GREAT BASIN ENGINEERING

**LEGACY MOUNTAIN ESTATES**
**RESIDENTIAL DEVELOPMENT**
**HUNTSVILLE, WEBER COUNTY, UTAH 84317**
**STORM WATER STUDY**
Project No. 20N224
June 11, 2021

**General Site Information:**

The proposed Legacy Mountain Estates Residential Development site is located in the Ogden Valley off Old Snowbasin Road South of Highway 39 in Huntsville, Weber County, Utah. Construction will consist of a new road, underground utilities, some retaining walls and detention ponds to accommodate (48) residential lots and (3) common areas when completed.

Storm water from the site will sheet flow across open ground or will be collected in catch basins and will continue via storm drain to one of eight detention areas designated on the attached figure. Storm water will be detained in these detention areas. The site is allowed a unit-release of 0.1 cfs per acre for the 10-yr storm into existing drainage streams throughout the site. Detention calculations have been provided for the site and are included in this report

The study area is broken up into 9 drainage areas (labeled A-1 and A-9). A runoff coefficient of 0.15 is used for natural ground and landscaped areas. A runoff coefficient of 0.90 is used for asphalt, concrete, buildings, and other hard surfaced areas. Some of the lots are larger than others. The lot sizes were broken up into (2) separate "zones" to classify more or less hard surface at a lot. Zone 1 represents lots that are sized 8 acres or larger. Zone 2 represents lots that are smaller than 8 acres in size. Using these zones, average runoff coefficients are shown tabulated below for each area. An average runoff coefficient for the entire project site is 0.212.

| **Area Characteristics** | | |
|---|---|---|
| Area | Runoff Coefficient | Time of Concentration |
| A-1 | 0.195 | 20 minutes |
| A-2 | 0.209 | 27 minutes |
| A-3 | 0.193 | 19 minutes |
| A-4 | 0.242 | 23 minutes |
| A-5 | 0.221 | 26 minutes |
| A-6 | 0.221 | 20 minutes |
| A-7 | 0.205 | 15 minutes |
| A-8 | 0.229 | 28 minutes |
| A-9 | 0194 | 21 minutes |

Times of concentration are calculated using the FAA method assuming flow resistance coefficients of K=0.35 for landscape and K=0.91 for hardscape for each of the areas. The times of concentration for each area are shown in the table above. These times are based on the hydraulically longest drainage path inside each respective drainage area over grass or other vegetation, asphalt, concrete, and/or through a pipeline as applicable. Times calculated to be less than 5 minutes are rounded to 5 minutes (as applicable) when using this method. Rainfall Intensities were taken from NOAA Atlas 14 for pipe sizing and detention requirements. The values obtained were interpolated as necessary. A copy of these data is attached.

Data showing area information, runoff coefficient, time of concentration, peak flows, and detention storage requirements for the site are also provided and can be found in the attached calculations.

**Pipe Sizes:**

Storm water pipes in the project are proposed to be polyvinylchloride pipes (PVC), concrete pipe (CP), and/or reinforced concrete pipe (RCP). All pipes in the project are sloped to provide the design capacity while maintaining a minimum scour speed of at least 2 feet per second when the pipes are flowing at least half full. Pipes at nodes 7, 9, 23, 25, 27, 38, & 40 were upsized to allow for pass-through historic flows from channels that run through the site. The pipes and inlet boxes have enough capacity to convey the 10-year storm without surcharging.

**Orifice Plates & Required Detention:**

An orifice plate will be used to control the rate that storm water flows from each area of the project. The locations of each orifice plate can be found on the attached figure. Each orifice plate opening size is located in the Detention Pond Characteristics table below. Each orifice plate was sized for each detention facility to utilize its capacity during a 10-yr storm with a release rate of 0.1 cfs/acre. The orifice plate will allow small flows to pass through without detention. As the rate of storm water into the pipes and detention facility increases, the orifice plate will restrict the flow. The maximum flow through the plate will occur when the detention basin reaches the maximum design depth. A detail of the orifice plate can be found in the construction documents for this project. Orifice flows at area A-1, A-2, A-5, and A-9 were upsized to allow for historic passthrough flows.

The required detention for the 10-year storm with a release rate of 0.1 cfs/acre for each area can also be found in the table below, along with the available pond volume and excess storage capacity. In the event the detention facility experiences a storm larger than the design storm water will then spill out over a 1 foot overflow to the existing drainage path and will continue southeasterly in a historical fashion.

| Detention Pond Characteristics | | | | |
|---|---|---|---|---|
| Area | Orifice Plate Diameter (inches) | Required Detention (cubic feet) | Available Detention (cubic feet) | Excess Storage (cubic feet) |
| A-1 | 17.45 | 12,189 | 12,809 | 620 |
| A-2 | 20.49 | 21,294 | 21,598 | 304 |
| A-3 | 4.99 | 7,108 | 7,177 | 69 |
| A-4 | 4.44 | 7,682 | 10,243 | 2.561 |
| A-5 | 21.97 | 22,678 | 22,788 | 110 |
| A-6 W | 3.51 | 1,558 | 2,129 | 571 |
| A-6 E | 5.47 | 4,686 | 6,291 | 1,605 |
| A-7 | 2.67 | 2,170 | 2,261 | 91 |
| A-8 | 6.65 | 10,532 | 10,674 | 142 |
| A-9 | 18.55 | 6,607 | 6,607 | 0 |

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LLC

ADAMS

JENSEN TOWERS FARMS LLC

UNDISTURBED

UNDISTURBED

NORTH

Scale: 1" = 200'

200 0 100 200 250 300 350 400

Graphic Scale

NIGHTHAWK LANE

NIGHTHAWK LANE

20' Trail Easement

20' Trail Easement

20' Trail Easement

LEGACY DRIVE

LEGACY DRIVE

LEGACY DRIVE

LEGACY DRIVE

LEGACY DRIVE

LEGACY DRIVE

A-1

A-2

A-3

A-4

A-5

A-6

A-7

A-8

A-9

CHALETS AT SKI LAKE

SAMAREL PROPERTY

JAMES & DIANNE BRANCH LIVING TRUST

KATHLEEN A CORNWALL FAMILY TRUST

BOTTLINGER, ESTEEN

BOTTLINGER, ESTEEN

FREUD TRUST

KRUSOFF, CARY & PENNY

WATSON, MARK

DENISE J GREEN LIVING TRUST

SNOWBASIN ROAD

SNOWBASIN ROAD

| REV | DATE | DESCRIPTION |
|---|---|---|
| | | |


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# Storm Water Study

# Legacy Mountain

23 JUL 2021

SHEET NO.

SWS

20N224

Storm Water Calculations
Legacy Mountain
Nighthawk Lane Weber County, UT 84317
20N224 - S4 SWS 20210406.dwg

06.11.2021

**1 Undisturbed Area**
**9 Detained Areas**

| | Zone 1 (ft^2) | Zone 2 (ft^2) |
|---|---|---|
| Avg. lot size | 644862 | 142525 |
| Avg. home size | 5000 | 5000 |
| Avg. patio/driveway size | 5000 | 5000 |
| C = | 0.162 | 0.203 |

| Hardscape C = | 0.90 |
|---|---|
| Landscape C = | 0.15 |

| | Category Runoff Coefficients | | | |
|---|---|---|---|---|
| | 0.475 | 0.100 | 0.162 | 0.203 |
| Drainage Areas | Total Area (acres) | 60' Road Area (acres) | Common Area (acres) | Zone 1 Area (acres) | Zone 2 Area Acres | **C** |
| Σ Det. Areas | 203.521 | 15.143 | 6.552 | 38.199 | 143.627 | 0.212 |
| Σ All Areas | 203.521 | 15.143 | 6.552 | 38.199 | 143.627 | 0.212 |
| A-1 | 22.243 | 1.942 | 0.000 | 16.922 | 3.378 | 0.195 |
| A-2 | 45.732 | 3.392 | 5.958 | 0.423 | 35.958 | 0.209 |
| A-3 | 17.251 | 0.579 | 0.000 | 8.103 | 8.569 | 0.193 |
| A-4 | 13.439 | 2.510 | 0.000 | 3.897 | 7.032 | 0.242 |
| A-5 | 44.995 | 3.043 | 0.000 | 0.100 | 41.852 | 0.221 |
| A-6 | 12.363 | 0.836 | 0.000 | 0.006 | 11.521 | 0.221 |
| A-7 | 4.808 | 0.035 | 0.000 | 0.000 | 4.773 | 0.205 |
| A-8 | 19.822 | 1.951 | 0.000 | 0.009 | 17.863 | 0.229 |
| A-9 | 22.869 | 0.856 | 0.594 | 8.738 | 12.682 | 0.194 |

**Time of Concentration--use FAA Method**

For FAA Method, use K's of..

K = 0.35 for landscape

K = 0.91 for hardscape

$$t_c = \frac{1.8(1.1 - K)\sqrt{L}}{\sqrt[3]{S}}$$

Assume Pipe Flow is at 2 ft/s Scour Speed

**Note: S is in percent, 5 min is smallest allowed Tc

| Area | Length on Landscape (ft) | Slope of Landscape (%) | Time on Landscape (min.) | Length on Hardscape (ft) | Slope of Hardscape (%) | Time on Hardscape (min.) | Length in Pipe (ft) | Time in Pipe (min.) | TC for entire Area (min.) |
|---|---|---|---|---|---|---|---|---|---|
| A-1 | 1000.00 | 20.00 | 15.73 | 1000.00 | 12.00 | 4.72 | 0.00 | 0.00 | 20.45 |
| A-2 | 2000.00 | 15.00 | 24.48 | 60.00 | 2.00 | 2.10 | 0.00 | 0.00 | 26.58 |
| A-3 | 1350.00 | 20.00 | 18.27 | 15.00 | 2.00 | 1.05 | 0.00 | 0.00 | 19.32 |
| A-4 | 1700.00 | 15.00 | 22.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 22.57 |
| A-5 | 2300.00 | 15.00 | 26.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 26.25 |
| A-6 | 985.00 | 10.00 | 19.67 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 19.67 |
| A-7 | 650.00 | 15.00 | 13.96 | 15.00 | 2.00 | 1.05 | 0.00 | 0.00 | 15.01 |
| A-8 | 1525.00 | 10.00 | 24.47 | 500.00 | 10.00 | 3.55 | 30.00 | 0.25 | 28.27 |
| A-9 | 1700.00 | 20.00 | 20.51 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 20.51 |

Rainfall Intensities
Data From NOAA

## 10-Year Storm Intensities

The equations used for the 10-Year Storm Intensities were found using the attached Rainfall data as well as Interpolated data where applicable.

| | | Storm Intensities |
|---|---|---|
| AREA | Tc (minutes) | I (10-yr.) (in./hr.) |
| A-1 | 20.5 | 2.11 |
| A-2 | 26.6 | 1.81 |
| A-3 | 19.3 | 2.18 |
| A-4 | 22.6 | 2.00 |
| A-5 | 26.3 | 1.82 |
| A-6 | 19.7 | 2.15 |
| A-7 | 15.0 | 2.50 |
| A-8 | 28.3 | 1.75 |
| A-9 | 20.5 | 2.10 |

Peak Flow Information
Use Rational Method
10-Year Storm Intensities

Q=CIA

| AREA | C | I10 (in./hr.) |
|---|---|---|
| A-1 | 0.195 | 2.106 |
| A-2 | 0.209 | 1.812 |
| A-3 | 0.193 | 2.179 |
| A-4 | 0.242 | 1.998 |
| A-5 | 0.221 | 1.825 |
| A-6 | 0.221 | 2.154 |
| A-7 | 0.205 | 2.499 |
| A-8 | 0.229 | 1.747 |
| A-9 | 0.194 | 2.103 |

Peak Flows

| ∑ detained = | 83.98 |
|---|---|
| A (acres) | Q (10-yr.) (cfs) |
| 22.24 | 9.15 |
| 45.73 | 17.33 |
| 17.25 | 7.24 |
| 13.44 | 6.49 |
| 44.99 | 18.14 |
| 12.36 | 5.89 |
| 4.81 | 2.46 |
| 19.82 | 7.94 |
| 22.87 | 9.35 |

Node Inlet Requirements

Size pipes for 10 year storm

| Area | Node # | % of Total | Q (cfs) |
|---|---|---|---|
| A-1 | 38 | 100.0% | 9.15 |
| A-2 | 7 | 0.0% | 0.00 |
| A-2 | 6 | 100.0% | 17.33 |
| A-3 | 36 | 100.0% | 7.24 |
| A-4 | 33 | 40.0% | 2.59 |
| A-4 | 34 | 60.0% | 3.89 |
| A-5 | 29 | 10.0% | 1.81 |
| A-5 | 8 | 0.0% | 0.00 |
| A-5 | 27 | 10.0% | 1.81 |
| A-5 | 28 | 0.0% | 0.00 |
| A-5 | 25 | 25.0% | 4.54 |
| A-5 | 30 | 0.0% | 0.00 |
| A-5 | 26 | 0.0% | 0.00 |
| A-5 | 9 | 25.0% | 4.54 |
| A-5 | 10 | 0.0% | 0.00 |
| A-5 | 11 | 8.0% | 1.45 |
| A-5 | 12 | 3.0% | 0.54 |
| A-5 | 13 | 3.0% | 0.54 |
| A-5 | 14 | 3.0% | 0.54 |
| A-5 | 15 | 3.0% | 0.54 |
| A-5 | 16 | 0.0% | 0.00 |
| A-5 | 23 | 10.0% | 1.81 |
| A-6 | 17 | 25.0% | 1.47 |
| A-6 | 18 | 11.0% | 0.65 |
| A-6 | 19 | 1.0% | 0.06 |
| A-6 | 22 | 1.0% | 0.06 |
| A-6 | 20 | 11.0% | 0.65 |
| A-6 | 22 | 1.0% | 0.06 |
| A-6 | 42 | 50.0% | 2.94 |
| A-7 | 31 | 100.0% | 2.46 |
| A-8 | 1 | 60.0% | 4.77 |
| A-8 | 2 | 10.0% | 0.79 |
| A-8 | 3 | 0.0% | 0.00 |
| A-8 | 4 | 10.0% | 0.79 |
| A-8 | 5 | 20.0% | 1.59 |
| A-9 | 40 | 100.0% | 9.35 |

Summary of Node Inlet Requirements

| Node | Is required to take (cfs) |
|---|---|
| 1 | 4.77 |
| 2 | 0.79 |
| 3 | 0.00 |
| 4 | 0.79 |
| 5 | 1.59 |
| 6 | 17.33 |
| 7 | 0.00 |
| 8 | 0.00 |
| 9 | 4.54 |
| 10 | 0.00 |
| 11 | 1.45 |
| 12 | 0.54 |
| 13 | 0.54 |
| 14 | 0.54 |
| 15 | 0.54 |
| 16 | 0.00 |
| 17 | 1.47 |
| 18 | 0.65 |
| 19 | 0.06 |
| 20 | 0.65 |
| 22 | 0.06 |
| 22 | 0.06 |
| 23 | 1.81 |
| 25 | 4.54 |
| 26 | 0.00 |
| 27 | 1.81 |
| 28 | 0.00 |
| 29 | 1.81 |
| 30 | 0.00 |
| 31 | 2.46 |
| 33 | 2.59 |
| 34 | 3.89 |
| 36 | 7.24 |
| 38 | 9.15 |
| 40 | 9.35 |
| 42 | 2.94 |

PIPE FLOWS

| Upstream Node | Downstream node | Pipe Flow (cfs) |
|---|---|---|
| 1 | 2 | 4.77 |
| 2 | 3 | 5.56 |
| 3 | 5 | 5.56 |
| 4 | 5 | 0.79 |
| 5 | 6 | 7.94 |
| 6 | 8 | 25.27 |
| 7 | 6 | 0.00 |
| 8 | 25 | 27.08 |
| 9 | 10 | 4.54 |
| 10 | 27 | 4.54 |
| 11 | 12 | 1.45 |
| 12 | 13 | 2.00 |
| 13 | 14 | 2.54 |
| 14 | 15 | 3.08 |
| 15 | 16 | 3.63 |
| 16 | 23 | 3.63 |
| 17 | 18 | 1.47 |
| 18 | 19 | 2.12 |
| 19 | 21 | 2.18 |
| 20 | 22 | 0.65 |
| 22 | 21 | 0.71 |
| 22 | 21 | 0.71 |
| 23 | 24 | 43.41 |
| 25 | 26 | 37.97 |
| 26 | 23 | 37.97 |
| 27 | 28 | 6.35 |
| 28 | 25 | 6.35 |
| 29 | 30 | 1.81 |
| 30 | 8 | 1.81 |
| 31 | 32 | 2.46 |
| 33 | 34 | 2.59 |
| 34 | 35 | 6.49 |
| 36 | 37 | 7.24 |
| 38 | 39 | 9.15 |
| 40 | 41 | 9.35 |
| 42 | OUT-6B | 2.94 |

| PIPE FLOWS | |
|---|---|
| Upstream Node | Pipe Flow (cfs) |
| 40 | 32.85 |
| 38 | 32.65 |
| 9 | 9.77 |
| 27 | 11.59 |
| 7 | 19.30 |
| 25 | 57.27 |
| 23 | 62.71 |

| NODE 9 & 27 | | |
|---|---|---|
| A = | 0.0203 | sq mi |
| | 12.992 | acres |
| C = | 0.221 | |
| i = | 1.82 | in/hr |
| | | |
| Q = | 5.24 | cfs |

## Options for Pipe Sizes Between the Specified Nodes

| Up Stream Node | Dn Stream Node | Q (cfs) | Pipe Size (in) | Design Min Slope (%) | Area (ft^2) | Rh (ft) | Manning's n | Scour Min. Slope (%) | First Trial Pipe Size |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 2 | 4.77 | 15 | 0.544% | 1.227 | 0.313 | 0.013 | 0.150% | **15** |
| | | 4.77 | 18 | 0.206% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 4.77 | 24 | 0.044% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 2 | 3 | 5.56 | 15 | 0.741% | 1.227 | 0.313 | 0.013 | 0.150% | **15** |
| | | 5.56 | 18 | 0.280% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 5.56 | 24 | 0.060% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 3 | 5 | 5.56 | 15 | 0.741% | 1.227 | 0.313 | 0.013 | 0.150% | **15** |
| | | 5.56 | 18 | 0.280% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 5.56 | 24 | 0.060% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 4 | 5 | 0.79 | 15 | 0.015% | 1.227 | 0.313 | 0.013 | 0.150% | **15** |
| | | 0.79 | 18 | 0.006% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 0.79 | 24 | 0.001% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 5 | 6 | 7.94 | 15 | 1.512% | 1.227 | 0.313 | 0.013 | 0.150% | **15** |
| | | 7.94 | 18 | 0.572% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 7.94 | 24 | 0.123% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 6 | 8 | 25.27 | 18 | 5.786% | 1.767 | 0.375 | 0.013 | 0.120% | **24** |
| | | 25.27 | 24 | 1.247% | 3.142 | 0.500 | 0.013 | 0.080% | |
| | | 25.27 | 30 | 0.379% | 4.909 | 0.625 | 0.013 | 0.060% | |
| 7 | 6 | 19.30 | 18 | 3.375% | 1.767 | 0.375 | 0.013 | 0.120% | **18** |
| | | 19.30 | 24 | 0.728% | 3.142 | 0.500 | 0.013 | 0.080% | |
| | | 19.30 | 30 | 0.221% | 4.909 | 0.625 | 0.013 | 0.060% | |
| 9 | 10 | 9.77 | 15 | 2.289% | 1.227 | 0.313 | 0.013 | 0.150% | **15** |
| | | 9.77 | 18 | 0.866% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 9.77 | 24 | 0.187% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 11 | 12 | 1.45 | 15 | 0.050% | 1.227 | 0.313 | 0.013 | 0.150% | **15** |
| | | 1.45 | 18 | 0.019% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 1.45 | 24 | 0.004% | 3.142 | 0.500 | 0.013 | 0.080% | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 12 | 13 | 2.00 | 15 | 0.095% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 2.00 | 18 | 0.036% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 2.00 | 24 | 0.008% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 13 | 14 | 2.54 | 15 | 0.155% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 2.54 | 18 | 0.058% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 2.54 | 24 | 0.013% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 14 | 15 | 3.08 | 15 | 0.228% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 3.08 | 18 | 0.086% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 3.08 | 24 | 0.019% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 15 | 16 | 3.63 | 15 | 0.315% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 3.63 | 18 | 0.119% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 3.63 | 24 | 0.026% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 17 | 18 | 1.47 | 15 | 0.052% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 1.47 | 18 | 0.020% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 1.47 | 24 | 0.004% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 18 | 19 | 2.12 | 15 | 0.108% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 2.12 | 18 | 0.041% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 2.12 | 24 | 0.009% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 19 | 21 | 2.18 | 15 | 0.114% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 2.18 | 18 | 0.043% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 2.18 | 24 | 0.009% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 20 | 22 | 0.65 | 15 | 0.010% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 0.65 | 18 | 0.004% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 0.65 | 24 | 0.001% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 22 | 21 | 0.71 | 15 | 0.012% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 0.71 | 18 | 0.005% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 0.71 | 24 | 0.001% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 22 | 21 | 0.71 | 15 | 0.012% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 0.71 | 18 | 0.005% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 0.71 | 24 | 0.001% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 23 | 24 | 62.71 | 24 | 7.683% | 3.142 | 0.500 | 0.013 | 0.080% | 30 |
| | | 62.71 | 30 | 2.337% | 4.909 | 0.625 | 0.013 | 0.060% | |
| | | 62.71 | 36 | 0.884% | 7.069 | 0.750 | 0.013 | 0.050% | |
| 25 | 26 | 57.27 | 24 | 6.407% | 3.142 | 0.500 | 0.013 | 0.080% | 30 |
| | | 57.27 | 30 | 1.949% | 4.909 | 0.625 | 0.013 | 0.060% | |
| | | 57.27 | 36 | 0.737% | 7.069 | 0.750 | 0.013 | 0.050% | |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 27 | 28 | 11.59 | 15 | 3.217% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 11.59 | 18 | 1.217% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 11.59 | 24 | 0.262% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 29 | 30 | 1.81 | 15 | 0.079% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 1.81 | 18 | 0.030% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 1.81 | 24 | 0.006% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 31 | 32 | 2.46 | 15 | 0.145% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 2.46 | 18 | 0.055% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 2.46 | 24 | 0.012% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 33 | 34 | 2.59 | 15 | 0.161% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 2.59 | 18 | 0.061% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 2.59 | 24 | 0.013% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 34 | 35 | 6.49 | 15 | 1.008% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 6.49 | 18 | 0.381% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 6.49 | 24 | 0.082% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 36 | 37 | 7.24 | 15 | 1.255% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 7.24 | 18 | 0.475% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 7.24 | 24 | 0.102% | 3.142 | 0.500 | 0.013 | 0.080% | |
| 38 | 39 | 32.65 | 24 | 2.082% | 3.142 | 0.500 | 0.013 | 0.080% | 24 |
| | | 32.65 | 30 | 0.633% | 4.909 | 0.625 | 0.013 | 0.060% | |
| | | 32.65 | 36 | 0.240% | 7.069 | 0.750 | 0.013 | 0.050% | |
| 40 | 41 | 32.85 | 24 | 2.109% | 3.142 | 0.500 | 0.013 | 0.080% | 24 |
| | | 32.85 | 30 | 0.642% | 4.909 | 0.625 | 0.013 | 0.060% | |
| | | 32.85 | 36 | 0.243% | 7.069 | 0.750 | 0.013 | 0.050% | |
| 42 | OUT-6B | 2.94 | 15 | 0.207% | 1.227 | 0.313 | 0.013 | 0.150% | 15 |
| | | 2.94 | 18 | 0.078% | 1.767 | 0.375 | 0.013 | 0.120% | |
| | | 2.94 | 24 | 0.017% | 3.142 | 0.500 | 0.013 | 0.080% | |

**Storm Water Study Detention Calculations**

Legacy Mountain

Nighthawk Lane Weber County, UT 84317

20N224 - S4 SWS 20210406.dwg

06.11.2021

| | | |
|---|---|---|
| Allowable Discharge Rate = | 0.10 | cfs per acre |
| Total Allowable Discharge = | 20.35 | cfs |
| Peak Undetained Flow = | 0.00 | cfs |
| Net Allowable Discharge = | 20.35 | cfs |
| Net Allowable Discharge Rate = | 0.10 | cfs/ac Ave. |

**A-1**

**Combined Detention Facility**

C = 0.20 Remaining Unit Discharge = 0.100 cfs/acre

Area = 22.24 acres

A-1 Required Release through Restriction = 2.224 cfs

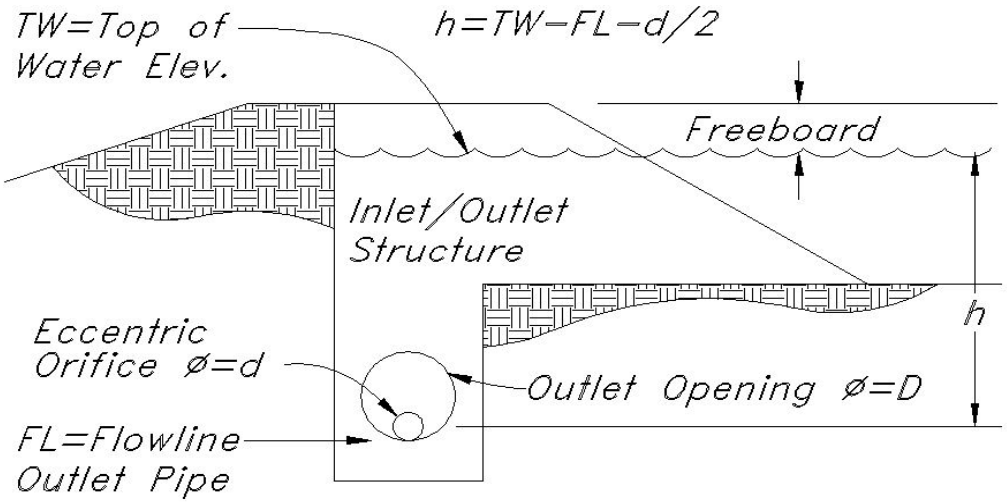
A-9 Additional Flow = 3.318 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 5500 | 667 | 4833 | |
| 10 | 3.02 | 8525 | 1335 | 7190 | |
| 15 | 2.50 | 10755 | 2002 | 8753 | |
| 20 | 2.13 | 12408 | 2669 | 9739 | |
| 25 | 1.87 | 13842 | 3336 | 10505 | |
| 30 | 1.68 | 15101 | 4004 | 11097 | |
| 35 | 1.54 | 16330 | 4671 | 11659 | |
| 40 | 1.40 | 17214 | 5338 | 11876 | |
| 45 | 1.28 | 18017 | 6006 | 12012 | |
| 50 | 1.19 | 18739 | 6673 | 12066 | |
| 55 | 1.10 | 19443 | 7340 | 12103 | |
| 60 | 1.04 | 20197 | 8007 | 12189 | <- Req. Det. |
| 90 | 0.77 | 23908 | 12011 | 11897 | |
| 120 | 0.62 | 27387 | 16015 | 11372 | |
| 180 | 0.45 | 32921 | 24022 | 8898 | |
| 360 | 0.29 | 50647 | 48044 | 2602 | |
| 720 | 0.19 | 82159 | 96089 | -13930 | |
| 1440 | 0.12 | 138056 | 192178 | -54121 | |

Required Storage Volume = **12,189** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5072.75 | |
| FL = | 5061.50 | |
| Q = | 26.818 | cfs |
| trial d= | 1.4545 | ft |
| $\Delta$ = | 0.000 | ft |

d = 17.45 inches

**A-2**

**Combined Detention Facility**

C = 0.21

Area = 45.73 acres

Remaining Unit Discharge = 0.100 cfs/acre

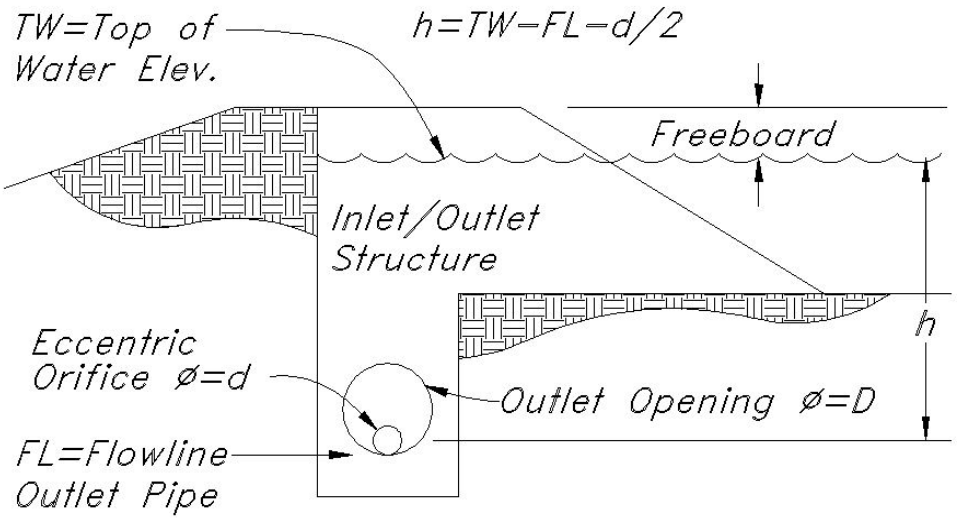
Release through Restriction = 4.573 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 11388 | 1372 | 10016 | |
| 10 | 3.02 | 17325 | 2744 | 14581 | |
| 15 | 2.50 | 21513 | 4116 | 17397 | |
| 20 | 2.13 | 24430 | 5488 | 18942 | |
| 25 | 1.87 | 26865 | 6860 | 20005 | |
| 30 | 1.68 | 28914 | 8232 | 20682 | |
| 35 | 1.54 | 30898 | 9604 | 21294 | <- Req. Det. |
| 40 | 1.40 | 32122 | 10976 | 21147 | |
| 45 | 1.28 | 33168 | 12348 | 20821 | |
| 50 | 1.19 | 34034 | 13720 | 20314 | |
| 55 | 1.10 | 34862 | 15092 | 19771 | |
| 60 | 1.04 | 35798 | 16464 | 19335 | |
| 90 | 0.77 | 39634 | 24695 | 14939 | |
| 120 | 0.62 | 42958 | 32927 | 10031 | |
| 180 | 0.45 | 46469 | 49391 | -2922 | |
| 360 | 0.29 | 59480 | 98781 | -39301 | |
| 720 | 0.19 | 76828 | 197562 | -120734 | |
| 1440 | 0.12 | 95829 | 395125 | -299296 | |

Required Storage Volume = **21294** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5211.75 | |
| FL = | 5205.75 | |
| Q = | 25.855 | cfs |
| trial d= | 1.7078 | ft |
| $\Delta$ = | 0.000 | ft |

d = **20.49** inches

**A-3**

**Combined Detention Facility (DISCHARGES TO A-1 POND; A-1 RESTRICTION UPSIZED TO ACCOMMODATE)**

C = 0.19 Remaining Unit Discharge = 0.100 cfs/acre

Area = 17.25 acres

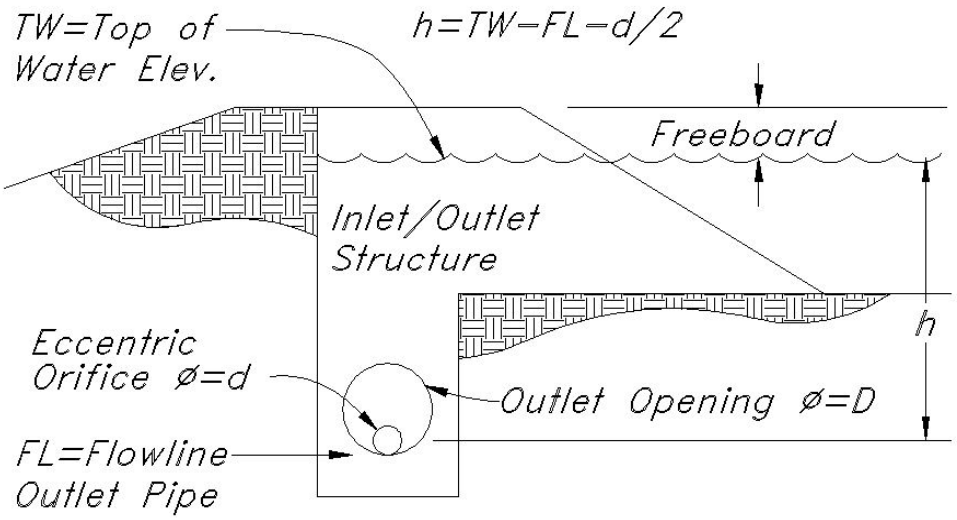
Allowable Release through Restriction = 1.725 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 3955 | 518 | 3438 | |
| 10 | 3.02 | 6017 | 1035 | 4982 | |
| 15 | 2.50 | 7472 | 1553 | 5919 | |
| 20 | 2.13 | 8485 | 2070 | 6415 | |
| 25 | 1.87 | 9330 | 2588 | 6743 | |
| 30 | 1.68 | 10042 | 3105 | 6937 | |
| 35 | 1.54 | 10731 | 3623 | 7108 | <- Req. Det. |
| 40 | 1.40 | 11156 | 4140 | 7016 | |
| 45 | 1.28 | 11520 | 4658 | 6862 | |
| 50 | 1.19 | 11820 | 5175 | 6645 | |
| 55 | 1.10 | 12108 | 5693 | 6415 | |
| 60 | 1.04 | 12433 | 6210 | 6223 | |
| 90 | 0.77 | 13765 | 9315 | 4450 | |
| 120 | 0.62 | 14920 | 12420 | 2499 | |
| 180 | 0.45 | 16139 | 18631 | -2492 | |
| 360 | 0.29 | 20658 | 37261 | -16603 | |
| 720 | 0.19 | 26683 | 74522 | -47839 | |
| 1440 | 0.12 | 33282 | 149045 | -115763 | |

Required Storage Volume = **7108** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5115.73 | |
| FL = | 5109.00 | |
| Q = | 1.725 | cfs |
| trial d= | 0.4158 | ft |
| $\Delta$ = | 0.000 | ft |

| | | |
|---|---|---|
| d = | 4.99 | inches |

**A-4**

**Combined Detention Facility**

C = 0.24

Area = 13.44 acres

Remaining Unit Discharge = 0.100 cfs/acre

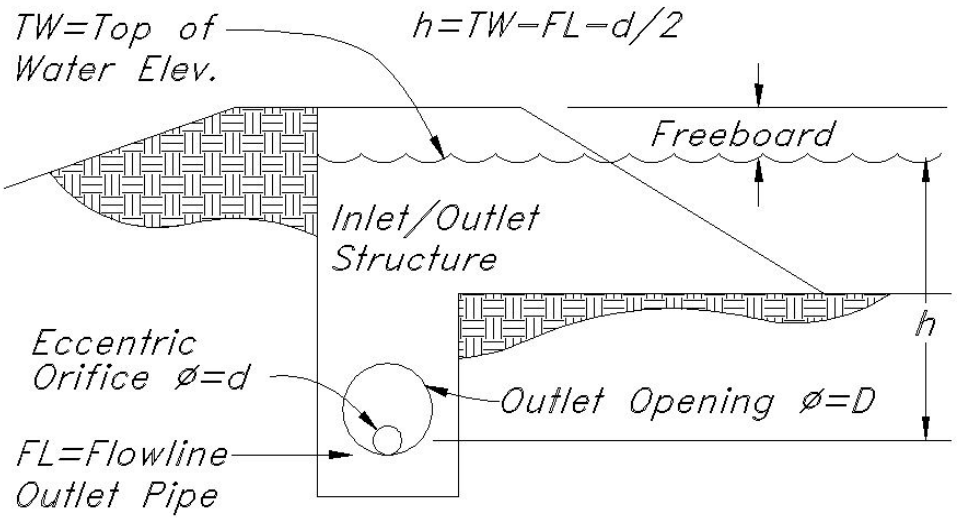
Release through Restriction = 1.344 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 3867 | 403 | 3464 | |
| 10 | 3.02 | 5883 | 806 | 5077 | |
| 15 | 2.50 | 7305 | 1209 | 6096 | |
| 20 | 2.13 | 8296 | 1613 | 6683 | |
| 25 | 1.87 | 9123 | 2016 | 7107 | |
| 30 | 1.68 | 9818 | 2419 | 7399 | |
| 35 | 1.54 | 10492 | 2822 | 7670 | |
| 40 | 1.40 | 10908 | 3225 | 7682 | <- Req. Det. |
| 45 | 1.28 | 11263 | 3628 | 7634 | |
| 50 | 1.19 | 11557 | 4032 | 7525 | |
| 55 | 1.10 | 11838 | 4435 | 7403 | |
| 60 | 1.04 | 12156 | 4838 | 7318 | |
| 90 | 0.77 | 13458 | 7257 | 6202 | |
| 120 | 0.62 | 14587 | 9676 | 4911 | |
| 180 | 0.45 | 15779 | 14514 | 1265 | |
| 360 | 0.29 | 20197 | 29028 | -8830 | |
| 720 | 0.19 | 26088 | 58055 | -31967 | |
| 1440 | 0.12 | 32540 | 116110 | -83570 | |

Required Storage Volume = **7682** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5123.00 | |
| FL = | 5116.50 | |
| Q = | 1.344 | cfs |
| trial d= | 0.3699 | ft |
| $\Delta$ = | 0.000 | ft |

d = **4.44** inches

**A-5**

**Combined Detention Facility**

C = 0.22

Area = 44.99 acres

Remaining Unit Discharge = 0.100 cfs/acre

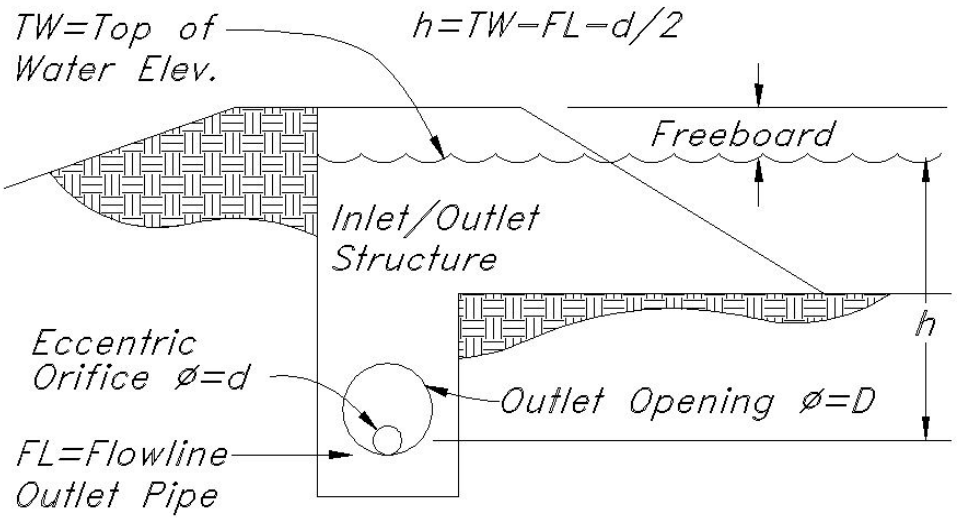
Release through Restriction = 4.499 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 11841 | 1350 | 10491 | |
| 10 | 3.02 | 18014 | 2700 | 15315 | |
| 15 | 2.50 | 22369 | 4050 | 18319 | |
| 20 | 2.13 | 25402 | 5399 | 20002 | |
| 25 | 1.87 | 27933 | 6749 | 21184 | |
| 30 | 1.68 | 30064 | 8099 | 21965 | |
| 35 | 1.54 | 32127 | 9449 | 22678 | <- Req. Det. |
| 40 | 1.40 | 33400 | 10799 | 22601 | |
| 45 | 1.28 | 34487 | 12149 | 22339 | |
| 50 | 1.19 | 35387 | 13498 | 21889 | |
| 55 | 1.10 | 36249 | 14848 | 21401 | |
| 60 | 1.04 | 37222 | 16198 | 21024 | |
| 90 | 0.77 | 41210 | 24297 | 16913 | |
| 120 | 0.62 | 44666 | 32396 | 12270 | |
| 180 | 0.45 | 48317 | 48594 | -278 | |
| 360 | 0.29 | 61845 | 97189 | -35343 | |
| 720 | 0.19 | 79884 | 194377 | -114494 | |
| 1440 | 0.12 | 99640 | 388755 | -289115 | |

Required Storage Volume = **22678** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5084.50 | |
| FL = | 5078.20 | |
| Q = | 30.355 | cfs |
| trial d= | 1.8306 | ft |
| $\Delta$ = | 0.001 | ft |

d = 21.97 inches

**A-6** **WEST**

**Combined Detention Facility**

C = 0.22

Area = 3.09 acres

Remaining Unit Discharge = 0.100 cfs/acre

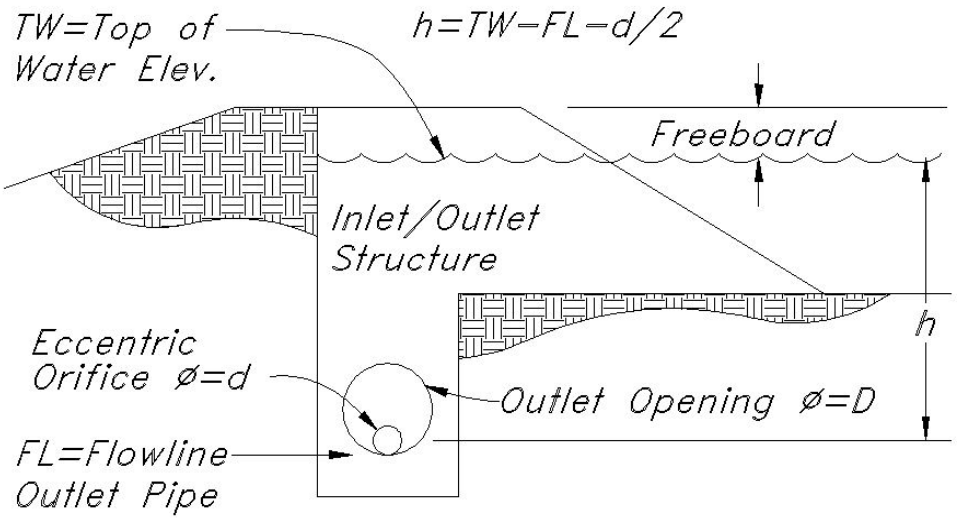
Release through Restriction = 0.309 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 814 | 93 | 721 | |
| 10 | 3.02 | 1238 | 185 | 1052 | |
| 15 | 2.50 | 1537 | 278 | 1259 | |
| 20 | 2.13 | 1745 | 371 | 1374 | |
| 25 | 1.87 | 1919 | 464 | 1456 | |
| 30 | 1.68 | 2066 | 556 | 1509 | |
| 35 | 1.54 | 2207 | 649 | 1558 | <- Req. Det. |
| 40 | 1.40 | 2295 | 742 | 1553 | |
| 45 | 1.28 | 2370 | 834 | 1535 | |
| 50 | 1.19 | 2431 | 927 | 1504 | |
| 55 | 1.10 | 2491 | 1020 | 1471 | |
| 60 | 1.04 | 2557 | 1113 | 1445 | |
| 90 | 0.77 | 2831 | 1669 | 1163 | |
| 120 | 0.62 | 3069 | 2225 | 844 | |
| 180 | 0.45 | 3320 | 3338 | -18 | |
| 360 | 0.29 | 4249 | 6676 | -2426 | |
| 720 | 0.19 | 5489 | 13352 | -7863 | |
| 1440 | 0.12 | 6846 | 26703 | -19857 | |

Required Storage Volume = **1558** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5055.45 | |
| FL = | 5054.45 | |
| Q = | 0.309 | cfs |
| trial d= | 0.2925 | ft |
| $\Delta$ = | 0.000 | ft |

| | | |
|---|---|---|
| d = | 3.51 | inches |

**A-6** **EAST**

**Combined Detention Facility**

C = 0.22 Remaining Unit Discharge = 0.100 cfs/acre

Area = 9.27 acres

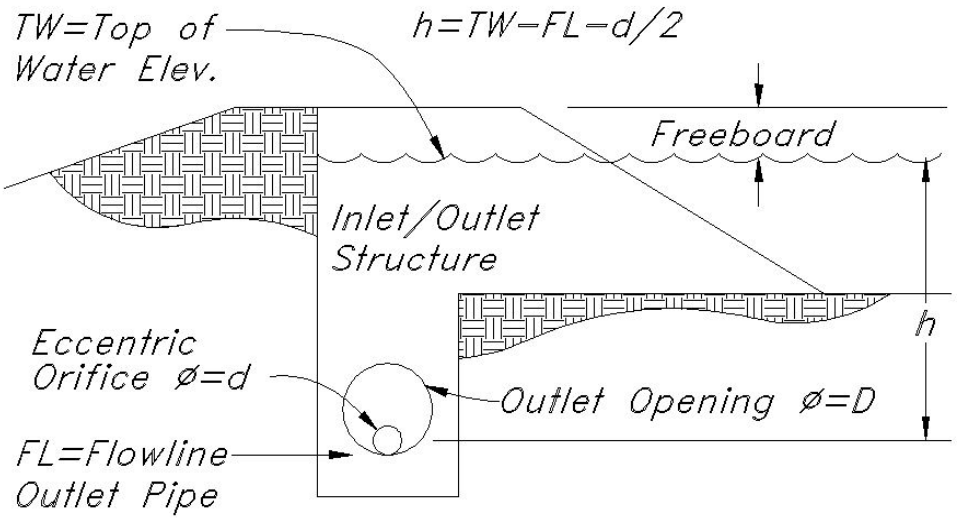
Release through Restriction = 0.927 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 2442 | 278 | 2164 | |
| 10 | 3.02 | 3716 | 556 | 3160 | |
| 15 | 2.50 | 4615 | 834 | 3781 | |
| 20 | 2.13 | 5242 | 1113 | 4130 | |
| 25 | 1.87 | 5766 | 1391 | 4375 | |
| 30 | 1.68 | 6206 | 1669 | 4537 | |
| 35 | 1.54 | 6633 | 1947 | 4686 | <- Req. Det. |
| 40 | 1.40 | 6897 | 2225 | 4672 | |
| 45 | 1.28 | 7123 | 2503 | 4619 | |
| 50 | 1.19 | 7310 | 2782 | 4528 | |
| 55 | 1.10 | 7489 | 3060 | 4429 | |
| 60 | 1.04 | 7691 | 3338 | 4353 | |
| 90 | 0.77 | 8522 | 5007 | 3515 | |
| 120 | 0.62 | 9244 | 6676 | 2568 | |
| 180 | 0.45 | 10015 | 10014 | 1 | |
| 360 | 0.29 | 12859 | 20027 | -7168 | |
| 720 | 0.19 | 16689 | 40055 | -23366 | |
| 1440 | 0.12 | 20983 | 80109 | -59126 | |

Required Storage Volume = **4686** $ft^3$

ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d}{4}$$

Solving for d, we have…..

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5052.00 | |
| FL = | 5049.46 | |
| Q = | 1.236 | cfs |
| trial d= | 0.4561 | ft |
| $\Delta$ = | 0.000 | ft |

d = 5.47 inches

**A-7**

**Combined Detention Facility**

C = 0.20

Area = 4.81 acres

Remaining Unit Discharge = 0.100 cfs/acre

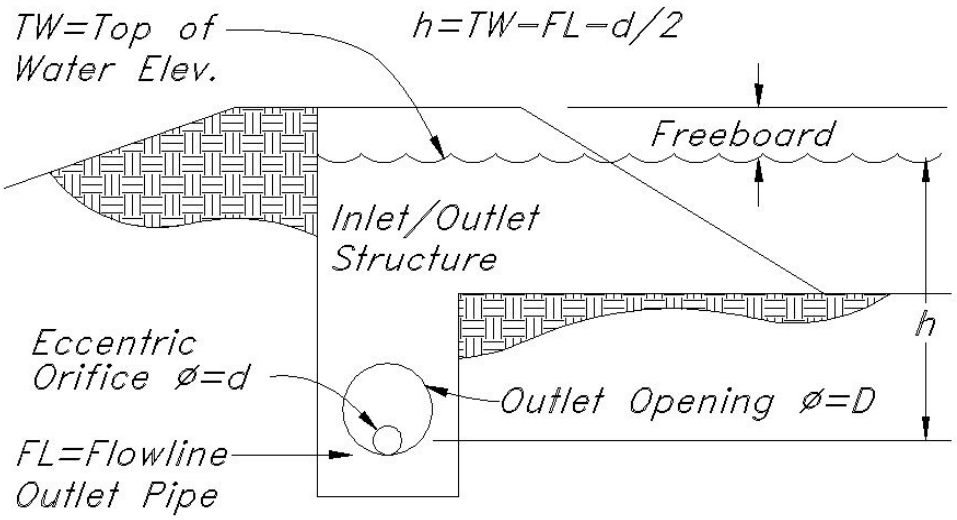
Release through Restriction = 0.481 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 1172 | 144 | 1028 | |
| 10 | 3.02 | 1783 | 288 | 1494 | |
| 15 | 2.50 | 2214 | 433 | 1781 | |
| 20 | 2.13 | 2514 | 577 | 1937 | |
| 25 | 1.87 | 2764 | 721 | 2043 | |
| 30 | 1.68 | 2975 | 865 | 2110 | |
| 35 | 1.54 | 3179 | 1010 | 2170 | <- Req. Det. |
| 40 | 1.40 | 3305 | 1154 | 2151 | |
| 45 | 1.28 | 3413 | 1298 | 2115 | |
| 50 | 1.19 | 3502 | 1442 | 2060 | |
| 55 | 1.10 | 3587 | 1587 | 2001 | |
| 60 | 1.04 | 3684 | 1731 | 1953 | |
| 90 | 0.77 | 4078 | 2596 | 1482 | |
| 120 | 0.62 | 4420 | 3462 | 958 | |
| 180 | 0.45 | 4782 | 5193 | -411 | |
| 360 | 0.29 | 6121 | 10386 | -4265 | |
| 720 | 0.19 | 7906 | 20772 | -12866 | |
| 1440 | 0.12 | 9861 | 41544 | -31683 | |

Required Storage Volume = **2170** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5209.50 | |
| FL = | 5203.30 | |
| Q = | 0.481 | cfs |
| trial d= | 0.2228 | ft |
| $\Delta$ = | 0.000 | ft |

| | | |
|---|---|---|
| d = | 2.67 | inches |

**A-8**

**Combined Detention Facility**

C = 0.23

Area = 19.82 acres

Remaining Unit Discharge = 0.100 cfs/acre

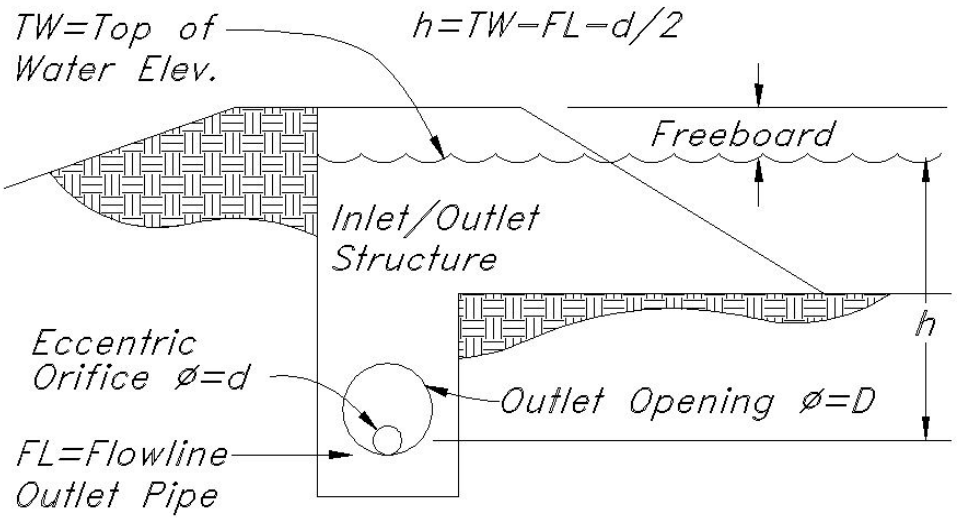
Release through Restriction = 1.982 cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 5416 | 595 | 4821 | |
| 10 | 3.02 | 8240 | 1189 | 7050 | |
| 15 | 2.50 | 10232 | 1784 | 8448 | |
| 20 | 2.13 | 11619 | 2379 | 9240 | |
| 25 | 1.87 | 12777 | 2973 | 9803 | |
| 30 | 1.68 | 13751 | 3568 | 10183 | |
| 35 | 1.54 | 14695 | 4163 | 10532 | <- Req. Det. |
| 40 | 1.40 | 15277 | 4757 | 10520 | |
| 45 | 1.28 | 15775 | 5352 | 10423 | |
| 50 | 1.19 | 16186 | 5947 | 10239 | |
| 55 | 1.10 | 16580 | 6541 | 10039 | |
| 60 | 1.04 | 17025 | 7136 | 9889 | |
| 90 | 0.77 | 18849 | 10704 | 8146 | |
| 120 | 0.62 | 20430 | 14272 | 6158 | |
| 180 | 0.45 | 22100 | 21408 | 692 | |
| 360 | 0.29 | 28288 | 42816 | -14528 | |
| 720 | 0.19 | 36539 | 85632 | -49093 | |
| 1440 | 0.12 | 45575 | 171264 | -125689 | |

Required Storage Volume = **10532** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5265.26 | |
| FL = | 5262.25 | |
| Q = | 1.982 | cfs |
| trial d= | 0.5539 | ft |
| $\Delta$ = | 0.000 | ft |

| | | |
|---|---|---|
| d = | 6.65 | inches |

**A-9**

**Combined Detention Facility**

C = 0.19 Remaining Unit Discharge = 0.100 cfs/acre

Area = 22.87 acres

Allowable Release through Restriction = 2.870 cfs

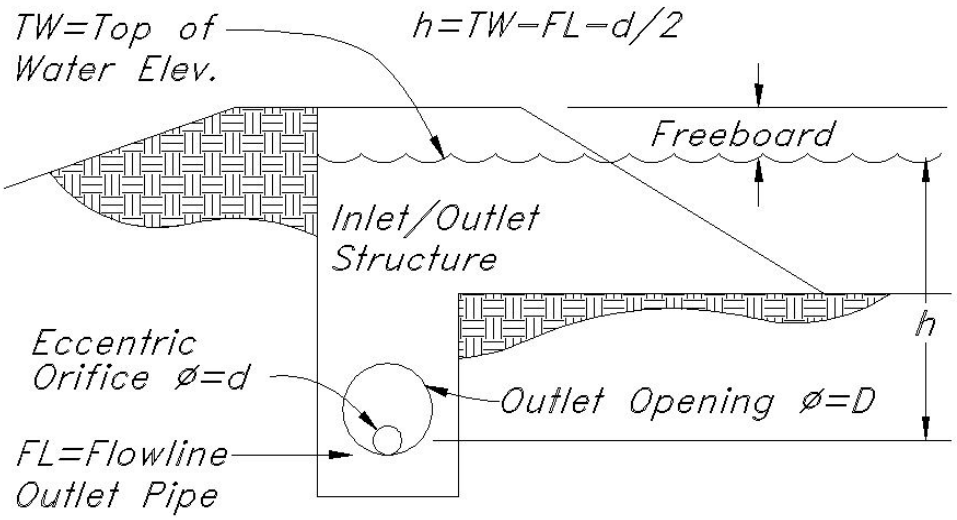
Actual Release Through Restriction = 3.96

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention | |
|---|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) | |
| 5 | 3.97 | 5297 | 1189 | 4108 | |
| 10 | 3.02 | 8059 | 2379 | 5681 | |
| 15 | 2.50 | 10007 | 3568 | 6439 | |
| 20 | 2.13 | 11364 | 4757 | 6607 | <- Req. Det. |
| 25 | 1.87 | 12497 | 5946 | 6550 | |
| 30 | 1.68 | 13450 | 7136 | 6314 | |
| 35 | 1.54 | 14373 | 8325 | 6048 | |
| 40 | 1.40 | 14942 | 9514 | 5428 | |
| 45 | 1.28 | 15429 | 10703 | 4725 | |
| 50 | 1.19 | 15831 | 11893 | 3939 | |
| 55 | 1.10 | 16217 | 13082 | 3135 | |
| 60 | 1.04 | 16652 | 14271 | 2381 | |
| 90 | 0.77 | 18436 | 21407 | -2970 | |
| 120 | 0.62 | 19982 | 28542 | -8560 | |
| 180 | 0.45 | 21616 | 42813 | -21198 | |
| 360 | 0.29 | 27668 | 85626 | -57958 | |
| 720 | 0.19 | 35738 | 171252 | -135514 | |
| 1440 | 0.12 | 44576 | 342504 | -297928 | |

Required Storage Volume = **6607** $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5370.00 | |
| FL = | 5360.57 | |
| Q = | 27.464 | cfs |
| trial d= | 1.5455 | ft |
| $\Delta$ = | 0.000 | ft |

d = 18.55 inches

**Combined Detention Facility**

C = 
Area = acres

Remaining Unit Discharge = 0.100 cfs/acre

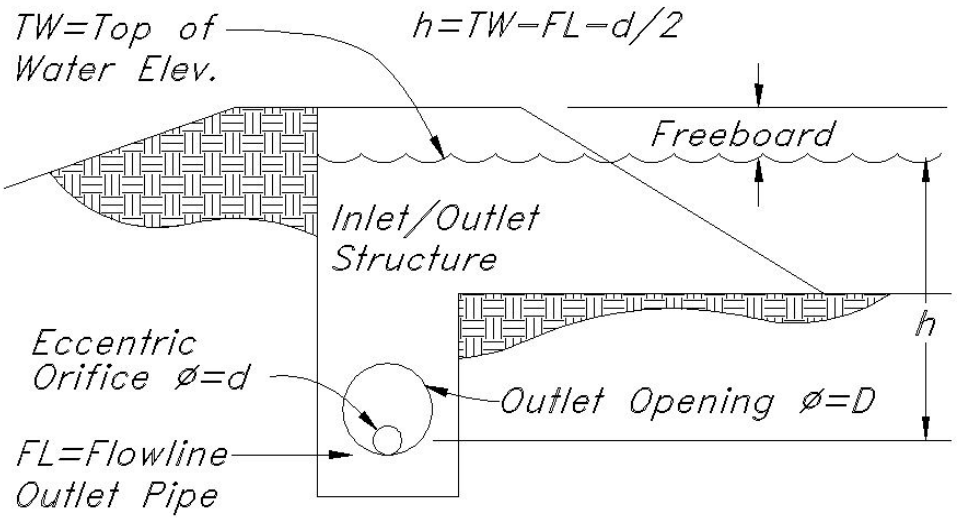
Release through Restriction = cfs

Detention Pond Sized For The 10 Year Storm

| Time | Rainfall Intensity | Accumulated Volume | Allowable Release | Needed Detention |
|---|---|---|---|---|
| min | in./hr. | (CF) | (CF) | (CF) |
| 5 | 3.97 | | | |
| 10 | 3.02 | | | |
| 15 | 2.50 | | | |
| 20 | 2.13 | | | |
| 25 | 1.87 | | | |
| 30 | 1.68 | | | |
| 35 | 1.54 | | | |
| 40 | 1.40 | | | |
| 45 | 1.28 | | | |
| 50 | 1.19 | | | |
| 55 | 1.10 | | | |
| 60 | 1.04 | | | |
| 90 | 0.77 | | | |
| 120 | 0.62 | | | |
| 180 | 0.45 | | | |
| 360 | 0.29 | | | |
| 720 | 0.19 | | | |
| 1440 | 0.12 | | | |

Required Storage Volume = $ft^3$

# ORIFICE PLATE CALCULATIONS




$$Q = 0.62 \cdot A_o \cdot \sqrt{64.4 \cdot h}$$

$$A_o = \frac{\pi \cdot d^2}{4}$$

Solving for d, we have.....

$$d = \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Let

$$\Delta = d - \sqrt{\frac{4 \cdot Q}{0.62 \cdot \pi \cdot \sqrt{64.4 \cdot \left(TW - FL - d/2\right)}}}$$

Goal-seek $\Delta$ to zero by changing "trial d"

| | | |
|---|---|---|
| TW = | 5353.00 | |
| FL = | 5347.65 | |
| Q = | #VALUE! | cfs |
| trial d= | 1.8573 | ft |
| $\Delta$ = | | ft |

d = inches

| Drainage Area Summary | | | |
|---|---|---|---|
| Area | Required Detention (CF) | Required Restriction (INCH) | Available Detention (CF) |
| A-1 | 12,189 | 17.45 | 12,809 |
| A-2 | 21,294 | 20.49 | 21,598 |
| A-3 | 7,108 | 4.99 | 7,177 |
| A-4 | 7,682 | 4.44 | 10,243 |
| A-5 | 22,678 | 21.97 | 22,788 |
| A-6 | 1,558 | 3.51 | 2,129 |
| A-7 | 2,170 | 2.67 | 2,261 |
| A-8 | 10,532 | 6.65 | 10,674 |
| A-6 | 4,686 | 5.47 | 6,291 |
| A-9 | 6,607 | 18.55 | 6,607 |

**NOAA Atlas 14, Volume 1, Version 5**
**Location name: Huntsville, Utah, USA***
**Latitude: 41.2463°, Longitude: -111.808°**
**Elevation: 5394.57 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

**PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches/hour)[1]**

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **1.86** (1.63-2.16) | **2.36** (2.09-2.72) | **3.20** (2.80-3.68) | **3.97** (3.44-4.57) | **5.18** (4.39-6.04) | **6.31** (5.20-7.42) | **7.63** (6.10-9.08) | **9.20** (7.09-11.2) | **11.8** (8.54-14.7) | **14.2** (9.80-18.3) |
| 10-min | **1.42** (1.24-1.64) | **1.80** (1.58-2.08) | **2.44** (2.13-2.81) | **3.02** (2.62-3.49) | **3.95** (3.35-4.59) | **4.80** (3.95-5.63) | **5.81** (4.64-6.91) | **7.01** (5.39-8.51) | **8.97** (6.50-11.2) | **10.8** (7.46-13.9) |
| 15-min | **1.18** (1.03-1.36) | **1.48** (1.31-1.72) | **2.02** (1.76-2.32) | **2.50** (2.16-2.88) | **3.26** (2.76-3.79) | **3.97** (3.27-4.66) | **4.80** (3.84-5.71) | **5.79** (4.46-7.03) | **7.41** (5.38-9.28) | **8.93** (6.17-11.5) |
| 30-min | **0.790** (0.692-0.912) | **1.00** (0.882-1.16) | **1.36** (1.19-1.56) | **1.68** (1.46-1.94) | **2.20** (1.86-2.55) | **2.67** (2.20-3.14) | **3.23** (2.58-3.84) | **3.90** (3.00-4.73) | **4.99** (3.62-6.25) | **6.01** (4.15-7.73) |
| 60-min | **0.489** (0.428-0.565) | **0.619** (0.546-0.716) | **0.840** (0.734-0.967) | **1.04** (0.902-1.20) | **1.36** (1.15-1.58) | **1.65** (1.36-1.94) | **2.00** (1.60-2.38) | **2.41** (1.86-2.93) | **3.09** (2.24-3.87) | **3.72** (2.57-4.79) |
| 2-hr | **0.319** (0.284-0.362) | **0.399** (0.355-0.454) | **0.514** (0.456-0.585) | **0.624** (0.546-0.712) | **0.802** (0.688-0.922) | **0.965** (0.808-1.12) | **1.16** (0.940-1.36) | **1.39** (1.09-1.67) | **1.76** (1.30-2.18) | **2.11** (1.48-2.67) |
| 3-hr | **0.245** (0.221-0.275) | **0.303** (0.273-0.340) | **0.378** (0.338-0.424) | **0.450** (0.399-0.505) | **0.563** (0.490-0.637) | **0.670** (0.571-0.766) | **0.798** (0.663-0.926) | **0.948** (0.763-1.12) | **1.19** (0.915-1.46) | **1.42** (1.05-1.80) |
| 6-hr | **0.169** (0.155-0.185) | **0.207** (0.189-0.227) | **0.249** (0.227-0.274) | **0.288** (0.260-0.318) | **0.346** (0.309-0.385) | **0.394** (0.347-0.442) | **0.450** (0.390-0.511) | **0.513** (0.435-0.591) | **0.639** (0.523-0.751) | **0.752** (0.599-0.905) |
| 12-hr | **0.109** (0.100-0.120) | **0.134** (0.123-0.147) | **0.161** (0.147-0.178) | **0.186** (0.168-0.205) | **0.222** (0.198-0.248) | **0.252** (0.222-0.284) | **0.285** (0.247-0.324) | **0.320** (0.271-0.369) | **0.374** (0.308-0.441) | **0.418** (0.336-0.503) |
| 24-hr | **0.070** (0.064-0.076) | **0.086** (0.079-0.093) | **0.102** (0.094-0.111) | **0.116** (0.107-0.126) | **0.135** (0.124-0.147) | **0.150** (0.137-0.163) | **0.165** (0.150-0.180) | **0.180** (0.163-0.197) | **0.201** (0.180-0.223) | **0.217** (0.193-0.255) |
| 2-day | **0.042** (0.039-0.045) | **0.051** (0.047-0.056) | **0.061** (0.056-0.067) | **0.069** (0.064-0.075) | **0.080** (0.074-0.088) | **0.089** (0.081-0.097) | **0.098** (0.089-0.107) | **0.107** (0.097-0.117) | **0.118** (0.106-0.130) | **0.127** (0.114-0.140) |
| 3-day | **0.031** (0.029-0.034) | **0.038** (0.035-0.041) | **0.045** (0.042-0.049) | **0.052** (0.048-0.056) | **0.060** (0.055-0.065) | **0.067** (0.061-0.073) | **0.074** (0.067-0.080) | **0.081** (0.073-0.088) | **0.090** (0.081-0.098) | **0.097** (0.086-0.107) |
| 4-day | **0.026** (0.024-0.028) | **0.031** (0.029-0.034) | **0.038** (0.035-0.041) | **0.043** (0.040-0.046) | **0.050** (0.046-0.054) | **0.056** (0.051-0.060) | **0.062** (0.056-0.067) | **0.068** (0.061-0.073) | **0.076** (0.068-0.083) | **0.082** (0.073-0.090) |
| 7-day | **0.018** (0.017-0.020) | **0.022** (0.020-0.024) | **0.026** (0.024-0.029) | **0.030** (0.028-0.033) | **0.035** (0.032-0.038) | **0.039** (0.035-0.043) | **0.043** (0.039-0.047) | **0.047** (0.042-0.051) | **0.052** (0.047-0.058) | **0.056** (0.050-0.063) |
| 10-day | **0.014** (0.013-0.016) | **0.018** (0.016-0.019) | **0.021** (0.019-0.023) | **0.024** (0.022-0.026) | **0.027** (0.025-0.030) | **0.030** (0.028-0.033) | **0.033** (0.030-0.036) | **0.035** (0.032-0.039) | **0.039** (0.035-0.043) | **0.041** (0.037-0.046) |
| 20-day | **0.010** (0.009-0.010) | **0.012** (0.011-0.013) | **0.014** (0.013-0.015) | **0.016** (0.014-0.017) | **0.018** (0.016-0.019) | **0.019** (0.018-0.021) | **0.021** (0.019-0.023) | **0.022** (0.020-0.024) | **0.024** (0.022-0.026) | **0.025** (0.023-0.028) |
| 30-day | **0.008** (0.007-0.009) | **0.010** (0.009-0.010) | **0.011** (0.011-0.012) | **0.013** (0.012-0.014) | **0.014** (0.013-0.016) | **0.016** (0.014-0.017) | **0.017** (0.015-0.018) | **0.018** (0.016-0.019) | **0.019** (0.018-0.021) | **0.020** (0.018-0.022) |
| 45-day | **0.007** (0.006-0.007) | **0.008** (0.008-0.009) | **0.010** (0.009-0.010) | **0.011** (0.010-0.011) | **0.012** (0.011-0.013) | **0.013** (0.012-0.014) | **0.014** (0.013-0.015) | **0.015** (0.014-0.016) | **0.016** (0.015-0.018) | **0.017** (0.016-0.019) |
| 60-day | **0.006** (0.005-0.006) | **0.007** (0.007-0.008) | **0.008** (0.008-0.009) | **0.009** (0.009-0.010) | **0.011** (0.010-0.011) | **0.012** (0.011-0.012) | **0.012** (0.011-0.013) | **0.013** (0.012-0.014) | **0.014** (0.013-0.015) | **0.015** (0.014-0.016) |

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

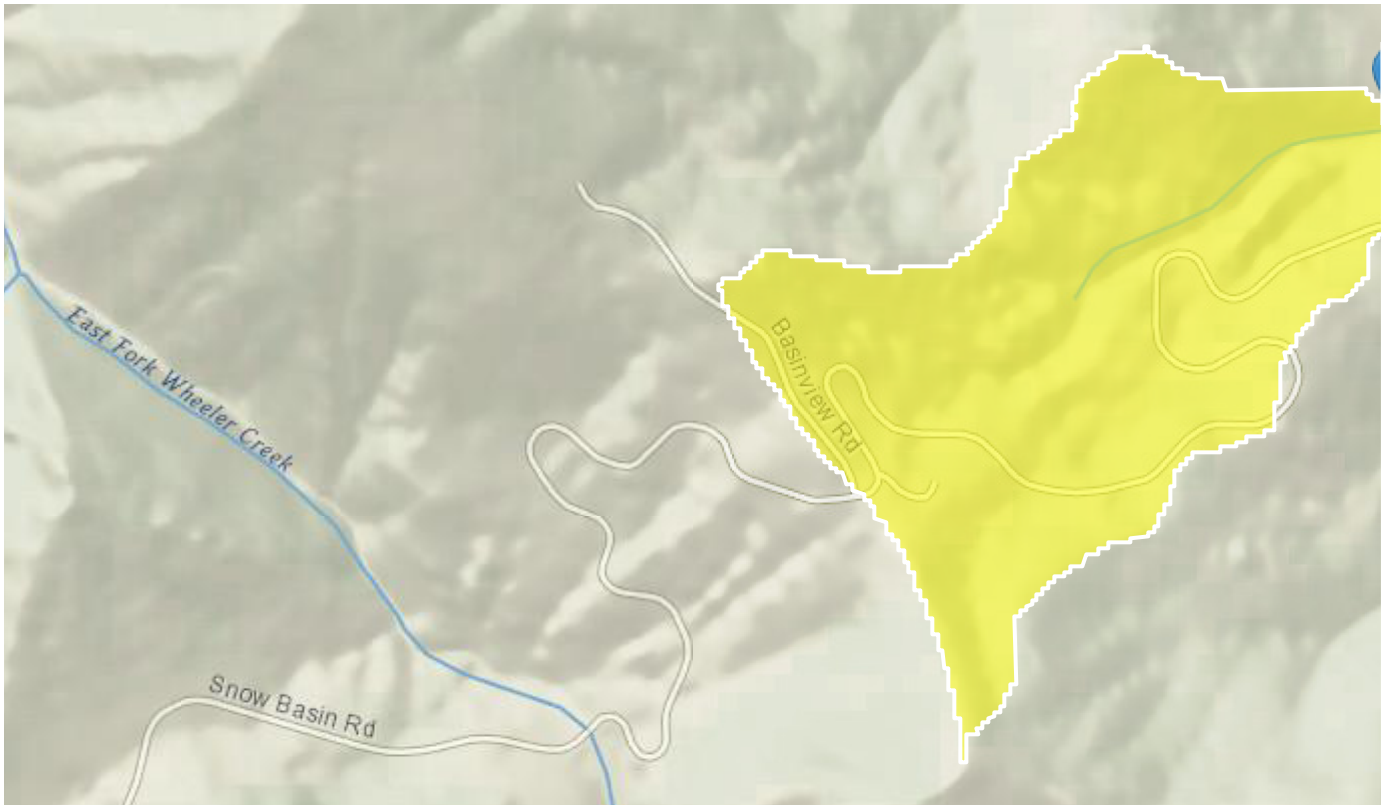
Back to Top

## PF graphical

# Legacy Mountain Stream Culvert Design Flows

Node 7, 23 & 25

**Region ID:** UT
**Workspace ID:** UT20201221223341276000
**Clicked Point (Latitude, Longitude):** 41.24280, -111.80370
**Time:** 2020-12-21 15:34:01 -0700




Only one road crossing with a stream occurs in the Legacy Mountain Subdivision. This Crossing is located at Lat:41.2428, Long:-111.8037. This report gives the expected peak flows for design use.

Basin Characteristics

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| DRNAREA | Area that drains to a point on a stream | 0.27 | square miles |
| PRECIP | Mean Annual Precipitation | 33 | inches |

Peak-Flow Statistics Parameters[Region 2]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.27 | square miles | 2.14 | 84.1 |
| PRECIP | Mean Annual Precipitation | 33 | inches | 16.5 | 53.7 |

Peak-Flow Statistics Disclaimers[Region 2]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report[Region 2]

| Statistic | Value | Unit |
|---|---|---|
| 50_percent_AEP_flood | 2.04 | ft^3/s |
| 20_percent_AEP_flood | 4.99 | ft^3/s |
| 10_percent_AEP_flood | 7.74 | ft^3/s |
| 4_percent_AEP_flood | 11.2 | ft^3/s |
| 2_percent_AEP_flood | 15.5 | ft^3/s |
| 1_percent_AEP_flood | 19.3 | ft^3/s |
| 0_5_percent_AEP_flood | 23.7 | ft^3/s |
| 0_2_percent_AEP_flood | 32.9 | ft^3/s |

*Peak-Flow Statistics Citations*

**Kenney, T.A., Wilkowske, C.D., and Wright, S.J.,2007, Methods for Estimating Magnitude and Frequency of Peak Flows for Natural Streams in Utah: U.S. Geological Survey Scientific Investigations Report 2007-5158, 28 p. (http://pubs.usgs.gov/sir/2007/5158/)**

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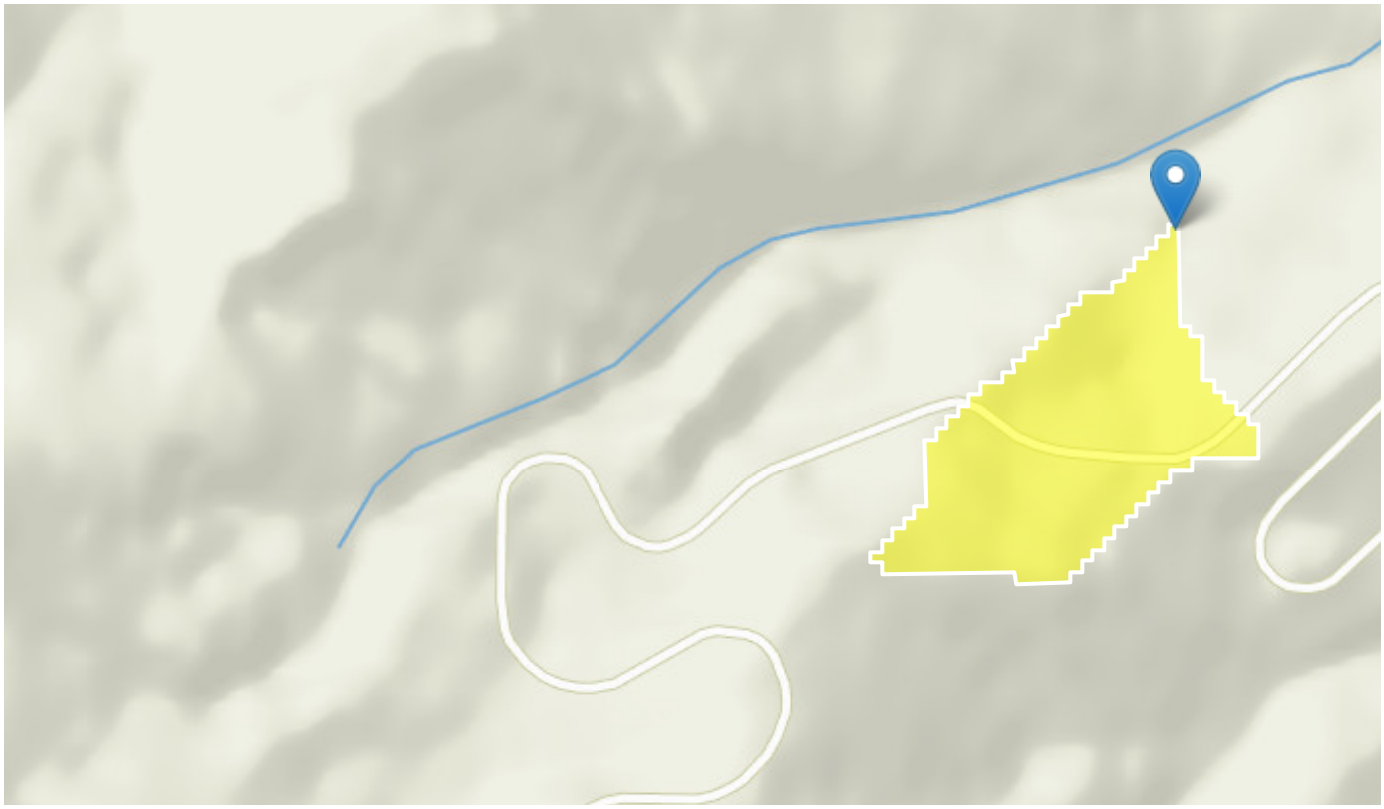
USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.4.0

# StreamStats Report

Node 9 & 27

**Region ID:** UT
**Workspace ID:** UT20210723061133295000
**Clicked Point (Latitude, Longitude):** 41.24253, -111.80164
**Time:** 2021-07-23 00:11:49 -0600



Basin Characteristics

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| DRNAREA | Area that drains to a point on a stream | 0.0203 | square miles |
| PRECIP | Mean Annual Precipitation | | inches |

Peak-Flow Statistics Parameters [Region 2]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.0203 | square miles | 2.14 | 84.1 |

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| PRECIP | Mean Annual Precipitation | | inches | 16.5 | 53.7 |

Peak-Flow Statistics Flow Report [Region 2]

| Statistic | Value | Unit |
|---|---|---|

*Peak-Flow Statistics Citations*

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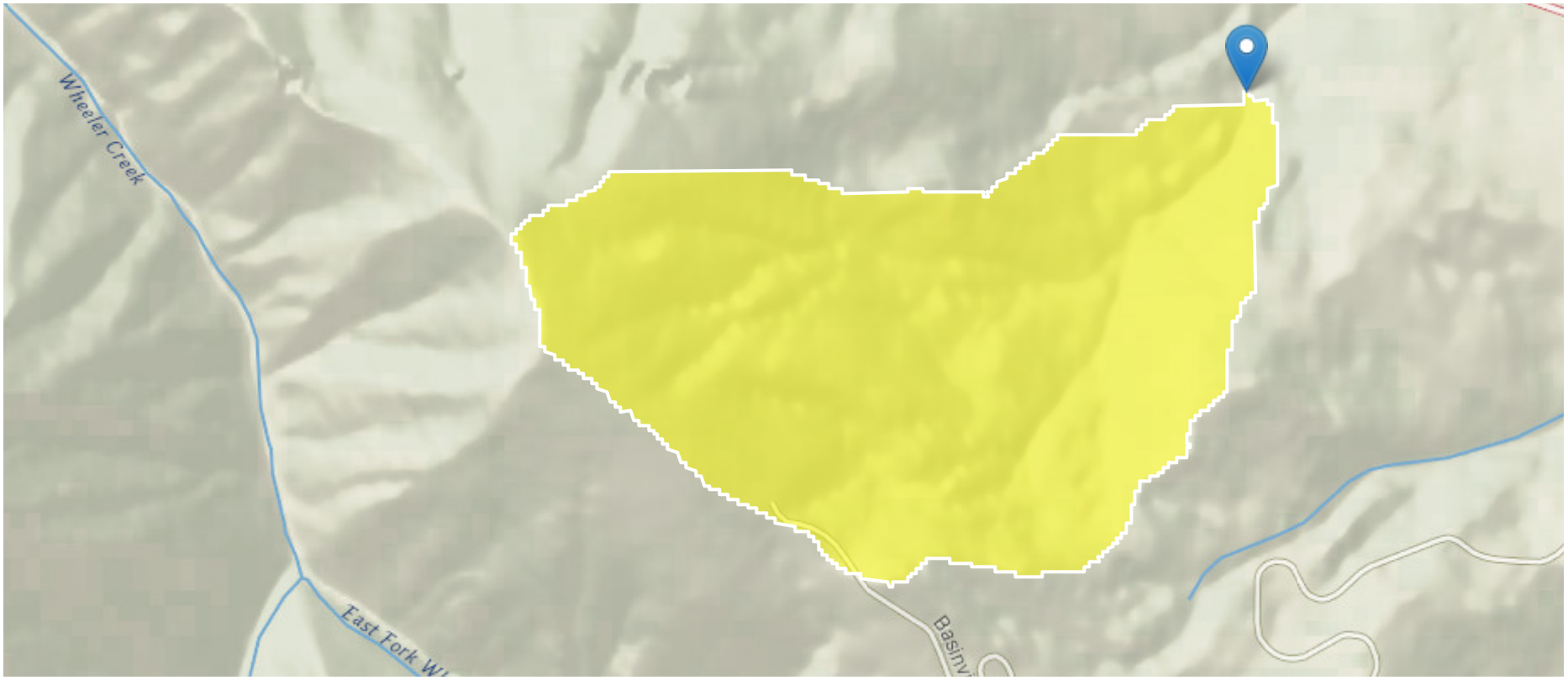
USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.6.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.2

# StreamStats Report

Node 38 & 40

**Region ID:** UT
**Workspace ID:** UT20210419182539051000
**Clicked Point (Latitude, Longitude):** 41.24973, -111.80915
**Time:** 2021-04-19 12:25:57 -0600




Basin Characteristics

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|

| Parameter Code | Parameter Description | Value | Unit |
|---|---|---|---|
| DRNAREA | Area that drains to a point on a stream | 0.42 | square miles |
| PRECIP | Mean Annual Precipitation | 31.9 | inches |

Peak-Flow Statistics Parameters [Region 2]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.42 | square miles | 2.14 | 84.1 |
| PRECIP | Mean Annual Precipitation | 31.9 | inches | 16.5 | 53.7 |

Peak-Flow Statistics Disclaimers [Region 2]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Peak-Flow Statistics Flow Report [Region 2]

| Statistic | Value | Unit |
|---|---|---|
| 50-percent AEP flood | 2.74 | ft^3/s |
| 20-percent AEP flood | 6.46 | ft^3/s |
| 10-percent AEP flood | 9.87 | ft^3/s |
| 4-percent AEP flood | 14 | ft^3/s |
| 2-percent AEP flood | 19.2 | ft^3/s |
| 1-percent AEP flood | 23.8 | ft^3/s |
| 0.5-percent AEP flood | 29 | ft^3/s |
| 0.2-percent AEP flood | 39.7 | ft^3/s |

*Peak-Flow Statistics Citations*

**Kenney, T.A., Wilkowske, C.D., and Wright, S.J.,2007, Methods for Estimating Magnitude and Frequency of Peak Flows for Natural Streams in Utah: U.S. Geological Survey Scientific Investigations Report 2007-5158, 28 p. (http://pubs.usgs.gov/sir/2007/5158/)**

Annual Flow Statistics Parameters [Mean Flow SIR08 5230 Region 2]

| Parameter Code | Parameter Name | Value | Units | Min Limit | Max Limit |
|---|---|---|---|---|---|
| DRNAREA | Drainage Area | 0.42 | square miles | 2.14 | 70.1 |
| PRECIP | Mean Annual Precipitation | 31.9 | inches | 22.3 | 49.5 |

Annual Flow Statistics Disclaimers [Mean Flow SIR08 5230 Region 2]

One or more of the parameters is outside the suggested range. Estimates were extrapolated with unknown errors

Annual Flow Statistics Flow Report [Mean Flow SIR08 5230 Region 2]

| Statistic | Value | Unit |
|---|---|---|
| Mean Annual Flow | 0.429 | ft^3/s |

*Annual Flow Statistics Citations*

**Wilkowske, C.D., Kenney, T.A., and Wright, S.J.,2009, Methods for Estimating Monthly and Annual Streamflow Statistics at Ungaged Sites in Utah: U.S. Geological Survey Scientific Investigations Report 2008-5230, 62 p. (http://pubs.usgs.gov/sir/2008/5230/)**

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Application Version: 4.5.1
StreamStats Services Version: 1.2.22
NSS Services Version: 2.1.1