# Appendix B – Hydraulic Calculations

- Normal Depth Calculations – Onsite
- Normal Depth Calculations – Swales
- Curb Cut Calculations

# Worksheet for Section UON1-A

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

| Input Data | | |
|---|---|---|
| Channel Slope | 0.30 | % |
| Discharge | 14.00 | cfs |

## Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00.00 | 0.60 |
| 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+29.50 | 0.71 |
| 0+29.50 | 1.21 |
| 0+30.00 | 1.21 |

## Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00.00, 0.60) | (0+30.00, 1.21) | 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 | 0.68 | ft |
| Roughness Coefficient | 0.016 | |
| Elevation | 0.68 | ft |
| Elevation Range | 0.00 to 1.21 | ft |
| Flow Area | 7.0 | ft² |
| Wetted Perimeter | 28.79 | ft |
| Hydraulic Radius | 0.24 | ft |
| Top Width | 28.18 | ft |
| Normal Depth | 0.68 | ft |
| Critical Depth | 0.62 | ft |
| Critical Slope | 0.65 | % |
| Velocity | 1.99 | ft/s |

# Worksheet for Section UON1-A

| Results | |
|---|---|
| Velocity Head | 0.06 ft |
| Specific Energy | 0.74 ft |
| Froude Number | 0.702 |
| Flow Type | Subcritical |

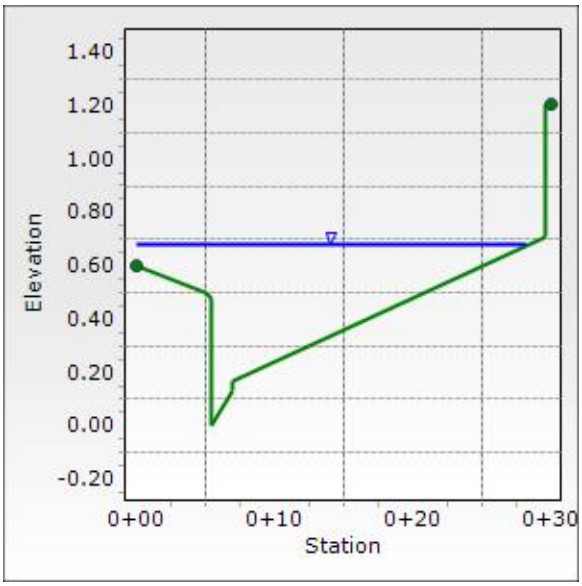
| GVF Input Data | |
|---|---|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

| 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 | 0.68 ft |
| Critical Depth | 0.62 ft |
| Channel Slope | 0.30 % |
| Critical Slope | 0.65 % |

# Cross Section for Section UON1-A

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

| Input Data | |
|---|---|
| Channel Slope | 0.30 % |
| Normal Depth | 0.68 ft |
| Discharge | 14.00 cfs |



# Worksheet for Section UON1-B

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

| Input Data | | |
|---|---|---|
| Channel Slope | 0.60 | % |
| Discharge | 4.50 | cfs |

## Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00.00 | 0.60 |
| 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+30.50 | 0.69 |
| 0+30.50 | 1.19 |
| 0+31.00 | 1.19 |

## Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00.00, 0.60) | (0+31.00, 1.19) | 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 | 0.44 | ft |
| Roughness Coefficient | 0.016 | |
| Elevation | 0.44 | ft |
| Elevation Range | 0.00 to 1.19 | ft |
| Flow Area | 2.2 | ft² |
| Wetted Perimeter | 14.06 | ft |
| Hydraulic Radius | 0.15 | ft |
| Top Width | 13.58 | ft |
| Normal Depth | 0.44 | ft |
| Critical Depth | 0.43 | ft |
| Critical Slope | 0.73 | % |
| Velocity | 2.07 | ft/s |

# Worksheet for Section UON1-B

| Results | |
|---|---|
| Velocity Head | 0.07 ft |
| Specific Energy | 0.50 ft |
| Froude Number | 0.913 |
| Flow Type | Subcritical |

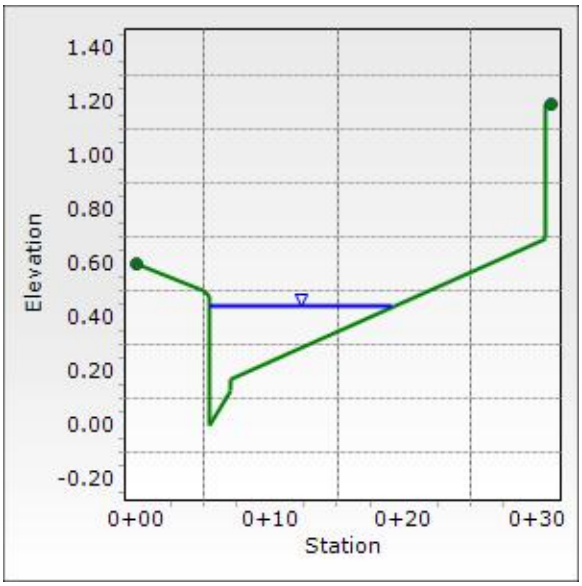
| GVF Input Data | |
|---|---|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

| 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 | 0.44 ft |
| Critical Depth | 0.43 ft |
| Channel Slope | 0.60 % |
| Critical Slope | 0.73 % |

# Cross Section for Section UON1-B

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

| Input Data | |
|---|---|
| Channel Slope | 0.60 % |
| Normal Depth | 0.44 ft |
| Discharge | 4.50 cfs |



# Worksheet for Section FD1

## Project Description

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

## Input Data

| | | |
|---|---|---|
| Channel Slope | 0.63 | % |
| Discharge | 1.00 | cfs |

## Section Definitions

| Station (ft) | Elevation (ft) |
|---|---|
| 0+00.00 | 0.60 |
| 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+30.50 | 0.99 |
| 0+30.50 | 1.49 |
| 0+31.00 | 1.49 |

## Roughness Segment Definitions

| Start Station | Ending Station | Roughness Coefficient |
|---|---|---|
| (0+00.00, 0.60) | (0+31.00, 1.49) | 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 | 0.30 | ft |
| Roughness Coefficient | 0.016 | |
| Elevation | 0.30 | ft |
| Elevation Range | 0.00 to 1.49 | ft |
| Flow Area | 0.6 | ft² |
| Wetted Perimeter | 5.61 | ft |
| Hydraulic Radius | 0.11 | ft |
| Top Width | 5.26 | ft |
| Normal Depth | 0.30 | ft |
| Critical Depth | 0.29 | ft |
| Critical Slope | 0.85 | % |
| Velocity | 1.66 | ft/s |

# Worksheet for Section FD1

| Results | |
|---|---|
| Velocity Head | 0.04 ft |
| Specific Energy | 0.34 ft |
| Froude Number | 0.867 |
| Flow Type | Subcritical |

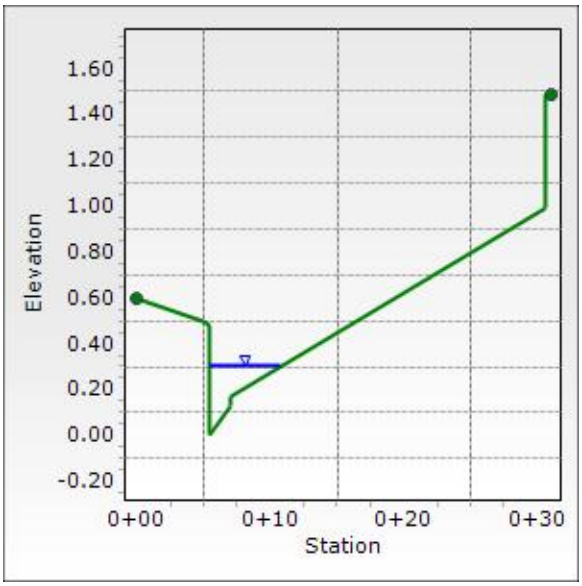
| GVF Input Data | |
|---|---|
| Downstream Depth | 0.00 ft |
| Length | 0.00 ft |
| Number Of Steps | 0 |

| 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 | 0.30 ft |
| Critical Depth | 0.29 ft |
| Channel Slope | 0.63 % |
| Critical Slope | 0.85 % |

# Cross Section for Section FD1

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

| Input Data | |
|---|---|
| Channel Slope | 0.63 % |
| Normal Depth | 0.30 ft |
| Discharge | 1.00 cfs |



# Worksheet for SW2

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

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.025 | |
| Channel Slope | 0.50 | % |
| Left Side Slope | 3.000 | H:V |
| Right Side Slope | 3.000 | H:V |
| Discharge | 4.00 | cfs |

| Results | | |
|---|---|---|
| Normal Depth | 0.78 | ft |
| Flow Area | 1.8 | ft² |
| Wetted Perimeter | 4.95 | ft |
| Hydraulic Radius | 0.37 | ft |
| Top Width | 4.70 | ft |
| Critical Depth | 0.64 | ft |
| Critical Slope | 1.43 | % |
| Velocity | 2.17 | ft/s |
| Velocity Head | 0.07 | ft |
| Specific Energy | 0.86 | ft |
| Froude Number | 0.612 | |
| Flow Type | Subcritical | |

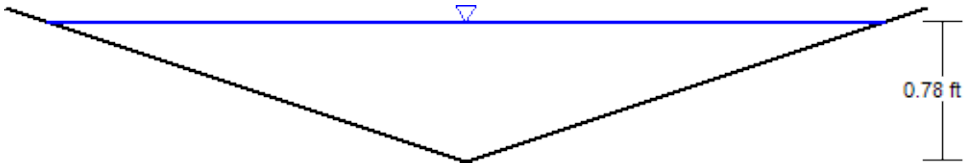
| GVF Input Data | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

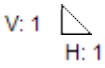
| GVF Output Data | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | N/A | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | 0.00 | ft/s |
| Upstream Velocity | 0.00 | ft/s |
| Normal Depth | 0.78 | ft |
| Critical Depth | 0.64 | ft |
| Channel Slope | 0.50 | % |
| Critical Slope | 1.43 | % |

# Cross Section for SW2

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

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.025 | |
| Channel Slope | 0.50 | % |
| Normal Depth | 0.78 | ft |
| Left Side Slope | 3.000 | H:V |
| Right Side Slope | 3.000 | H:V |
| Discharge | 4.00 | cfs |



# Worksheet for SW3

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

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 0.75 | % |
| Left Side Slope | 4.000 | H:V |
| Right Side Slope | 4.000 | H:V |
| Discharge | 3.50 | cfs |

| Results | | |
|---|---|---|
| Normal Depth | 0.70 | ft |
| Flow Area | 2.0 | ft² |
| Wetted Perimeter | 5.77 | ft |
| Hydraulic Radius | 0.34 | ft |
| Top Width | 5.60 | ft |
| Critical Depth | 0.54 | ft |
| Critical Slope | 2.87 | % |
| Velocity | 1.79 | ft/s |
| Velocity Head | 0.05 | ft |
| Specific Energy | 0.75 | ft |
| Froude Number | 0.533 | |
| Flow Type | Subcritical | |

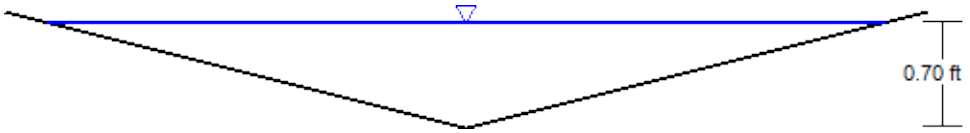
| GVF Input Data | | |
|---|---|---|
| Downstream Depth | 0.00 | ft |
| Length | 0.00 | ft |
| Number Of Steps | 0 | |

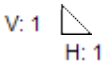
| GVF Output Data | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | N/A | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | 0.00 | ft/s |
| Upstream Velocity | 0.00 | ft/s |
| Normal Depth | 0.70 | ft |
| Critical Depth | 0.54 | ft |
| Channel Slope | 0.75 | % |
| Critical Slope | 2.87 | % |

# Cross Section for SW3

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

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.035 | |
| Channel Slope | 0.75 | % |
| Normal Depth | 0.70 | ft |
| Left Side Slope | 4.000 | H:V |
| Right Side Slope | 4.000 | H:V |
| Discharge | 3.50 | cfs |



# Worksheet for EX CH-3

## Project Description

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

## Input Data

| | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 2.40 | % |
| Bottom Width | 2.00 | ft |
| Discharge | 3.50 | cfs |

## Results

| | | |
|---|---|---|
| Normal Depth | 0.27 | ft |
| Flow Area | 0.5 | ft² |
| Wetted Perimeter | 2.55 | ft |
| Hydraulic Radius | 0.22 | ft |
| Top Width | 2.00 | ft |
| Critical Depth | 0.46 | ft |
| Critical Slope | 0.53 | % |
| Velocity | 6.37 | ft/s |
| Velocity Head | 0.63 | ft |
| Specific Energy | 0.90 | ft |
| Froude Number | 2.141 | |
| Flow Type | Supercritical | |

## GVF Input Data

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

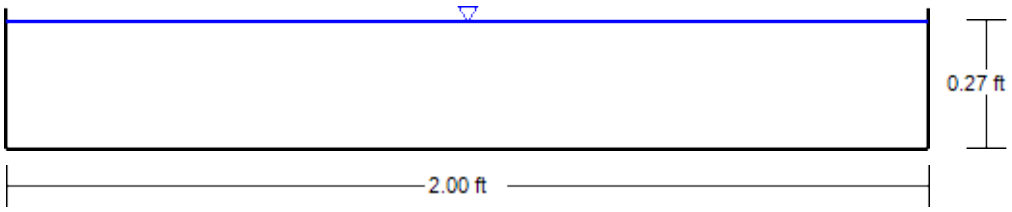
## GVF Output Data

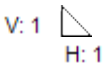
| | | |
|---|---|---|
| Upstream Depth | 0.00 | ft |
| Profile Description | N/A | |
| Profile Headloss | 0.00 | ft |
| Downstream Velocity | Infinity | ft/s |
| Upstream Velocity | Infinity | ft/s |
| Normal Depth | 0.27 | ft |
| Critical Depth | 0.46 | ft |
| Channel Slope | 2.40 | % |
| Critical Slope | 0.53 | % |

# Cross Section for EX CH-3

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

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 2.40 | % |
| Normal Depth | 0.27 | ft |
| Bottom Width | 2.00 | ft |
| Discharge | 3.50 | cfs |



# Worksheet for CH-4

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

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 1.00 | % |
| Bottom Width | 3.00 | ft |
| Discharge | 4.00 | cfs |

| Results | | |
|---|---|---|
| Normal Depth | 0.30 | ft |
| Flow Area | 0.9 | ft² |
| Wetted Perimeter | 3.59 | ft |
| Hydraulic Radius | 0.25 | ft |
| Top Width | 3.00 | ft |
| Critical Depth | 0.38 | ft |
| Critical Slope | 0.46 | % |
| Velocity | 4.51 | ft/s |
| Velocity Head | 0.32 | ft |
| Specific Energy | 0.61 | ft |
| Froude Number | 1.460 | |
| 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 | 0.30 | ft |
| Critical Depth | 0.38 | ft |
| Channel Slope | 1.00 | % |
| Critical Slope | 0.46 | % |

# Cross Section for CH-4

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

| Input Data | | |
|---|---|---|
| Roughness Coefficient | 0.013 | |
| Channel Slope | 1.00 | % |
| Normal Depth | 0.30 | ft |
| Bottom Width | 3.00 | ft |
| Discharge | 4.00 | cfs |