

## NATURAL RESOURCES CONSERVATION SERVICE

### CONSERVATION PRACTICE STANDARD

## IRRIGATION LAND LEVELING

(acre)

CODE 464

### DEFINITION

Reshaping the surface of land to be irrigated to planned grades.

### PURPOSES

This practice may be applied as part of a resource management system to support one or more of the following:

- Improve uniformity of irrigation water application to fields.
- Permit uniform and efficient application of irrigation water without causing erosion, loss of water quality, or damage to land by waterlogging.
- Reduce on field and down slope ponding, flooding and accumulation of excess water.
- Conserve farm irrigation water.
- Provide for adequate surface drainage.

### CONDITIONS WHERE PRACTICE APPLIES

This practice is used for precision leveling of irrigated land based on detailed engineering survey and layout.

All land to be leveled shall be suitable for irrigation and for the proposed surface irrigation application system.

Water supplies and irrigation deliveries to the area shall be sufficient to make irrigation practical for crops to be grown and the irrigation water application system to be used.

Soils shall be of sufficient depth that when work is done an adequate, usable root zone remains to

permit satisfactory crop production with proper conservation measures.

All leveling work shall be planned as an integral part of an overall farm irrigation system to facilitate the conservation use of soil and water resources. Boundaries, elevations, and direction of irrigation of individual field leveling jobs shall be of such that requirements of all adjacent areas in the farm unit can be met.

### CRITERIA

#### Design

Land leveling design shall be based on a properly designed surface irrigation system. Total water required, net water stored in the plant root zone, field application uniformity, and tailwater runoff must be considered.

Design land leveling grade (slope in the direction of irrigation) shall be based on best field irrigation water application uniformity and net water stored in the plant root zone, compared to alternative grades flatter and steeper than the design grade.

#### Soils

Soils shall be of adequate depth and texture to sustain land leveling operations. Sufficient depth must remain after leveling to provide a desirable root zone condition for growing plants.

After construction soil surface textures shall be uniform across the irrigated area. Limited areas of shallower soils may be leveled to provide adequate irrigation grades or a better field arrangement. Finished leveling work must not result in exposed areas of highly permeable

materials than can inhibit proper distribution of water over the field.

### **Field grades**

If more than one irrigation system or crop is planned, the land must be leveled to meet requirements of the most restrictive irrigation system and crop.

All leveling work must be designed within slope limits required for the irrigation system used.

Reverse grades in the direction of irrigation shall not be permitted.

### **Slope to control erosion caused by rainfall**

Design field grades shall be such that erosion caused by rainfall, and removal of excess surface water, can be controlled within the limits permissible for conservation farming.

### **Slope for level surface irrigation systems**

The maximum fall across the field in the direction of irrigation (length of run) shall not exceed one-half the design depth of application for a normal irrigation.

The difference in elevation across an individual border strip shall not exceed 0.10 ft.

### **Slope for graded surface irrigation systems**

The maximum slope in the direction of irrigation, if rainfall erosion is not a significant problem, shall be as follows:

1. Furrows - 3 percent,
2. Corrugations - 8 percent,
3. Borders for nonsod-forming crops, such as alfalfa or grain - 2 percent,
4. Borders for erosion-resistant grass or grass-legume crops or for nonsod-forming crops on sites where water application using border

strips will not be required after good crop stands have been established - 4 percent.

In humid areas where potential for rainfall erosion is great, the maximum slope for furrows shall be 0.5 percent. Maximum slope for borders shall be 2 percent for sod forming grasses and 0.5 percent for other crops.

Slopes may be uniform in the direction of irrigation or may increase or decrease. On slopes of more than 0.5 percent where leveling designs provide for increasing or decreasing slopes, the maximum grade in an irrigation run shall be no more than twice the minimum. Short, level sections are permissible at the upper or lower ends of irrigation runs to facilitate water control or to reduce runoff.

The maximum cross slope for borders shall be 0.1 ft per border strip width. The allowable cross slope for furrows and corrugations depends on soil stability, size of furrows used, and the rainfall pattern in the area. Cross slopes must be such that "breakthroughs" from both irrigation water and runoff from rainfall are held to a minimum.

### **Slope for subsurface irrigation systems**

In areas where subirrigation is practiced, through ground-water level control, it may be desirable to grade the soil surface to a plane having no slope. Actual slope shall depend upon the ability of subirrigation laterals to uniformly distribute water across the field.

### **Surface drainage**

Farm irrigation systems shall include facilities for removing or controlling excess storm water runoff. Leveling designs must provide field elevations and grades that will permit proper functioning of planned drainage facilities.

### **Maximum field elevation**

Maximum field elevation shall be far enough below the water source to permit delivery of needed irrigating streams onto the field surface.

### **Borrow computations**

Excavation and fill material required for or obtained from ditches, ditch pads, structures and roadways shall be considered part of the overall leveling design. The appropriate yardage shall be included when balancing cuts and fills and determining borrow requirements. An appropriate shrinkage factor (cut vs. fill) shall be considered.

## **CONSIDERATIONS**

### **General**

Proper surface irrigation system design is essential. Limiting runoff can increase deep percolation in all or parts of a field.

Often leveling a smaller area to the optimum grade is more effective than leveling the entire area to a grade limited by available funding. Decisions should be based on leveling operation effects on irrigation water application uniformity across the field and/or water stored in the plant root zone, not cubic yards moved.

### **Water Quantity**

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, evaporation, transpiration, and deep percolation.
2. Potential for a change in plant growth and transpiration because of changes in the volume of soil water.
3. Potential to manage irrigation water through root zone management.

### **Water Quality**

1. Effects on erosion and the movement of sediment, and soluble and sediment- attached substances carried by runoff.
2. Effects of nutrients and pesticides on surface and ground water quality.
3. Effects on the movement of dissolved substances below the root zone or to ground water.

4. Effects of water level control on the salinity of soils, soil water or downstream surface and ground water.
5. Short-term and construction-related effects on the quality of downstream water courses.
6. Potential of uncovering or redistributing toxic material such as saline soil.
7. Effects on the visual quality of downstream water.

## **OPERATION AND MAINTENANCE**

An Operation and Maintenance plan must be prepared for use by the landowner or operator responsible for irrigation land leveling operation and maintenance. The plan should provide specific instructions for operating and maintaining leveled land to help insure proper surface irrigation system performance. Minimum requirements to be addressed in the Operation and Maintenance Plan are:

1. Avoid use of tillage equipment that leaves ridges or depressions that cannot be removed by subsequent tillage operations.
2. Periodically use a planing operation to reestablish the installed field gradient. High efficiency surface irrigation systems on cultivated ground require releveling or "touch up" every growing season. With on-farm laser controlled equipment, releveling every year has been shown to be approximately the same cost as releveling every third or fourth year. Increased irrigation uniformity is a benefit of more frequent re-establishment of planned leveling grades and elevations.
3. Eradicate or otherwise remove all rodents or burrowing animals. Immediately repair any damage caused by their activity.
4. Immediately repair any vandalism, vehicular, or livestock damage.
5. Maintain irrigation system facilities.
6. Maintain good vegetative cover on all slopes and watercourses.

## **PLANS AND SPECIFICATIONS**

Plans and specifications for irrigation land leveling shall be in keeping with this standard and shall

describe requirements for applying the practice to achieve its intended purpose.

## **REFERENCES**

USDA NRCS, Washington Irrigation Guide.

USDA NRCS, Standard Drawings Handbook - Washington.

USDA NRCS, National Engineering Field Handbook for Conservation Practices, Chapters 3 and 15.

USDA NRCS, National Engineering Handbook Series: Part 623 Irrigation and Part 652 Irrigation Guide