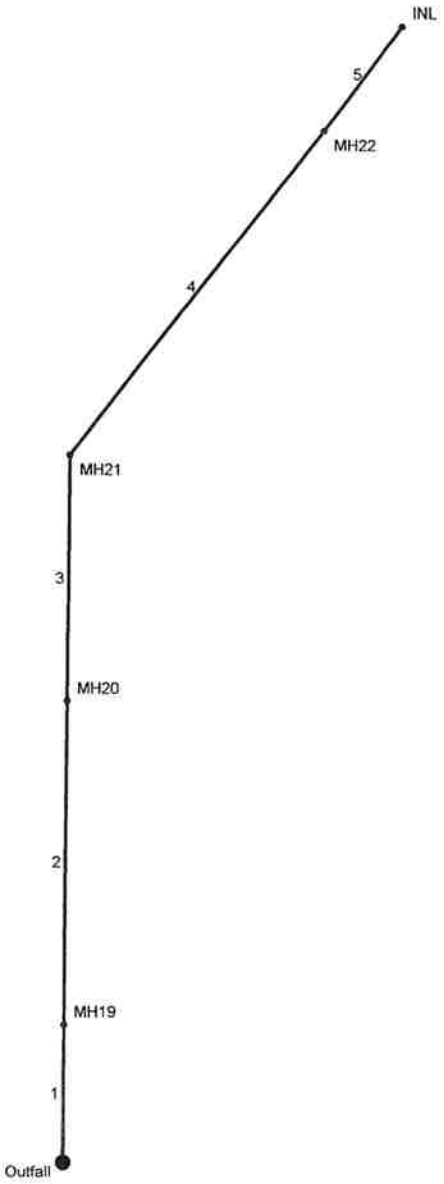
# Hydraulic Analysis

# Outfall 4 (Drainage Area 7)

# Outfall 4 - normal_stage




- Maximum flow of 200 cfs with river at normal stage

| Project File: Outfall 4 - normal_stage.stm | Number of lines: 5 | Date: 11-30-2010 |
|---|---|---|

Hydraflow Storm Sewers Extension v6.066

# Storm Sewer Inventory Report



| Line No. | Alignment | | | | Flow Data | | | | Physical Data | | | | | | | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dnstr line No. | Line length (ft) | Defl angle (deg) | Junc type | Known Q (cfs) | Drng area (ac) | Runoff coeff (C) | Inlet time (min) | Invert El Dn (ft) | Line slope (%) | Invert El Up (ft) | Line size (in) | Line shape | N value (n) | J-loss coeff (K) | Inlet/ Rim El (ft) | |
| 1 | End | 153.00 | -89.35 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 0.50 | 0.92 | 1.90 | 48x48 | Box | 0.013 | 0.15 | 10.00 | OUT - MH19 |
| 2 | 1 | 360.00 | 0.00 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 1.90 | 0.14 | 2.40 | 48 | Cir | 0.013 | 0.15 | 17.00 | MH19 - MH20 |
| 3 | 2 | 272.00 | 0.00 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 6.80 | 1.36 | 10.50 | 48 | Cir | 0.013 | 0.66 | 16.00 | MH20 - MH21 |
| 4 | 3 | 460.00 | 37.56 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 10.50 | 0.65 | 13.50 | 48 | Cir | 0.013 | 0.15 | 35.00 | MH21 - MH22 |
| 5 | 4 | 145.00 | -1.22 | MH | 200.00 | 0.00 | 0.00 | 0.0 | 21.00 | 2.76 | 25.00 | 48 | Cir | 0.013 | 1.00 | 34.00 | MH22 - INL |

$Q_T$

Outfall 4 - normal_stage | Number of lines: 5 | Date: 11-30-2010

# Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | |
| 1 | End | 153.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.3 | 0.0 | 200.0 | 174.9 | 12.50 | 48 x 48 b | 0.92 | 0.50 | 1.90 | 4.50 | 5.90 | 4.50 | 10.00 | OUT - MH19 |
| 2 | 1 | 360.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.9 | 0.0 | 200.0 | 53.53 | 15.92 | 48 | 0.14 | 1.90 | 2.40 | 5.90 | 12.88 | 10.00 | 17.00 | MH19 - MH20 |
| 3 | 2 | 272.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.6 | 0.0 | 200.0 | 167.5 | 15.92 | 48 | 1.36 | 6.80 | 10.50 | 13.47 | 18.75 | 17.00 | 16.00 | MH20 - MH21 |
| 4 | 3 | 460.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.2 | 0.0 | 200.0 | 116.0 | 15.92 | 48 | 0.65 | 10.50 | 13.50 | 21.35 | 30.27 | 16.00 | 35.00 | MH21 - MH22 |
| 5 | 4 | 145.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 200.0 | 238.6 | 15.92 | 48 | 2.76 | 21.00 | 25.00 | 30.86 | 33.67 | 35.00 | 34.00 | MH22 - INL |

pipe full

below overtopping elev.

Outfall 4 - normal_stage

Number of lines: 5

Run Date: 11-30-2010

NOTES: Intensity = 106.59 / (Inlet time + 17.00) ^ 0.85; Return period = 100 Yrs. ; c = cir e = ellip b = box

# Hydraulic Grade Line Computations

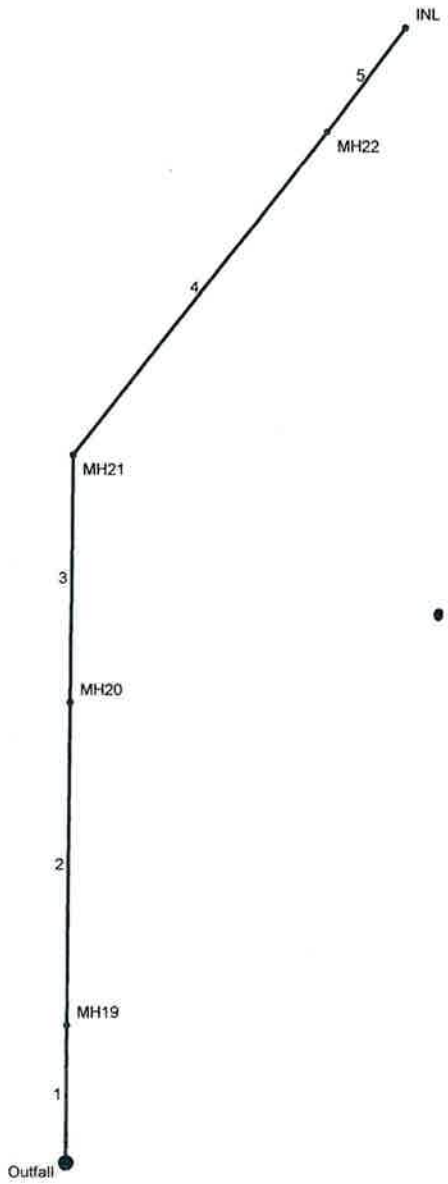


| Line | Size | Q | Downstream | | | | | | | | Len | Upstream | | | | | | | | Check | | JL coeff | Minor loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | Ave Sf | Enrgy loss | | |
| | (in) | (cfs) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (ft) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (%) | (ft) | (K) | (ft) |
| 1 | 48<br>48 b | 200.0 | 0.50 | 4.50 | 4.00 | 16.00 | 12.50 | 2.43 | 6.93 | 1.196 | 153.00 | 1.90 | 5.90 | 4.00** | 16.00 | 12.50 | 2.43 | 8.33 | 1.196 | 1.196 | n/a | 0.15 | n/a |
| 2 | 48 | 200.0 | 1.90 | 5.90 | 4.00* | 12.56 | 15.92 | 3.94 | 9.84 | 1.939 | 360.00 | 2.40 | 12.88 | 4.00 | 12.57 | 15.92 | 3.94 | 16.82 | 1.939 | 1.939 | 6.980 | 0.15 | 0.59 |
| 3 | 48 | 200.0 | 6.80 | 13.47 | 4.00 | 12.56 | 15.92 | 3.94 | 17.41 | 1.939 | 272.00 | 10.50 | 18.75 | 4.00 | 12.57 | 15.92 | 3.94 | 22.69 | 1.939 | 1.939 | 5.274 | 0.66 | 2.60 |
| 4 | 48 | 200.0 | 10.50 | 21.35 | 4.00 | 12.56 | 15.92 | 3.94 | 25.29 | 1.939 | 460.00 | 13.50 | 30.27 | 4.00 | 12.57 | 15.92 | 3.94 | 34.21 | 1.939 | 1.939 | 8.919 | 0.15 | 0.59 |
| 5 | 48 | 200.0 | 21.00 | 30.86 | 4.00 | 12.56 | 15.92 | 3.94 | 34.80 | 1.939 | 145.00 | 25.00 | 33.67 | 4.00 | 12.57 | 15.92 | 3.94 | 37.61 | 1.939 | 1.939 | 2.812 | 1.00 | 3.94 |

**Outfall 4 - normal_stage** | Number of lines: 5 | Run Date: 11-30-2010

Notes: * Normal depth assumed.; ** Critical depth. ; c = cir e = ellip b = box

# Outfall 4 - 10-yr_stage




- Maximum flow of 155 cfs with river at 10-yr storm stage

| Project File: Outfall 4 - 10-yr_stage.stm | Number of lines: 5 | Date: 11-30-2010 |
|---|---|---|

# Storm Sewer Inventory Report



| Line No. | Alignment | | | | Flow Data | | | | Physical Data | | | | | | | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Dnstr line No. | Line length (ft) | Defl angle (deg) | Junc type | Known Q (cfs) | Drng area (ac) | Runoff coeff (C) | Inlet time (min) | Invert El Dn (ft) | Line slope (%) | Invert El Up (ft) | Line size (in) | Line shape | N value (n) | J-loss coeff (K) | Inlet/ Rim El (ft) | |
| 1 | End | 153.00 | -89.35 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 0.50 | 0.92 | 1.90 | 48x48 | Box | 0.013 | 0.15 | 10.00 | OUT - MH19 |
| 2 | 1 | 360.00 | 0.00 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 1.90 | 0.14 | 2.40 | 48 | Cir | 0.013 | 0.15 | 17.00 | MH19 - MH20 |
| 3 | 2 | 272.00 | 0.00 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 6.80 | 1.36 | 10.50 | 48 | Cir | 0.013 | 0.66 | 16.00 | MH20 - MH21 |
| 4 | 3 | 460.00 | 37.56 | MH | 0.00 | 0.00 | 0.00 | 0.0 | 10.50 | 0.65 | 13.50 | 48 | Cir | 0.013 | 0.15 | 35.00 | MH21 - MH22 |
| 5 | 4 | 145.00 | -1.22 | MH | 155.00 | 0.00 | 0.00 | 0.0 | 21.00 | 2.76 | 25.00 | 48 | Cir | 0.013 | 1.00 | 34.00 | MH22 - INL |

$Q_T$

Outfall 4 - 10-yr_stage

Number of lines: 5

Date: 11-30-2010

# Storm Sewer Tabulation



| Station | | Len | Drng Area | | Rnoff coeff | Area x C | | Tc | | Rain (I) | Total flow | Cap full | Vel | Pipe | | Invert Elev | | HGL Elev | | Grnd / Rim Elev | | Line ID |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Line | To Line | (ft) | Incr (ac) | Total (ac) | (C) | Incr | Total | Inlet (min) | Syst (min) | (in/hr) | (cfs) | (cfs) | (ft/s) | Size (in) | Slope (%) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | Dn (ft) | Up (ft) | |
| 1 | End | 153.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.7 | 0.0 | 155.0 | 174.9 | 9.69 | 48 x 48 b | 0.92 | 0.50 | 1.90 | 15.50 | 16.60 | 4.50 | 10.00 | OUT - MH19 |
| 2 | 1 | 360.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 1.2 | 0.0 | 155.0 | 53.53 | 12.34 | 48 | 0.14 | 1.90 | 2.40 | 16.82 | 21.01 | 10.00 | 17.00 | MH19 - MH20 |
| 3 | 2 | 272.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.8 | 0.0 | 155.0 | 167.5 | 12.34 | 48 | 1.36 | 6.80 | 10.50 | 21.37 | 24.53 | 17.00 | 16.00 | MH20 - MH21 |
| 4 | 3 | 460.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.2 | 0.0 | 155.0 | 116.0 | 12.34 | 48 | 0.65 | 10.50 | 13.50 | 26.10 | 31.45 | 16.00 | 35.00 | MH21 - MH22 |
| 5 | 4 | 145.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.0 | 0.0 | 0.0 | 155.0 | 238.6 | 12.34 | 48 | 2.76 | 21.00 | 25.00 | 31.81 | 33.50 | 35.00 | 34.00 | MH22 - INL |

below overtopping elev.

Nauguatuck River
10-yr storm elev.
(10% annual chance)

| | | |
|---|---|---|
| Outfall 4 - 10-yr_stage | Number of lines: 5 | Run Date: 11-30-2010 |

NOTES: Intensity = 106.59 / (Inlet time + 17.00) ^ 0.85; Return period = 100 Yrs. ; c = cir e = ellip b = box

# Hydraulic Grade Line Computations



| Line | Size | Q | Downstream | | | | | | | | Len | Upstream | | | | | | | | Check | | JL coeff | Minor loss |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | | Invert elev | HGL elev | Depth | Area | Vel | Vel head | EGL elev | Sf | Ave Sf | Enrgy loss | | |
| | (in) | (cfs) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (ft) | (ft) | (ft) | (ft) | (sqft) | (ft/s) | (ft) | (ft) | (%) | (%) | (ft) | (K) | (ft) |
| 1 | 48<br>48 b | 155.0 | 0.50 | 15.50 | 4.00 | 16.00 | 9.69 | 1.46 | 16.96 | 0.718 | 153.00 | 1.90 | 16.60 | 4.00 | 16.00 | 9.69 | 1.46 | 18.06 | 0.718 | 0.718 | 1.099 | 0.15 | 0.22 |
| 2 | 48 | 155.0 | 1.90 | 16.82 | 4.00 | 12.56 | 12.34 | 2.37 | 19.18 | 1.165 | 360.00 | 2.40 | 21.01 | 4.00 | 12.57 | 12.33 | 2.37 | 23.38 | 1.164 | 1.165 | 4.193 | 0.15 | 0.35 |
| 3 | 48 | 155.0 | 6.80 | 21.37 | 4.00 | 12.56 | 12.34 | 2.37 | 23.73 | 1.165 | 272.00 | 10.50 | 24.53 | 4.00 | 12.57 | 12.33 | 2.37 | 26.90 | 1.164 | 1.165 | 3.168 | 0.66 | 1.56 |
| 4 | 48 | 155.0 | 10.50 | 26.10 | 4.00 | 12.56 | 12.34 | 2.37 | 28.46 | 1.165 | 460.00 | 13.50 | 31.45 | 4.00 | 12.57 | 12.33 | 2.37 | 33.82 | 1.164 | 1.165 | 5.357 | 0.15 | 0.35 |
| 5 | 48 | 155.0 | 21.00 | 31.81 | 4.00 | 12.56 | 12.34 | 2.37 | 34.17 | 1.165 | 145.00 | 25.00 | 33.50 | 4.00 | 12.57 | 12.33 | 2.37 | 35.86 | 1.164 | 1.165 | 1.689 | 1.00 | 2.37 |

**Outfall 4 - 10-yr_stage** | Number of lines: 5 | Run Date: 11-30-2010

; c = cir e = ellip b = box

Engineering,
Landscape Architecture
and Environmental Science

MILONE & MACBROOM®
99 Realty Drive
Cheshire, Connecticut 06410
(203) 271-1773 Fax (203) 272-9733

JOB Derby / Ansonia Levee Certification (1560-119)
SHEET NO. 1 OF 1
CALCULATED BY FAB DATE 11/19/10
CHECKED BY DATE
SCALE Discharges from BJ's site (D.A. 7)

- Discharge from BJ's site:

  - D.A. = 484,340 $ft^2$ ≈ 11.20 acres //

  - $C_{COMP} = \frac{(0.17 \times 0.45) + (11.03 \times 0.60)}{11.20}$

  - $C_{COMP} = 0.60$ //

  - $T_c = 5$ min ≈ $I_{10} = 6.0$ in/hr

    $I_{100} = 7.8$ in/hr

  - $Q_{10} = 0.60 \times 6.0 \times 11.20 = 40.32$ cfs

  - $Q_{100} = 0.60 \times 7.8 \times 11.20 = 52.42$ cfs

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JOB Derby / Ansonia Levee Certification (1560-119)
SHEET NO. 1 OF 1
CALCULATED BY FAB DATE 11/13/10
CHECKED BY _____ DATE _____
SCALE Analysis of 48-inch pressure conduit

- Analysis of 48-inch pressure conduit:
  - 100-yr storm runoff for Area 7 = 281.5 cfs (Outfall 4)
  - 100-yr storm runoff from DJ's = 52.4 cfs

    281.5 - 52.4 ≈ 229 cfs

  - Capacity of pressure conduit = 155 cfs

    229 - 155 = 74 cfs (additional flow to Outfall 2 - Derby Pump Station)

  - 8'x6' gravity conduit in Derby Pump Station:

    100-yr storm runoff = 475.9 cfs (Outfall 2)

  - Maximum capacity of gravity conduit = ± 548 cfs

    548 - 475.9 ≈ 72 cfs ≈ 74 cfs OK //

**Hydraulic Analysis**

**Outfall 5 (Drainage Area 8)**

Manning Pipe Calculator

Given Input Data:

| | |
|---|---|
| Shape | Rectangular |
| Solving for | Depth of Flow |
| Height | 60.0000 in |
| Width | 72.0000 in |
| Flowrate | 290.0000 cfs |
| Slope | 0.0031 ft/ft |
| Manning's n | 0.0130 |

Computed Results:

| | |
|---|---|
| Depth | 59.9469 in |
| Area | 30.0000 ft2 |
| Wetted Area | 29.9735 ft2 |
| Wetted Perimeter | 191.8939 in |
| Perimeter | 264.0000 in |
| Velocity | 9.6752 fps |
| Hydraulic Radius | 22.4925 in |
| Percent Full | 99.9115 % |
| Full flow Flowrate | 234.7884 cfs |
| Full flow velocity | 7.8263 fps |

- Outfall 5
  - Maximum capacity = 290 cfs
  - pump capacity (2/3 operating) = 90 cfs (45 cfs each pump)
  - 100-yr storm runoff = 364 cfs

**Overall Watershed Area Map**