



Natural Resources Conservation Service
CONSERVATION PRACTICE STANDARD
IRRIGATION LAND LEVELING

CODE 464

(ac)

DEFINITION

Reshape a land surface according to the planned lines and grades for irrigation.

PURPOSE

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

- Facilitate the efficient use of water on irrigated land
- Provide uniform distribution of water on irrigated land

CONDITIONS WHERE PRACTICE APPLIES

This standard applies to leveling land irrigated by surface or subsurface irrigation systems. The leveling is based on a detailed engineering survey, design, and layout. This standard does not apply to NRCS Conservation Practice Standard (CPS) Precision Land Forming (Code 462) or Land Smoothing (Code 466).

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct all land leveling to comply with all Federal, State, Tribal, and local laws and regulations. The landowner is required to obtain all necessary permits prior to construction. The landowner/contractor is responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

Before land is leveled, ensure it is suitable for irrigation and for the proposed methods of water application. Also ensure that soil is deep enough that, after leveling, an adequate usable root zone remains that permits satisfactory crop production with proper conservation measures. Limited areas of shallow soils may be leveled to provide adequate irrigation grades or an improved field alignment. The finished leveling work must not result in exposed areas of highly permeable soil materials that would inhibit proper distribution of water over the field.

Plan all land leveling work as an integral part of an overall farm irrigation system that enhances the conservation of soil and water resources. Also plan the boundaries, elevations, and irrigation direction of individual fields so the requirements of all adjacent areas in the farm unit can be met.

Design

Design grades, slopes, and field configurations using local irrigation guides; NRCS CPS Irrigation System, Surface and Subsurface (Code 443); NRCS National Engineering Handbook (NEH) (Title 210), Part 623, Chapter 4, "Surface Irrigation"; and 210-NEH, Section 15, Chapter 12, "Land Leveling." Final elevations from the leveling work must permit the delivery of required irrigation flows to the highest point on the field

surface. Field elevations must be at least 0.33 feet below the water surface elevation at the point of delivery.

Field grades

If there is more than one method of water application or more than one kind of crop planned, the land must be leveled to meet the requirements of the most restrictive method and crop. Design all leveling work within the slope limits. Slope limits vary depending on water application method, ability to remove excess surface water, and control of erosion caused by rainfall. Reversing grades in the direction of irrigation is not permitted.

Slope for level irrigation methods

For level irrigation methods, the maximum elevation drop in the direction of irrigation will not exceed one-half the design depth of application for a normal irrigation. The difference in elevation across an individual basin or border strip will not exceed 0.1 feet.

Slope for graded irrigation methods

As soil and rainfall-induced erosion rates permit, the maximum slope in the direction of irrigation, for graded irrigation method is—

- Furrows—3 percent.
- Corrugations—8 percent.
- Borders for nonsod-forming crops, such as alfalfa or grain—2 percent.
- Borders for erosion-resistant grass or grass-legume crops or for nonsod-forming crops on sites where water application by the border method will not be required until after good crop stands have been established—4 percent.

In areas that contain soils classified as erosive, the maximum slope is—

- Furrows—0.5 percent.
- Borders with sod-forming grasses—2 percent.
- Other crops—0.5 percent.

Where slopes in the direction of irrigation are more than 0.5 percent, and where leveling designs provide for increasing or decreasing slopes, the following limits apply:

- The change in slope in any 100-foot reach will not exceed one-half the maximum permissible slope change along the length of run. However, short-level sections are permissible at the upper or lower ends of the irrigation runs to facilitate water control or to reduce runoff. The maximum permissible slope change is defined as the difference between the flattest and steepest design slope along the length of the run.

Cross slope

The maximum cross slope for basin or borders will be 0.1 feet per border-strip width. The allowable cross slope for furrows and corrugations depends on the soil stability, furrow size, and rainfall pattern in the area. Cross slopes must be planned such that breakthroughs from both irrigation water and rainfall runoff are held to a minimum.

Slope for subsurface irrigation methods

In areas where subsurface irrigation uses ground water-level controls, shape the field surface to parallel the expected subsurface water elevations. Base the leveling design on the desired depth of soil above the elevation of the ground water.

Surface drainage

Include provisions in the design for removing or controlling excess irrigation and storm water runoff in farm irrigation systems. Provide field elevations and field grade for leveling designs that permit proper functioning of the planned surface drainage system facilities.

CONSIDERATIONS

Account for additional excavation and fill as the result of constructing structures such as ditches, ditch pads, and roadways. Include the appropriate yardage when balancing cuts and fills, and determining borrow requirements.

Consider related structures and measures needed to control irrigation water and storm water runoff. Consider land leveling effects on existing infrastructure including any underground utilities or buried pipe.

When determining or evaluating the length of irrigation runs, consider crop types, method of irrigation, soil-intake rates, field slope, irrigation stream size, deep percolation, and runoff.

Consider the depth of cuts and the resulting available plant rooting depths to saline soils and to shallow water tables.

In areas irrigating with sediment-laden water, consider increasing the required height of the water surface at the point of delivery.

Consider effects on instream flows and aquifers, and the effects to other water uses and users.

Land leveling can alter runoff and affect adjacent wetlands. Consider these impacts when planning leveling projects and ensure all policy and procedures are followed.

PLANS AND SPECIFICATIONS

Develop site-specific plans and specifications for irrigation land leveling and show the requirements for installing the practice to achieve the intended purpose.

As a minimum, include—

- Field boundaries.
- Planned cuts and fills.
- Earthwork volumes.
- Cut/fill ratio.
- Direction of irrigation.
- Design run slope and cross slope.
- Required water surface and location of irrigation water delivery.
- Tailwater return/disposal.
- Appurtenant structures.
- Location of utilities.
- State and local notification requirements.

OPERATION AND MAINTENANCE

Develop a site-specific operation and maintenance (O&M) plan for use by the landowner or operator responsible for the irrigation land leveling practice. Document the required actions in an O&M plan to ensure the practice performs adequately throughout the expected life.

Ensure O&M requirements are included as an identifiable part of the design. Depending on the scope of the project, this may be accomplished in a brief statement in the plans and specifications or as a separate O&M plan.

At a minimum, the O&M plan includes—

- Checking grades after major storm event.
- Periodically removing or grading mounds and depressions.
- Periodic land grading to restore the design gradient.

REFERENCES

USDA NRCS. Field Office Technical Guide (eFOTG), Section IV, Conservation Practice Standard Irrigation System, Surface and Subsurface, 443.

USDA NRCS. 2012. National Engineering Handbook (Title 210), Part 623, Chapter 4, Surface Irrigation. Washington D.C. <https://directives.sc.egov.usda.gov/>

USDA NRCS. 1983. National Engineering Handbook (Title 210), Section 15, Chapter 12, Land Leveling. Washington D.C. <https://directives.sc.egov.usda.gov/>