

**NATURAL RESOURCES CONSERVATION SERVICE**  
**CONSERVATION PRACTICE STANDARD**  
*(Texas Addendum)*

**TERRACE, LEVEL**  
**(Ft.)**  
**CODE 600B**

*This addendum serves as an integral part to the companion Standard of the National Handbook of Conservation Practices. The contents of this addendum magnify national guidance and implement experience factors important to the installation of this practice under the range of conditions found within Texas. Criteria or guidance contained herein addresses items to be conformed to in addition to satisfying the items of the Standard in the National Handbook of Conservation Practices.*

**CONDITIONS WHERE PRACTICE APPLIES.**

*Level ridge type terraces are recommended in rainfall areas averaging less than 24 inches annually where water conservation is the major concern. Land forming of the terrace interval is also recommended for better moisture conservation and distribution. Ridge type terraces may be used for water spreading on gentle cultivated slopes where soil depth and permeability make the practice applicable.*

**DESIGN CRITERIA.**

**Spacing.** *Design dimensions provided in this addendum are based on spacing determined by the V.I. formula. Spacing based on the RUSLE equation will require an evaluation of site specific conditions for determination of design dimensions.*

*The formula  $V.I. = xs + y$  in the National Terrace Standard should be used to determine terrace spacing. Values of "y" in the formula shall be selected between 2.0 and 3.0 for level terraces. A value of  $y = 2.0$  will normally be selected for general row crop farming with average tillage conditions. A value of  $y = 2.5$  will normally be selected where the land is planted to small grain or other sown crops over 75 percent of the time. The "y" value may be increased or decreased by 0.5 when soil erodibility or tillage systems warrant the change. The average slope above each terrace should be used in determining the percent slope used in the vertical interval formula.*

*When terrace spacings are designed by the RUSLE in lieu of the above spacing formula, the terrace shall be designed and constructed according to criteria found in the Basin Terrace, Texas Addendum. An individual design shall be prepared for each terrace in the system. An engineer must approve terrace designs and spacing based on RUSLE, however, this authority may be delegated in writing to selected field office personnel.*

**RUSLE (Guidance and Definitions)**

*Maximum allowable terrace spacing determined by RUSLE shall not exceed the maximum allowed by the National Standard. The "C" factor used will be based on the planned crop rotation and cropping system for the field to be*

terraced, site specific. Average slope will be used when selecting the “P” factor from the Erosion Handbook. The average horizontal interval above each terrace shall be used when determining a composite “P” factor, which is adjusted for terracing and contouring. Terrace spacing for terrace system design will be based on the Soil Loss Tolerance “T”, for the dominant soil mapping unit in the system.

Allowable erosion rates for terrace system evaluation shall be limited to 125% of “T”, for the dominant soil mapping unit in the system.

Slope length as it relates to RUSLE is the distance from the point of origin of overland flow to the point where the slope decreases enough that deposition begins, or the runoff water enters a well defined channel. A well defined channel cannot be plowed out with normal farming operations. Rills can be removed by normal farming operations.

The top terrace in a system should be spaced not more than one vertical interval below the top of the field, or below a diversion or basin terrace. Where it is necessary to exceed one vertical interval by more than 30 percent in locating the top terrace, or when outside water is entering the system, the terrace, shall be designed to handle the expected runoff safely. Soil depth, depth of cuts required to level the interval or to alter the slope in the interval, and width of farm machinery shall be considered in determining terrace spacing.

**Alignment.** Variations from a level grade should not exceed  $\pm 0.2$  foot. The variation should be undulating so the average grade will approach zero.

When the grade along the designed alignment varies in excess of  $\pm 0.2$  foot from a level grade, modification of the terrace interval with land forming and/or internal blocks, shall be required to accomplish the moisture distribution normally expected of level terraces.

**Capacity.** Storage of the 10-year, 24-hour storm runoff shall be provided at the elevation of internal block or end closure spill locations. In order to prevent a breach of the terrace, internal blocks and end closures shall be a minimum of 0.3 foot lower in elevation than the design terrace height.

Standard ridge type level terraces with full internal blocks and end closures, which impound the 10 -year, 24 hour storm (Sketch 1), should have a design height as shown in Table 1 of this Addendum. Table 1 provides terrace ridge height required to contain from 1.3 to 2.8 inches of storm runoff. Select the required terrace heights from Table 1 using the terrace spacing, land slope and runoff to be impounded.

Standard ridge type level terraces with open end or partial end closures (Sketch 2) should have a design height as shown in Table 1, of this Addendum.

Standard Ridge type level terraces constructed with all the fill from the back side or an outside borrow area (Sketch 3) shall have a design terrace height as shown in Table 2, of this Addendum.

Standard ridge type level terraces constructed from the front side only (Sketch 4) shall have the basin storage capacity (Cu.Ft./Ft.) as shown in Table 3. DIVCALC or other approved method

shall be used with a 1.0 cut/fill ratio, to determine the centerline design height that would obtain the required basin storage capacity (Cu.Ft./Ft.).

**Cross Section** All cultivated terraces shall comply with all the following:

1. Minimum side slope of 6:1,
2. Top width shall be a minimum of 4 feet,
3. Base width shall be 20 feet or greater.

**End Closures and Internal Blocks.**

Full end closures and blocks shall be set 0.3 foot below the design elevation. Any end closure or block lower than a full block shall be considered a partial block. The base width of end closures and internal blocks shall be equal to or greater than the design base width of the terrace ridge.

**Outlets.** An emergency spill area shall be provided for level terraces that impound the 10-year 24-hour rainfall runoff. Emergency spill areas shall convey runoff to the drainage pattern of the field unless easements are obtained.

A perennial grass pasture or a Grassed Waterway (Practice Standard 412) shall be provided as an outlet for systems of level terraces that do not impound the 10-year, 24-hour storm runoff.

If possible, emergency spill areas and waterway outlets should be located in existing natural drains.

A level terrace shall not be designed to spill onto a lower terrace, unless the lower terrace is designed to control the runoff from the total drainage area of both terraces.

The technician shall determine if outlets must be vegetated before terraces are constructed.

**CONSIDERATIONS**

**Water Quantity.** Level terraces and terraces with underground outlets are storage terraces that retain or retard runoff, increase infiltration time, and conserve soil moisture. For storage terraces, soil permeability, underlying geology, and depth to water table are all factors that determine the amount of deep percolation and ground-water recharge.

**Water Quality.** Sediment: Terraces reduce the occurrence of ephemeral and classic gullies on areas down slope of the terrace. Runoff velocity is reduced, so sedimentation occurs in the channel. Terraces can reduce overall sediment yield by 30 to 95 percent. Level storage terraces can reduce sediment yield up to 100 percent, for storm events equal to or less than the design storm.

Underground outlet terraces will trap 85 to 99 percent of the sediment.

**Nutrients:** Underground outlet terraces will trap up to 95 percent of adsorbed chemicals, and generally remove from 30 to 90 percent of the soluble substances from surface runoff. Beneath the storage basins, in more permeable soils, more soluble materials will be leached below the root zone. Storage terraces increase the time available for the downward leaching of soluble substances toward the ground water.

**Pesticides:** the movement of sediment-attached pesticides will be reduced in the same proportion as the reduction of sediment. The amount of soluble

*pesticides lost from the field or below the root zone depends on the time of application, persistence, solubility and how soon there is precipitation after the pesticide is applied.*

*Salinity: Storage terraces increase the potential for recharge that may concentrate and accelerate salinity problems in saline seeps or ground water.*

### **PLANS AND SPECIFICATIONS**

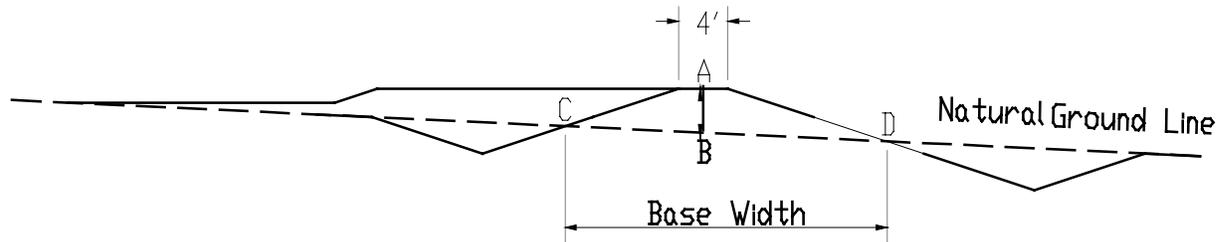
*Construction specifications describing the requirements for applying this practice shall be developed from the generalized Construction Specifications (Texas) for Terrace (Level). The Construction Details section shall be*

*used to describe site specific job requirements.*

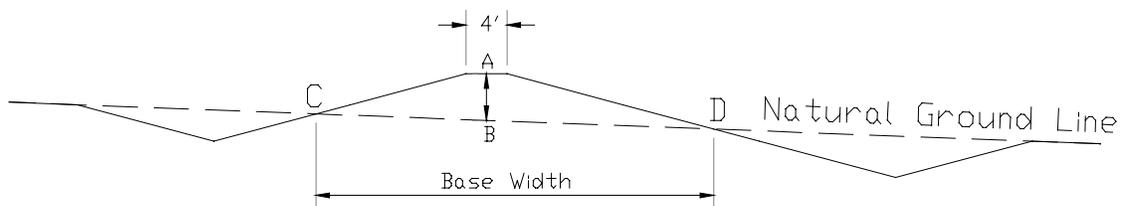
### **OPERATION AND MAINTENANCE**

*When accumulation of sediment significantly reduces the storage capacity or farming operations reduce the height of the ridge or end closures, appropriate maintenance measures should be employed to restore the height and capacity of the basin terrace.*

*Vegetation established to protect the ridge should be maintained by controlling weed or brush growth with appropriate chemical or mechanical means.*

**SKETCHES:***Sketch No. 1 - Standard Ridge Type Terrace With Full End Closure*

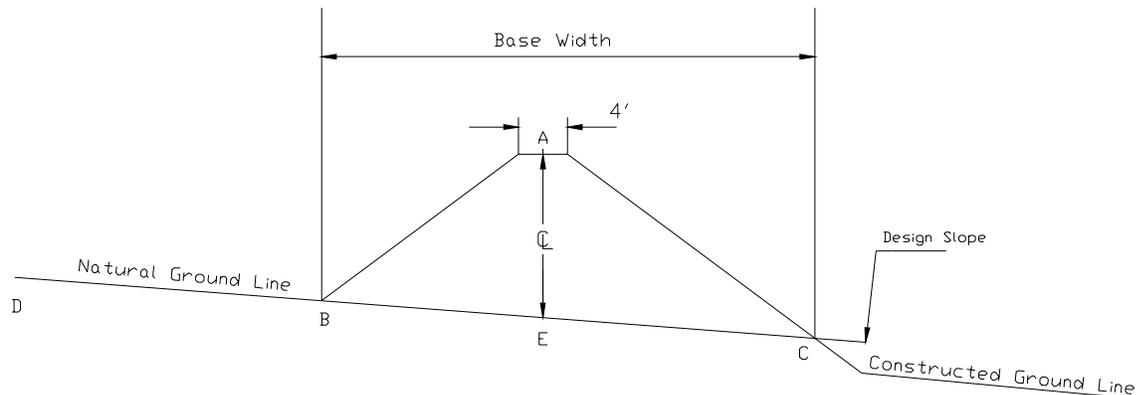
- A = Top of terrace ridge (measurement for height to be made 2 feet from center of terrace).*
- B = Natural ground below center of terrace ridge.*
- C = End of front slope at natural ground.*
- D = End of back slope at natural ground.*
- AB = Design terrace height*
- CD = Base width*

*Sketch No. 2 - Standard Ridge Type Terrace With Open Ends*

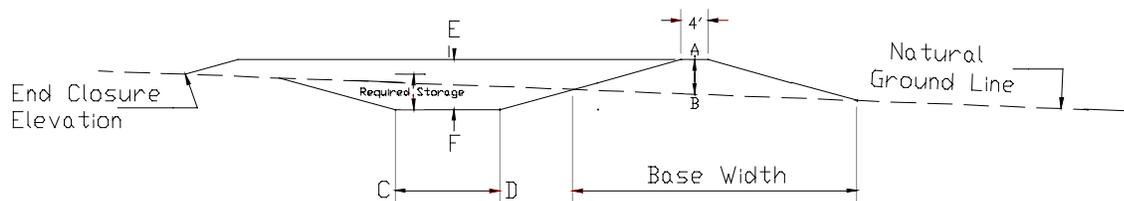
- A = Top of terrace ridge (measurement for height to be made 2 feet from center of terrace).*
- B = Natural ground below center of terrace ridge.*
- C = End of front slope at natural ground.*
- D = End of back slope at natural ground.*
- AB = Design terrace height*
- CD = Base width*

## SKETCHS (cont.):

Sketch No. 3 - Standard Ridge Type Level Terrace Constructed From the Back Side or Outside Borrow Area (end closure not shown)



- A = Top terrace ridge (measurement for height to be made 2 feet from center of terrace).
- B = Intersection of interval slope and terrace front slope - this is based on an evaluation of the check-out profile and cross section.
- C = End of back slope at intersection with projection of design slope (used to determine spacing) from B.
- D = Point upstream of terrace on natural ground
- E = Point under centerline of terrace ridge
- AE = Design Terrace Height
- BC = Base width



Sketch No. 4 - Standard Ridge Type Level Terrace Constructed From Front

- A = Top of terrace ridge (settled).
- B = Natural ground below center of terrace ridge
- CD = Channel Bottom Width. Channel elevation variation shall not exceed  $\pm 0.2'$
- AB = Terrace height
- EF = Height, channel to top of terrace

## TABLES:

**Table 1 - Design Terrace Height (feet) to Impound Runoff (inches) For Standard Ridge Type Terraces**

| Land<br>Slope<br>% | Impounded Runoff (inches) <sup>1/</sup> |     |     |     |     |     |     |     |     |     |     |     |     |     |
|--------------------|---|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                    | 1.3                                     |     | 1.5 |     | 1.8 |     | 2.0 |     | 2.3 |     | 2.5 |     | 2.8 |     |
|                    | Spacing <sup>2/</sup>                   |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                    | A                                       | B   | A   | B   | A   | B   | A   | B   | A   | B   | A   | B   | A   | B   |
| 0.3                | 1.0                                     | 1.1 | 1.0 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 |
| 0.5                | 1.0                                     | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.3 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 |
| 0.7                | 1.0                                     | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 | 1.4 | 1.5 |
| 0.9                | 1.0                                     | 1.1 | 1.1 | 1.2 | 1.2 | 1.3 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 | 1.4 | 1.5 |
| 1.0                | 1.1                                     | 1.1 | 1.1 | 1.2 | 1.2 | 1.3 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 | 1.4 | 1.5 |
| 1.2                | 1.1                                     | 1.1 | 1.1 | 1.2 | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.4 | 1.5 |
| 1.5                | 1.1                                     | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 |
| 2.0                | 1.1                                     | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 1.6 |
| 2.5                | 1.2                                     | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.7 |
| 3.0                | 1.2                                     | 1.3 | 1.3 | 1.3 | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 |
| 3.5                | 1.2                                     | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 |
| 4.0                | 1.3                                     | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 | 1.6 | 1.7 | 1.7 | 1.7 | 1.7 | 1.8 |
| 4.5                | 1.3                                     | 1.4 | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 |
| 5.0                | 1.3                                     | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 | 1.7 | 1.8 | 1.8 | 1.9 |

<sup>1/</sup> Design terrace height based on natural storage at full end closure elevation (See Sketches 1 and 2). This table assumes half the earthfill for the terrace ridge is taken from the front (channel) side of the terrace. Runoff to be impounded shall be obtained from the selected soil cover complex curve number (CN) and the 10-year, 24-hour storm runoff in accordance with Texas Engineering Technical Note No. 210-18-TX-5, Hydrology; or Engineering Field Handbook, Chapter 2, Estimating Runoff and Peak Discharges. Values shown include 0.3 foot of freeboard.

<sup>2/</sup> Terrace spacing "A" in the table is  $V.I. - 0.6 S + 2.0$  and "B" is  $V.I. = 0.6 S + 2.5$ . Horizontal distance for terrace intervals to be measured from terrace ridge to terrace ridge.

**Table 2- Design Terrace Height (feet) to Impound Runoff (inches) For Standard Ridge Type Level Terrace Constructed From the Back Side or Outside Borrow Area**

| Land<br>Slope<br>% | Impounded Runoff (inches) <u>1/</u> |     |     |     |     |     |     |     |     |     |     |     |     |     |
|--------------------|-------------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
|                    | 1.3                                 |     | 1.5 |     | 1.8 |     | 2.0 |     | 2.3 |     | 2.5 |     | 2.8 |     |
|                    | Spacing <u>2/</u>                   |     |     |     |     |     |     |     |     |     |     |     |     |     |
|                    | A                                   | B   | A   | B   | A   | B   | A   | B   | A   | B   | A   | B   | A   | B   |
| 0.3                | 1.0                                 | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.3 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 |
| 0.5                | 1.0                                 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 | 1.4 | 1.5 |
| 0.7                | 1.1                                 | 1.1 | 1.1 | 1.2 | 1.2 | 1.3 | 1.2 | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.4 | 1.5 |
| 0.9                | 1.1                                 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 |
| 1.0                | 1.1                                 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.4 | 1.5 | 1.5 | 1.6 |
| 1.2                | 1.1                                 | 1.2 | 1.2 | 1.3 | 1.3 | 1.4 | 1.3 | 1.4 | 1.4 | 1.5 | 1.4 | 1.5 | 1.5 | 1.6 |
| 1.5                | 1.2                                 | 1.3 | 1.2 | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.7 |
| 2.0                | 1.3                                 | 1.3 | 1.3 | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 | 1.5 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 |
| 2.5                | 1.3                                 | 1.4 | 1.4 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 |
| 3.0                | 1.4                                 | 1.5 | 1.5 | 1.5 | 1.6 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 | 1.9 | 2.0 |
| 3.5                | 1.5                                 | 1.5 | 1.5 | 1.6 | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 | 1.9 | 2.0 | 2.0 | 2.0 |
| 4.0                | 1.5                                 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 | 1.9 | 2.0 | 2.0 | 2.0 | 2.0 | 2.1 |
| 4.5                | 1.6                                 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 | 1.9 | 2.0 | 2.0 | 2.1 | 2.0 | 2.1 | 2.1 | 2.2 |
| 5.0                | 1.7                                 | 1.7 | 1.8 | 1.8 | 1.9 | 2.0 | 2.0 | 2.0 | 2.1 | 2.1 | 2.1 | 2.2 | 2.2 | 2.3 |

1/ Design terrace height based on natural storage at full end closure elevation (See Sketch 3). This table assumes no earthfill is taken from front (channel) side of the terrace. Runoff to be impounded shall be obtained from the selected soil cover complex curve number (CN) and the 10-year, 24-hour storm runoff in accordance with Texas Engineering Technical Note No. 210-18-TX-5, Hydrology; or Engineering Field Handbook, Chapter 2, Estimating Runoff and Peak Discharges. Values shown include 0.3 foot of freeboard.

2/ Terrace spacing "A" in the table is  $V.I. - 0.6 S + 2.0$  and "B" is  $V.I. = 0.6 S + 2.5$ . Horizontal distance for terrace intervals to be measured from terrace ridge to terrace ridge.

**Table 3- Basin Storage Capacity Required (Cu.Ft./Ft.) to Impound Runoff (inches) For Standard Ridge Type Level Terrace Constructed Entirely From Front (Channel) Side**

|                     |  | <b>Impounded Runoff (inches) <u>1/</u></b> |          |            |          |            |          |            |          |            |          |            |          |            |          |
|---------------------|--|--|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|------------|----------|
|                     |  | <b>1.3</b>                                 |          | <b>1.5</b> |          | <b>1.8</b> |          | <b>2.0</b> |          | <b>2.3</b> |          | <b>2.5</b> |          | <b>2.8</b> |          |
| <b>Land Slope %</b> |  | <b>Spacing <u>2/</u></b>                   |          |            |          |            |          |            |          |            |          |            |          |            |          |
|                     |  | <b>A</b>                                   | <b>B</b> | <b>A</b>   | <b>B</b> | <b>A</b>   | <b>B</b> | <b>A</b>   | <b>B</b> | <b>A</b>   | <b>B</b> | <b>A</b>   | <b>B</b> | <b>A</b>   | <b>B</b> |
| 0.3                 |  | 78.7                                       | 96.8     | 90.8       | 111.7    | 109.0      | 134.0    | 121.1      | 148.9    | 139.3      | 171.2    | 151.4      | 186.1    | 169.6      | 208.4    |
| 0.5                 |  | 49.8                                       | 60.7     | 57.5       | 70.0     | 69.0       | 84.0     | 76.7       | 93.3     | 88.2       | 107.3    | 95.8       | 116.7    | 107.3      | 130.7    |
| 0.7                 |  | 37.5                                       | 45.2     | 43.2       | 52.1     | 51.9       | 62.6     | 57.6       | 69.5     | 66.3       | 80.0     | 72.0       | 86.9     | 80.7       | 97.3     |
| 0.9                 |  | 30.6                                       | 36.6     | 35.3       | 42.2     | 42.3       | 50.7     | 47.0       | 56.3     | 54.1       | 64.7     | 58.8       | 70.4     | 65.9       | 78.8     |
| 1.0                 |  | 28.2                                       | 33.6     | 32.5       | 38.8     | 39.0       | 46.5     | 43.3       | 51.7     | 49.8       | 59.4     | 54.2       | 64.6     | 60.7       | 72.3     |
| 1.2                 |  | 24.6                                       | 29.1     | 28.3       | 33.5     | 34.0       | 40.3     | 37.8       | 44.7     | 43.4       | 51.4     | 47.2       | 55.9     | 52.9       | 62.6     |
| 1.5                 |  | 20.9                                       | 24.6     | 24.2       | 28.3     | 29.0       | 34.0     | 32.2       | 37.8     | 37.1       | 43.4     | 40.3       | 47.2     | 45.1       | 52.9     |
| 2.0                 |  | 17.3                                       | 20.0     | 20.0       | 23.1     | 24.0       | 27.8     | 26.7       | 30.8     | 30.7       | 35.5     | 33.3       | 38.5     | 37.3       | 43.2     |
| 2.5                 |  | 15.2                                       | 17.3     | 17.5       | 20.0     | 21.0       | 24.0     | 23.3       | 26.7     | 26.8       | 30.7     | 29.2       | 33.3     | 32.7       | 37.3     |
| 3.0                 |  | 13.7                                       | 15.5     | 15.8       | 17.9     | 19.0       | 21.5     | 21.1       | 23.9     | 24.3       | 27.5     | 26.4       | 29.9     | 29.6       | 33.4     |
| 3.5                 |  | 12.7                                       | 14.2     | 14.6       | 16.4     | 17.6       | 19.7     | 19.5       | 21.9     | 22.5       | 25.2     | 24.4       | 27.4     | 27.3       | 30.7     |
| 4.0                 |  | 11.9                                       | 13.3     | 13.8       | 15.3     | 16.5       | 18.4     | 18.3       | 20.4     | 21.1       | 23.5     | 22.9       | 25.5     | 25.7       | 28.6     |
| 4.5                 |  | 11.3                                       | 12.5     | 13.1       | 14.4     | 15.7       | 17.3     | 17.4       | 19.3     | 20.0       | 22.1     | 21.8       | 24.1     | 24.4       | 27.0     |
| 5.0                 |  | 10.8                                       | 11.9     | 12.5       | 13.8     | 15.0       | 16.5     | 16.7       | 18.3     | 19.2       | 21.1     | 20.8       | 22.9     | 23.3       | 25.7     |

1/ Required Capacity based on excavated plus natural storage at full end closure elevation (See Sketch 4). Runoff to be impounded shall be obtained from the selected soil cover complex curve number (CN) and the 10-year, 24-hour storm runoff in accordance with Texas Engineering Technical Note No. 210-18-TX-5, Hydrology; or Engineering Field Handbook, Chapter 2, Estimating Runoff and Peak Discharges. Values shown do not consider freeboard.

2/ Terrace spacing "A" in the table is  $V.I. - 0.6 S + 2.0$  and "B" is  $V.I. = 0.6 S + 2.5$ . Horizontal distance for terrace intervals to be measured from terrace ridge to terrace ridge.

**APPROVAL AND CERTIFICATION**

**TERRACE (LEVEL)**

(ft.)

**CODE 600B**

**PRACTICE STANDARD APPROVED:**

**/s/ JOHN W. MUELLER**

**State Conservation Engineer**

**06/24/02**

**Date**