

December 13, 2023

Brandon Theobald  
WHKS  
2905 South Broadway South  
Rochester, MN 55904

MEMO: Kasson Apartments - Flood analysis for 5<sup>th</sup> Ave NE

Dear Mr. Theobald,

The proposed Kasson Apartments project (PIN 246081009) owned by 504 Development, LLC has an understory garage located in close proximity to the westerly right of way of 5<sup>th</sup> Ave NE which limits the acceptable slope from right of way to the building to just half a foot. The location of the driveway is also at the low point of 5<sup>th</sup> Ave NE so there is concern that if the street were to flood, it would back up into the garage which could cause flooding. An analysis has been performed to determine the potential for flooding of the street and apartment building garage area.

On December 12<sup>th</sup>, 2023, our survey crew visited the site and collected data both within the 5<sup>th</sup> Ave NE right of way and school property where stormwater would flow if not captured and conveyed by the existing storm system in the street. The following critical elevations were collected.

- Catchbasin in driveway of proposed apartment building - Grate: 1236.50 TBC\* 1237.16  
\* catchbasin frame to be replaced with a drive over frame and grate for the proposed entrance
- Catchbasin across street of proposed apartment building - Grate: 1236.49 TBC 1237.06
- Flowline elevation of entrance to school to the north - 1236.61.
- Elevation of sidewalk at entrance to school to the north - 1236.80 (this was determined as the Emergency Overflow).

With this information, we entered storage areas into HydroCad to compute the volume of storage in the street from the catchbasin grate elevations of 1236.50 to an elevation of 1237.50 (which is half a foot higher than the proposed parking garage elevation of 1237.50). We were able to use our topographic survey data to determine areas between 1236.50 (CB Grate) and 1236.80 (E.O.). We interpolated areas above this elevation by connecting the contours along the sidewalk on the east side of 5<sup>th</sup> Ave. We also entered the total watershed that drains to this low point in the system (9.36 acres).

We ran the model without any flow being captured in any catchbasins or being routed via any of the existing pipes to mimic a plugged system. This forces all runoff to overtop 5<sup>th</sup> Ave NE and flow into the school property. Under this scenario, the calculated depths of pooling in the street and outflow rates overtopping the sidewalk were calculated to be:

|        |           |                                 |
|--------|-----------|---------------------------------|
| 2yr    | 20.69 cfs | 1237.09 - 0.29 feet overtopping |
| 10 yr  | 38.35 cfs | 1237.18 - 0.38 feet overtopping |
| 100 yr | 77.54 cfs | 1237.34 - 0.54 feet overtopping |

The analysis shows that the flooding of 5<sup>th</sup> Ave would not back up into the proposed garage at an elevation of 1237.50. This is primarily attributed to the elevations at the entrance into the school at the entrance north of the low point of 5<sup>th</sup> Ave. We also looked at the route this surface routing would flow through the school property and found it would route through the parking lot and north of the building.

The scenario modeled is highly unlikely to happen but does provide assurance that if the entire system were plugged, stormwater would not back up into the proposed garage nor would it flood the school building.

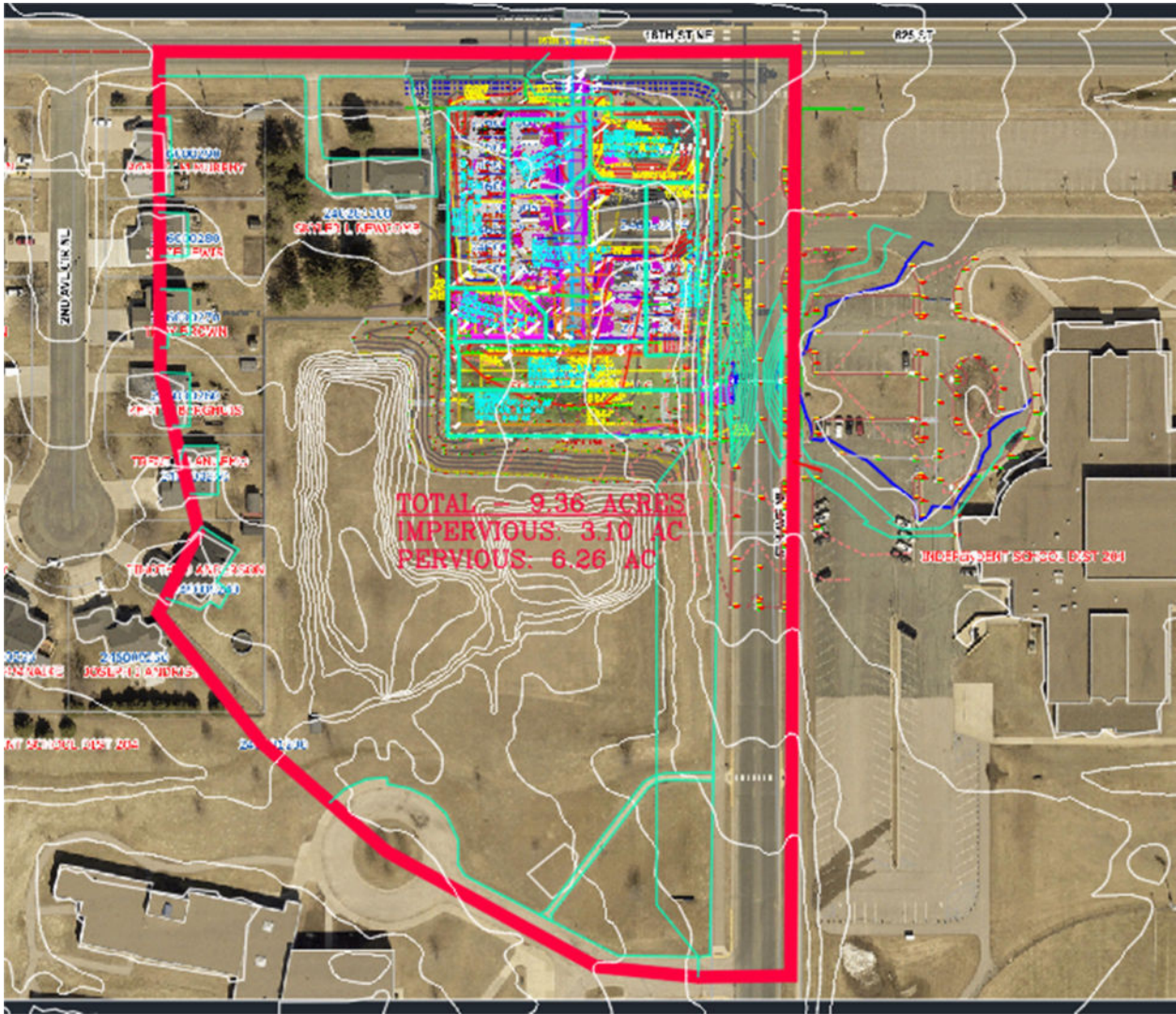
Please review and provide comments if you need any additional information pertaining to this question of whether flooding in 5<sup>th</sup> Ave NE could have detriment to the project or adjoining properties.

Sincerely,  
Mark  
Welch  
Mark Welch, PE

A digital signature block for Mark Welch. It includes the text "Digitally signed by Mark Welch", "DN: cn=Mark Welch, o=G", "Cubed, ou", "email=markw@ggg.to, c=US", and "Date: 2023.12.13 12:48:51 -06'00'". A red line is drawn through the signature text.

Cc: 504 Development, LLC

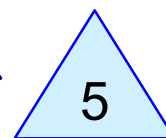
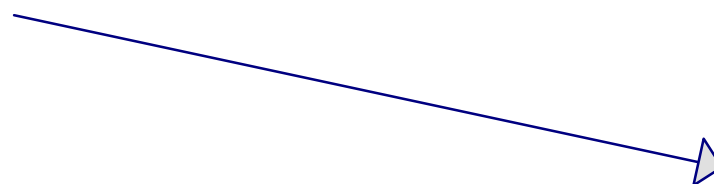
Attachments:  
Contributing Watershed Map  
HydroCad Model

[illegible]

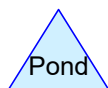
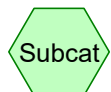
## HydroCad Report



Existing



5th Ave



**Routing Diagram for 5th Ave NE flood analysis**

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## 5th Ave NE flood analysis

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### Area Listing (all nodes)

| Area<br>(acres) | CN        | Description<br>(subcatchment-numbers)    |
|-----------------|-----------|------------------------------------------|
| 5.731           | 79        | 50-75% Grass cover, Fair, HSG C (EX)     |
| 2.028           | 98        | Paved roads w/curbs & sewers, HSG B (EX) |
| 1.060           | 98        | Proposed Impervious, HSG C (EX)          |
| 0.540           | 79        | Proposed Pervious, HSG C (EX)            |
| <b>9.359</b>    | <b>85</b> | <b>TOTAL AREA</b>                        |

## 5th Ave NE flood analysis

MSE 24-hr 3 2-yr Rainfall=2.94"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

### Subcatchment EX: Existing

Runoff Area=9.359 ac 32.99% Impervious Runoff Depth=1.54"

Tc=12.0 min CN=85 Runoff=20.77 cfs 1.199 af

### Pond 5: 5th Ave

Peak Elev=1,237.09' Storage=974 cf Inflow=20.77 cfs 1.199 af

Outflow=20.69 cfs 1.197 af

**Total Runoff Area = 9.359 ac Runoff Volume = 1.199 af Average Runoff Depth = 1.54"**  
**67.01% Pervious = 6.271 ac 32.99% Impervious = 3.088 ac**

## 5th Ave NE flood analysis

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MSE 24-hr 3 2-yr Rainfall=2.94"

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### Summary for Subcatchment EX: Existing

Runoff = 20.77 cfs @ 12.20 hrs, Volume= 1.199 af, Depth= 1.54"

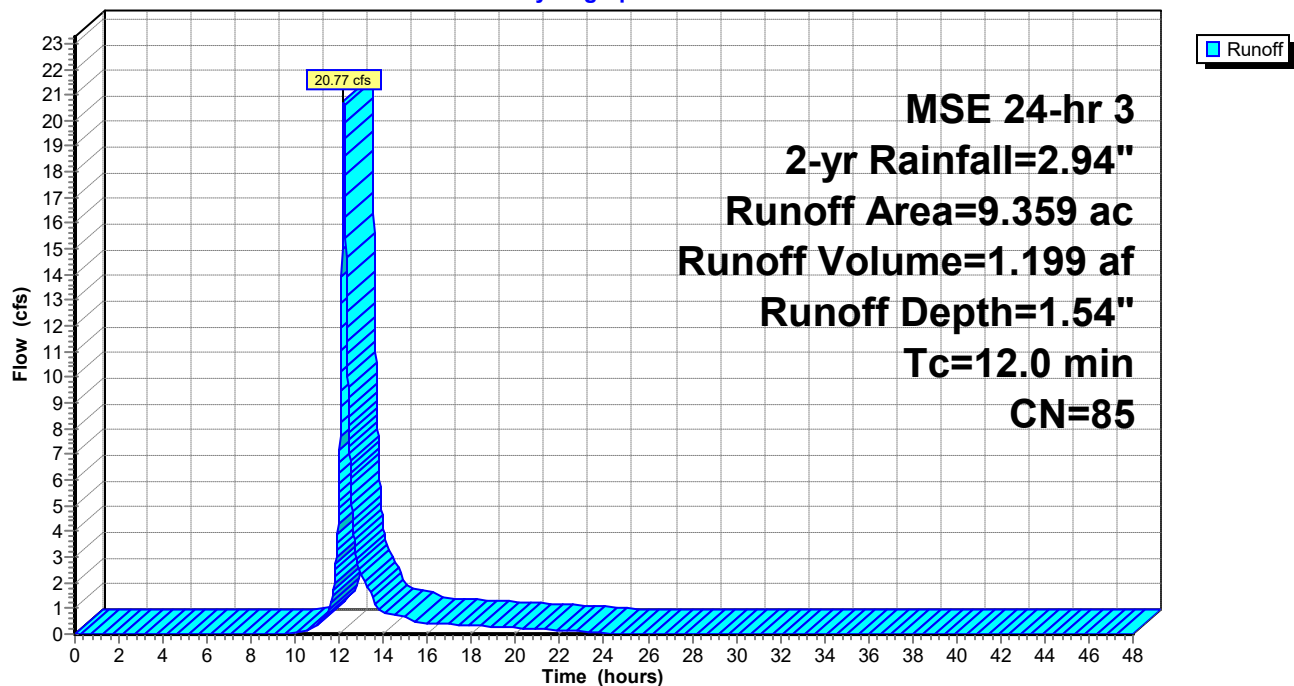
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
MSE 24-hr 3 2-yr Rainfall=2.94"

| Area (ac) | CN | Description                         |
|-----------|----|-------------------------------------|
| 0.739     | 79 | 50-75% Grass cover, Fair, HSG C     |
| 2.028     | 98 | Paved roads w/curbs & sewers, HSG B |
| * 1.060   | 98 | Proposed Impervious, HSG C          |
| * 0.540   | 79 | Proposed Pervious, HSG C            |
| 4.992     | 79 | 50-75% Grass cover, Fair, HSG C     |
| 9.359     | 85 | Weighted Average                    |
| 6.271     |    | 67.01% Pervious Area                |
| 3.088     |    | 32.99% Impervious Area              |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description          |
|----------|---------------|---------------|-------------------|----------------|----------------------|
| 12.0     |               |               |                   |                | Direct Entry, direct |

### Subcatchment EX: Existing

Hydrograph



## 5th Ave NE flood analysis

MSE 24-hr 3 2-yr Rainfall=2.94"

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### Summary for Pond 5: 5th Ave

Inflow Area = 9.359 ac, 32.99% Impervious, Inflow Depth = 1.54" for 2-yr event  
Inflow = 20.77 cfs @ 12.20 hrs, Volume= 1.199 af  
Outflow = 20.69 cfs @ 12.21 hrs, Volume= 1.197 af, Atten= 0%, Lag= 0.5 min  
Primary = 20.69 cfs @ 12.21 hrs, Volume= 1.197 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Peak Elev= 1,237.09' @ 12.21 hrs Surf.Area= 4,399 sf Storage= 974 cf

Plug-Flow detention time= 3.5 min calculated for 1.197 af (100% of inflow)  
Center-of-Mass det. time= 2.1 min ( 812.9 - 810.8 )

| Volume | Invert    | Avail.Storage | Storage Description                                        |
|--------|-----------|---------------|------------------------------------------------------------|
| #1     | 1,236.50' | 11,436 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 1,236.50            | 0                    | 0                         | 0                         |
| 1,236.60            | 160                  | 8                         | 8                         |
| 1,236.70            | 482                  | 32                        | 40                        |
| 1,236.80            | 1,052                | 77                        | 117                       |
| 1,236.90            | 2,317                | 168                       | 285                       |
| 1,237.00            | 4,101                | 321                       | 606                       |
| 1,237.20            | 4,790                | 889                       | 1,495                     |
| 1,237.30            | 7,138                | 596                       | 2,092                     |
| 1,237.50            | 11,388               | 1,853                     | 3,944                     |
| 1,238.00            | 18,578               | 7,492                     | 11,436                    |

| Device | Routing | Invert    | Outlet Devices                                                                                                                                                                                                                                                             |
|--------|---------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 1,236.80' | <b>Asymmetrical Weir, C= 3.27</b><br>Offset (feet) 0.00 13.45 22.67 26.89 31.89 37.37 42.46 53.13<br>75.12 97.57 107.45 116.63 124.00 130.82 139.87 149.08 156.64<br>Height (feet) 0.80 0.70 0.60 0.50 0.40 0.30 0.20 0.10 0.00 0.10<br>0.20 0.30 0.40 0.50 0.60 0.70 0.80 |

**Primary OutFlow** Max=20.67 cfs @ 12.21 hrs HW=1,237.09' (Free Discharge)

↑ **1=Asymmetrical Weir** (Weir Controls 20.67 cfs @ 1.17 fps)

## 5th Ave NE flood analysis

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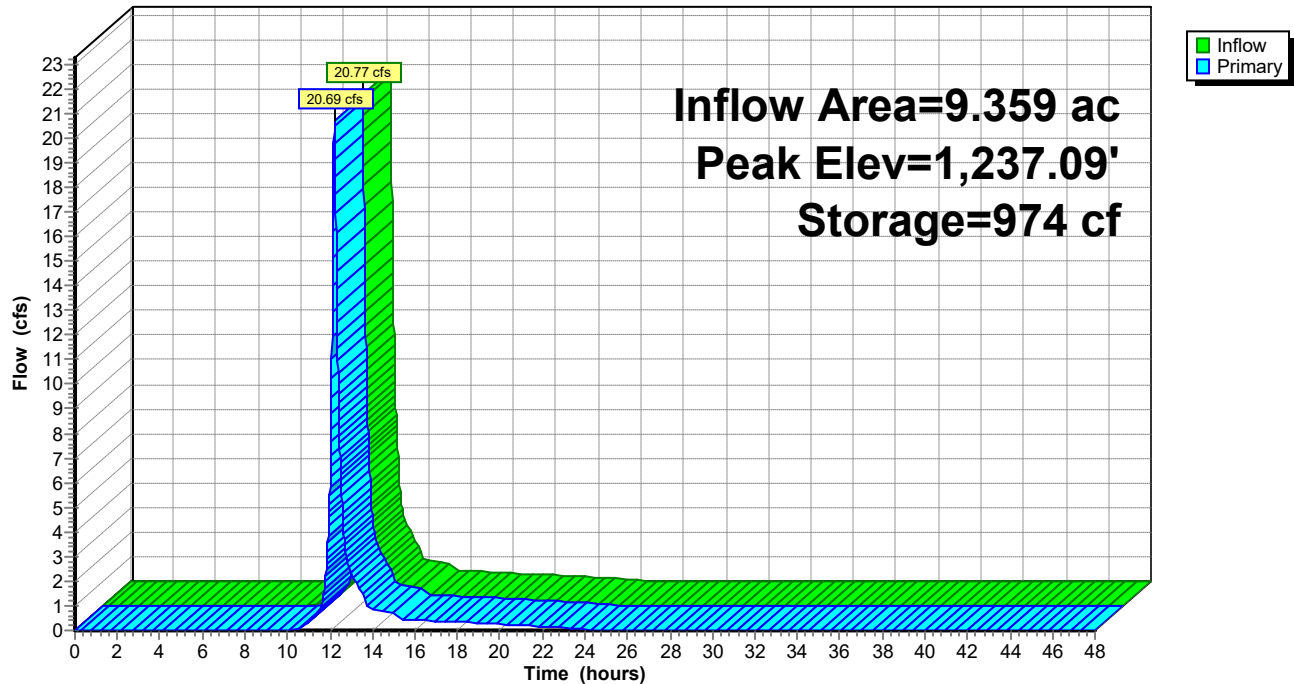
MSE 24-hr 3 2-yr Rainfall=2.94"

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### Pond 5: 5th Ave

#### Hydrograph



## 5th Ave NE flood analysis

MSE 24-hr 3 10-yr Rainfall=4.47"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

### Subcatchment EX: Existing

Runoff Area=9.359 ac 32.99% Impervious Runoff Depth=2.88"

Tc=12.0 min CN=85 Runoff=38.45 cfs 2.248 af

### Pond 5: 5th Ave

Peak Elev=1,237.18' Storage=1,417 cf Inflow=38.45 cfs 2.248 af

Outflow=38.35 cfs 2.245 af

**Total Runoff Area = 9.359 ac Runoff Volume = 2.248 af Average Runoff Depth = 2.88"**  
**67.01% Pervious = 6.271 ac 32.99% Impervious = 3.088 ac**

## 5th Ave NE flood analysis

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MSE 24-hr 3 10-yr Rainfall=4.47"

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### Summary for Subcatchment EX: Existing

Runoff = 38.45 cfs @ 12.20 hrs, Volume= 2.248 af, Depth= 2.88"

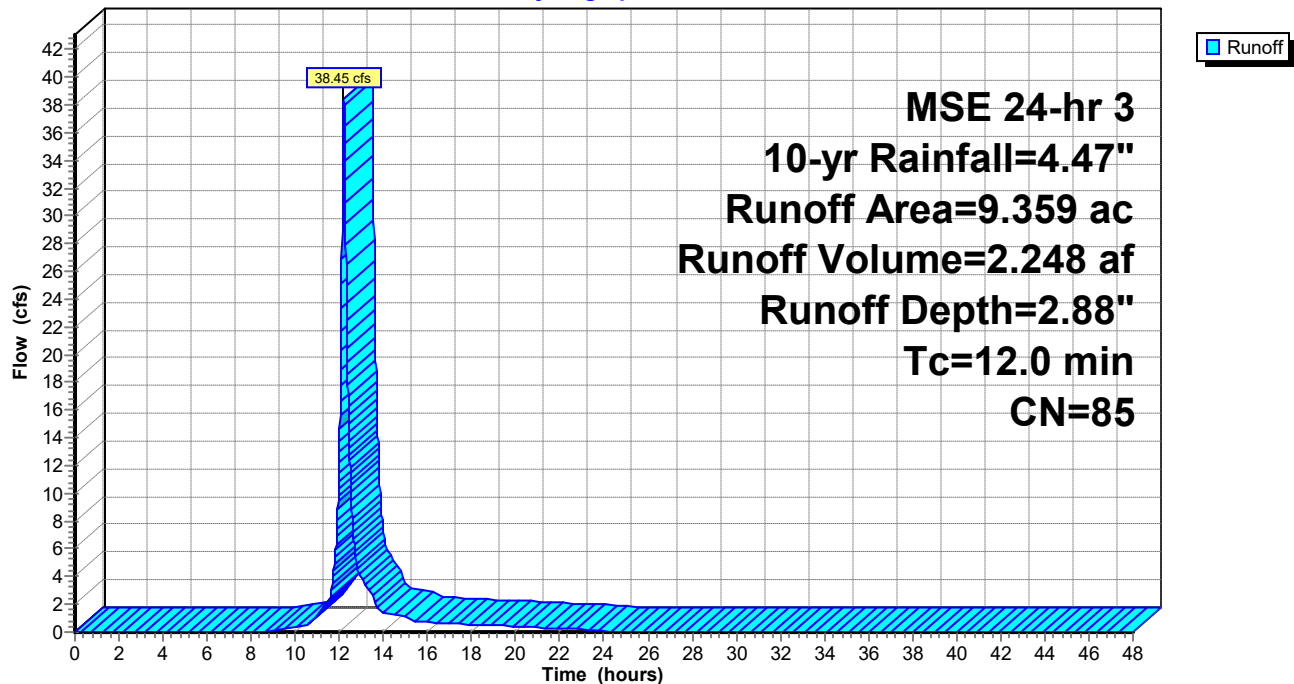
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
MSE 24-hr 3 10-yr Rainfall=4.47"

| Area (ac) | CN | Description                         |
|-----------|----|-------------------------------------|
| 0.739     | 79 | 50-75% Grass cover, Fair, HSG C     |
| 2.028     | 98 | Paved roads w/curbs & sewers, HSG B |
| * 1.060   | 98 | Proposed Impervious, HSG C          |
| * 0.540   | 79 | Proposed Pervious, HSG C            |
| 4.992     | 79 | 50-75% Grass cover, Fair, HSG C     |
| 9.359     | 85 | Weighted Average                    |
| 6.271     |    | 67.01% Pervious Area                |
| 3.088     |    | 32.99% Impervious Area              |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description          |
|----------|---------------|---------------|-------------------|----------------|----------------------|
| 12.0     |               |               |                   |                | Direct Entry, direct |

### Subcatchment EX: Existing

Hydrograph



## 5th Ave NE flood analysis

MSE 24-hr 3 10-yr Rainfall=4.47"

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### Summary for Pond 5: 5th Ave

Inflow Area = 9.359 ac, 32.99% Impervious, Inflow Depth = 2.88" for 10-yr event  
Inflow = 38.45 cfs @ 12.20 hrs, Volume= 2.248 af  
Outflow = 38.35 cfs @ 12.20 hrs, Volume= 2.245 af, Atten= 0%, Lag= 0.4 min  
Primary = 38.35 cfs @ 12.20 hrs, Volume= 2.245 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Peak Elev= 1,237.18' @ 12.20 hrs Surf.Area= 4,733 sf Storage= 1,417 cf

Plug-Flow detention time= 2.5 min calculated for 2.245 af (100% of inflow)  
Center-of-Mass det. time= 1.6 min ( 799.8 - 798.2 )

| Volume | Invert    | Avail.Storage | Storage Description                                        |
|--------|-----------|---------------|------------------------------------------------------------|
| #1     | 1,236.50' | 11,436 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 1,236.50            | 0                    | 0                         | 0                         |
| 1,236.60            | 160                  | 8                         | 8                         |
| 1,236.70            | 482                  | 32                        | 40                        |
| 1,236.80            | 1,052                | 77                        | 117                       |
| 1,236.90            | 2,317                | 168                       | 285                       |
| 1,237.00            | 4,101                | 321                       | 606                       |
| 1,237.20            | 4,790                | 889                       | 1,495                     |
| 1,237.30            | 7,138                | 596                       | 2,092                     |
| 1,237.50            | 11,388               | 1,853                     | 3,944                     |
| 1,238.00            | 18,578               | 7,492                     | 11,436                    |

| Device | Routing | Invert    | Outlet Devices                                                                                                                                                                                                                                                             |
|--------|---------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 1,236.80' | <b>Asymmetrical Weir, C= 3.27</b><br>Offset (feet) 0.00 13.45 22.67 26.89 31.89 37.37 42.46 53.13<br>75.12 97.57 107.45 116.63 124.00 130.82 139.87 149.08 156.64<br>Height (feet) 0.80 0.70 0.60 0.50 0.40 0.30 0.20 0.10 0.00 0.10<br>0.20 0.30 0.40 0.50 0.60 0.70 0.80 |

**Primary OutFlow** Max=38.30 cfs @ 12.20 hrs HW=1,237.18' (Free Discharge)

↑1=Asymmetrical Weir (Weir Controls 38.30 cfs @ 1.45 fps)

## 5th Ave NE flood analysis

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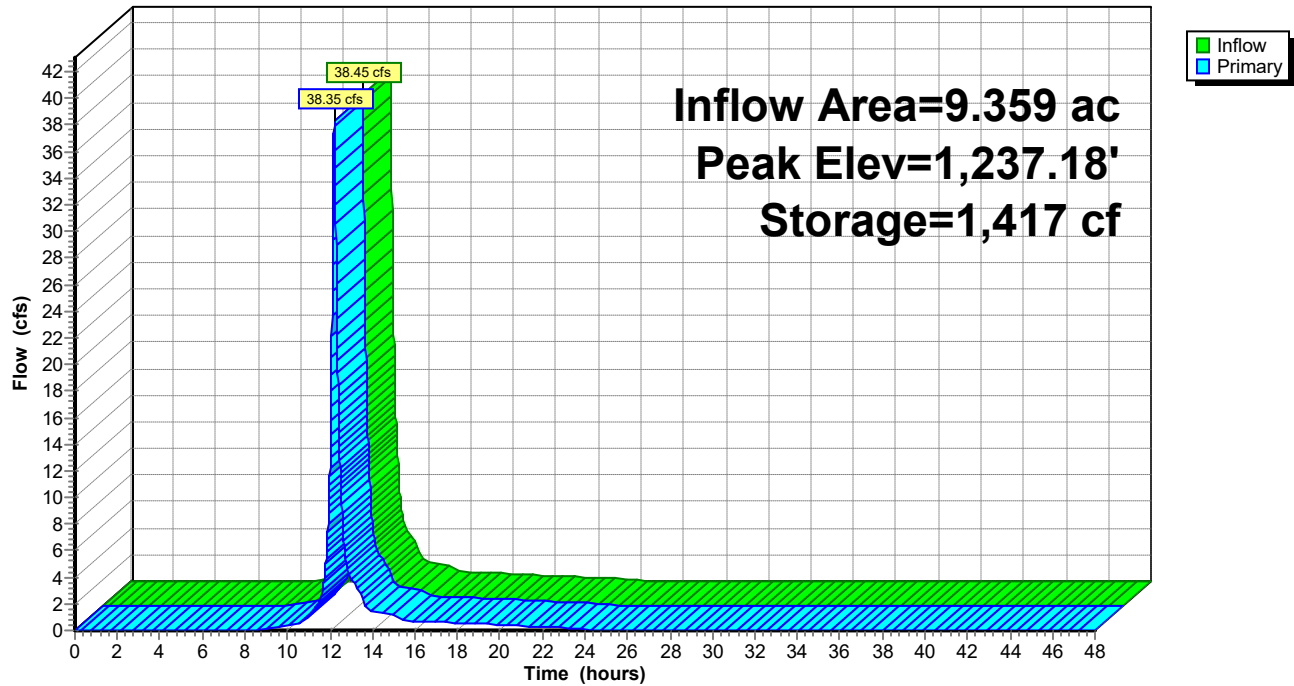
MSE 24-hr 3 10-yr Rainfall=4.47"

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### Pond 5: 5th Ave

#### Hydrograph



## 5th Ave NE flood analysis

MSE 24-hr 3 100-yr Rainfall=7.81"

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Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

### Subcatchment EX: Existing

Runoff Area=9.359 ac 32.99% Impervious Runoff Depth=6.03"

Tc=12.0 min CN=85 Runoff=77.78 cfs 4.703 af

### Pond 5: 5th Ave

Peak Elev=1,237.34' Storage=2,375 cf Inflow=77.78 cfs 4.703 af

Outflow=77.54 cfs 4.700 af

**Total Runoff Area = 9.359 ac Runoff Volume = 4.703 af Average Runoff Depth = 6.03"**  
**67.01% Pervious = 6.271 ac 32.99% Impervious = 3.088 ac**

## 5th Ave NE flood analysis

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MSE 24-hr 3 100-yr Rainfall=7.81"

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### Summary for Subcatchment EX: Existing

Runoff = 77.78 cfs @ 12.20 hrs, Volume= 4.703 af, Depth= 6.03"

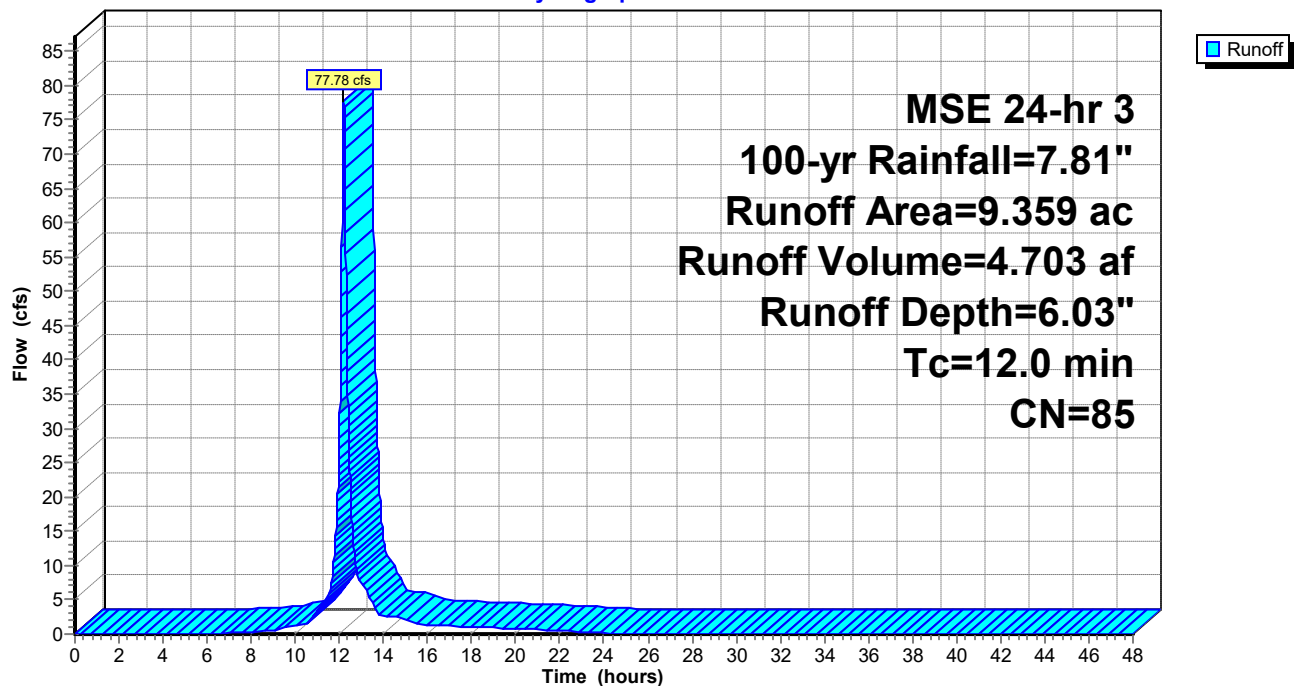
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
MSE 24-hr 3 100-yr Rainfall=7.81"

| Area (ac) | CN | Description                         |
|-----------|----|-------------------------------------|
| 0.739     | 79 | 50-75% Grass cover, Fair, HSG C     |
| 2.028     | 98 | Paved roads w/curbs & sewers, HSG B |
| * 1.060   | 98 | Proposed Impervious, HSG C          |
| * 0.540   | 79 | Proposed Pervious, HSG C            |
| 4.992     | 79 | 50-75% Grass cover, Fair, HSG C     |
| 9.359     | 85 | Weighted Average                    |
| 6.271     |    | 67.01% Pervious Area                |
| 3.088     |    | 32.99% Impervious Area              |

| Tc (min) | Length (feet) | Slope (ft/ft) | Velocity (ft/sec) | Capacity (cfs) | Description          |
|----------|---------------|---------------|-------------------|----------------|----------------------|
| 12.0     |               |               |                   |                | Direct Entry, direct |

### Subcatchment EX: Existing

Hydrograph



## 5th Ave NE flood analysis

MSE 24-hr 3 100-yr Rainfall=7.81"

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### Summary for Pond 5: 5th Ave

Inflow Area = 9.359 ac, 32.99% Impervious, Inflow Depth = 6.03" for 100-yr event  
Inflow = 77.78 cfs @ 12.20 hrs, Volume= 4.703 af  
Outflow = 77.54 cfs @ 12.20 hrs, Volume= 4.700 af, Atten= 0%, Lag= 0.4 min  
Primary = 77.54 cfs @ 12.20 hrs, Volume= 4.700 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs  
Peak Elev= 1,237.34' @ 12.20 hrs Surf.Area= 7,936 sf Storage= 2,375 cf

Plug-Flow detention time= 1.8 min calculated for 4.700 af (100% of inflow)  
Center-of-Mass det. time= 1.2 min ( 784.8 - 783.5 )

| Volume | Invert    | Avail.Storage | Storage Description                                        |
|--------|-----------|---------------|------------------------------------------------------------|
| #1     | 1,236.50' | 11,436 cf     | <b>Custom Stage Data (Prismatic)</b> Listed below (Recalc) |

| Elevation<br>(feet) | Surf.Area<br>(sq-ft) | Inc.Store<br>(cubic-feet) | Cum.Store<br>(cubic-feet) |
|---------------------|----------------------|---------------------------|---------------------------|
| 1,236.50            | 0                    | 0                         | 0                         |
| 1,236.60            | 160                  | 8                         | 8                         |
| 1,236.70            | 482                  | 32                        | 40                        |
| 1,236.80            | 1,052                | 77                        | 117                       |
| 1,236.90            | 2,317                | 168                       | 285                       |
| 1,237.00            | 4,101                | 321                       | 606                       |
| 1,237.20            | 4,790                | 889                       | 1,495                     |
| 1,237.30            | 7,138                | 596                       | 2,092                     |
| 1,237.50            | 11,388               | 1,853                     | 3,944                     |
| 1,238.00            | 18,578               | 7,492                     | 11,436                    |

| Device | Routing | Invert    | Outlet Devices                                                                                                                                                                                                                                                             |
|--------|---------|-----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| #1     | Primary | 1,236.80' | <b>Asymmetrical Weir, C= 3.27</b><br>Offset (feet) 0.00 13.45 22.67 26.89 31.89 37.37 42.46 53.13<br>75.12 97.57 107.45 116.63 124.00 130.82 139.87 149.08 156.64<br>Height (feet) 0.80 0.70 0.60 0.50 0.40 0.30 0.20 0.10 0.00 0.10<br>0.20 0.30 0.40 0.50 0.60 0.70 0.80 |

**Primary OutFlow** Max=77.47 cfs @ 12.20 hrs HW=1,237.34' (Free Discharge)

↑ **1=Asymmetrical Weir** (Weir Controls 77.47 cfs @ 1.82 fps)

5th Ave NE flood analysis

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MSE 24-hr 3 100-yr Rainfall=7.81"

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Pond 5: 5th Ave

Hydrograph

