# REVISED DRAINAGE COMPUTATIONS

REVISED 11/18/08
{- sheet flow ≤ 100'
- driveway pitch to north}

COMMON DRIVEWAY - 2 LOTS

WELSCH PROPERTY HORSE HILL RD. (ROUTE 145) WESTBROOK, CT

## ☆ CULVERT #1 - STA. 0+55

DRAINAGE AREA = 0.65 acres = A
$T_c$ - say 10 minute minimum.

Reference - 2000 Connecticut D.O.T. Drainage Manual

$i_2$ - 3.6 in/hr
$i_{10}$ - 4.8
$i_{25}$ - 5.5
$i_{50}$ - 6.0
$i_{100}$ - 6.5

$\overline{C}$ → pavement C=0.9 → 0.23 acres (Route 145 + paved apron)
gravel/grass C=0.4 → 0.09 acres (shoulder + driveway embank)
woods C=0.25 → 0.33 acres

$$\overline{C} = \left[\overset{.207}{0.9(.23)} + \overset{.036}{0.4(0.09)} + 0.25(.33)\right] / 0.65 = 0.50$$

CA = 0.325

$Q_2 = \overline{C}\, i_2 A = 1.2$ cfs
$Q_{10} = 1.6$ cfs
$Q_{25} = 1.8$ cfs
$Q_{50} = 2.0$ cfs
$Q_{100} = 2.1$ cfs

## ☆ CULVERT #2 - STA. 2+32

A = 1.60 acres
$T_c$ = 17 minutes (see TR55 worksheet)

$i_2$ = 2.7 in/hr
$i_{10}$ = 3.8
$i_{25}$ = 4.4
$i_{50}$ = 4.9
$i_{100}$ = 5.4

$\overline{C}$ → pavement/roof C=0.9 → 0.11 acres
Lawn C=0.3 → 0.10 acres
Woods C=0.25 → 1.39 acres

$$\overline{C} = \left[0.9(0.11) + 0.3(0.10) + 0.25(1.39)\right] / 1.60 = 0.30$$

CA = 0.480

$Q_2 = \overline{C}\, i_2 A = 1.3$ cfs
$Q_{10} = 1.8$
$Q_{25} = 2.1$
$Q_{50} = 2.4$
$Q_{100} = 2.6$

REVISED DRAINAGE COMPUTATIONS, cont.

REVISED 11/18/2008

## ★ CULVERT #3 - STA. 2+77

A = 2.57 acres
$T_c$ = 24 minutes (see TR55 worksheet)

$i_2$ = 2.3 in/hr
$i_{10}$ = 3.3
$i_{25}$ = 3.8
$i_{50}$ = 4.2
$i_{100}$ = 4.7

$\bar{C}$ →
stone drive C = 0.7 → 0.07 ac.
rooftop C = 0.9 → 0.04 acres
lawn C = 0.3 → 0.16 acres
woods C = 0.25 → 2.3 acres

$\bar{C} = [0.7(.07) + 0.9(.04) + 0.3(.16) + .25(2.3)] / 2.57 = 0.28$

CA = 0.7196

$Q_2$ = 1.7 cfs
$Q_{10}$ = 2.4 cfs
$Q_{25}$ = 2.7
$Q_{50}$ = 3.0
$Q_{100}$ = 3.4

## ★ CULVERT #4 - STA. 6+12

A = 8.99 acres
$T_c$ = 26 minutes (see TR55 worksheet)

$\bar{C}$ → stone drive C = 0.7 → 0.05 acres
woods C = 0.25 → 8.94 acres

$\bar{C} = [.7(.05) + .25(8.94)] / 8.99 = 0.25$

CA = 2.2475

$i_2$ = 2.2 in/hr
$i_{10}$ = 3.1
$i_{25}$ = 3.7
$i_{50}$ = 4.1
$i_{100}$ = 4.5

$Q_2$ = 4.9 cfs
$Q_{10}$ = 7.0 cfs
$Q_{25}$ = 8.3
$Q_{50}$ = 9.2
$Q_{100}$ = 10.1

## ★ CULVERT #5 - STA. 7+62

A = 2.26 acres
$T_c$ = 23 minutes (see TR55 worksheet)

$\bar{C}$ → stone drive C = 0.7 → 0.07 ac.
proposed roof C = 0.9 → 0.03 ac.
proposed lawn C = 0.3 → 0.16 ac
woods C = 0.25 → 2.00 ac

$i_2$ = 2.3 in/hr
$i_{10}$ = 3.4
$i_{25}$ = 3.9
$i_{50}$ = 4.3
$i_{100}$ = 4.8

$Q_2$ = 1.5 cfs
$Q_{10}$ = 2.2
$Q_{25}$ = 2.5
$Q_{50}$ = 2.7
$Q_{100}$ = 3.0

$\bar{C} = [.7(.07) + .9(.03) + .3(.16) + .25(2.0)] / 2.26$

$\bar{C}$ = 0.28

CA = 0.6328

11/18/08

# ADDITIONAL DRAINAGE COMPUTATIONS

WELSCH PROPERTY – HORSE HILL RD (ROUTE 145) WESTBROOK, CT.

PRE-CONSTRUCTION VS. POST-CONSTRUCTION TO SOUTH PROPERTY LINE

## AREA #1

THIS AREA DRAINS TO A CROSS CULVERT IN ROUTE 145 AND DIRECTS RUNOFF TO THE WEST (DOES NOT FLOW TO SOUTHERN PROPERTY LINE)

## AREAS #2 + #3

THESE AREAS JOIN UPSTREAM OF THE SOUTHERN PROPERTY LINE. THE PEAK RATE OF RUNOFF IS EVALUATED AT "DESIGN POINT A" AS SHOWN ON THE DRAINAGE AREA MAP.

A (#2) = 1.60 acres  A (#3) = 2.57 acres

ADDITIONAL DRAINAGE AREA (A) = 0.86 acres  TOTAL A = 5.03 acres

$T_c$ → USE GOVERNING $T_c$ FROM AREA 2 or 3 + ADDITIONAL $T_c$

$T_c$ AREA 2 = 17 min

$T_c$ AREA 3 = 24 min ←

ADDITIONAL $T_c$ (see TR55 worksheet) = 0.6 minutes

TOTAL $T_c$ = 25 minutes (same for pre + post construction)

POST $\bar{C} = \left[0.30\overset{.48}{(1.60)} + 0.28\overset{.7196}{(2.57)} + 0.25(0.86)\right] / 5.03 = \underline{0.28}$  cA = 1.4084

PRE $\bar{C}$ =
- C → 0.9 pavement/roof = $\overset{\#2}{0.07} + \overset{\#3}{0.04}$ = 0.11 ac (not inc. proposed driveway)
- C → 0.3 lawn = 0.10 + 0.16 = 0.26 ac
- C → 0.25 woods = 1.43 + 2.37 = 3.80 + 0.86 additional = 4.66 acres

$\bar{C} = \left[0.9(.11) + .3(.26) + .25(4.66)\right] / 5.03 = \underline{0.27}$  cA = 1.3581

| | PRE-CONST | POST-CONST. |
|---|---|---|
| $i_2$ = 2.2 in/hr | | |
| $i_{10}$ = 3.2 | | |
| $i_{25}$ = 3.7 | $Q_2$ = 3.0 cfs | $Q_2$ = 3.1 cfs |
| $i_{50}$ = 4.2 | $Q_{10}$ = 4.3 | $Q_{10}$ = 4.5 |
| $i_{100}$ = 4.6 | $Q_{25}$ = 5.0 | $Q_{25}$ = 5.2 |
| | $Q_{50}$ = 5.7 | $Q_{50}$ = 5.9 |
| | $Q_{100}$ = 6.2 | $Q_{100}$ = 6.5 |

ADDITIONAL DRAINAGE COMPUTATIONS, cont. 11/18/08

AREAS #4 + #5

THESE AREAS JOIN UPSTREAM OF THE SOUTHERN PROPERTY LINE. THE PEAK RATE OF RUNOFF IS EVALUATED AT DESIGN POINT 'B' AS SHOWN ON THE DRAINAGE AREA MAP.

A(#4) = 8.99 ac. A(#5) = 2.26 ac.
ADDITIONAL DRAINAGE AREA (A) = 3.92 acres
TOTAL A = 15.17 acres

$T_c$ (#4) = 26 min. ←
$T_c$ (#5) = 23 min.

ADDITIONAL $T_c$ (see TR55 worksheet) = 2.2 minutes
TOTAL $T_c$ = 28 minutes (same for pre + post construction)

PRE-CONST. $\overline{C}$ = 0.25 (all woods) PRE cA = 3.7925
POST-CONST. $\overline{C}$ →

woods (c=0.25) = 14.42 ac.
prop. stone drive (c=0.7) = 0.20 ac.
prop. roof (c=0.9) = 0.12 ac.
prop. lawn (c=0.3) = 0.43 ac.

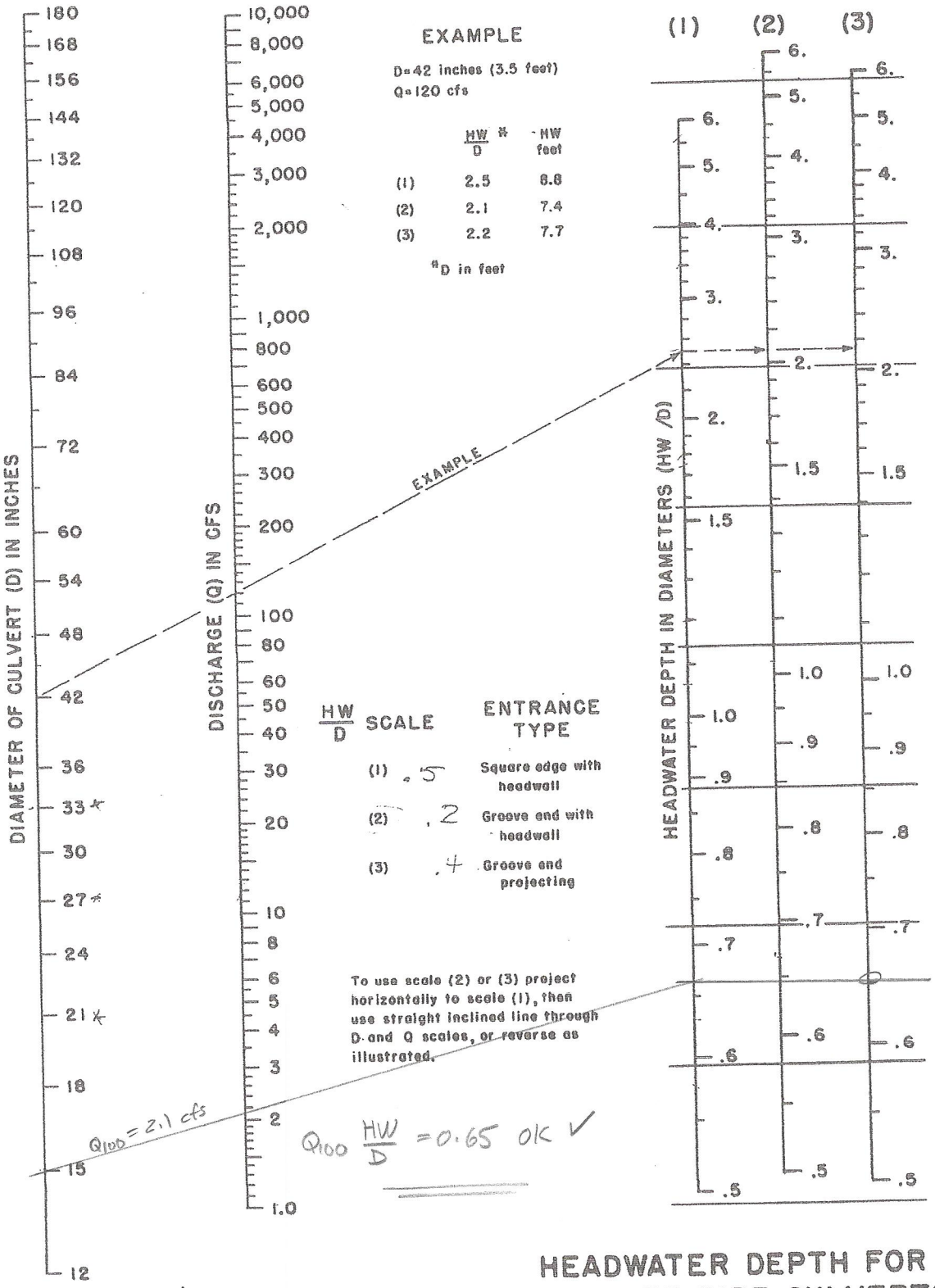
POST CONST. $\overline{C} = \left[\overset{3.605}{.25(14.42)} + .7(.2) + .9(.12) + .3(.43)\right] / 15.17$ ac

= 0.26 POST cA = 3.9442

$i_2$ = 2.0 in/hr
$i_{10}$ = 3.0
$i_{25}$ = 3.5
$i_{50}$ = 3.9
$i_{100}$ = 4.3

| PRE-CONST. Q | POST-CONST. Q |
|---|---|
| $Q_2$ = 7.6 cfs | $Q_2$ = 7.9 cfs |
| $Q_{10}$ = 11.4 | $Q_{10}$ = 11.8 |
| $Q_{25}$ = 13.3 | $Q_{25}$ = 13.8 |
| $Q_{50}$ = 14.8 | $Q_{50}$ = 15.4 |
| $Q_{100}$ = 16.3 | $Q_{100}$ = 17.0 |

CHART 1




# HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

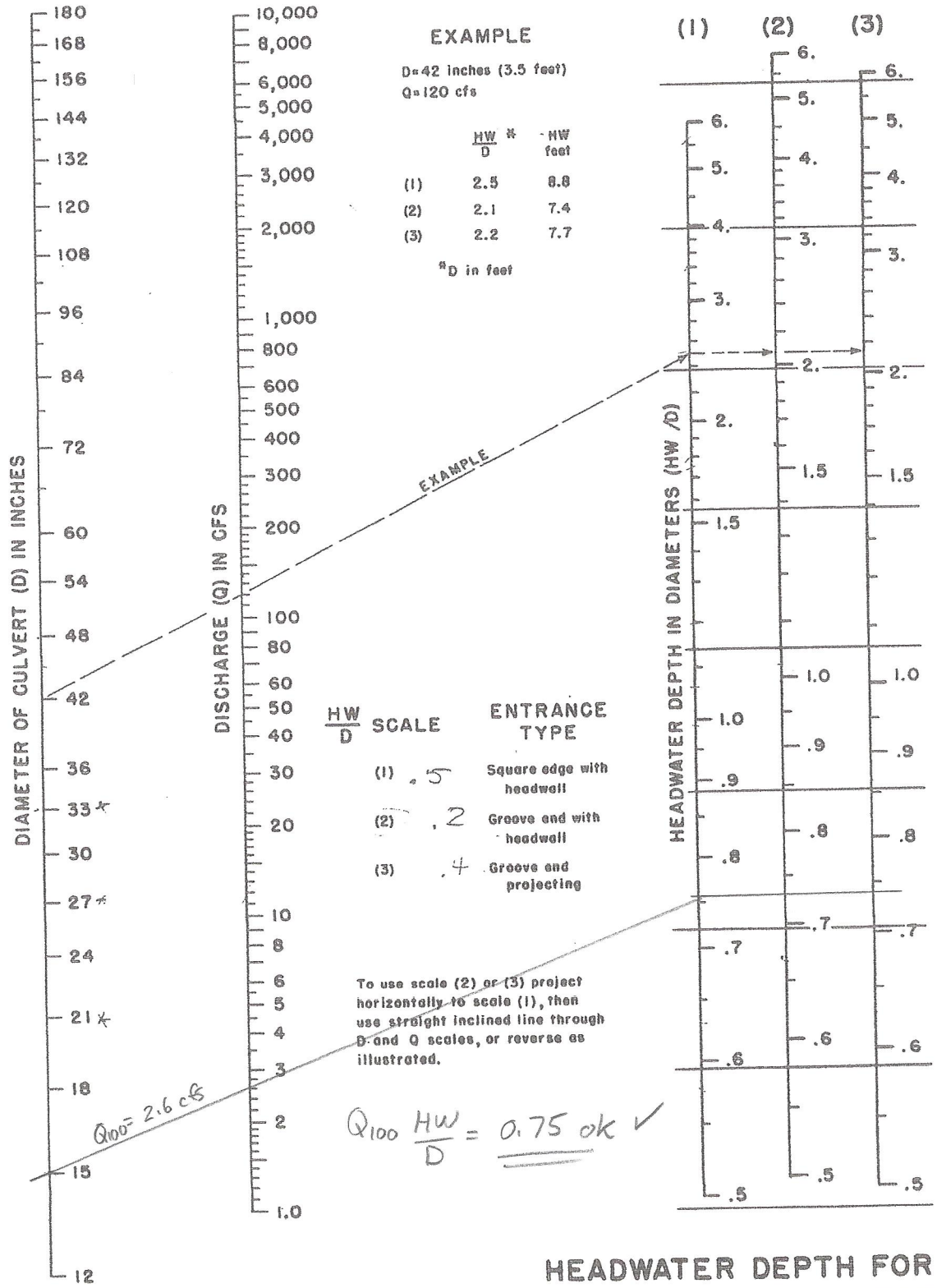
HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



CULVERT #1
REV. 11/18/08

CHART 1




HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

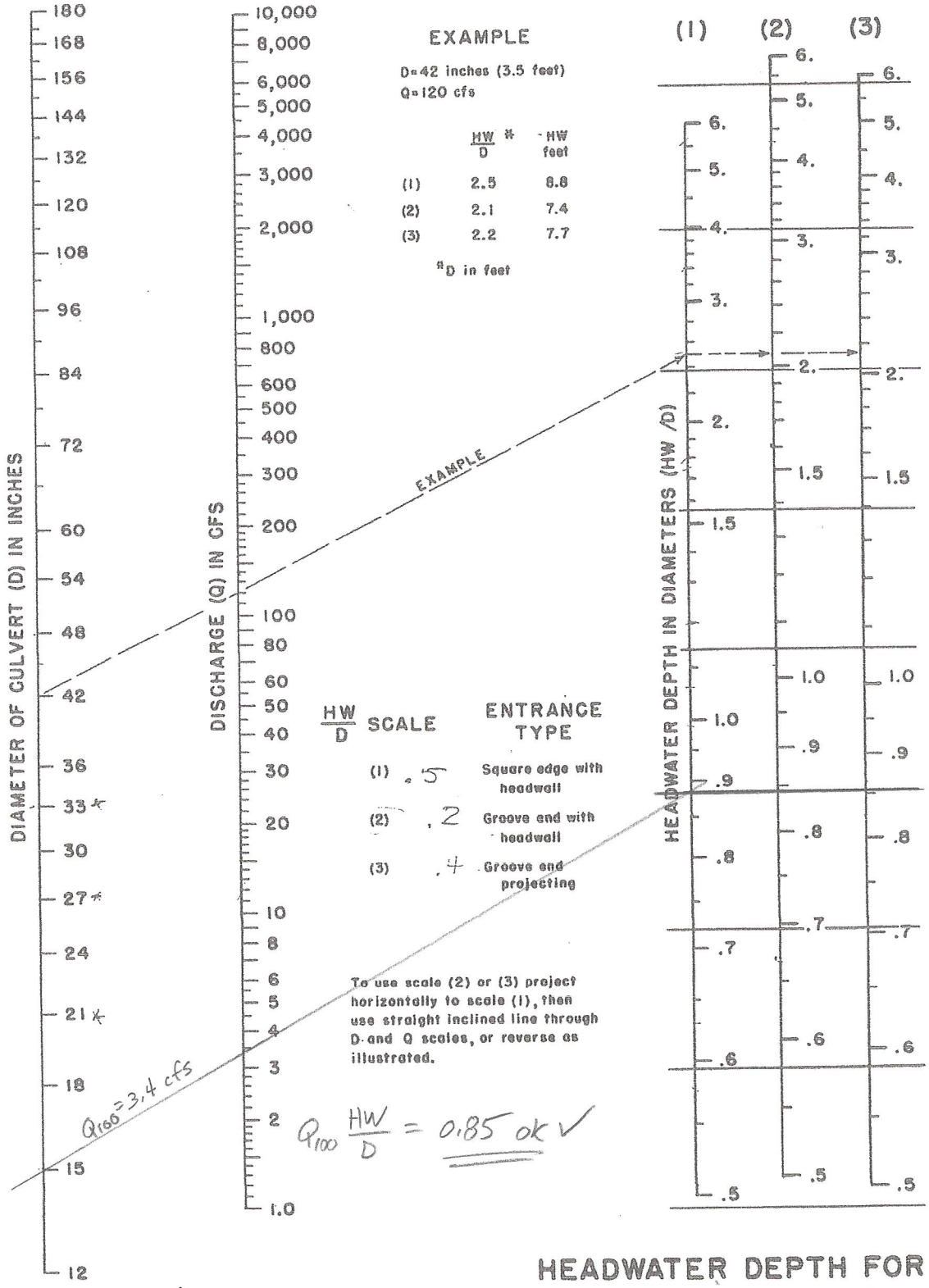
HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



CULVERT #2
REVISED 11/18/08

CHART 1




# HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

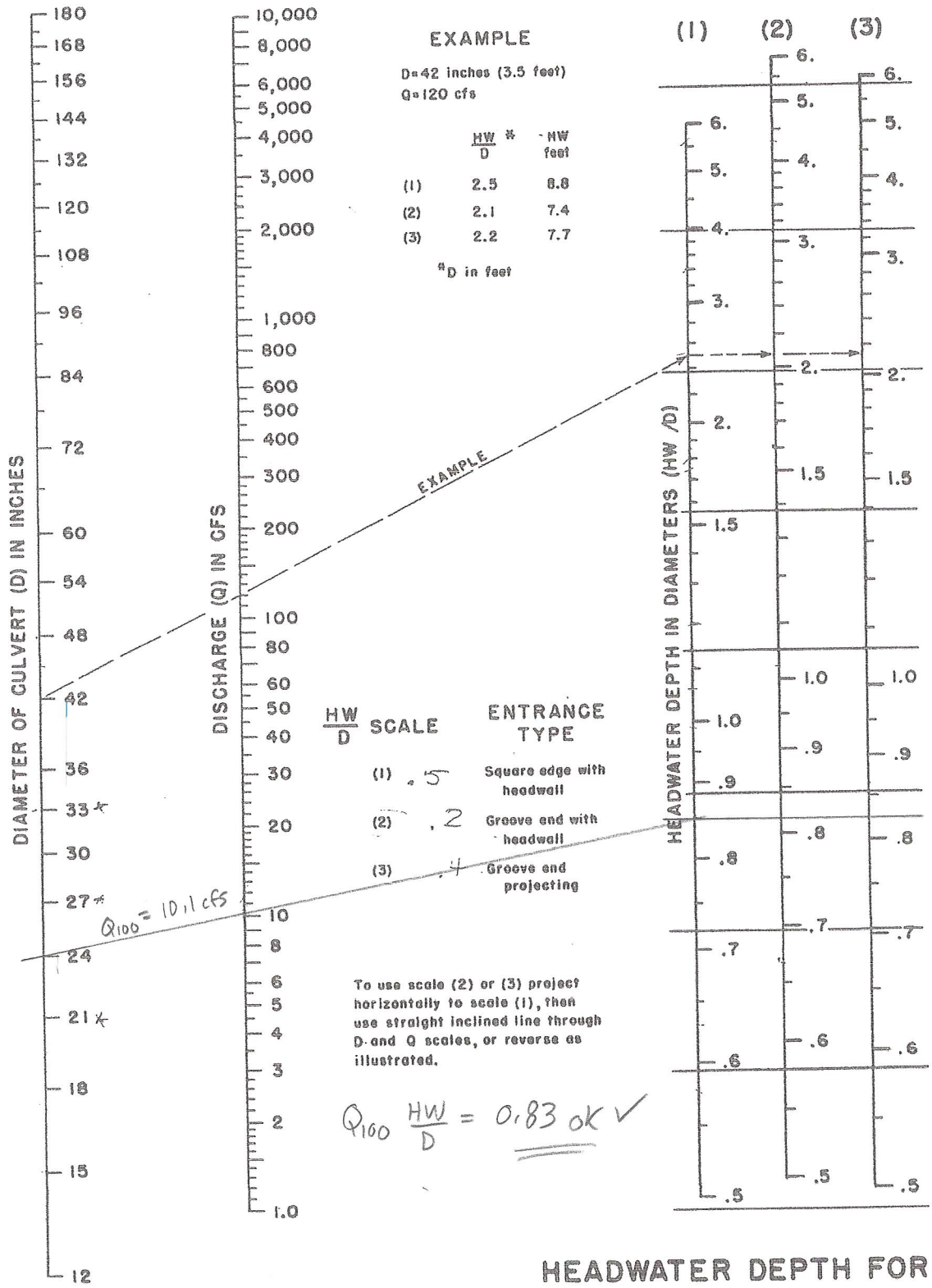
HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



CULVERT # 3
REV. 11/18/08

CHART 1




HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

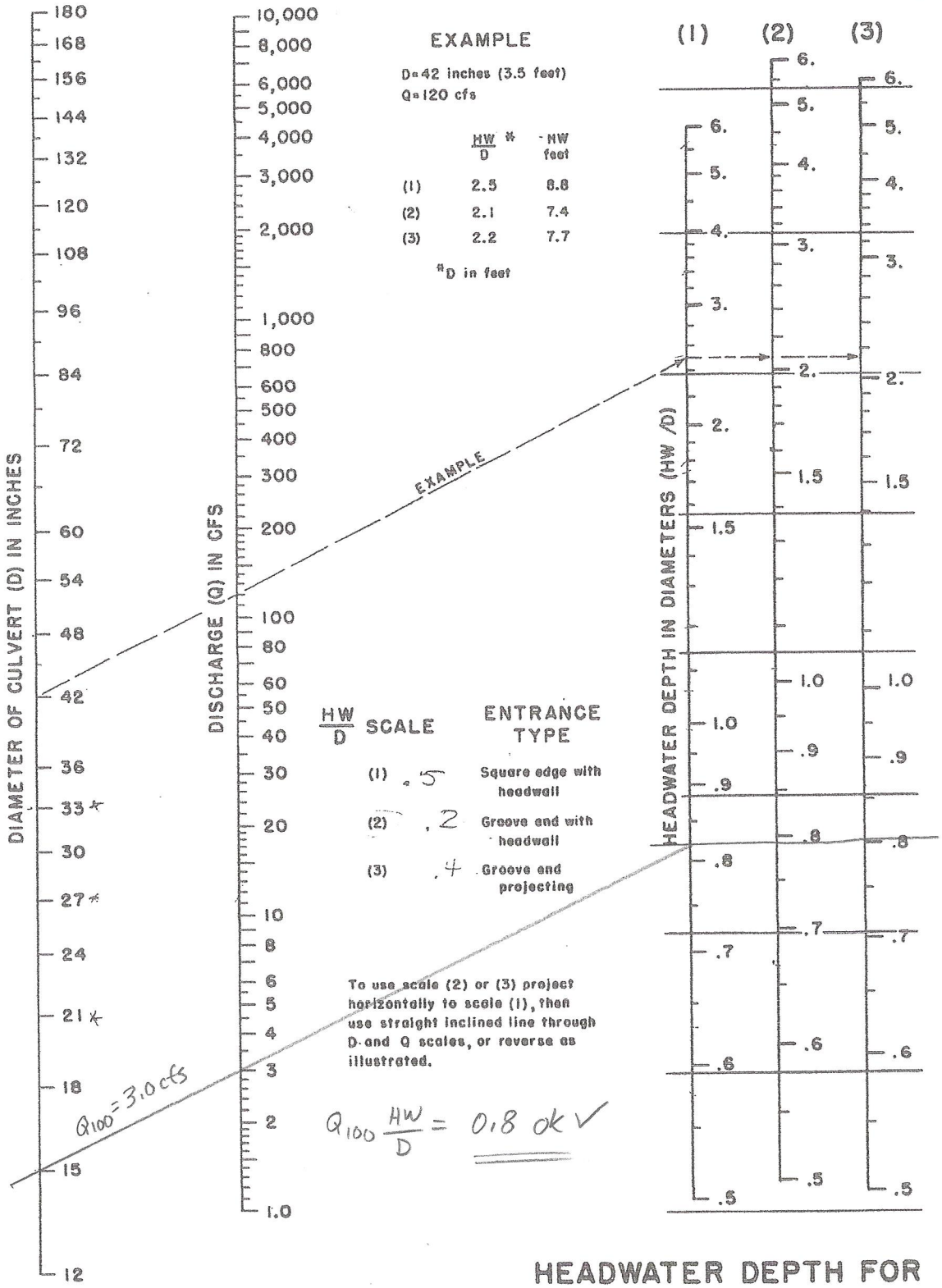
HEADWATER SCALES 2 & 3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



CULVERT #4
REV. 11/18/08

CHART 1




# HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2&3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963



CULVERT #5
REV. 11/18/08

## Time of Concentration Worksheet (Page 1 of 3)

Project No. Welsch By JW Date 8/2008

Location Horse Hill Rd. Checked JW Date

Circle one: Present Developed

Circle one: metric units English units

CULVERT #2

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Must include a map showing travel time flow paths.

| **Sheet flow (Applicable to $T_c$ only)** | Segment ID | | | | | |
|---|---|---|---|---|---|---|
| 1 Surface description (Table 6.C.1) | | med. woods | | | | |
| 2 Manning's roughness coeff., n (Table 6.C.1) | | 0.6 | | | | |
| 3 Flow length, L (See Section 6.C.4) | m (ft) | 100 | | | | |
| 4 Two-yr 24-hr rainfall, $P_2$ (Table B-1) | mm (in) | 3.3 | | | | |
| 5 Land slope, s $\frac{151.5-141}{100}$ | m/m (ft/ft) | 0.105 | | | | |
| 6 Travel Time, $T_t$ (Equation 6.C.2) | h | 0.25 | + | | = | |

| **Shallow concentrated flow** | Segment ID | | | | | |
|---|---|---|---|---|---|---|
| 7 Surface description (paved or unpaved) | | unpaved | | | | |
| 8 Flow length, L | m (ft) | 440 | | | | |
| 9 Watercourse slope, s | m/m (ft/ft) | 0.039 | | $\frac{141-124}{440}$ | | |
| 10 Average velocity, V (Equation 6.C.4 or 6.C.5) | m/s (ft/s) | 3.19 | | | | |
| 11 Travel Time, $T_t$ (Equation 6.C.3) | h | .038 | + | | = | |



$T_c$ = 17 minutes

## Time of Concentration Worksheet (Page 1 of 3)

Project No. _____ By _____ Date _____

Location _____ Checked _____ Date _____

Circle one: Present Developed CULVERT #3

Circle one: metric units English units REVISED 11/18/08

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Must include a map showing travel time flow paths.

| **Sheet flow (Applicable to $T_c$ only)** | Segment ID | | | | | |
|---|---|---|---|---|---|---|
| 1 Surface description (Table 6.C.1) | | med woods | | | | |
| 2 Manning's roughness coeff., n (Table 6.C.1) | | 0.6 | | | | |
| 3 Flow length, L (See Section 6.C.4) | m (ft) | 100 | | | | |
| 4 Two-yr 24-hr rainfall, $P_2$ (Table B-1) | mm (in) | 3.3 | | | | |
| 5 Land slope, s $\frac{148-143}{100}$ | m/m (ft/ft) | 0.05 | | | | |
| 6 Travel Time, $T_t$ (Equation 6.C.2) | h | 0.338 | + | | = | |

| **Shallow concentrated flow** | Segment ID | | | | | |
|---|---|---|---|---|---|---|
| 7 Surface description (paved or unpaved) | | unpaved | | | | |
| 8 Flow length, L | m (ft) | 645 | | | | |
| 9 Watercourse slope, s | m/m (ft/ft) | 0.029 | | $\frac{143-124}{645}$ | | |
| 10 Average velocity, V (Equation 6.C.4 or 6.C.5) | m/s (ft/s) | 2.75 | | | | |
| 11 Travel Time, $T_t$ (Equation 6.C.3) | h | 0.065 | + | | = | |



$T_c$ = 0.403 hr = 24 minutes

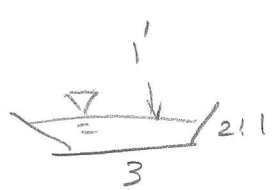
## Time of Concentration Worksheet (Page 2 of 3)

ADDITIONAL Tc
AREAS 2+3
DESIGN POINT A

| **Channel flow** | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 12 | Cross sectional flow area, a | $m^2$ ($ft^2$) | 5 | | | |
| 13 | Wetted perimeter, $p_w$ | m (ft) | 7.47 | | | |
| 14 | Hydraulic radius, $r = a/p_w$ | m (ft) | 0.67 | | | |
| 15 | Channel slope, s $\frac{124-119}{120}$ | m/m (ft/ft) | 0.042 | | | |
| 16 | Manning's roughness coeff., n (Table 7-1 & Append. A, Ch. 8) | | 0.07 | | | |
| 17 | Average velocity, v (Equation 6.C.6) | m/s (ft/s) | 3.3 | | | |
| 18 | Flow length, L | m (ft) | 120 | | | |
| 19 | Travel Time, $T_t$ (Equation 6.C.3) | h | 0.01 | + | | = 0.01 hr |

= 0.6 minutes

Channel Section ID
Schematic




Channel Section ID
Schematic

## Time of Concentration Worksheet (Page 1 of 3)

Project No. _____ By _____ Date _____

Location _____ Checked _____ Date _____

Circle one: Present Developed

Circle one: metric units English units

CULVERT #4
REVISED 11/18/08

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Must include a map showing travel time flow paths.

| **Sheet flow (Applicable to $T_c$ only)** | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 1 | Surface description (Table 6.C.1) | | med woods | | | |
| 2 | Manning's roughness coeff., n (Table 6.C.1) | | 0.6 | | | |
| 3 | Flow length, L (See Section 6.C.4) | m (ft) | ~~150~~ | 100 | | |
| 4 | Two-yr 24-hr rainfall, $P_2$ (Table B-1) | mm (in) | 3.3 | | | |
| 5 | Land slope, s ~~164-156 / 150~~ | m/m (ft/ft) | ~~.053~~ | 0.055 | 164-158.5 / 100 | |
| 6 | Travel Time, $T_t$ (Equation 6.C.2) | h | ~~0.457~~ + | 0.325 | = | 0.325 |

| **Shallow concentrated flow** | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 7 | Surface description (paved or unpaved) | | unpaved | | | |
| 8 | Flow length, L | m (ft) | ~~750~~ | 800 | | |
| 9 | Watercourse slope, s | m/m (ft/ft) | ~~.037~~ | 0.038 | 158.5-128 / 800 | |
| 10 | Average velocity, V (Equation 6.C.4 or 6.C.5) | m/s (ft/s) | ~~3.1~~ | 3.15 | | |
| 11 | Travel Time, $T_t$ (Equation 6.C.3) | h | ~~0.067~~ + | 0.071 | = | 0.071 |

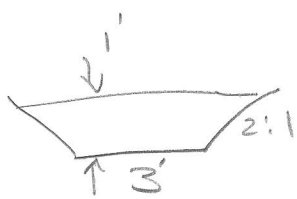
CULVERT #4

## Time of Concentration Worksheet (Page 2 of 3)

REVISED 11/18/08

| **Channel flow** | Segment ID | | | |
|---|---|---|---|---|
| 12 Cross sectional flow area, a | $m^2$ ($ft^2$) | 5.0 | | |
| 13 Wetted perimeter, $p_w$ | m (ft) | 7.47 | | |
| 14 Hydraulic radius, $r = a/p_w$ | m (ft) | 0.67 | | |
| 15 Channel slope, s | m/m (ft/ft) | .029 | $\frac{128-117}{380}$ | |
| 16 Manning's roughness coeff., n (Table 7-1 & Append. A, Ch. 8) | | 0.08 | | |
| 17 Average velocity, v (Equation 6.C.6) | m/s (ft/s) | 2.4 | | |
| 18 Flow length, L | m (ft) | 380 | | |
| 19 Travel Time, $T_t$ (Equation 6.C.3) | h | 0.044 + | | = 0.044 |

Channel Section ID
Schematic




Channel Section ID
Schematic

Tc = ~~34~~ minutes = 0.44 hr = 26 minutes

~~0.446 hr = 27 minutes Revised~~

## Time of Concentration Worksheet (Page 1 of 3)

Project No. _____ By _____ Date _____

Location _____ Checked _____ Date _____

Circle one: Present Developed

Circle one: metric units English units

CULVERT #5

REVISED 11/18/08

NOTES: Space for as many as two segments per flow type can be used for each worksheet. Must include a map showing travel time flow paths.

| **Sheet flow (Applicable to $T_c$ only)** | | Segment ID | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | Surface description (Table 6.C.1) | | med woods | | | | |
| 2 | Manning's roughness coeff., n (Table 6.C.1) | | 0.6 | | | | |
| 3 | Flow length, L (See Section 6.C.4) | m (ft) | ~~150~~ | | 100 | | |
| 4 | Two-yr 24-hr rainfall, $P_2$ (Table B-1) | mm (in) | 3.3 | | | | |
| 5 | Land slope, s | m/m (ft/ft) | ~~0.06~~ | | 0.05 | | $\frac{157-146}{100}$ |
| 6 | Travel Time, $T_t$ (Equation 6.C.2) | h | ~~0.434~~ | + | 0.338 | = | 0.338 |

| **Shallow concentrated flow** | | Segment ID | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | Surface description (paved or unpaved) | | unpaved | | | | |
| 8 | Flow length, L | m (ft) | ~~560~~ | | 610 | | |
| 9 | Watercourse slope, s | m/m (ft/ft) | 0.041 | | 0.044 | | $\frac{146-119}{610}$ |
| 10 | Average velocity, V (Equation 6.C.4 or 6.C.5) | m/s (ft/s) | 3.27 | | 3.38 | | |
| 11 | Travel Time, $T_t$ (Equation 6.C.3) | h | 0.048 | + | 0.050 | = | 0.050 |



Tc = 29 minutes

.388hr = 23 minutes

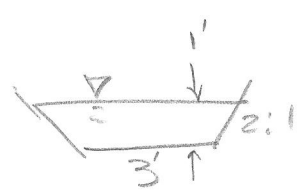
## Time of Concentration Worksheet (Page 2 of 3)

ADDITIONAL Tc
AREAS 4+5
DESIGN POINT B

| **Channel flow** | | Segment ID | | | | |
|---|---|---|---|---|---|---|
| 12 | Cross sectional flow area, a | $m^2$ ($ft^2$) | 5 | | | |
| 13 | Wetted perimeter, $p_w$ | m (ft) | 7.47 | | | |
| 14 | Hydraulic radius, $r = a/p_w$ | m (ft) | 0.67 | | | |
| 15 | Channel slope, s $\frac{118-106.5}{370}$ | m/m (ft/ft) | 0.031 | | | |
| 16 | Manning's roughness coeff., n (Table 7-1 & Append. A, Ch. 8) | | 0.07 | | | |
| 17 | Average velocity, v (Equation 6.C.6) | m/s (ft/s) | 2.9 | | | |
| 18 | Flow length, L | m (ft) | 370 | | | |
| 19 | Travel Time, $T_t$ (Equation 6.C.3) | h | 0.036 | + | | = 0.036 hr |

= 2.2 min.

Channel Section ID
Schematic




Channel Section ID
Schematic

# Calculation Results Summary

==========
Scenario: Base

CULVERT #1

100-year

>>>> Info: Subsurface Network Rooted by: O-1
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

CALCULATION SUMMARY FOR SURFACE NETWORKS

| Label | Inlet Type | Inlet | Total Intercepted Flow (cfs) | Total Bypassed Flow (cfs) | Capture Efficiency (%) | Gutter Spread (ft) | Gutter Depth (ft) |
|---|---|---|---|---|---|---|---|
| I-1 | Generic Inlet | Generic Default 100% | 0.00 | 0.00 | 100.0 | 0.00 | 0.00 |

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-1

| Label | Number of Sections | Section Size | Section Shape | Length (ft) | Total System Flow (cfs) | Average Velocity (ft/s) | Hydraulic Grade Upstream (ft) | Hydraulic Grade Downstream (ft) |
|---|---|---|---|---|---|---|---|---|
| P-1 | 1 | 15 inch | Circular | 20.00 | 2.10 | 6.26 | 138.58 | 136.90 |

| Label | Total System Flow (cfs) | Ground Elevation (ft) | Hydraulic Grade Line In (ft) | Hydraulic Grade Line Out (ft) |
|---|---|---|---|---|
| O-1 | 2.10 | 137.75 | 136.50 | 136.50 |
| I-1 | 2.10 | 141.30 | 138.58 | 138.58 |

==========
Completed: 11/20/2008 04:27:34 PM

# Calculation Results Summary

==========
Scenario: Base

>>>> Info: Subsurface Network Rooted by: O-1
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

CULVERT #2

100-year

CALCULATION SUMMARY FOR SURFACE NETWORKS

| Label | Inlet Type | Inlet | Total Intercepted Flow (cfs) | Total Bypassed Flow (cfs) | Capture Efficiency (%) | Gutter Spread (ft) | Gutter Depth (ft) |
|---|---|---|---|---|---|---|---|
| I-1 | Generic Inlet | Generic Default 100% | 0.00 | 0.00 | 100.0 | 0.00 | 0.00 |

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-1

| Label | Number of Sections | Section Size | Section Shape | Length (ft) | Total System Flow (cfs) | Average Velocity (ft/s) | Hydraulic Grade Upstream (ft) | Hydraulic Grade Downstream (ft) |
|---|---|---|---|---|---|---|---|---|
| P-1 | 1 | 15 inch | Circular | 40.00 | 2.60 | 4.75 | 126.65 | 125.37 |

| Label | Total System Flow (cfs) | Ground Elevation (ft) | Hydraulic Grade Line In (ft) | Hydraulic Grade Line Out (ft) |
|---|---|---|---|---|
| O-1 | 2.60 | 126.05 | 124.80 | 124.80 |
| I-1 | 2.60 | 132.50 | 126.65 | 126.65 |

==========
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# Calculation Results Summary

==========
Scenario: Base

CULVERT #3

100-year

>>>> Info: Subsurface Network Rooted by: O-1
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

CALCULATION SUMMARY FOR SURFACE NETWORKS

| Label | Inlet Type | Inlet | Total Intercepted Flow (cfs) | Total Bypassed Flow (cfs) | Capture Efficiency (%) | Gutter Spread (ft) | Gutter Depth (ft) |
|---|---|---|---|---|---|---|---|
| I-1 | Generic Inlet | Generic Default 100% | 0.00 | 0.00 | 100.0 | 0.00 | 0.00 |

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-1

| Label | Number of Sections | Section Size | Section Shape | Length (ft) | Total System Flow (cfs) | Average Velocity (ft/s) | Hydraulic Grade Upstream (ft) | Hydraulic Grade Downstream (ft) |
|---|---|---|---|---|---|---|---|---|
| P-1 | 1 | 15 inch | Circular | 27.00 | 3.40 | 5.50 | 126.24 | 125.13 |

| Label | Total System Flow (cfs) | Ground Elevation (ft) | Hydraulic Grade Line In (ft) | Hydraulic Grade Line Out (ft) |
|---|---|---|---|---|
| O-1 | 3.40 | 125.75 | 124.50 | 124.50 |
| I-1 | 3.40 | 129.20 | 126.24 | 126.24 |

==========
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# Calculation Results Summary

==========
Scenario: Base

>>>> Info: Subsurface Network Rooted by: O-1
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

CULVERT # 4
100-year

CALCULATION SUMMARY FOR SURFACE NETWORKS

| Label | Inlet Type | Inlet | Total Intercepted Flow (cfs) | Total Bypassed Flow (cfs) | Capture Efficiency (%) | Gutter Spread (ft) | Gutter Depth (ft) |
|---|---|---|---|---|---|---|---|
| I-1 | Generic Inlet | Generic Default 100% | 0.00 | 0.00 | 100.0 | 0.00 | 0.00 |

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-1

| Label | Number of Sections | Section Size | Section Shape | Length (ft) | Total System Flow (cfs) | Average Velocity (ft/s) | Hydraulic Grade Upstream (ft) | Hydraulic Grade Downstream (ft) |
|---|---|---|---|---|---|---|---|---|
| P-1 | 1 | 24 inch | Circular | 23.00 | 10.10 | 7.36 | 120.74 | 119.60 |

| Label | Total System Flow (cfs) | Ground Elevation (ft) | Hydraulic Grade Line In (ft) | Hydraulic Grade Line Out (ft) |
|---|---|---|---|---|
| O-1 | 10.10 | 120.70 | 118.70 | 118.70 |
| I-1 | 10.10 | 123.10 | 120.74 | 120.74 |

==========
Completed: 11/20/2008 04:20:01 PM

# Calculation Results Summary

==========
Scenario: Base

CULVERT #5

100-year

>>>> Info: Subsurface Network Rooted by: O-1
>>>> Info: Subsurface Analysis iterations: 1
>>>> Info: Convergence was achieved.

CALCULATION SUMMARY FOR SURFACE NETWORKS

| Label | Inlet Type | Inlet | Total Intercepted Flow (cfs) | Total Bypassed Flow (cfs) | Capture Efficiency (%) | Gutter Spread (ft) | Gutter Depth (ft) |
|---|---|---|---|---|---|---|---|
| I-1 | Generic Inlet | Generic Default 100% | 0.00 | 0.00 | 100.0 | 0.00 | 0.00 |

CALCULATION SUMMARY FOR SUBSURFACE NETWORK WITH ROOT: O-1

| Label | Number of Sections | Section Size | Section Shape | Length (ft) | Total System Flow (cfs) | Average Velocity (ft/s) | Hydraulic Grade Upstream (ft) | Hydraulic Grade Downstream (ft) |
|---|---|---|---|---|---|---|---|---|
| P-1 | 1 | 15 inch | Circular | 23.00 | 3.00 | 7.29 | 120.40 | 118.16 |

100-yr

| Label | Total System Flow (cfs) | Ground Elevation (ft) | Hydraulic Grade Line In (ft) | Hydraulic Grade Line Out (ft) |
|---|---|---|---|---|
| O-1 | 3.00 | 118.95 | 117.70 | 117.70 |
| I-1 | 3.00 | 121.40 | 120.40 | 120.40 |

==========
Completed: 11/20/2008 04:15:58 PM

# Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Inflow Hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-Yr | 2-Yr | 3-Yr | 5-Yr | 10-Yr | 25-Yr | 50-Yr | 100-Yr | |
| 1 | SCS Runoff | ------- | ------- | 1.138 | ------- | ------- | 4.355 | 5.775 | 7.540 | 9.674 | Design Point A |
| 2 | SCS Runoff | ------- | ------- | 2.087 | ------- | ------- | 9.928 | 13.57 | 18.14 | 23.84 | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 1.138 | 3 | 747 | 7,972 | ---- | ------ | ------ | Design Point A |
| 2 | SCS Runoff | 2.087 | 3 | 753 | 18,921 | ---- | ------ | ------ | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 4.355 | 3 | 738 | 23,162 | ---- | ------ | ------ | Design Point A |
| 2 | SCS Runoff | 9.928 | 3 | 744 | 60,822 | ---- | ------ | ------ | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 5.775 | 3 | 738 | 29,642 | ---- | ------ | ------ | Design Point A |
| 2 | SCS Runoff | 13.57 | 3 | 744 | 79,219 | ---- | ------ | ------ | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 7.540 | 3 | 738 | 37,749 | ---- | ------ | ------ | Design Point A |
| 2 | SCS Runoff | 18.14 | 3 | 744 | 102,481 | ---- | ------ | ------ | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 9.674 | 3 | 738 | 47,615 | ---- | ------ | ------ | Design Point A |
| 2 | SCS Runoff | 23.84 | 3 | 741 | 131,061 | ---- | ------ | ------ | Design Point B |

# Hydrograph Return Period Recap

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Inflow Hyd(s) | Peak Outflow (cfs) | | | | | | | | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1-Yr | 2-Yr | 3-Yr | 5-Yr | 10-Yr | 25-Yr | 50-Yr | 100-Yr | |
| 1 | SCS Runoff | ------- | ------- | 0.575 | ------- | ------- | 1.882 | 2.426 | 3.096 | 3.897 | Area to Culvert #2 |
| 2 | SCS Runoff | ------- | ------- | 0.581 | ------- | ------- | 2.225 | 2.951 | 3.853 | 4.943 | Area to Culvert #3 |
| 3 | Combine | 1, 2 | ------- | 1.131 | ------- | ------- | 4.062 | 5.303 | 6.883 | 8.789 | Add 2+3 |
| 4 | Reservoir | 3 | ------- | 0.530 | ------- | ------- | 1.983 | 2.652 | 3.554 | 4.725 | Storage Route 2&3 |
| 5 | SCS Runoff | ------- | ------- | 0.172 | ------- | ------- | 0.798 | 1.076 | 1.432 | 1.874 | Additional Area 2&3 to DP A |
| 6 | Combine | 4, 5 | ------- | 0.599 | ------- | ------- | 2.292 | 3.050 | 4.086 | 5.432 | Design Point A |
| 7 | SCS Runoff | ------- | ------- | 1.039 | ------- | ------- | 5.439 | 7.520 | 10.16 | 13.44 | Area to Culvert #4 |
| 8 | SCS Runoff | ------- | ------- | 0.511 | ------- | ------- | 1.957 | 2.595 | 3.388 | 4.346 | Area to Culvert #5 |
| 9 | Reservoir | 7 | ------- | 0.969 | ------- | ------- | 4.130 | 5.894 | 8.198 | 11.02 | Storage Route 4 |
| 10 | Reservoir | 8 | ------- | 0.467 | ------- | ------- | 1.603 | 2.145 | 2.838 | 3.673 | Storage Route 5 |
| 11 | Combine | 9, 10 | ------- | 1.416 | ------- | ------- | 5.579 | 7.865 | 10.82 | 14.49 | Add 4&5 |
| 12 | SCS Runoff | ------- | ------- | 0.907 | ------- | ------- | 3.908 | 5.209 | 6.892 | 8.947 | Additional Area 4&5 to DP B |
| 13 | Combine | 11, 12 | ------- | 1.872 | ------- | ------- | 7.145 | 10.00 | 13.74 | 18.31 | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 0.575 | 3 | 738 | 3,383 | ---- | ------ | ------ | Area to Culvert #2 |
| 2 | SCS Runoff | 0.581 | 3 | 747 | 4,073 | ---- | ------ | ------ | Area to Culvert #3 |
| 3 | Combine | 1.131 | 3 | 744 | 7,456 | 1, 2 | ------ | ------ | Add 2+3 |
| 4 | Reservoir | 0.530 | 3 | 768 | 7,437 | 3 | 125.84 | 1,586 | Storage Route 2&3 |
| 5 | SCS Runoff | 0.172 | 3 | 738 | 1,177 | ---- | ------ | ------ | Additional Area 2&3 to DP A |
| 6 | Combine | 0.599 | 3 | 765 | 8,614 | 4, 5 | ------ | ------ | Design Point A |
| 7 | SCS Runoff | 1.039 | 3 | 756 | 10,147 | ---- | ------ | ------ | Area to Culvert #4 |
| 8 | SCS Runoff | 0.511 | 3 | 747 | 3,582 | ---- | ------ | ------ | Area to Culvert #5 |
| 9 | Reservoir | 0.969 | 3 | 762 | 10,141 | 7 | 120.00 | 597 | Storage Route 4 |
| 10 | Reservoir | 0.467 | 3 | 753 | 3,582 | 8 | 120.01 | 54.9 | Storage Route 5 |
| 11 | Combine | 1.416 | 3 | 759 | 13,723 | 9, 10 | ------ | ------ | Add 4&5 |
| 12 | SCS Runoff | 0.907 | 3 | 738 | 5,860 | ---- | ------ | ------ | Additional Area 4&5 to DP B |
| 13 | Combine | 1.872 | 3 | 756 | 19,583 | 11, 12 | ------ | ------ | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 1.882 | 3 | 735 | 9,037 | ---- | ------ | ------ | Area to Culvert #2 |
| 2 | SCS Runoff | 2.225 | 3 | 738 | 11,834 | ---- | ------ | ------ | Area to Culvert #3 |
| 3 | Combine | 4.062 | 3 | 738 | 20,872 | 1, 2 | ------ | ------ | Add 2+3 |
| 4 | Reservoir | 1.983 | 3 | 759 | 20,853 | 3 | 126.16 | 5,008 | Storage Route 2&3 |
| 5 | SCS Runoff | 0.798 | 3 | 732 | 3,649 | ---- | ------ | ------ | Additional Area 2&3 to DP A |
| 6 | Combine | 2.292 | 3 | 750 | 24,502 | 4, 5 | ------ | ------ | Design Point A |
| 7 | SCS Runoff | 5.439 | 3 | 747 | 33,991 | ---- | ------ | ------ | Area to Culvert #4 |
| 8 | SCS Runoff | 1.957 | 3 | 738 | 10,407 | ---- | ------ | ------ | Area to Culvert #5 |
| 9 | Reservoir | 4.130 | 3 | 759 | 33,985 | 7 | 120.46 | 4,434 | Storage Route 4 |
| 10 | Reservoir | 1.603 | 3 | 750 | 10,407 | 8 | 120.31 | 991 | Storage Route 5 |
| 11 | Combine | 5.579 | 3 | 759 | 44,392 | 9, 10 | ------ | ------ | Add 4&5 |
| 12 | SCS Runoff | 3.908 | 3 | 732 | 17,563 | ---- | ------ | ------ | Additional Area 4&5 to DP B |
| 13 | Combine | 7.145 | 3 | 750 | 61,955 | 11, 12 | ------ | ------ | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 2.426 | 3 | 735 | 11,390 | ---- | ------ | ------ | Area to Culvert #2 |
| 2 | SCS Runoff | 2.951 | 3 | 738 | 15,145 | ---- | ------ | ------ | Area to Culvert #3 |
| 3 | Combine | 5.303 | 3 | 735 | 26,535 | 1, 2 | ------ | ------ | Add 2+3 |
| 4 | Reservoir | 2.652 | 3 | 759 | 26,516 | 3 | 126.26 | 6,631 | Storage Route 2&3 |
| 5 | SCS Runoff | 1.076 | 3 | 732 | 4,723 | ---- | ------ | ------ | Additional Area 2&3 to DP A |
| 6 | Combine | 3.050 | 3 | 753 | 31,239 | 4, 5 | ------ | ------ | Design Point A |
| 7 | SCS Runoff | 7.520 | 3 | 744 | 44,560 | ---- | ------ | ------ | Area to Culvert #4 |
| 8 | SCS Runoff | 2.595 | 3 | 738 | 13,318 | ---- | ------ | ------ | Area to Culvert #5 |
| 9 | Reservoir | 5.894 | 3 | 759 | 44,554 | 7 | 120.66 | 6,028 | Storage Route 4 |
| 10 | Reservoir | 2.145 | 3 | 750 | 13,318 | 8 | 120.43 | 1,356 | Storage Route 5 |
| 11 | Combine | 7.865 | 3 | 756 | 57,872 | 9, 10 | ------ | ------ | Add 4&5 |
| 12 | SCS Runoff | 5.209 | 3 | 732 | 22,602 | ---- | ------ | ------ | Additional Area 4&5 to DP B |
| 13 | Combine | 10.00 | 3 | 750 | 80,474 | 11, 12 | ------ | ------ | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 3.096 | 3 | 735 | 14,306 | ---- | ------ | ------ | Area to Culvert #2 |
| 2 | SCS Runoff | 3.853 | 3 | 738 | 19,287 | ---- | ------ | ------ | Area to Culvert #3 |
| 3 | Combine | 6.883 | 3 | 735 | 33,593 | 1, 2 | ------ | ------ | Add 2+3 |
| 4 | Reservoir | 3.554 | 3 | 756 | 33,575 | 3 | 126.37 | 8,538 | Storage Route 2&3 |
| 5 | SCS Runoff | 1.432 | 3 | 729 | 6,077 | ---- | ------ | ------ | Additional Area 2&3 to DP A |
| 6 | Combine | 4.086 | 3 | 750 | 39,651 | 4, 5 | ------ | ------ | Design Point A |
| 7 | SCS Runoff | 10.16 | 3 | 744 | 57,976 | ---- | ------ | ------ | Area to Culvert #4 |
| 8 | SCS Runoff | 3.388 | 3 | 738 | 16,961 | ---- | ------ | ------ | Area to Culvert #5 |
| 9 | Reservoir | 8.198 | 3 | 756 | 57,970 | 7 | 120.88 | 7,903 | Storage Route 4 |
| 10 | Reservoir | 2.838 | 3 | 747 | 16,960 | 8 | 120.56 | 1,776 | Storage Route 5 |
| 11 | Combine | 10.82 | 3 | 753 | 74,931 | 9, 10 | ------ | ------ | Add 4&5 |
| 12 | SCS Runoff | 6.892 | 3 | 729 | 28,928 | ---- | ------ | ------ | Additional Area 4&5 to DP B |
| 13 | Combine | 13.74 | 3 | 750 | 103,859 | 11, 12 | ------ | ------ | Design Point B |

# Hydrograph Summary Report

Hydraflow Hydrographs by Intelisolve v9.1

| Hyd. No. | Hydrograph type (origin) | Peak flow (cfs) | Time interval (min) | Time to peak (min) | Hyd. volume (cuft) | Inflow hyd(s) | Maximum elevation (ft) | Total strge used (cuft) | Hydrograph description |
|---|---|---|---|---|---|---|---|---|---|
| 1 | SCS Runoff | 3.897 | 3 | 735 | 17,824 | ---- | ------ | ------ | Area to Culvert #2 |
| 2 | SCS Runoff | 4.943 | 3 | 738 | 24,328 | ---- | ------ | ------ | Area to Culvert #3 |
| 3 | Combine | 8.789 | 3 | 735 | 42,152 | 1, 2 | ------ | ------ | Add 2+3 |
| 4 | Reservoir | 4.725 | 3 | 756 | 42,133 | 3 | 126.50 | 10,741 | Storage Route 2&3 |
| 5 | SCS Runoff | 1.874 | 3 | 729 | 7,734 | ---- | ------ | ------ | Additional Area 2&3 to DP A |
| 6 | Combine | 5.432 | 3 | 750 | 49,867 | 4, 5 | ------ | ------ | Design Point A |
| 7 | SCS Runoff | 13.44 | 3 | 741 | 74,516 | ---- | ------ | ------ | Area to Culvert #4 |
| 8 | SCS Runoff | 4.346 | 3 | 738 | 21,393 | ---- | ------ | ------ | Area to Culvert #5 |
| 9 | Reservoir | 11.02 | 3 | 756 | 74,510 | 7 | 121.15 | 10,102 | Storage Route 4 |
| 10 | Reservoir | 3.673 | 3 | 747 | 21,393 | 8 | 120.72 | 2,288 | Storage Route 5 |
| 11 | Combine | 14.49 | 3 | 753 | 95,903 | 9, 10 | ------ | ------ | Add 4&5 |
| 12 | SCS Runoff | 8.947 | 3 | 729 | 36,651 | ---- | ------ | ------ | Additional Area 4&5 to DP B |
| 13 | Combine | 18.31 | 3 | 747 | 132,554 | 11, 12 | ------ | ------ | Design Point B |

**Table 2-2a.—Runoff curve numbers for urban areas[1]**

| Cover description | | Curve numbers for hydrologic soil group— | | | |
|---|---|---|---|---|---|
| Cover type and hydrologic condition | Average percent impervious area[2] | A | B | C | D |
| *Fully developed urban areas (vegetation established)* | | | | | |
| Open space (lawns, parks, golf courses, cemeteries, etc.)[3]: | | | | | |
| Poor condition (grass cover < 50%) | | 68 | 79 | 86 | 89 |
| Fair condition (grass cover 50% to 75%) | | 49 | 69 | 79 | 84 |
| Good condition (grass cover > 75%) | | 39 | 61 | 74 | 80 |
| Impervious areas: | | | | | |
| Paved parking lots, roofs, driveways, etc. (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Streets and roads: | | | | | |
| Paved; curbs and storm sewers (excluding right-of-way) | | 98 | 98 | 98 | 98 |
| Paved; open ditches (including right-of-way) | | 83 | 89 | 92 | 93 |
| Gravel (including right-of-way) | | 76 | 85 | 89 | 91 |
| Dirt (including right-of-way) | | 72 | 82 | 87 | 89 |
| Western desert urban areas: | | | | | |
| Natural desert landscaping (pervious areas only)[4] | | 63 | 77 | 85 | 88 |
| Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders) | | 96 | 96 | 96 | 96 |
| Urban districts: | | | | | |
| Commercial and business | 85 | 89 | 92 | 94 | 95 |
| Industrial | 72 | 81 | 88 | 91 | 93 |
| Residential districts by average lot size: | | | | | |
| 1/8 acre or less (town houses) | 65 | 77 | 85 | 90 | 92 |
| 1/4 acre | 38 | 61 | 75 | 83 | 87 |
| 1/3 acre | 30 | 57 | 72 | 81 | 86 |
| 1/2 acre | 25 | 54 | 70 | 80 | 85 |
| 1 acre | 20 | 51 | 68 | 79 | 84 |
| 2 acres | 12 | 46 | 65 | 77 | 82 |
| *Developing urban areas* | | | | | |
| Newly graded areas (pervious areas only, no vegetation)[5] | | 77 | 86 | 91 | 94 |
| Idle lands (CN's are determined using cover types similar to those in table 2-2c). | | | | | |

USING CONNECTED IMPERVIOUS AREAS

[1]Average runoff condition, and $I_a = 0.2S$.
[2]The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.
[3]CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
[4]Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
[5]Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4, based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

**Table 2-2c.—Runoff curve numbers for other agricultural lands[1]**

| Cover description | | Curve numbers for hydrologic soil group— | | | |
|---|---|---|---|---|---|
| Cover type | Hydrologic condition | A | B | C | D |
| Pasture, grassland, or range—continuous forage for grazing.[2] | Poor | 68 | 79 | 86 | 89 |
| | Fair | 49 | 69 | 79 | 84 |
| | Good | 39 | 61 | 74 | 80 |
| Meadow—continuous grass, protected from grazing and generally mowed for hay. | — | 30 | 58 | 71 | 78 |
| Brush—brush-weed-grass mixture with brush the major element.[3] | Poor | 48 | 67 | 77 | 83 |
| | Fair | 35 | 56 | 70 | 77 |
| | Good | [4]30 | 48 | 65 | 73 |
| Woods—grass combination (orchard or tree farm).[5] | Poor | 57 | 73 | 82 | 86 |
| | Fair | 43 | 65 | 76 | 82 |
| | Good | 32 | 58 | 72 | 79 |
| Woods.[6] | Poor | 45 | 66 | 77 | 83 |
| | Fair | 36 | 60 | 73 | 79 |
| | Good | [4]30 | 55 | 70 | 77 |
| Farmsteads—buildings, lanes, driveways, and surrounding lots. | — | 59 | 74 | 82 | 86 |

[1]Average runoff condition, and $I_a = 0.2S$.

[2]*Poor:* <50% ground cover or heavily grazed with no mulch.
*Fair:* 50 to 75% ground cover and not heavily grazed.
*Good:* >75% ground cover and lightly or only occasionally grazed.

[3]*Poor:* <50% ground cover.
*Fair:* 50 to 75% ground cover.
*Good:* >75% ground cover.

[4]Actual curve number is less than 30; use CN = 30 for runoff computations.

[5]CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6]*Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
*Fair:* Woods are grazed but not burned, and some forest litter covers the soil.
*Good:* Woods are protected from grazing, and litter and brush adequately cover the soil.