# Appendix B – Hydraulic Calculations

- Normal Depth Calculations - Proposed Conditions Street Sections
- Normal Depth Calculations – Onsite Sections
- Drop Inlet Calculations
- Trench Drain Calculations
- Nomographs
- Finished Floor Elevation Calculations

# Worksheet for RA - Rigel 100-Yr ADD

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | |
|---|---|
| Channel Slope | 0.45 % |
| Discharge | 99.00 cfs |

## Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00.00 | 0.60 |
| 0+05.00 | 0.50 |
| 0+05.00 | 0.50 |
| 0+05.50 | 0.48 |
| 0+05.50 | 0.00 |
| 0+07.00 | 0.13 |
| 0+07.00 | 0.17 |
| 0+30.00 | 0.63 |
| 0+30.00 | 0.63 |
| 0+53.00 | 0.17 |
| 0+53.00 | 0.13 |
| 0+54.50 | 0.00 |
| 0+54.50 | 0.48 |
| 0+55.00 | 0.50 |
| 0+55.00 | 0.50 |
| 0+55.00 | 0.50 |
| 0+60.00 | 0.60 |
| 0+60.00 | 3.60 |

## Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00.00, 0.60) | (0+60.00, 3.60) | 0.016 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | |
|---|---|
| Normal Depth | 0.87 ft |
| Roughness Coefficient | 0.016 |
| Elevation | 0.87 ft |

# Worksheet for RA - Rigel 100-Yr ADD

## Results

| | |
|---|---|
| Elevation Range | 0.00 to 3.60 ft |
| Flow Area | 27.3 ft² |
| Wetted Perimeter | 61.59 ft |
| Hydraulic Radius | 0.44 ft |
| Top Width | 60.00 ft |
| Normal Depth | 0.87 ft |
| Critical Depth | 0.85 ft |
| Critical Slope | 0.51 % |
| Velocity | 3.62 ft/s |
| Velocity Head | 0.20 ft |
| Specific Energy | 1.07 ft |
| Froude Number | 0.947 |
| Flow Type | Subcritical |

## GVF Input Data

| | |
|---|---|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

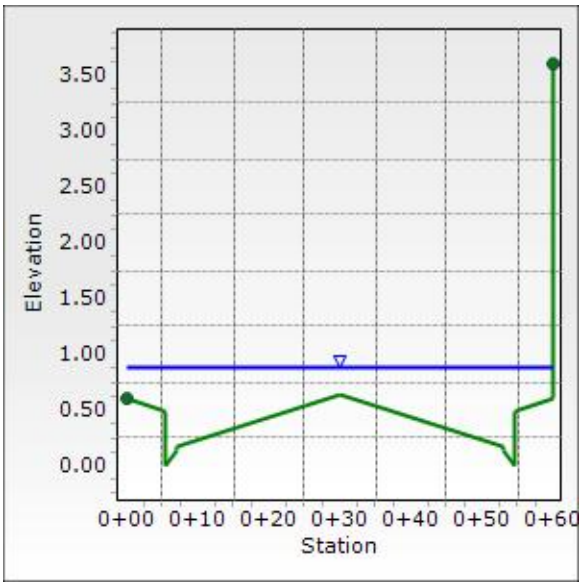
## GVF Output Data

| | |
|---|---|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.87 ft |
| Critical Depth | 0.85 ft |
| Channel Slope | 0.45 % |
| Critical Slope | 0.51 % |

# Cross Section for RA - Rigel 100-Yr ADD

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Channel Slope | 0.45 % |
| Normal Depth | 0.87 ft |
| Discharge | 99.00 cfs |



# Worksheet for MA-2C Meade 100-Yr ADD

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | |
|---|---|
| Channel Slope | 1.40 % |
| Discharge | 190.00 cfs |

## Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00.00 | 0.75 |
| 0+05.00 | 0.65 |
| 0+05.50 | 0.63 |
| 0+05.50 | 0.15 |
| 0+07.00 | 0.28 |
| 0+07.00 | 0.32 |
| 0+30.00 | 0.45 |
| 0+53.00 | 0.17 |
| 0+53.00 | 0.13 |
| 0+54.50 | 0.00 |
| 0+54.50 | 0.48 |
| 0+55.00 | 0.50 |
| 0+60.00 | 0.60 |

## Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00.00, 0.75) | (0+60.00, 0.60) | 0.016 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | |
|---|---|
| Normal Depth | 0.87 ft |
| Roughness Coefficient | 0.016 |
| Elevation | 0.87 ft |
| Elevation Range | 0.00 to 0.75 ft |
| Flow Area | 28.7 ft² |
| Wetted Perimeter | 61.44 ft |
| Hydraulic Radius | 0.47 ft |
| Top Width | 60.00 ft |

# Worksheet for MA-2C Meade 100-Yr ADD

| Results | |
|---|---|
| Normal Depth | 0.87 ft |
| Critical Depth | 1.07 ft |
| Critical Slope | 0.44 % |
| Velocity | 6.62 ft/s |
| Velocity Head | 0.68 ft |
| Specific Energy | 1.55 ft |
| Froude Number | 1.687 |
| Flow Type | Supercritical |

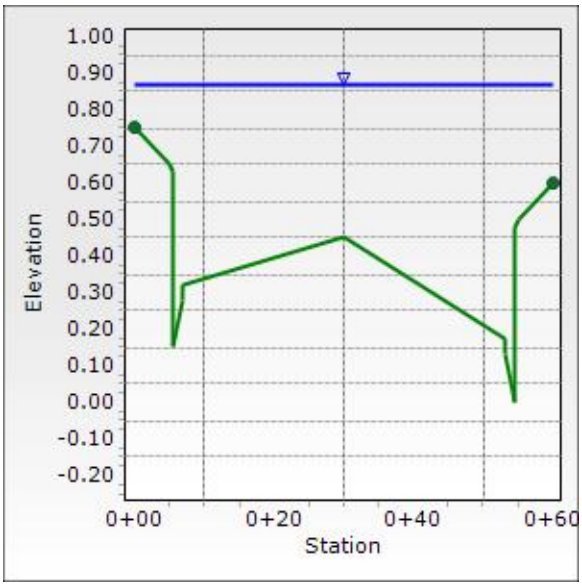
| GVF Input Data | |
|---|---|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.87 ft |
| Critical Depth | 1.07 ft |
| Channel Slope | 1.40 % |
| Critical Slope | 0.44 % |

# Cross Section for MA-2C Meade 100-Yr ADD

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Channel Slope | 1.40 % |
| Normal Depth | 0.87 ft |
| Discharge | 190.00 cfs |



# Worksheet for ONG3N ADD

## Project Description

| | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.10 | % |
| Discharge | 2.00 | cfs |

## Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00.00 | 4.00 |
| 0+00.00 | 0.00 |
| 0+77.70 | 1.19 |

## Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00.00, 4.00) | (0+77.70, 1.19) | 0.013 |

## Options

| | |
|---|---|
| Current Roughness Weighted Method | Pavlovskii's Method |
| Open Channel Weighting Method | Pavlovskii's Method |
| Closed Channel Weighting Method | Pavlovskii's Method |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.26 | ft |
| Roughness Coefficient | 0.013 | |
| Elevation | 0.26 | ft |
| Elevation Range | 0.00 to 4.00 | ft |
| Flow Area | 2.2 | ft² |
| Wetted Perimeter | 17.15 | ft |
| Hydraulic Radius | 0.13 | ft |
| Top Width | 16.89 | ft |
| Normal Depth | 0.26 | ft |
| Critical Depth | 0.19 | ft |
| Critical Slope | 0.55 | % |
| Velocity | 0.92 | ft/s |
| Velocity Head | 0.01 | ft |
| Specific Energy | 0.27 | ft |
| Froude Number | 0.449 | |
| Flow Type | Subcritical | |

## GVF Input Data

# Worksheet for ONG3N ADD

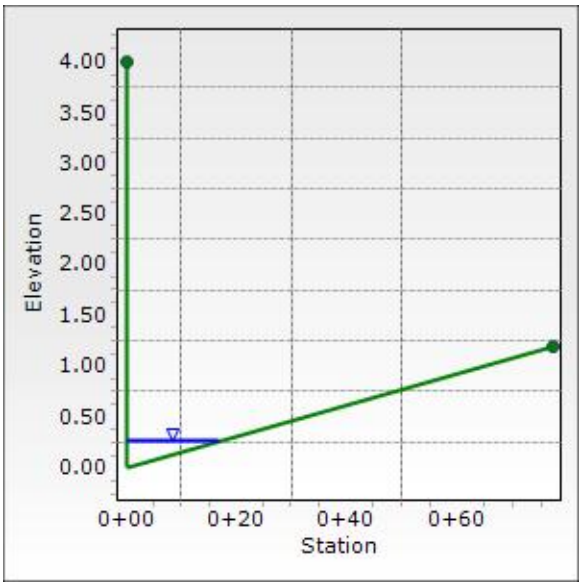
| GVF Input Data | |
|---|---|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

| GVF Output Data | |
|---|---|
| Upstream Depth | 0.00 ft |
| Profile Description | N/A |
| Profile Headloss | 0.00 ft |
| Downstream Velocity | Infinity ft/s |
| Upstream Velocity | Infinity ft/s |
| Normal Depth | 0.26 ft |
| Critical Depth | 0.19 ft |
| Channel Slope | 0.10 % |
| Critical Slope | 0.55 % |

# Cross Section for ONG3N ADD

| Project Description | |
|---|---|
| Friction Method | Manning Formula |
| Solve For | Normal Depth |

| Input Data | |
|---|---|
| Channel Slope | 0.10 % |
| Normal Depth | 0.26 ft |
| Discharge | 2.00 cfs |



# Grate Inlet Headwater Depth Calculation

**2-ft by 2-ft Jensen Grate at OF5 DI #4**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 0.5 |
| W= | Width of Grate (ft) | 2.0 |
| L= | Length of Grate (ft) | 2.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 8.0 |
| Pc= | Perimeter (w/clogging) (ft) | 4.0 |
| Hw= | Headwater depth (ft) | 0.13 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 4.0 |
| Gf= | Grate Opening Factor | 0.64 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 1.3 |
| Hw= | Headwater depth (ft) | 0.01 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.13

# Grate Inlet Headwater Depth Calculation

**4.5-in by 163-ft Trench Drain ONA #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 2.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 163.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 326.8 |
| Pc= | Perimeter (w/clogging) (ft) | 163.4 |
| Hw= | Headwater depth (ft) | 0.03 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 61.1 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 7.6 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.03

# Grate Inlet Headwater Depth Calculation

**4.5-in by 329-ft Trench Drain OND2 #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 329.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 658.8 |
| Pc= | Perimeter (w/clogging) (ft) | 329.4 |
| Hw= | Headwater depth (ft) | 0.01 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 123.4 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 15.4 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.01

# Grate Inlet Headwater Depth Calculation

**4.5-in by 166-ft Trench Drain OND2 #2**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 166.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 332.8 |
| Pc= | Perimeter (w/clogging) (ft) | 166.4 |
| Hw= | Headwater depth (ft) | 0.02 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 62.3 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 7.8 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.02

# Grate Inlet Headwater Depth Calculation

**4.5-in by 85-ft Trench Drain ONE2 #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 2.5 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 85.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 170.8 |
| Pc= | Perimeter (w/clogging) (ft) | 85.4 |
| Hw= | Headwater depth (ft) | 0.05 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 31.9 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 4.0 |
| Hw= | Headwater depth (ft) | 0.01 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.05

# Grate Inlet Headwater Depth Calculation

**4.5-in by 126-ft Trench Drain ONE3 #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 126.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 252.8 |
| Pc= | Perimeter (w/clogging) (ft) | 126.4 |
| Hw= | Headwater depth (ft) | 0.02 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 47.3 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 5.9 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.02

# Grate Inlet Headwater Depth Calculation

**4.5-in by 110-ft Trench Drain ONE3 #2**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 110.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 220.8 |
| Pc= | Perimeter (w/clogging) (ft) | 110.4 |
| Hw= | Headwater depth (ft) | 0.02 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 41.3 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 5.2 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.02

# Grate Inlet Headwater Depth Calculation

**4.5-in by 80-ft Trench Drain ONE4 #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 80.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 160.8 |
| Pc= | Perimeter (w/clogging) (ft) | 80.4 |
| Hw= | Headwater depth (ft) | 0.03 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 30.0 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 3.8 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.03

# Grate Inlet Headwater Depth Calculation

**4.5-in by 44-ft Trench Drain ONE4 #2**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 44.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 88.8 |
| Pc= | Perimeter (w/clogging) (ft) | 44.4 |
| Hw= | Headwater depth (ft) | 0.04 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 16.5 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 2.1 |
| Hw= | Headwater depth (ft) | 0.01 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.04

# Grate Inlet Headwater Depth Calculation

**4.5-in by 25-ft Trench Drain ONE4 #3**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 25.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 50.8 |
| Pc= | Perimeter (w/clogging) (ft) | 25.4 |
| Hw= | Headwater depth (ft) | 0.06 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 9.4 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 1.2 |
| Hw= | Headwater depth (ft) | 0.03 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.06

# Grate Inlet Headwater Depth Calculation

**4.5-in by 158-ft Trench Drain ONF1 #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 158.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 316.8 |
| Pc= | Perimeter (w/clogging) (ft) | 158.4 |
| Hw= | Headwater depth (ft) | 0.02 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 59.3 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 7.4 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.02

# Grate Inlet Headwater Depth Calculation

**4.5-in by 53-ft Trench Drain ONF1 #2**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 53.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 106.8 |
| Pc= | Perimeter (w/clogging) (ft) | 53.4 |
| Hw= | Headwater depth (ft) | 0.04 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 19.9 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 2.5 |
| Hw= | Headwater depth (ft) | 0.01 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.04

# Grate Inlet Headwater Depth Calculation

**4.5-in by 77-ft Trench Drain ONF1 #3**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 77.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 154.8 |
| Pc= | Perimeter (w/clogging) (ft) | 77.4 |
| Hw= | Headwater depth (ft) | 0.03 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^2/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 28.9 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 3.6 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.03

# Grate Inlet Headwater Depth Calculation

**4.5-in by 152-ft Trench Drain ONF2 #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 152.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 304.8 |
| Pc= | Perimeter (w/clogging) (ft) | 152.4 |
| Hw= | Headwater depth (ft) | 0.02 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 57.0 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 7.1 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.02

# Grate Inlet Headwater Depth Calculation

**4.5-in by 417-ft Trench Drain ONG #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 4.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 417.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 834.8 |
| Pc= | Perimeter (w/clogging) (ft) | 417.4 |
| Hw= | Headwater depth (ft) | 0.02 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 156.4 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 19.5 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.02

# Grate Inlet Headwater Depth Calculation

**4.5-in by 190-ft Trench Drain ONG #2**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 4.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 190.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 380.8 |
| Pc= | Perimeter (w/clogging) (ft) | 190.4 |
| Hw= | Headwater depth (ft) | 0.04 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 71.3 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 8.9 |
| Hw= | Headwater depth (ft) | 0.01 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.04

# Grate Inlet Headwater Depth Calculation

**4.5-in by 102-ft Trench Drain ONG #3**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 102.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 204.8 |
| Pc= | Perimeter (w/clogging) (ft) | 102.4 |
| Hw= | Headwater depth (ft) | 0.02 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 38.3 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 4.8 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.02

# Grate Inlet Headwater Depth Calculation

**4.5-in by 135-ft Trench Drain ONG #4**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 4.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 135.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 270.8 |
| Pc= | Perimeter (w/clogging) (ft) | 135.4 |
| Hw= | Headwater depth (ft) | 0.05 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 50.6 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 6.3 |
| Hw= | Headwater depth (ft) | 0.01 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.05

# Grate Inlet Headwater Depth Calculation

**4.5-in by 61-ft Trench Drain ONG #5**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 61.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 122.8 |
| Pc= | Perimeter (w/clogging) (ft) | 61.4 |
| Hw= | Headwater depth (ft) | 0.03 |

**Orifice Conditions:**

$Hw=(Q/(Co*Ac))^2/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 22.9 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 2.9 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.03

# Grate Inlet Headwater Depth Calculation

**4.5-in by 334-ft Trench Drain ONH #1**

**Known:**

| | | |
|---|---|---|
| Q= | Flow (cfs) | 1.0 |
| W= | Width of Grate (ft) | 0.375 |
| L= | Length of Grate (ft) | 334.0 |
| D= | Diameter of Circle (in) | |
| Cf= | Clogging Factor (%) | 50 |

**Weir Conditions:**

$Hw=(Q/(Cw*P))^{2/3}$

| | | |
|---|---|---|
| Cw= | Weir Coefficient | 2.7 |
| P= | Perimeter of grate (ft) | 668.8 |
| Pc= | Perimeter (w/clogging) (ft) | 334.4 |
| Hw= | Headwater depth (ft) | 0.01 |

**Orifice Conditions:**

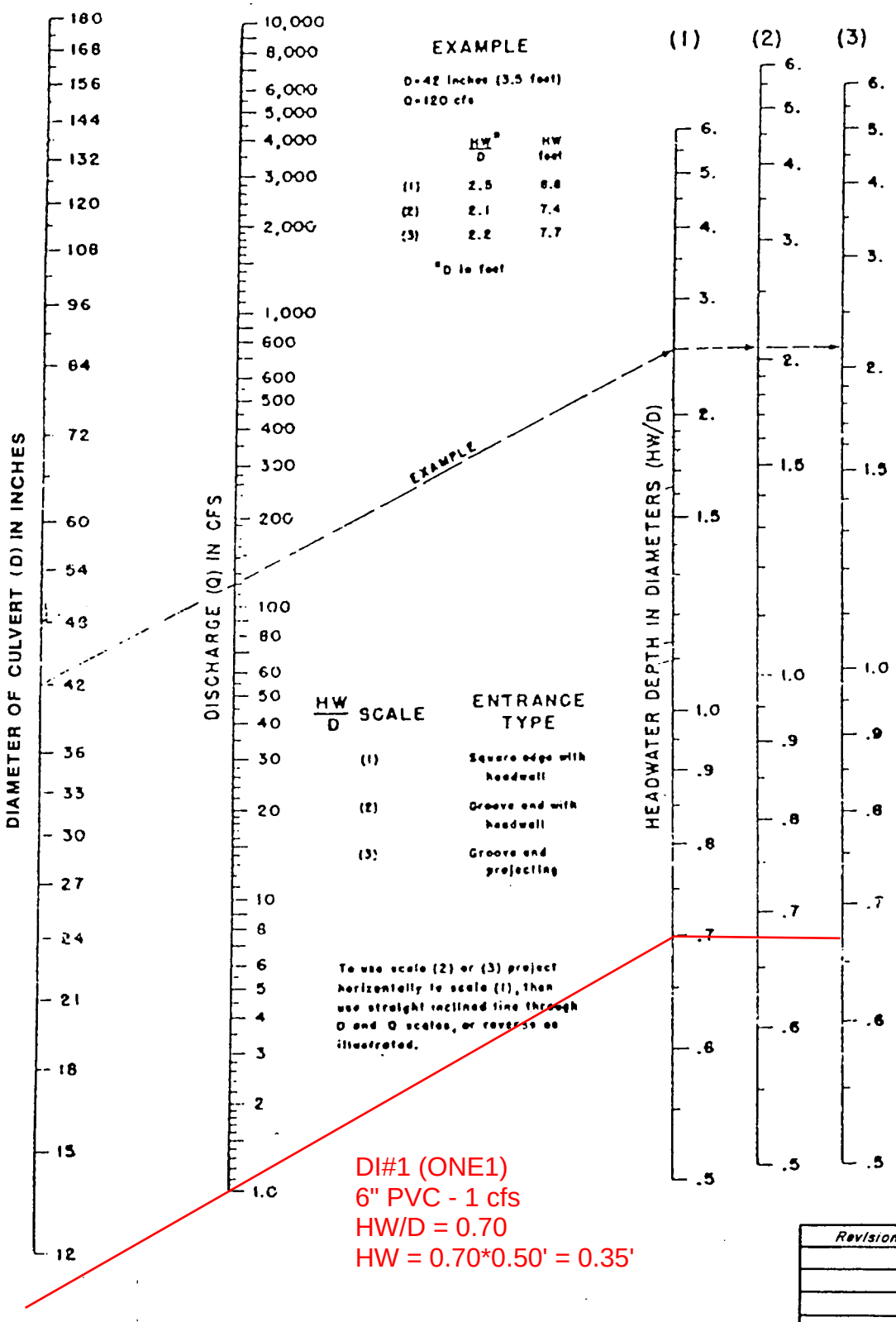
$Hw=(Q/(Co*Ac))^{2}/2*g$

| | | |
|---|---|---|
| Co= | Orifice Coefficient | 0.67 |
| Ag= | Grate Area ($ft^2$) | 125.3 |
| Gf= | Grate Opening Factor | 0.25 |
| Ac= | Grate Open Area (w/ clogging) ($ft^2$) | 15.7 |
| Hw= | Headwater depth (ft) | 0.00 |

**Worst Case Scenario Occurs Under Weir Conditions**

Headwater Depth (ft) = 0.01

# NOMOGRAPH – INLET CONTROL RCP



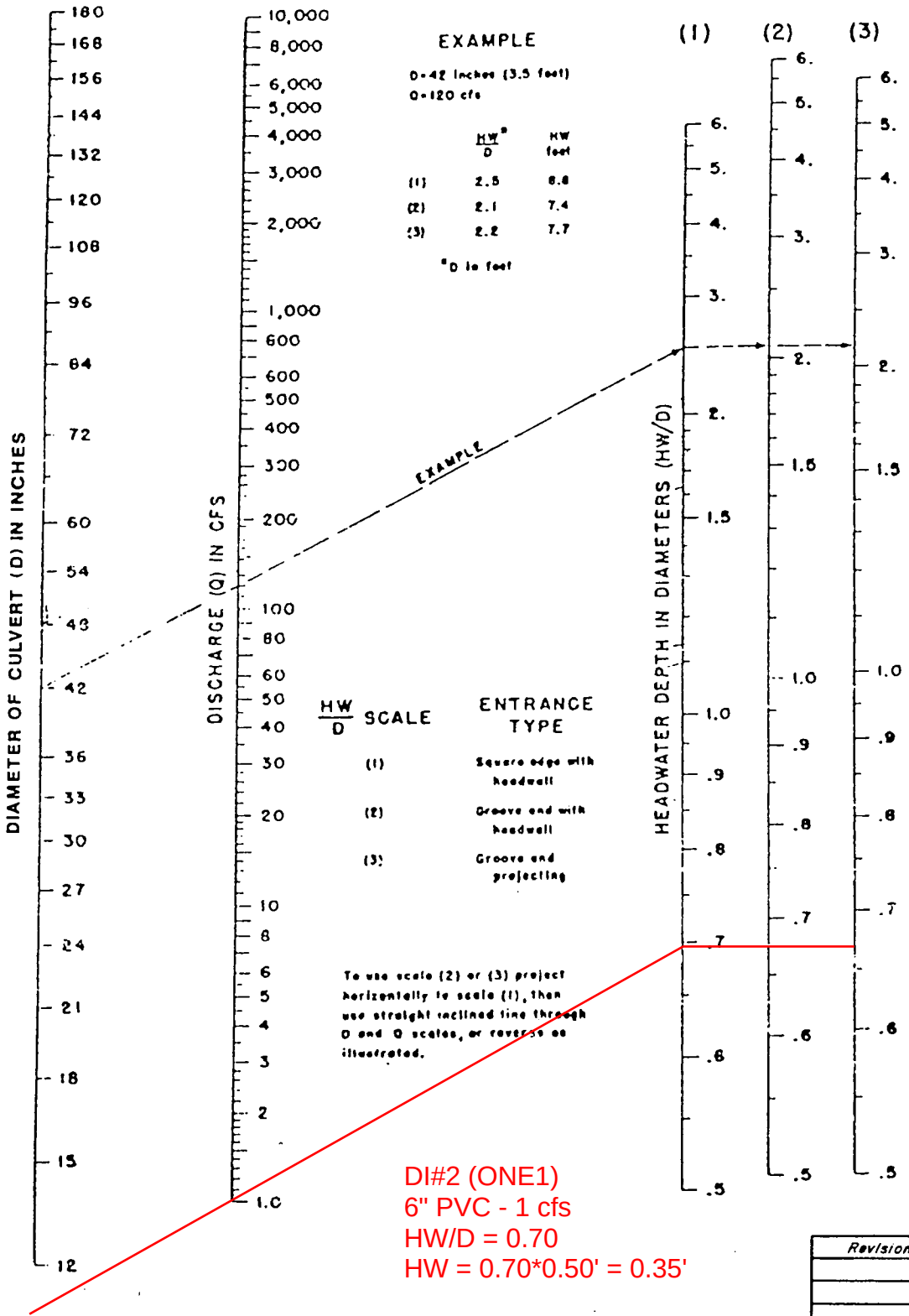

| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

WRC ENGINEERING

REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

# NOMOGRAPH – INLET CONTROL RCP




| Revision | Date |
|---|---|
| | |
| | |
| | |
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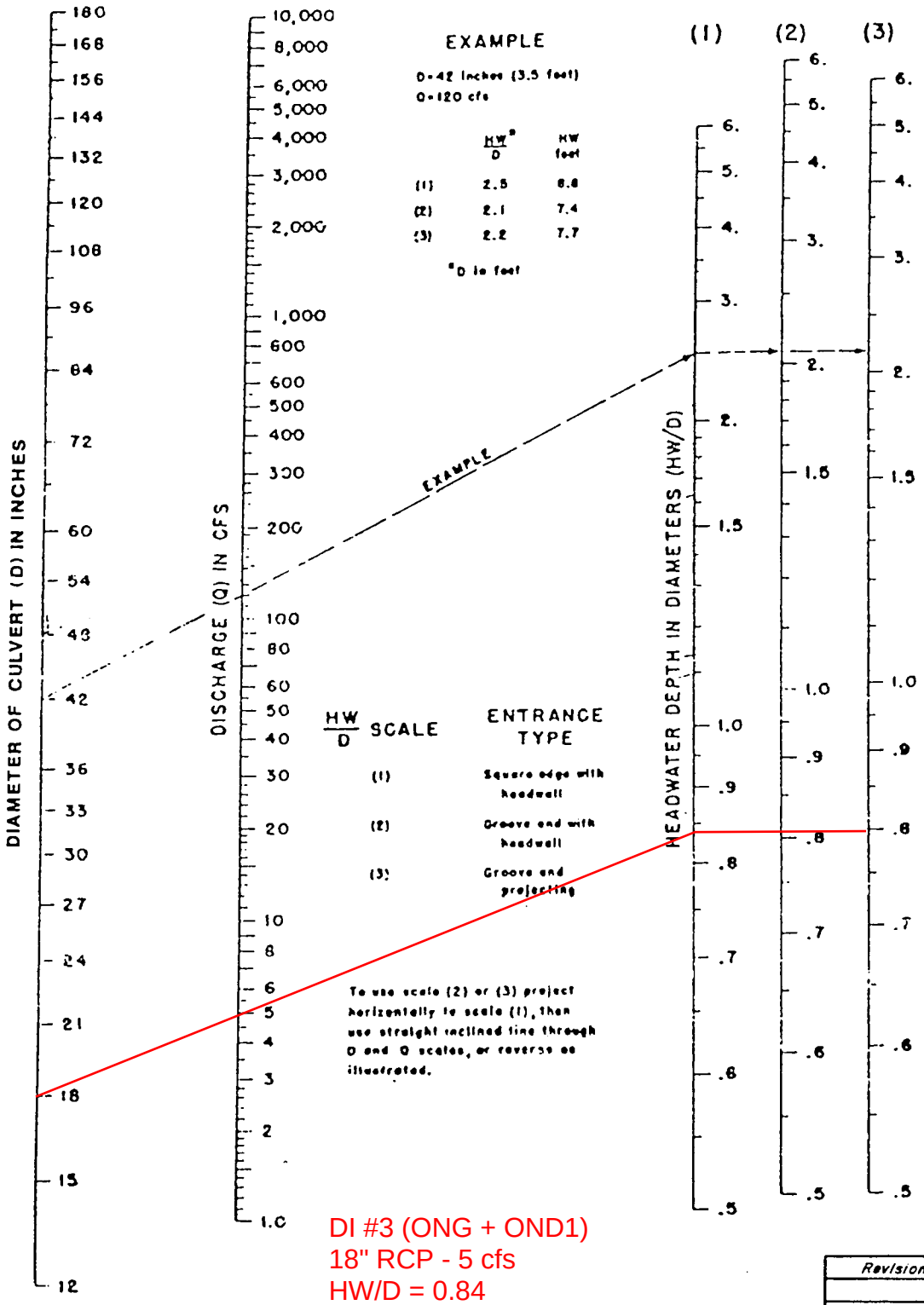
WRC ENGINEERING

REFERENCE: USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

# NOMOGRAPH – INLET CONTROL RCP




DI #3 (ONG + OND1)
18" RCP - 5 cfs
HW/D = 0.84
HW = 0.84*1.5' = 1.26'

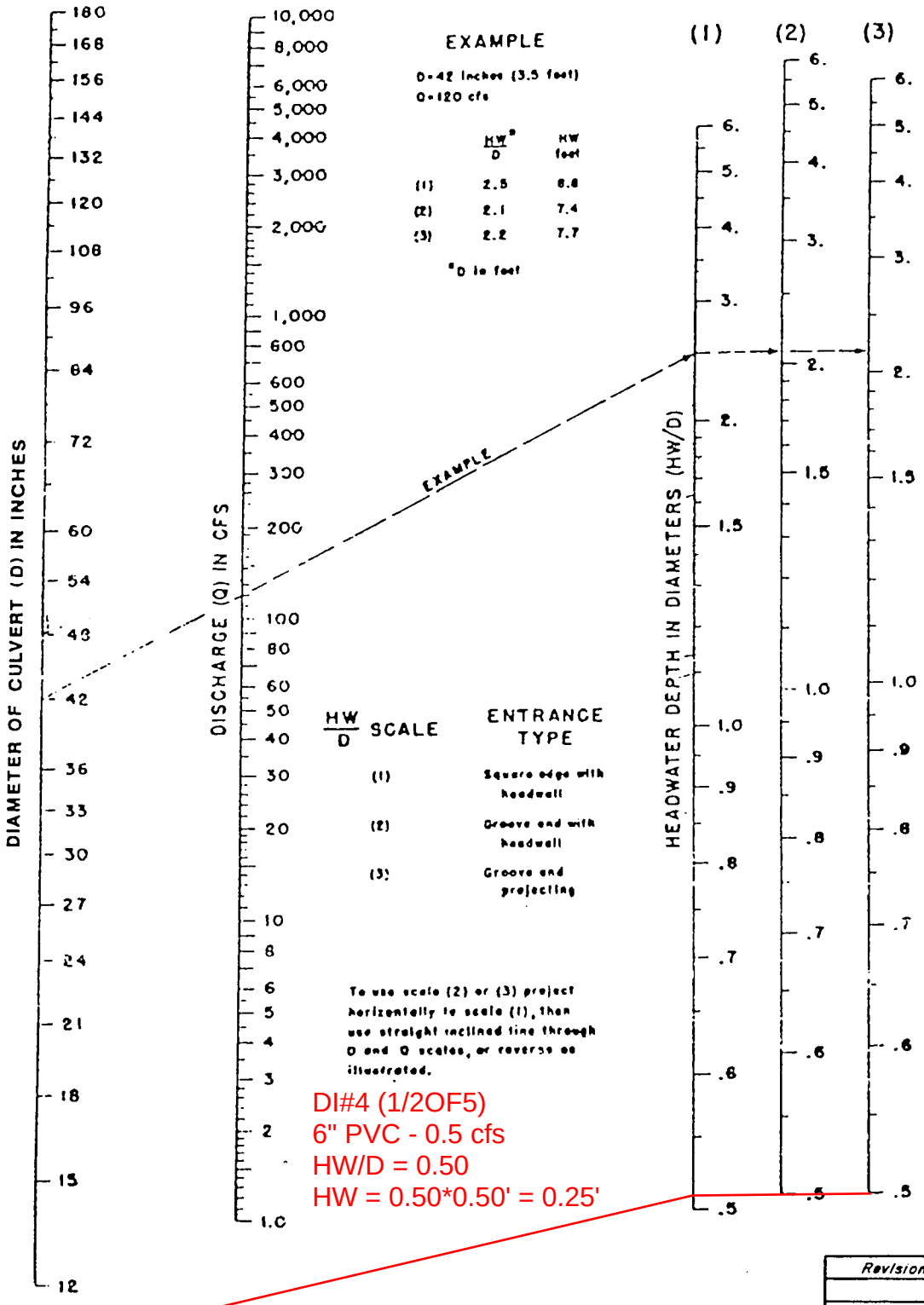
| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

WRC ENGINEERING

REFERENCE:
USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

# NOMOGRAPH – INLET CONTROL RCP




DI#4 (1/2OF5)
6" PVC - 0.5 cfs
HW/D = 0.50
HW = 0.50*0.50' = 0.25'

| Revision | Date |
|---|---|
| | |
| | |
| | |
| | |

WRC ENGINEERING

REFERENCE:
USDOT, FHWA, HDS, No. 5, 1985

FIGURE 1005

| FFE Hydraulic Sections | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ONSITE SECTION | TRIBUTARY BASINS | SLOPE % | $Q_{100}$ (cfs) | FLOW DEPTH (ft) | FLOW LINE (ft) | FLOW LINE + 2D (ft) | WSE (ft) | FFE BLDG1 (ft) | FFE BLDG2 (ft) | FFE BLDG3 (ft) | FFE BLDG4 (ft) | FFE BLDG5 (ft) | FFE BLDG6 (ft) | BLDG PROTECTED? | BLDG PROTECTED? |
| ONA | ONA | 0.54 | 2 | 0.35 | 2107.10 | 2107.80 | - | 2108.00 | - | - | - | - | - | YES | - |
| ONE2 | ONE2 | 0.50 | 2.5 | 0.14 | 2106.90 | 2107.18 | - | 2108.00 | - | - | - | - | 2107.20 | YES | YES |
| ONE4 | ONE4 | 3.60 | 1 | 0.06 | 2107.25 | 2107.37 | - | 2108.00 | - | - | - | 2110.00 | - | YES | YES |
| ONG1 | 1/2ONG | 0.15 | 2 | 0.19 | 2111.35 | 2111.73 | - | - | - | 2111.70 | 2111.80 | - | - | ** | YES |
| ONG2 | 1/2ONG | 0.80 | 2 | 0.13 | 2111.35 | 2111.61 | - | - | 2112.00 | - | - | 2110.00 | - | YES | ** |
| ONG3N | 1/2ONG | 0.10 | 2 | 0.26 | 2107.40 | 2107.92 | - | 2108.00 | - | - | - | - | - | YES | - |
| ONG3S | 1/2ONG | 3.02 | 2 | 0.14 | 2111.70 | 2111.98 | - | - | 2112.00 | - | - | - | - | YES | - |
| **RD | **CRCPS06 + OND1 + OND2 + ONG + ***RD | 0.25 | 2546.5 | 8.56 | - | - | 2108.42 | 2108.00 | - | - | - | - | - | * | - |
| ST2 | **CRCPS06 | 0.90 | 2538 | 6.48 | - | - | 2108.06 | - | 2112.00 | - | - | - | - | YES | - |
| *F-F(ROAD) | **CRCPS06 | 0.70 | 2538 | 3.58 | - | - | 2110.58 | - | - | 2111.70 | - | - | - | YES | - |
| RA | **PS08(OF1) + 78-cfs + ONF2 + ONH | 0.45 | 99 | 0.87 | 2109.90 | 2112.27 | - | - | - | - | 2111.80 | 2110.00 | - | NO | * |
| RA1 | **PS08(OF1) + 78-cfs + ONF1 + ONF2 + ONC + ONB + ONH + 1/2OF5 | 0.68 | 104 | 1.30 | 2107.60 | 2110.40 | - | - | - | - | - | 2110.00 | 2107.20 | * | * |
| MA2A | **PS08(OF1) + **PS08(OF3) + **PS08(OF5) + 78cfs + RA + ONB + ONC + ONE1 + ONE2 + ONE3 + ONE4 + ONF1 + ONF2 + ONH | 0.30 | 196.5 | 1.22 | 2102.30 | 2105.02 | - | 2108.00 | - | - | - | - | - | YES | - |
| MA2C | **PS08(OF1) + **PS08(OF3) + **PS08(OF5) + 78cfs + RA + ONB + ONC + ONF1 + ONF2 + ONH | 1.40 | 190 | 0.87 | 2105.61 | 2107.98 | - | - | - | - | - | - | 2107.20 | * | - |

*Solid Grouted Flood Walls have been provided adjacent to building
**Trench Drains have been provided adjacent to building