practice is wastewater application. Where implemented for waste

application, as a component of a Comprehensive Nutrient Management Plan (CNMP), a waste utilization plan and/or nutrient management plan shall be developed that meets the requirements of NRCS Conservation Practice Standards, Waste Utilization (633) and Nutrient Management (590), as appropriate.

***Achieving Consistent, High Yields***

In order to achieve yields that consistently maximize profits, the following should be considered (where applicable):

1. Understanding crop water demand and soil characteristics.
2. Determining required system capacity.
3. Selecting a well location or water source location, and the sizing of pumps, power units and piping.
4. Planning the management and maintenance of the system.
5. Timing water application to supplement available soil moisture and rainfall.

***Fully Utilizing Nutrients from Fertilizers, Treated Processing Water, and Animal Wastes***

In order to utilize applied nutrients and nutrients already in the soil in order to maximize profits and minimize environmental impact, the following should be considered (where applicable):

1. Nutrient management planning for irrigated crops.
2. Fertigation and other forms of chemigation.
3. Residue management for irrigated crop production.
4. Applying treated effluent or liquid manures to growing crops.

***Enhancing Grain Marketing Opportunities and Farm Profits***

In order to maximize profits when utilizing irrigation, the following should be considered (where applicable):

i) Yield goals consistent with the soil types and yields in Delaware
ii) Grain marketing strategies that leverage consistent crop yields thus allowing lower risk contracting, and the contracting of a greater percentage of the expected yield.
iii) Grain storage capacity to hold grain crops after harvest, and subsequently sell crops when market prices are high.

## PLANS AND SPECIFICATIONS

Plans and specifications for constructing sprinkler irrigation systems shall be in keeping with this standard and shall describe the requirements for properly installing the practice to achieve its intended purpose.

For center pivot and lateral irrigation systems, specifications should include or address the flow rate per acre (GPM per acre), high verses low pressure systems, sprinkle nozzle options, pumping options, and installation and operating costs (e.g. diesel engines vs electric motors), distribution line sizing to reduce transmission loss (pressure drop), and mitigating drift onto adjacent properties.

## OPERATION AND MAINTENANCE

An operation and maintenance plan must provide specific instructions for operating and maintaining an irrigation system to insure that it functions properly. It should also provide information regarding periodic inspections and prompt repair or replacement of damaged components.

All irrigation equipment must be maintained in accordance with manufacturer's recommendations, and records of maintenance procedures and results will be kept.

Irrigation system operation should be based on sound knowledge of several system characteristics including:

1. Design flow rates and actual system application amounts.
2. Effects of variable pressure on application amounts.
3. Effects of wind on application uniformity and drift.
4. Matching application amounts to soil infiltration characteristics.

An O&M plan, at a minimum, shall include provisions to address the following in-season and annual maintenance and monitoring requirements:

1. Periodic operational checks and removal of debris and sediment, as necessary, from nozzles to assure proper operation;
2. Periodic removal and cleaning of sediment from traps, suction lines and/or storage facilities to maintain design flow capacity and system efficiency;
3. Inspection or testing of all pipeline and pumping plant components including intake (suction) lines from surface water sources, as applicable;
4. Regular testing and/or monitoring of pressures and flow rates to assure proper operation;
5. Periodic checks of all nozzles and spray heads for proper operation and wear, and uniformity of distribution;
6. Routine maintenance of all mechanical components in accordance with the manufacturer's recommendations; and
7. Prior to inspecting or repairing any electrically powered irrigation equipment, the electrical service must be disconnected and stray electrical current mitigated.

## SUPPORTING DATA AND DOCUMENTATION

The following is a list of the minimum data and documentation to be recorded and maintained for each irrigation system:

1. Location of the system on the conservation map along with a record of crops grown;
2. An inspection and maintenance record;
3. Application methodology, and irrigation timing and amounts during the growing season; and
4. Water quality monitoring results, as necessary.

Additional documentation will be required when irrigating with treated wastewater and liquid manures. Refer to permit requirements and Nutrient Management Planning requirements, as appropriate.

## REFERENCES

1. USDA-NRCS, Irrigation Water Management. 2010. NRCS Document No. 449.
2. USDA-NRCS, National Engineering Handbook, Part 623, Chapter 2, Irrigation Water Requirements. 442 – 9 NRCS, NHCP May 2011.
3. USDA-NRCS, National Engineering Handbook, Part 623, Chapter 11, Sprinkler Irrigation.
4. USDA-NRCS Conservation Practice Standard, Pumping Plant (533).
5. Sprinkler Irrigation Systems. 1999. MWPS-30. Midwest Planning Service, Iowa State University.
6. NRCS Standard 590. Nutrient Management. May 2002.
7. Delaware Department of Natural Resources and Environmental Control (DNREC). Regulations Governing the Design, Installation and Operation of On-Site Wastewater Treatment and Disposal Systems. January, 2014.