



May 4, 2018

El Paso County  
Planning and Community Development  
2880 International Circle, Suite 110  
Colorado Springs, CO 80910

ATTN: Ms. Kari Parsons  
  
RE: Bent Grass East Commercial Filing No. 2B  
Drainage Letter

Dear Kari:

Please consider this the drainage letter for Bent Grass East Commercial Filing No. 2B. This letter is in support of the application for an amended plat for Bent Grass East Commercial Filing No. 2. The proposal is to re-plat lot 3 and tract B of Filing 2 in order to increase the size of lot 3 for a proposed building/parking lot expansion. Tract B is owned by the developer and was platted as a tract for future commercial development. Both the owners of lot 3 and tract B have agreed to this re-plat.

Along with the original plat of Bent Grass East Commercial Filing No. 2, a final drainage report was approved including both lot 3 and tract B in the calculations for the construction of the adjacent detention/SWQ facility. This facility is currently constructed and was inspected by County staff. The proposed minor expansion of the current vet. building on lot 3 was already accounted for as a part of the drainage within tract B and therefore does not affect the current pond design or function. Upon a plot plan submittal to the County for this expansion, additional minor storm facilities may be required to facilitate a direct outfall connection to the pond. Please reference the attached approved Final Drainage Report for Bent Grass East Commercial Filing No. 2.

Respectfully submitted,

A handwritten signature in blue ink, appearing to read "Marc A. Whorton", is written over a horizontal line.

Marc A. Whorton, P.E.  
Project Manager



**FINAL DRAINAGE REPORT  
FOR  
BENT GRASS EAST COMMERCIAL FILING NO. 2**

**MAY 2014  
REVISED JULY 2014**

Prepared for:

**LAND FIRST, INC.**  
154 DEL ORO CIRCLE  
COLORADO SPRINGS, CO 80919  
Contact: Ron Waldthasuen

Prepared by:

**CLASSIC CONSULTING ENGINEERS & SURVEYORS, LLC**  
6385 CORPORATE DRIVE, SUITE 101  
COLORADO SPRINGS, CO 80919  
(719) 785-0790

RECEIVED VERSION  
AUG 20 2014 2

Job no. 2177.53

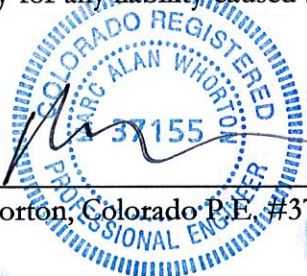


**FINAL DRAINAGE REPORT  
FOR BENT GRASS EAST COMMERCIAL FILING NO. 2**

**DRAINAGE REPORT STATEMENT**

**ENGINEER'S STATEMENT:**

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the Drainage Criteria Manual for the City of Colorado Springs and El Paso County. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.



\_\_\_\_\_  
Marc A. Whorton, Colorado P.E. #37155

6/20/14  
\_\_\_\_\_  
Date

**DEVELOPER'S STATEMENT:**

I, the developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: Land First, Inc.

*Randall Whorton*

Title: Pres.

Address: 154 Del Oro Circle

Colorado Springs, CO 80919

**EL PASO COUNTY:**

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

*Andrea B...*  
For El Paso County Engineer/Director

8-24-14  
\_\_\_\_\_  
Date

Conditions:



**FINAL DRAINAGE REPORT  
FOR BENT GRASS EAST COMMERCIAL FILING NO. 2**

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# **FINAL DRAINAGE REPORT FOR BENT GRASS EAST COMMERCIAL FILING NO. 2**

## **PURPOSE**

This document is the Final Drainage Report for Bent Grass East Commercial Filing No. 2. The purpose of this report is to address and remain consistent with on-site and off-site drainage patterns discussed and approved within the previous report for this property (Bent Grass East Commercial – Phase 1), prepared by Classic Consulting and describe specific methods to handle these flows via on-site detention and storm sewer in order to limit any flows released off-site to historic levels or less.

## **GENERAL DESCRIPTION**

The Bent Grass East Commercial Filing No. 2 site is a 10.3 acre site located in the county of El Paso within Section 1, Township 13 South, Range 65 West of the Sixth Principal Meridian, El Paso County, Colorado. The site is bounded on the north by future Bent Grass Meadows Drive, west by unplatted (Bent Grass Residential Filing No. 1), to the south by existing residential (Falcon Ranchettes) and on the east by Meridian Road. The site is proposed for 3 commercial lots and 2 tracts (Tract A for detention pond and utility purposes and Tract B for future commercial use). These proposed commercial lots remain consistent with the previous Preliminary Drainage Report assumptions.

The average soil condition reflects Hydrologic Group “A” (Columbine gravelly sandy loam), as determined by the “Soil Survey of El Paso County Area,” prepared by the Soil Conservation Service. (See Appendix) For the purposes of the hydrologic calculations within this report, the soil type A was utilized.

## **EXISTING DRAINAGE CONDITIONS**

Portions of this site was overlotted graded along with the 7-Eleven development (Bent Grass East Commercial Filing No. 1). An existing stockpile still exists on-site as well. This material will be utilized in the overlotted grading of this development along with the proposed residential development to the west. The natural grade, which consists of mostly native grasses and no significant trees of other vegetation, sheet flows in a south easterly direction off-site directly onto the adjacent large lot residential properties (Falcon Ranchettes). Upon development, this flow will be captured in streets and parking lots and routed to a proposed detention/stormwater quality facility on-site. The historic



flow analysis was discussed in the previous drainage study for Bent Grass East Commercial Filing No. 1, prepared by Classic Consulting, dated May 2013. The proposed release from this development remains consistent with this analysis. (See Appendix for historic drainage map) Referencing this report, Basin EX-1 ( $Q_5 = 7$  cfs and  $Q_{100} = 18$  cfs) represents the historic flow from the proposed property. The next section of this report will show the developed release from this development to be equal to or less than this historic flow.

## DEVELOPED DRAINAGE CONDITIONS

Basin L ( $Q_5 = 18$  cfs and  $Q_{100} = 35$  cfs) represents developed flow from the majority of Tract B (future commercial use) that will ultimately drain directly into the proposed detention facility to the south. Much of this basin will not be graded at this time and will continue to sheet flow directly into the proposed facility. Basin M1 ( $Q_5 = 6$  cfs and  $Q_{100} = 11$  cfs) represents the easterly portion of the future Tract B development along with the easterly portion of Lot 3 that is anticipated to drain into Trey Lane. **Design Point 12** ( $Q_5 = 6$  cfs and  $Q_{100} = 11$  cfs) represents this basin flow that will be captured with a proposed 6' Type R sump inlet. Basin M2 ( $Q_5 = 2$  cfs and  $Q_{100} = 4$  cfs) represents the easterly portion of Trey Lane. This developed flow will be routed via curb and gutter to Design Point 13. Basin N ( $Q_5 = 5$  cfs and  $Q_{100} = 10$  cfs) represents the westerly portion of the proposed commercial lots 1 and 2. This developed flow is also anticipated to be routed towards Design Point 13. **Design Point 13** ( $Q_5 = 7$  cfs and  $Q_{100} = 13$  cfs) represents the total developed flow from these basins and will be captured with a proposed 6' Type R sump inlet. The total collected flows at these facilities will then be routed directly into the proposed detention facility. **Design Point 14** ( $Q_5 = 12$  cfs and  $Q_{100} = 23$  cfs) represents this total collected flow that will enter the detention/SWQ facility from the east.

The eastern 1/3 of lots 1 and 2 will be allowed to continue to drain in a southeasterly direction. However, individual on-site stormwater quality facilities will be installed prior to release into the existing channel along the west side of Meridian road. No detention is required for this minimal area per the previous approved drainage report for Bent Grass East Commercial Filing No. 1, dated May 2013. Upon specific site plans for these lots, additional drainage analysis may need to be prepared to confirm this allowed release and required water quality capture volume. (See Basins D and E of this previous report) Basin O ( $Q_5 = 1$  cfs and  $Q_{100} = 2$  cfs) represents a small basin along the south boundary that will consist of landscape area that will continue to sheet flow off-site. This

developed flow is well less than the historic flow at this location as mentioned previously above. Basins H3 ( $Q_5 = 3$  cfs and  $Q_{100} = 6$  cfs), H4 ( $Q_5 = 1$  cfs and  $Q_{100} = 2$  cfs), I1 ( $Q_5 = 7$  cfs and  $Q_{100} = 14$  cfs), I2 ( $Q_5 = 4$  cfs and  $Q_{100} = 8$  cfs) and K ( $Q_5 = 2$  cfs and  $Q_{100} = 4$  cfs) represent developed flow from the adjacent residential property to the west – Bent Grass Residential Filing No. 1. All of these basins will be routed via storm sewer to the on-site detention/SWQ facility. **Design Point 11** ( $Q_5 = 12$  cfs and  $Q_{100} = 25$  cfs) represents this total collected flow that will enter the detention/SWQ facility from the west.

## DETENTION FACILITY

The detention facility has been designed to accommodate the full spectrum Excess Urban Runoff Volume (EURV) as described by the Denver Urban Drainage and Flood Control District. The specific design data for this facility is contained in the Appendix and utilizes the UD-BMP v3.03 EDB spreadsheet. This facility is proposed to be owned and maintained by the local Metro District with a private maintenance agreement with the County.

### Detention Pond 2 (Full Spectrum)

2.08 Ac.-ft. EURV required

2.79 Ac.-ft. design provided with multiple forebays and plunge pool outlet

|                      |                  |                    |                    |                    |
|----------------------|------------------|--------------------|--------------------|--------------------|
| Total In-flow:       | $Q_5 = 38$ cfs,  | $Q_{100} = 74$ cfs |                    |                    |
| Pond Design Release: | $Q_2 = 0.2$ cfs, | $Q_5 = 0.4$ cfs    | $Q_{10} = 0.6$ cfs | $Q_{100} = 10$ cfs |
| Historic Release:    | $Q_2 = 5$ cfs,   | $Q_5 = 7$ cfs      | $Q_{10} = 9$ cfs   | $Q_{100} = 18$ cfs |
| Max. 100 yr. WSE     | 6925.94          |                    |                    |                    |

This facility will be constructed with Bent Grass Residential Filing No. 1. The outfall for this facility is an 18" RCP outfall routing release flows due east within a public utility esmt. along the south boundary and directly into the existing channel along the west side of Meridian Road. This is represented by **Design Point 15** ( $Q_5 = 15$  cfs and  $Q_{100} = 37$  cfs). Release at this point remains consistent with the previously approved Bent Grass East Commercial Filing No. 1 report equaling  $Q_5 = 19$  cfs and  $Q_{100} = 44$  cfs, which includes the previously mentioned water quality only release from the eastern portion of lots 1 and 2 along with the off-site basins OS-1 and OS-2. Historic flow at this location equals  $Q_5 = 19$  cfs and  $Q_{100} = 47$  cfs.

## HYDROLOGIC CALCULATIONS

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and 1994. The overall drainage basin and pond/water quality design model was calculated using PondPack V8i with time of concentrations estimated using SCS procedures described in the DCM based upon the hydrologic soil type and runoff curve numbers (CN) chart. (Table 5-5) Individual on-site developed basin design used for storm system routing was calculated using the Rational Method.

## FLOODPLAIN STATEMENT

No portion of this site is located within a FEMA floodplain as determined by the Flood Insurance Rate Map (F.I.R.M.) Map Numbers 08041C 0575F, with effective date of March 17, 1997. These are based on the 2003 LOMR dated Nov. 26, 2003 prepared by Kiowa Engineering.

## DRAINAGE & BRIDGE FEES

This site lies within the Falcon Drainage Basin. As mentioned previously, the Falcon DBPS is in the process of being updated. However, until this report is formally approved the current basin fees will be utilized. The following is the impervious acreage calculation to determine the required fees:

This subdivision has a total platted area of 10.30 acres. However, Tract B (5.35 ac.) is for future commercial development and must be re-platted into a lot prior to any development. Thus, no fees will be paid on Tract B at this time. The remaining acreage equals 4.95 acres.

The percent imperviousness for the subdivision is calculated as follows:

Tract A (Detention facility) equals 1.50 ac.

(Per El Paso County Percent Impervious Chart – open space/greenbelt: 2%)

$1.50 \text{ Ac.} \times 2\% = \mathbf{0.03 \text{ Impervious Ac.}}$

Lots 1-3 and Trey Lane ROW (Commercial Use) equal 3.45 ac.

(Per El Paso County Percent Impervious Chart – commercial: 95%)

$3.45 \text{ Ac.} \times 95\% = \mathbf{3.28 \text{ Impervious Ac.}}$





The following calculations are based on the 2014 drainage/bridge fees:

**Bridge Fees**

$$\$3,115 \times 3.31 \text{ Impervious Ac.} = \underline{\$ 10,310.65}$$

**Drainage Fees**

$$\$8,115 \times 3.31 \text{ Impervious Ac.} = \underline{\$ 26,860.65}$$

**Fee Reduction (50% reasonable const. costs for detention facility)**

$$\text{Detention Pond 2 (Full Spectrum on-site facility)} \quad \$75,000 \times 50\% = \$37,500.00$$

(See FAE for Pond estimate)

$$\text{Drainage Fee Total } \$26,860.65 - \$37,500.00 = \underline{\text{N/A}}$$

$$\text{Bridge Fee Total } \underline{\$10,310.65}$$

**SUMMARY**

All detention facilities have been designed to release at or below historic rates. The proposed development will not adversely impact surrounding developments.

PREPARED BY:

**Classic Consulting Engineers & Surveyors, LLC**

Marc A. Whorton, P.E.  
Project Manager

mw/217753/Reports/217753FDR.doc



## REFERENCES

City of Colorado Springs/County of El Paso Drainage Criteria Manual, dated October 1991.

Soil Survey of El Paso County Area, Colorado Soil Conservation Service, June 1981.

“Preliminary and Final Drainage Report for Bent Grass East Commercial Filing No. 1”, by Classic Consulting, April 2013.

“Master Development Drainage Plan and Preliminary Drainage Plan – Bent Grass Subdivision” by Kiowa Engineering, Corp., December 2006.

“Final Drainage Report for Meadows Filing 3 Subdivision”, by Ladd Engineering, August 2000.

“Final Drainage Report for Woodmen Hills Subdivision Filing No. 4”, by URS Greiner, Inc., December 1997.

“Final Drainage Report for Woodmen Hills Subdivision Filing No. 1”, by URS Greiner, Inc., September 1995.

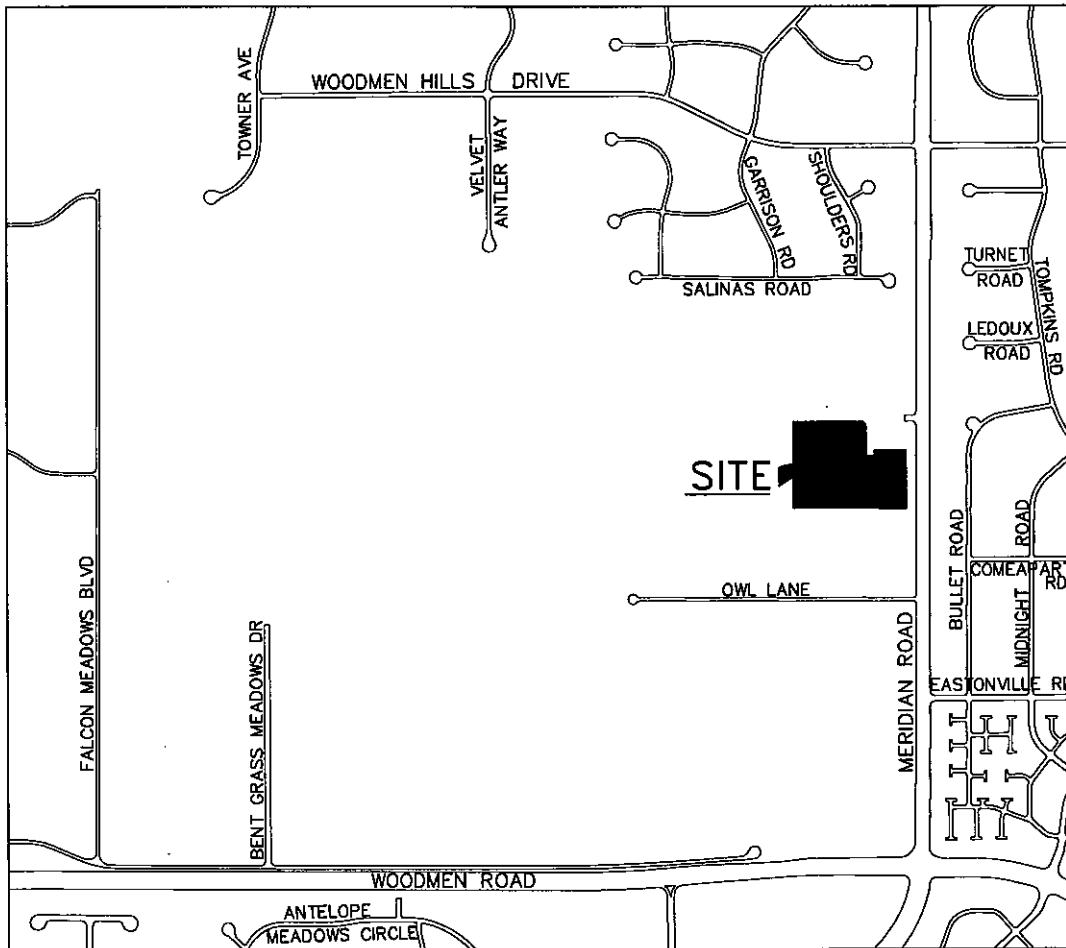
“Falcon Drainage Basin Planning Study,” by URS Corp., 2000.

“Falcon Drainage Basin Planning Study - Update,” by Matrix Design Group, dated August 2013 (In Process).



**APPENDIX**

**VICINITY MAP**



VICINITY MAP

N.T.S.

**SOILS MAP (S.C.S. SURVEY)**

Soil Map—El Paso County Area, Colorado



Map Scale: 1:2,450 if printed on A landscape (11" x 8.5") sheet.













Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84



Natural Resources  
Conservation Service

Web Soil Survey  
National Cooperative Soil Survey

## MAP LEGEND

-  Area of Interest (AOI)
-  Soils
-  Area of Interest (AOI)
-  Soil Map Unit Polygons
-  Soil Map Unit Lines
-  Soil Map Unit Points
- Special Point Features**
-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot
-  Water Features
-  Streams and Canals
- Transportation**
-  Rails
-  Interstate Highways
-  US Routes
-  Major Roads
-  Local Roads
- Background**
-  Aerial Photography
-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
- Special Line Features**

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

**Warning:** Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: El Paso County Area, Colorado  
 Survey Area Data: Version 10, Dec 23, 2013

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Apr 15, 2011—Sep 22, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.



## Map Unit Legend

| El Paso County Area, Colorado (CO825) |   |              |                |
|---------------------------------------|---|--------------|----------------|
| Map Unit Symbol                       | Map Unit Name   | Acres in AOI | Percent of AOI |
| 19                                    | Columbine gravelly sandy loam,<br>0 to 3 percent slopes | 31.6         | 100.0%         |
| <b>Totals for Area of Interest</b>    |   | <b>31.6</b>  | <b>100.0%</b>  |

## El Paso County Area, Colorado

### 19—Columbine gravelly sandy loam, 0 to 3 percent slopes

#### Map Unit Setting

*Elevation:* 6,500 to 7,300 feet

*Mean annual precipitation:* 14 to 16 inches

*Mean annual air temperature:* 46 to 50 degrees F

*Frost-free period:* 125 to 145 days

#### Map Unit Composition

*Columbine and similar soils:* 85 percent

#### Description of Columbine

##### Setting

*Landform:* Fans, fan terraces, flood plains

*Down-slope shape:* Linear

*Across-slope shape:* Linear

*Parent material:* Alluvium

##### Typical profile

*A - 0 to 14 inches:* neutral, gravelly sandy loam

*C - 14 to 60 inches:* neutral, very gravelly loamy sand

##### Properties and qualities

*Slope:* 0 to 3 percent

*Depth to restrictive feature:* More than 80 inches

*Natural drainage class:* Well drained

*Capacity of the most limiting layer to transmit water (Ksat):* High to very high (5.95 to 19.98 in/hr)

*Depth to water table:* More than 80 inches

*Frequency of flooding:* None

*Frequency of ponding:* None

*Available water storage in profile:* Very low (about 2.5 inches)

##### Interpretive groups

*Farmland classification:* Not prime farmland

*Land capability classification (irrigated):* 4e

*Land capability classification (nonirrigated):* 6e

*Hydrologic Soil Group:* A

*Ecological site:* Gravelly Foothill (R049BY214CO)

#### Minor Components

##### Other soils

*Percent of map unit:*

##### Fluvaquentic haplaquolls

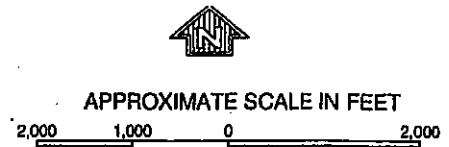
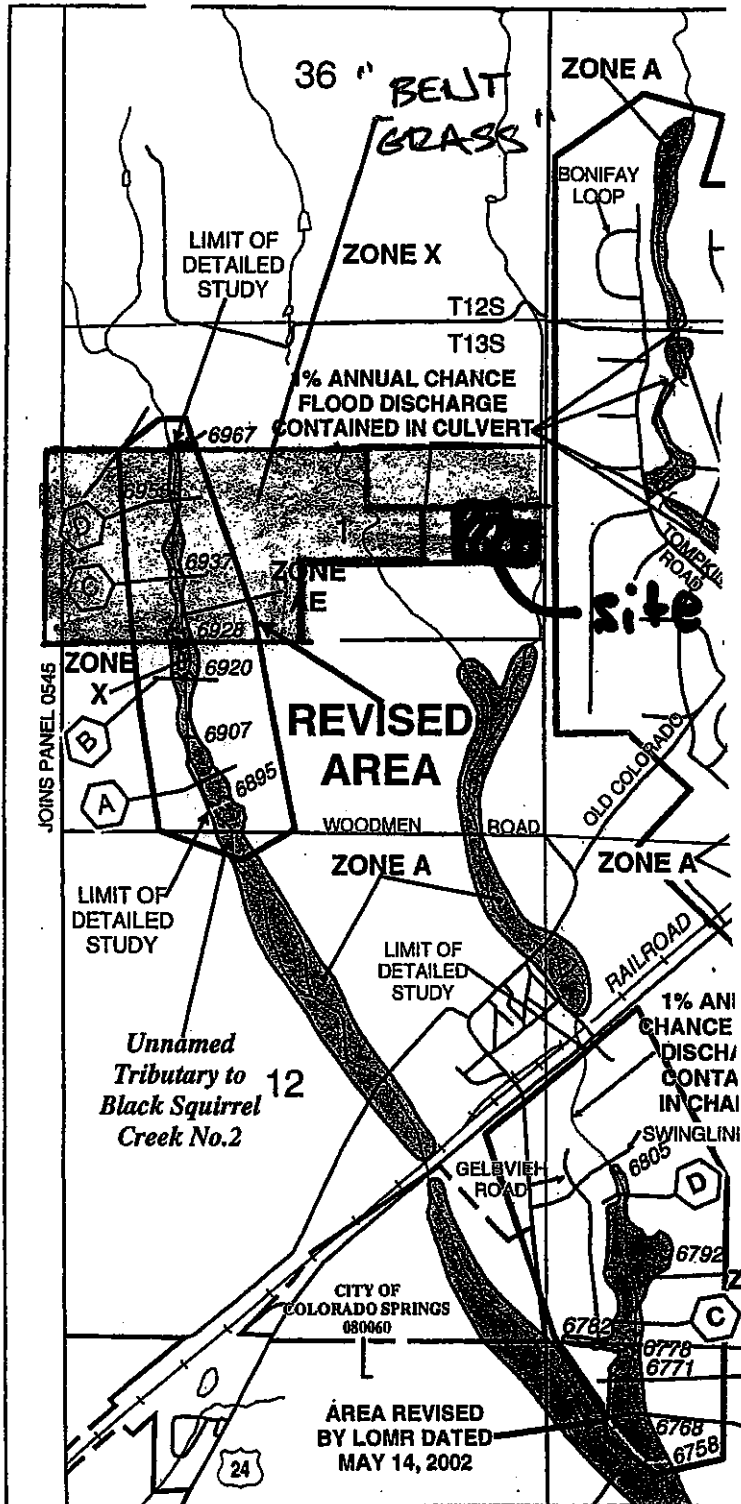
*Percent of map unit:*

*Landform:* Swales

##### Pleasant

*Percent of map unit:*

**F.E.M.A MAP**



NATIONAL FLOOD INSURANCE PROGRAM

**FIRM**  
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,  
COLORADO  
AND INCORPORATED AREAS

PANEL 575 OF 1300  
(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

| COMMUNITY                            | NUMBER | PANEL | SUFFIX |
|--------------------------------------|--------|-------|--------|
| EL PASO COUNTY, UNINCORPORATED AREAS | 080050 | 0575  | F      |
| COLORADO SPRINGS, CITY OF            | 080060 | 0575  | F      |

**REVISED TO REFLECT LOMR DATED NOV 26 2003**

MAP NUMBER 08041C0575 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

FIGURE 3  
FLOODPLAIN INFORMATION

## HYDROLOGIC/DETENTION CALCULATIONS

**JOB NAME:** Bent Grass East Commercial

**JOB NUMBER:** 2177.50

**DATE:** 06/30/14

**CALCULATED BY:** MAW

**FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY**

| BASIN | IMPERVIOUS AREA / STREETS |           |      | LANDSCAPE/UNDEVELOPED AREAS |      |        | WEIGHTED |        |      | WEIGHTED CA |       |         |
|-------|---------------------------|-----------|------|-----------------------------|------|--------|----------|--------|------|-------------|-------|---------|
|       | TOTAL AREA (AC)           | AREA (AC) | C(5) | AREA (AC)                   | C(5) | C(100) | C(5)     | C(100) | C(5) | C(100)      | CA(5) | CA(100) |
| EX-1  | 13.21                     | 0.00      | 0.90 | 13.21                       | 0.25 | 0.35   | 0.25     | 0.35   | 0.25 | 0.35        | 3.30  | 4.62    |
| EX-2  | 25.30                     | 0.00      | 0.90 | 25.30                       | 0.25 | 0.35   | 0.25     | 0.35   | 0.25 | 0.35        | 6.33  | 8.86    |
| EX-3  | 2.40                      | 0.00      | 0.90 | 2.40                        | 0.25 | 0.35   | 0.25     | 0.35   | 0.25 | 0.35        | 0.60  | 0.84    |

JOB NAME: Bent Grass East Commercial  
 JOB NUMBER: 2177.50  
 DATE: 06/30/14  
 CALC'D BY: MAW

**FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY**

| BASIN | WEIGHTED |         | OVERLAND |             |             | STREET / CHANNEL FLOW |             |           | Tc             |          |             | INTENSITY    |              |               | TOTAL FLOWS    |            |            |             |              |
|-------|----------|---------|----------|-------------|-------------|-----------------------|-------------|-----------|----------------|----------|-------------|--------------|--------------|---------------|----------------|------------|------------|-------------|--------------|
|       | CA(5)    | CA(100) | C(5)     | Length (ft) | Height (ft) | Tc (min)              | Length (ft) | Slope (%) | Velocity (fps) | Tc (min) | TOTAL (min) | I(2) (in/hr) | I(5) (in/hr) | I(10) (in/hr) | I(100) (in/hr) | Q(2) (cfs) | Q(5) (cfs) | Q(10) (cfs) | Q(100) (cfs) |
| EX-1  | 3.30     | 4.62    | 0.25     | 850         | 20          | 34.9                  |             |           |                | 34.9     | 1.61        | 2.22         | 2.59         | 3.94          | 3.94           | 5          | 7          | 9           | 18           |
| EX-2  | 6.33     | 8.86    | 0.25     | 1000        | 23          | 38.2                  |             |           |                | 38.2     | 1.53        | 2.10         | 2.45         | 3.74          | 3.74           | 10         | 13         | 16          | 33           |
| EX-3  | 0.60     | 0.84    | 0.25     | 500         | 12          | 26.6                  |             |           |                | 26.6     | 1.88        | 2.59         | 3.02         | 4.60          | 4.60           | 1          | 2          | 2           | 4            |

JOB NAME: **BENT GRASS EAST COMMERCIAL FIL. 2**  
 JOB NUMBER: **2177.53**  
 DATE: **07/01/14**  
 CALCULATED BY: **MAW**

**FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY**

| BASIN | IMPERVIOUS AREA / STREETS |           |      | LANDSCAPE/UNDEVELOPED AREAS |           |      | WEIGHTED |      | WEIGHTED CA |       |         |
|-------|---------------------------|-----------|------|-----------------------------|-----------|------|----------|------|-------------|-------|---------|
|       | TOTAL AREA (AC)           | AREA (AC) | C(5) | C(100)                      | AREA (AC) | C(5) | C(100)   | C(5) | C(100)      | CA(5) | CA(100) |
| OS-1  | 24.20                     | 0.00      | 0.27 | 0.37                        | 24.20     | 0.25 | 0.35     | 0.25 | 0.35        | 6.05  | 8.47    |
| OS-2  | 1.60                      | 1.50      | 0.90 | 0.95                        | 0.10      | 0.25 | 0.35     | 0.86 | 0.91        | 1.38  | 1.46    |
| OS-3  | 1.70                      | 1.40      | 0.90 | 0.95                        | 0.30      | 0.25 | 0.35     | 0.79 | 0.84        | 1.34  | 1.44    |
| H3    | 1.54                      | 1.54      | 0.55 | 0.65                        | 0.00      | 0.25 | 0.35     | 0.55 | 0.65        | 0.85  | 1.00    |
| H4    | 0.42                      | 0.42      | 0.55 | 0.65                        | 0.00      | 0.25 | 0.35     | 0.55 | 0.65        | 0.23  | 0.27    |
| I1    | 3.00                      | 3.00      | 0.55 | 0.65                        | 0.00      | 0.25 | 0.35     | 0.55 | 0.65        | 1.65  | 1.95    |
| I2    | 1.70                      | 1.70      | 0.55 | 0.65                        | 0.00      | 0.25 | 0.35     | 0.55 | 0.65        | 0.94  | 1.11    |
| J     | 1.64                      | 1.64      | 0.40 | 0.55                        | 0.00      | 0.25 | 0.35     | 0.40 | 0.55        | 0.66  | 0.90    |
| K     | 1.00                      | 1.00      | 0.40 | 0.55                        | 0.00      | 0.25 | 0.35     | 0.40 | 0.55        | 0.40  | 0.55    |
| L     | 5.90                      | 5.20      | 0.85 | 0.90                        | 0.70      | 0.25 | 0.35     | 0.78 | 0.83        | 4.60  | 4.93    |
| M1    | 1.56                      | 1.56      | 0.85 | 0.90                        | 0.00      | 0.25 | 0.35     | 0.85 | 0.90        | 1.33  | 1.40    |
| M2    | 0.44                      | 0.44      | 0.85 | 0.90                        | 0.00      | 0.25 | 0.35     | 0.85 | 0.90        | 0.37  | 0.40    |
| N     | 1.32                      | 1.32      | 0.85 | 0.90                        | 0.00      | 0.25 | 0.35     | 0.85 | 0.90        | 1.12  | 1.19    |
| O     | 0.58                      | 0.00      | 0.85 | 0.90                        | 0.58      | 0.25 | 0.35     | 0.25 | 0.35        | 0.15  | 0.20    |



JOB NAME: **BENT GRASS EAST COMMERCIAL FIL. 2**

JOB NUMBER: **2177.53**

DATE: **07/01/14**

CALCD BY: **MAW**

**FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY**

| BASIN | WEIGHTED |         | OVERLAND |             | STREET / CHANNEL FLOW |          |             | INTENSITY |                |          |              |              | TOTAL FLOWS   |               |               |                |            |            |             |             |             |              |  |
|-------|----------|---------|----------|-------------|-----------------------|----------|-------------|-----------|----------------|----------|--------------|--------------|---------------|---------------|---------------|----------------|------------|------------|-------------|-------------|-------------|--------------|--|
|       | CA(5)    | CA(100) | C(5)     | Length (ft) | Height (ft)           | Tc (min) | Length (ft) | Slope (%) | Velocity (fps) | Tc (min) | I(2) (in/hr) | I(5) (in/hr) | I(10) (in/hr) | I(25) (in/hr) | I(50) (in/hr) | I(100) (in/hr) | Q(2) (cfs) | Q(5) (cfs) | Q(10) (cfs) | Q(25) (cfs) | Q(50) (cfs) | Q(100) (cfs) |  |
| OS-1  | 6.05     | 8.47    | 0.25     | 950         | 22                    | 37.1     |             |           |                |          | 1.55         | 2.14         | 2.49          | 3.21          | 3.63          | 3.80           | 9          | 13         | 15          | 27          | 31          | 32           |  |
| OS-2  | 1.38     | 1.46    | 0.25     |             |                       |          |             |           |                |          | 3.71         | 5.10         | 5.96          | 7.66          | 8.68          | 9.07           | 5          | 7          | 8           | 11          | 13          | 13           |  |
| OS-3  | 1.34     | 1.44    | 0.25     | 30          | 0.6                   | 6.9      | 200         | 1.5%      | 4.3            | 0.8      | 3.27         | 4.50         | 5.25          | 6.75          | 7.65          | 8.00           | 4          | 6          | 7           | 10          | 11          | 11           |  |
| H3    | 0.85     | 1.00    | 0.25     | 100         | 2                     | 12.6     | 360         | 2.0%      | 4.9            | 1.2      | 2.61         | 3.59         | 4.19          | 5.39          | 6.11          | 6.38           | 2          | 3          | 4           | 5           | 6           | 6            |  |
| H4    | 0.23     | 0.27    | 0.25     | 50          | 1                     | 8.9      | 150         | 2.0%      | 4.9            | 0.5      | 3.05         | 4.19         | 4.89          | 6.29          | 7.12          | 7.45           | 0.7        | 1.0        | 1.1         | 1.7         | 1.9         | 2.0          |  |
| I1    | 1.65     | 1.95    | 0.25     | 50          | 1                     | 8.9      | 550         | 2.0%      | 4.9            | 1.9      | 2.89         | 3.98         | 4.65          | 5.97          | 6.77          | 7.08           | 5          | 7          | 8           | 12          | 13          | 14           |  |
| I2    | 0.94     | 1.11    | 0.25     | 50          | 1                     | 8.9      | 300         | 2.0%      | 4.9            | 1.0      | 2.99         | 4.11         | 4.79          | 6.16          | 6.99          | 7.31           | 3          | 4          | 4           | 7           | 8           | 8            |  |
| J     | 0.66     | 0.90    | 0.25     | 75          | 4                     | 7.9      |             |           |                |          | 3.24         | 4.46         | 5.20          | 6.69          | 7.58          | 7.93           | 2          | 3          | 3           | 6           | 7           | 7            |  |
| K     | 0.40     | 0.55    | 0.25     | 65          | 3                     | 7.7      |             |           |                |          | 3.27         | 4.49         | 5.24          | 6.74          | 7.64          | 7.99           | 1          | 2          | 2           | 4           | 4           | 4            |  |
| L     | 4.60     | 4.93    | 0.25     | 30          | 0.6                   | 6.9      | 800         | 1.0%      | 3.5            | 3.8      | 2.90         | 3.99         | 4.66          | 5.99          | 6.78          | 7.10           | 13         | 18         | 21          | 29          | 33          | 35           |  |
| M1    | 1.33     | 1.40    | 0.25     | 30          | 0.6                   | 6.9      | 300         | 1.0%      | 3.5            | 1.4      | 3.18         | 4.38         | 5.11          | 6.57          | 7.44          | 7.78           | 4          | 6          | 7           | 9           | 10          | 11           |  |
| M2    | 0.37     | 0.40    | 0.25     |             |                       |          |             |           |                |          | 3.71         | 5.10         | 5.96          | 7.66          | 8.68          | 9.07           | 1.4        | 1.9        | 2.2         | 3.0         | 3.4         | 3.6          |  |
| N     | 1.12     | 1.19    | 0.25     | 20          | 0.4                   | 5.7      | 300         | 2.0%      | 4.9            | 1.1      | 3.41         | 4.69         | 5.47          | 7.04          | 7.97          | 8.34           | 4          | 5          | 6           | 8           | 9           | 10           |  |
| O     | 0.15     | 0.20    | 0.25     | 60          | 5                     | 6.1      |             |           |                |          | 3.51         | 4.83         | 5.64          | 7.25          | 8.22          | 8.59           | 0.5        | 0.7        | 0.8         | 1.5         | 1.7         | 1.7          |  |

JOB NAME: BENT GRASS EAST COMMERCIAL FIL. 2  
 JOB NUMBER: 2177.53  
 DATE: 07/22/14  
 CALCULATED BY: MAW

**FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY**

| Design Point(s) | Contributing Basins                                    | Equivalent CA(5) | Equivalent CA(100) | Maximum Tc  | Intensity   |             | Flow      |           | Facility Size           |
|-----------------|--|------------------|--------------------|-------------|-------------|-------------|-----------|-----------|-------------------------|
|                 |  |                  |                    |             | I(5)        | I(100)      | Q(5)      | Q(100)    |                         |
| 7               | H3   | 0.85             | 1.00               | 13.8        | 3.59        | 6.38        | 3         | 6         | 4' TYPE R SUMP INLET    |
| 8               | H4   | 0.23             | 0.27               | 9.4         | 4.19        | 7.45        | 1         | 2         | 4' TYPE R SUMP INLET    |
| 9               | I1   | 1.65             | 1.95               | 10.8        | 3.98        | 7.08        | 7         | 14        | 6' TYPE R SUMP INLET    |
| 10              | I2   | 0.94             | 1.11               | 10.0        | 4.11        | 7.31        | 4         | 8         | 4' TYPE R SUMP INLET    |
| 11              | DP 7 - DP 10<br>(Westerly Flow into Pond 2)            | 3.66             | 4.33               | 16.9        | 3.27        | 5.82        | 12        | 25        | 30" RCP                 |
| 12              | M1   | 1.33             | 1.40               | 8.4         | 4.38        | 7.76        | 6         | 11        | 4' TYPE R SUMP INLET    |
| 13              | M2 & N   | 1.50             | 1.58               | 6.8         | 4.69        | 8.34        | 7         | 13        | 6' TYPE R SUMP INLET    |
| 14              | DP 12 & DP 13<br>(Easterly Flow into Pond 2)           | 2.82             | 2.99               | 8.9         | 4.29        | 7.63        | 12        | 23        | 30" RCP                 |
|                 | <b>Total Flow into Pond 2 (Inch Basins, K &amp; L)</b> | <b>11.48</b>     | <b>12.79</b>       | <b>16.9</b> | <b>3.27</b> | <b>5.82</b> | <b>33</b> | <b>74</b> | <b>2.3 AC-FT POND 2</b> |
| 15              | OS-1, OS-2, OS-3, O AND POND 2 RELEASE                 | SCS MODEL        |                    |             |             |             | 15        | 37        |                         |

JOB NAME: BENT GRASS RESIDENTIAL FIL. 1  
 JOB NUMBER: 2430.00  
 DATE: 05/28/14  
 CALCULATED BY: MAW

**DESIGN POINT 7**

*Total Flow:*       $Q_5 = 3$       cfs  
                           $Q_{100} = 6$       cfs

*Max. allowable ponding depth:  
 (Residential street, ramp curb)*

$D_5 = 0.50$       ft.  
 $D_{100} = 1.00$       ft.

*Std. Type R curb inlet detail:*

$$Q_i = 1.7(L_i + 1.8(W))(d_{max} + a)^{1.85}$$

$$W = 2 \text{ ft.}$$

$$a = 3 \text{ in.}$$

$$\text{Clogging Factor} = 1.25$$

$$L_i(1.25) = \text{Length of inlet opening}$$

*Curb inlet sizing:*

*5-Year Event:*            foot inlet required

*100-Year Event:*            foot inlet required

JOB NAME: BENT GRASS RESIDENTIAL FIL. 1  
 JOB NUMBER: 2430.00  
 DATE: 05/28/14  
 CALCULATED BY: MAW

**DESIGN POINT**                    **8**

**Total Flow:**         $Q_5$         =        **1**        cfs  
     $Q_{100}$       =        **2**        cfs

**Max. allowable ponding depth:**  
**(Residential street, ramp curb)**

$D_5$             =        **0.50**    ft.  
 $D_{100}$        =        **1.00**    ft.

**Std. Type R curb inlet detail:**

$Q_i = 1.7(L_i + 1.8(W))(d_{max} + a)^{1.85}$

$W = 2$  ft.

$a = 3$  in.

Clogging Factor = 1.25  
 $L_i(1.25)$  = Length of inlet opening

**Curb inlet sizing:**

**5-Year Event:**                foot inlet required

**100-Year Event:**            foot inlet required

JOB NAME: BENT GRASS RESIDENTIAL FIL. 1 &  
BENT GRASS EAST COMM. FIL. 2

JOB NUMBER: 2430.00

DATE: 05/16/14

CALCULATED BY: MAW

**DESIGN POINT 9**

*Total Flow:*  $Q_5 = 7$  cfs  
 $Q_{100} = 14$  cfs

*Max. allowable ponding depth:  
 (Residential street, ramp curb)*

$D_5 = 0.50$  ft.  
 $D_{100} = 1.00$  ft.

*Std. Type R curb inlet detail:*

$$Q_i = 1.7(Li + 1.8(W))(d_{max} + a)^{1.85}$$

$$W = 2 \text{ ft.}$$

$$a = 3 \text{ in.}$$

$$\text{Clogging Factor} = 1.25$$

$$Li(1.25) = \text{Length of inlet opening}$$

*Curb inlet sizing:*

*5-Year Event:*  foot inlet required

*100-Year Event:*  foot inlet required

JOB NAME: BENT GRASS RESIDENTIAL FIL. 1 &  
BENT GRASS EAST COMM. FIL. 2  
 JOB NUMBER: 2430.00  
 DATE: 05/16/14  
 CALCULATED BY: MAW

**DESIGN POINT**                      **10**

*Total Flow:*             $Q_5 = 4$     cfs  
                                   $Q_{100} = 8$     cfs

*Max. allowable ponding depth:  
 (Residential street, ramp curb)*

$D_5 = 0.50$     ft.  
 $D_{100} = 1.00$     ft.

*Std. Type R curb inlet detail:*

$$Q_i = 1.7(L_i + 1.8(W))(d_{max} + a)^{1.85}$$

$$W = 2 \text{ ft.}$$

$$a = 3 \text{ in.}$$

$$\text{Clogging Factor} = 1.25$$

$$L_i(1.25) = \text{Length of inlet opening}$$

*Curb inlet sizing:*

*5-Year Event:*        foot inlet required

*100-Year Event:*        foot inlet required

JOB NAME: BENT GRASS RESIDENTIAL FIL. 1 &  
BENT GRASS EAST COMM. FIL. 2  
 JOB NUMBER: 2430.00  
 DATE: 05/16/14  
 CALCULATED BY: MAW

**DESIGN POINT 12**

*Total Flow:*       $Q_5 = 5$  cfs  
                           $Q_{100} = 11$  cfs

*Max. allowable ponding depth:  
 (Residential street, ramp curb)*

$D_5 = 0.50$  ft.  
 $D_{100} = 1.00$  ft.

*Std. Type R curb inlet detail:*

$$Q_i = 1.7(L_i + 1.8(W))(d_{max} + a)^{1.85}$$

$W = 2$  ft.

$a = 3$  in.

Clogging Factor = 1.25  
 $L_i (1.25) =$  Length of inlet opening

*Curb inlet sizing:*

*5-Year Event:*            foot inlet required

*100-Year Event:*            foot inlet required

JOB NAME: BENT GRASS RESIDENTIAL FIL. 1 &  
BENT GRASS EAST COMM. FIL. 2  
 JOB NUMBER: 2430.00  
 DATE: 05/16/14  
 CALCULATED BY: MAW

**DESIGN POINT 13**

**Total Flow:**  $Q_5 = 7$  cfs  
 $Q_{100} = 13$  cfs

**Max. allowable ponding depth:  
 (Residential street, ramp curb)**

$D_5 = 0.50$  ft.  
 $D_{100} = 1.00$  ft.

**Std. Type R curb inlet detail:**

$$Q_i = 1.7(L_i + 1.8(W))(d_{max} + a)^{1.85}$$

$$W = 2 \text{ ft.}$$

$$a = 3 \text{ in.}$$

$$\text{Clogging Factor} = 1.25$$

$$L_i(1.25) = \text{Length of inlet opening}$$

**Curb inlet sizing:**

**5-Year Event:**  foot inlet required

**100-Year Event:**  foot inlet required





6385 Corporate Drive, Suite 101  
Colorado Springs, CO 80919

Project: SENT GRASS East Comm. C  
 Date: 5/20/14  
 Contact: \_\_\_\_\_  
 Phone: \_\_\_\_\_  
 By: MAW

**NOTES**

- Telephone Record
- Note to the File
- Job Information
- Meeting Minutes
- \_\_\_\_\_

Pond Imperviousness

Residential Basins: H3, H4, I1, I2, K

|                  |          |   |     |   |      |                   |
|------------------|----------|---|-----|---|------|-------------------|
| (H3, H4, I1, I2) | 6.66 ac. | x | .53 | = | 3.53 |                   |
| (K)              | 1.0 ac.  | x | .30 | = | .30  |                   |
|                  |          |   |     |   |      | <u>3.83 total</u> |

Commercial Basins L, M1, M2, N

|             |          |   |                       |   |                         |                   |
|-------------|----------|---|-----------------------|---|-------------------------|-------------------|
| (L)         | 5.9 ac.  | x | <del>.75</del><br>.84 | = | <del>4.43</del><br>4.96 |                   |
| (M1, M2, N) | 3.32 ac. | x | .95                   | = | 3.15                    |                   |
|             |          |   |                       |   |                         | <u>8.11 total</u> |

|             |                  |  |  |   |   |                                |
|-------------|------------------|--|--|---|---|--------------------------------|
|             | <u>11.94</u>     |  |  |   | <u>.71</u>  |                                |
|             | <del>11.41</del> |  |  |   |   |                                |
| (total ac.) | 16.88            |  |  | = | <span style="border: 1px solid black; padding: 5px;">.88</span> | <u>5.1%</u><br><u>68% Imp.</u> |

## EXIST. CHANNEL ALONG MERIDIAN (Reach M8)

### Project Description

Friction Method                      Manning Formula  
Solve For                                Discharge

Approx. Exst. Capacity

### Input Data

|                       |         |             |
|-----------------------|---------|-------------|
| Roughness Coefficient | 0.035   |             |
| Channel Slope         | 0.01200 | ft/ft       |
| Normal Depth          | 3.50    | ft          |
| Left Side Slope       | 3.00    | ft/ft (H:V) |
| Right Side Slope      | 3.00    | ft/ft (H:V) |

### Results

|                  |             |                    |
|------------------|-------------|--------------------|
| Discharge        | * 239.63    | ft <sup>3</sup> /s |
| Flow Area        | 36.75       | ft <sup>2</sup>    |
| Wetted Perimeter | 22.14       | ft                 |
| Hydraulic Radius | 1.66        | ft                 |
| Top Width        | 21.00       | ft                 |
| Critical Depth   | 3.31        | ft                 |
| Critical Slope   | 0.01619     | ft/ft              |
| Velocity         | 6.52        | ft/s               |
| Velocity Head    | 0.66        | ft                 |
| Specific Energy  | 4.16        | ft                 |
| Froude Number    | 0.87        |                    |
| 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 |          |       |
| Profile Headloss    | 0.00     | ft    |
| Downstream Velocity | Infinity | ft/s  |
| Upstream Velocity   | Infinity | ft/s  |
| Normal Depth        | 3.50     | ft    |
| Critical Depth      | 3.31     | ft    |
| Channel Slope       | 0.01200  | ft/ft |
| Critical Slope      | 0.01619  | ft/ft |

**Design Procedure Form: Extended Detention Basin (EDB)**

Sheet 1 of 4

**Designer:** Marc A. Whorton  
**Company:** CCES  
**Date:** July 21, 2014  
**Project:** Bent Grass East Commercial - Entire Pond  
**Location:** \_\_\_\_\_

**1. Basin Storage Volume**

- A) Effective Imperviousness of Tributary Area,  $I_a$
- B) Tributary Area's Imperviousness Ratio ( $i = I_a / 100$ )
- C) Contributing Watershed Area
- D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- E) Design Concept  
(Select EURV when also designing for flood control)
- F) Design Volume (1.2 WQCV) Based on 40-hour Drain Time  
( $V_{DESIGN} = (1.0 * (0.91 * I^2 - 1.19 * I + 0.78 * i) / 12 * Area * 1.2)$ )
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume  
( $V_{WQCV\ OTHER} = (d_s * (V_{DESIGN} / 0.43))$ )
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume  
(Only if a different WQCV Design Volume is desired)
- I) Predominant Watershed NRCS Soil Group
- J) Excess Urban Runoff Volume (EURV) Design Volume  
 For HSG A:  $EURV_A = (0.1878i - 0.0104) * Area$   
 For HSG B:  $EURV_B = (0.1178i - 0.0042) * Area$   
 For HSG C/D:  $EURV_{C/D} = (0.1043i - 0.0031) * Area$

$I_a =$  71.0 %

$i =$  0.710

Area = 16.880 ac

$d_s =$  0.42 in

Choose One

Water Quality Capture Volume (WQCV)

Excess Urban Runoff Volume (EURV)

$V_{DESIGN} =$  0.472 ac-ft

$V_{DESIGN\ OTHER} =$  0.461 ac-ft

$V_{DESIGN\ USER} =$  \_\_\_\_\_ ac-ft

Choose One

A

B

C / D

EURV = 2.075 ac-ft

- 2. Basin Shape: Length to Width Ratio  
(A basin length to width ratio of at least 2:1 will improve TSS reduction.)

L : W = 4.0 : 1

**3. Basin Side Slopes**

- A) Basin Maximum Side Slopes  
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

Z = 4.00 ft / ft

**4. Inlet**

- A) Describe means of providing energy dissipation at concentrated inflow locations:

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Design Procedure Form: Extended Detention Basin (EDB)**

Sheet 2 of 4

**Designer:** Marc A. Whorton  
**Company:** CCES  
**Date:** July 21, 2014  
**Project:** Bent Grass East Commercial - Entire Pond  
**Location:** \_\_\_\_\_

**5. Forebay**

A) Minimum Forebay Volume  
( $V_{MIN} = 3\%$  of the WQCV)

$V_{MIN} = 0.012$  ac-ft

B) Actual Forebay Volume

$V_F =$  \_\_\_\_\_ ac-ft

C) Forebay Depth  
( $D_F = 18$  inch maximum)

$D_F = 8.0$  in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge

$Q_{100} = 74.00$  cfs

ii) Forebay Discharge Design Flow  
( $Q_F = 0.02 * Q_{100}$ )

$Q_F = 1.48$  cfs

E) Forebay Discharge Design

Choose One

- Berm With Pipe  
 Wall with Rect. Notch  
 Wall with V-Notch Weir

(flow too small for berm w/ pipe)

F) Discharge Pipe Size (minimum 8-inches)

Calculated  $D_p =$  \_\_\_\_\_ in

G) Rectangular Notch Width

Calculated  $W_N = 11.4$  in

**6. Trickle Channel**

A) Type of Trickle Channel

Choose One

- Concrete  
 Soft Bottom

PROVIDE A CONSISTENT LONGITUDINAL SLOPE FROM FOREBAY TO MICROPOOL WITH NO MEANDERING. RIPRAP AND SOIL RIPRAP LINED CHANNELS ARE NOT RECOMMENDED. MINIMUM DEPTH OF 1.5 FEET

F) Slope of Trickle Channel

$S = 0.0050$  ft / ft

**7. Micropool and Outlet Structure**

A) Depth of Micropool (2.5-feet minimum)

$D_M = 2.5$  ft

B) Surface Area of Micropool (10 ft<sup>2</sup> minimum)

$A_M = 100$  sq ft

C) Outlet Type

Choose One

- Orifice Plate  
 Other (Describe): \_\_\_\_\_

D) Depth of Design Volume (EURV or 1.2 WQCV) Based on the Design Concept Chosen Under 1.E.

$H = 2.50$  feet

E) Volume to Drain Over Prescribed Time

EURV = 2.075 ac-ft

F) Drain Time  
(Min  $T_D$  for WQCV= 40 hours; Max  $T_D$  for EURV= 72 hours)

$T_D = 72$  hours

G) Recommended Maximum Outlet Area per Row, ( $A_o$ )

$A_o = 2.30$  square inches

H) Orifice Dimensions:

- i) Circular Orifice Diameter or  
 ii) Width of 2" High Rectangular Orifice

$D_{orifice} = 1-11/16$  inches  
 $W_{orifice} =$  \_\_\_\_\_ inches

I) Number of Columns

$n_c = 1$  number

J) Actual Design Outlet Area per Row ( $A_o$ )

$A_o = 2.24$  square inches

K) Number of Rows ( $n_r$ )

$n_r = 7$  number

L) Total Outlet Area ( $A_{ot}$ )

$A_{ot} = 16.8$  square inches

M) Depth of WQCV ( $H_{wacv}$ )  
(Estimate using actual stage-area-volume relationship and  $V_{wacv}$ )

$H_{wacv} = 0.5$  feet

N) Ensure Minimum 40 Hour Drain Time for WQCV

$T_{D\ wacv} = 34.9$  hours

**Design Procedure Form: Extended Detention Basin (EDB)**

Sheet 1 of 4

**Designer:** Marc A. Whorton  
**Company:** CCES  
**Date:** May 20, 2014  
**Project:** Bent Grass East Commercial - Westerly Forebay  
**Location:** \_\_\_\_\_

**1. Basin Storage Volume**

- A) Effective Imperviousness of Tributary Area,  $i_p$
- B) Tributary Area's Imperviousness Ratio ( $i = i_p / 100$ )
- C) Contributing Watershed Area
- D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- E) Design Concept  
(Select EURV when also designing for flood control)
- F) Design Volume (1.2 WQCV) Based on 40-hour Drain Time  
( $V_{DESIGN} = (1.0 * (0.91 * i^2 - 1.19 * i + 0.78 * i) / 12 * Area * 1.2)$ )
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume  
( $V_{WQCV OTHER} = (d_s * (V_{DESIGN} / 0.43))$ )
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume  
(Only if a different WQCV Design Volume is desired)
- I) Predominant Watershed NRCS Soil Group
- J) Excess Urban Runoff Volume (EURV) Design Volume  
 For HSG A:  $EURVA = (0.1878i - 0.0104) * Area$   
 For HSG B:  $EURVB = (0.1178i - 0.0042) * Area$   
 For HSG C/D:  $EURV_{C/D} = (0.1043i - 0.0031) * Area$

$i_p =$  53.0 %

$i =$  0.530

Area = 6.660 ac

$d_s =$  0.42 in

Choose One

Water Quality Capture Volume (WQCV)

Excess Urban Runoff Volume (EURV)

$V_{DESIGN} =$  0.143 ac-ft

$V_{DESIGN OTHER} =$  0.140 ac-ft

$V_{DESIGN USER} =$  \_\_\_\_\_ ac-ft

Choose One

A

B

C / D

EURV = 0.594 ac-ft

**2. Basin Shape: Length to Width Ratio**

(A basin length to width ratio of at least 2:1 will improve TSS reduction.)

L: W = 4.0 : 1

**3. Basin Side Slopes**

- A) Basin Maximum Side Slopes  
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

Z = 3.00 ft / ft  
DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

**4. Inlet**

- A) Describe means of providing energy dissipation at concentrated inflow locations:

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

**Design Procedure Form: Extended Detention Basin (EDB)**

Sheet 2 of 4

**Designer:** Marc A. Whorton  
**Company:** CCES  
**Date:** May 20, 2014  
**Project:** Bent Grass East Commercial - Westerly Forebay  
**Location:** \_\_\_\_\_

**5. Forebay**

A) Minimum Forebay Volume  
( $V_{MIN} =$  2% of the WQCV)

$V_{MIN} =$  0.002 ac-ft

B) Actual Forebay Volume

$V_F =$  \_\_\_\_\_ ac-ft

C) Forebay Depth  
( $D_F =$  18 inch maximum)

$D_F =$  8.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge

$Q_{100} =$  25.00 cfs

ii) Forebay Discharge Design Flow  
( $Q_F = 0.02 * Q_{100}$ )

$Q_F =$  0.50 cfs

E) Forebay Discharge Design

Choose One

- Berm With Pipe  
 Wall with Rect. Notch  
 Wall with V-Notch Weir

(flow too small for berm w/ pipe)

F) Discharge Pipe Size (minimum 8-inches)

Calculated  $D_p =$  \_\_\_\_\_ in

G) Rectangular Notch Width

Calculated  $W_N =$  4.9 in

**6. Trickle Channel**

A) Type of Trickle Channel

Choose One

- Concrete  
 Soft Bottom

PROVIDE A CONSISTENT LONGITUDINAL SLOPE FROM FOREBAY TO MICROPOOL WITH NO MEANDERING. RIPRAP AND SOIL RIPRAP LINED CHANNELS ARE NOT RECOMMENDED. MINIMUM DEPTH OF 1.5 FEET

F) Slope of Trickle Channel

$S =$  0.0050 ft / ft

**7. Micropool and Outlet Structure**

A) Depth of Micropool (2.5-feet minimum)

$D_M =$  2.5 ft

B) Surface Area of Micropool (10 ft<sup>2</sup> minimum)

$A_M =$  10 sq ft

C) Outlet Type

Choose One

- Orifice Plate  
 Other (Describe): \_\_\_\_\_

D) Depth of Design Volume (EURV or 1.2 WQCV) Based on the Design Concept Chosen Under 1.E.

$H =$  \_\_\_\_\_ feet

E) Volume to Drain Over Prescribed Time

EURV = 0.594 ac-ft

F) Drain Time  
(Min  $T_D$  for WQCV = 40 hours; Max  $T_D$  for EURV = 72 hours)

$T_D =$  \_\_\_\_\_ hours

G) Recommended Maximum Outlet Area per Row, ( $A_o$ )

$A_o =$  \_\_\_\_\_ square inches

H) Orifice Dimensions:

- i) Circular Orifice Diameter or  
 ii) Width of 2" High Rectangular Orifice

$D_{orifice} =$  \_\_\_\_\_ inches  
 $W_{orifice} =$  \_\_\_\_\_ inches

I) Number of Columns

$n_c =$  \_\_\_\_\_ number

J) Actual Design Outlet Area per Row ( $A_o$ )

$A_o =$  \_\_\_\_\_ square inches

K) Number of Rows ( $n_r$ )

$n_r =$  \_\_\_\_\_ number

L) Total Outlet Area ( $A_{ot}$ )

$A_{ot} =$  \_\_\_\_\_ square inches

M) Depth of WQCV ( $H_{wqcv}$ )  
(Estimate using actual stage-area-volume relationship and  $V_{wqcv}$ )

$H_{wqcv} =$  \_\_\_\_\_ feet

N) Ensure Minimum 40 Hour Drain Time for WQCV

$T_{D\ wqcv} =$  \_\_\_\_\_ hours

**Design Procedure Form: Extended Detention Basin (EDB)**

Sheet 1 of 4

**Designer:** Marc A. Whorton  
**Company:** CCES  
**Date:** May 20, 2014  
**Project:** Bent Grass East Commercial - Easterly Forebay  
**Location:** \_\_\_\_\_

**1. Basin Storage Volume**

- A) Effective Imperviousness of Tributary Area,  $I_e$
- B) Tributary Area's Imperviousness Ratio ( $i = I_e / 100$ )
- C) Contributing Watershed Area
- D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- E) Design Concept  
(Select EURV when also designing for flood control)
- F) Design Volume (1.2 WQCV) Based on 40-hour Drain Time  
( $V_{DESIGN} = (1.0 * (0.91 * i^2 - 1.19 * i + 0.78 * 1) / 12 * Area * 1.2)$ )
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume  
( $V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN} / 0.43))$ )
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume  
(Only if a different WQCV Design Volume is desired)
- I) Predominant Watershed NRCS Soil Group
- J) Excess Urban Runoff Volume (EURV) Design Volume  
 For HSG A:  $EURV_A = (0.1878i - 0.0104) * Area$   
 For HSG B:  $EURV_B = (0.1178i - 0.0042) * Area$   
 For HSG C/D:  $EURV_{C/D} = (0.1043i - 0.0031) * Area$

$I_e =$  90.0 %

$i =$  0.900

Area = 3.320 ac

$d_6 =$  0.42 in

Choose One

- Water Quality Capture Volume (WQCV)
- Excess Urban Runoff Volume (EURV)

$V_{DESIGN} =$  0.133 ac-ft

$V_{DESIGN\ OTHER} =$  0.130 ac-ft

$V_{DESIGN\ USER} =$  \_\_\_\_\_ ac-ft

Choose One

- A
- B
- C/D

EURV = 0.527 ac-ft

- 2. Basin Shape: Length to Width Ratio  
(A basin length to width ratio of at least 2:1 will improve TSS reduction.)

L : W = 4.0 : 1

**3. Basin Side Slopes**

- A) Basin Maximum Side Slopes  
(Horizontal distance per unit vertical, 4:1 or flatter preferred)

$Z =$  3.00 ft / ft  
DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE

**4. Inlet**

- A) Describe means of providing energy dissipation at concentrated inflow locations:

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

**Design Procedure Form: Extended Detention Basin (EDB)**

Sheet 2 of 4

**Designer:** Marc A. Whorton  
**Company:** CCEs  
**Date:** May 20, 2014  
**Project:** Bent Grass East Commercial - Easterly Forebay  
**Location:** \_\_\_\_\_

**5. Forebay**

A) Minimum Forebay Volume  
 ( $V_{FMIN} = \underline{2\%}$  of the WQCV)

$V_{FMIN} = \underline{0.002}$  ac-ft

B) Actual Forebay Volume

$V_F =$  \_\_\_\_\_ ac-ft

C) Forebay Depth  
 ( $D_F = \underline{18}$  inch maximum)

$D_F = \underline{8.0}$  in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge

$Q_{100} = \underline{23.00}$  cfs

ii) Forebay Discharge Design Flow  
 ( $Q_F = 0.02 * Q_{100}$ )

$Q_F = \underline{0.46}$  cfs

E) Forebay Discharge Design

Choose One

- Berm With Pipe
- Wall with Rect. Notch
- Wall with V-Notch Weir

(flow too small for berm w/ pipe)

F) Discharge Pipe Size (minimum 8-inches)

Calculated  $D_p =$  \_\_\_\_\_ in

G) Rectangular Notch Width

Calculated  $W_N = \underline{4.6}$  in

**6. Trickle Channel**

A) Type of Trickle Channel

Choose One

- Concrete
- Soft Bottom

PROVIDE A CONSISTENT LONGITUDINAL SLOPE FROM FOREBAY TO MICROPOOL WITH NO MEANDERING. RIPRAP AND SOIL RIPRAP LINED CHANNELS ARE NOT RECOMMENDED. MINIMUM DEPTH OF 1.5 FEET

F) Slope of Trickle Channel

$S = \underline{0.0050}$  ft / ft

**7. Micropool and Outlet Structure**

A) Depth of Micropool (2.5-foot minimum)

$D_M = \underline{2.5}$  ft

B) Surface Area of Micropool (10 ft<sup>2</sup> minimum)

$A_M = \underline{10}$  sq ft

C) Outlet Type

Choose One

- Orifice Plate
- Other (Describe): \_\_\_\_\_

D) Depth of Design Volume (EURV or 1.2 WQCV) Based on the Design Concept Chosen Under 1.E.

$H =$  \_\_\_\_\_ feet

E) Volume to Drain Over Prescribed Time

EURV = 0.527 ac-ft

F) Drain Time  
 (Min  $T_D$  for WQCV= 40 hours; Max  $T_D$  for EURV= 72 hours)

$T_D =$  \_\_\_\_\_ hours

G) Recommended Maximum Outlet Area per Row, ( $A_o$ )

$A_o =$  \_\_\_\_\_ square inches

H) Orifice Dimensions:

- i) Circular Orifice Diameter or
- ii) Width of 2" High Rectangular Orifice

$D_{orifice} =$  \_\_\_\_\_ inches  
 $W_{orifice} =$  \_\_\_\_\_ inches

I) Number of Columns

$n_c =$  \_\_\_\_\_ number

J) Actual Design Outlet Area per Row ( $A_o$ )

$A_o =$  \_\_\_\_\_ square inches

K) Number of Rows (nr)

$n_r =$  \_\_\_\_\_ number

L) Total Outlet Area ( $A_{ot}$ )

$A_{ot} =$  \_\_\_\_\_ square inches

M) Depth of WQCV ( $H_{wqcv}$ )  
 (Estimate using actual stage-area-volume relationship and  $V_{wqcv}$ )

$H_{wqcv} =$  \_\_\_\_\_ feet

N) Ensure Minimum 40 Hour Drain Time for WQCV

$T_{Dwqcv} =$  \_\_\_\_\_ hours



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|                        |  |
|------------------------|--|
| <b>Project Summary</b> |  |
| <b>Title</b>           | BENT GRASS<br>EAST<br>COMMERCIAL<br>FILING NO. 2 |
| <b>Engineer</b>        | MAW  |
| <b>Company</b>         | CLASSIC<br>CONSULTING                            |
| <b>Date</b>            | 7/22/2014  |

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|              |                  |
|--------------|------------------|
| <b>Notes</b> | POND 2<br>2 YEAR |
|--------------|------------------|

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Subsection: Master Network Summary

**Catchments Summary**

| Label  | Scenario                | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) |
|--------|-------------------------|----------------------|---------------------------|----------------------|--------------------------------|
| Basins | Post-Development 2 Year | 2                    | 0.807                     | 0.300                | 21.71                          |
| OS-1   | Post-Development 2 Year | 2                    | 0.577                     | 0.650                | 7.10                           |
| OS-2   | Post-Development 2 Year | 2                    | 0.131                     | 0.100                | 1.62                           |
| OS-3   | Post-Development 2 Year | 2                    | 0.128                     | 0.150                | 1.58                           |

**Node Summary**

| Label | Scenario                | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) |
|-------|-------------------------|----------------------|---------------------------|----------------------|--------------------------------|
| O-1   | Post-Development 2 Year | 2                    | 1.097                     | 0.750                | 10.52                          |

**Pond Summary**

| Label        | Scenario                | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|--------------|-------------------------|----------------------|---------------------------|----------------------|--------------------------------|--------------------------------------|------------------------------|
| Pond 2 (IN)  | Post-Development 2 Year | 2                    | 0.807                     | 0.300                | 21.71                          | (N/A)                                | (N/A)                        |
| Pond 2 (OUT) | Post-Development 2 Year | 2                    | 0.262                     | 0.750                | 0.23                           | 6,923.40                             | 0.798                        |

Subsection: I-D-F Table  
Label: CO SPRINGS

Return Event: 2 years  
Storm Event: CO SPRINGS - 2 Year

**I-D-F Curve**

| Time<br>(hours) | Intensity<br>(in/h) |
|-----------------|---------------------|
| 0.083           | 3.710               |
| 0.167           | 2.980               |
| 0.250           | 2.520               |
| 0.333           | 2.190               |
| 0.417           | 1.950               |
| 0.500           | 1.760               |
| 0.583           | 1.610               |
| 0.667           | 1.490               |
| 0.750           | 1.380               |
| 0.833           | 1.290               |
| 0.917           | 1.220               |
| 1.000           | 1.150               |

Subsection: Elevation-Area Volume Curve  
 Label: Pond 2

Return Event: 2 years  
 Storm Event: CO SPRINGS - 2 Year

| Elevation<br>(ft) | Planimeter<br>(ft <sup>2</sup> ) | Area<br>(acres) | A1+A2+sqr<br>(A1*A2)<br>(acres) | Volume<br>(ac-ft) | Volume (Total)<br>(ac-ft) |
|-------------------|----------------------------------|-----------------|---------------------------------|-------------------|---------------------------|
| 6,920.00          | 0.0                              | 0.003           | 0.000                           | 0.000             | 0.000                     |
| 6,922.00          | 0.0                              | 0.289           | 0.321                           | 0.214             | 0.214                     |
| 6,923.00          | 0.0                              | 0.476           | 1.136                           | 0.379             | 0.593                     |
| 6,924.00          | 0.0                              | 0.693           | 1.743                           | 0.581             | 1.174                     |
| 6,925.00          | 0.0                              | 0.820           | 2.267                           | 0.756             | 1.930                     |
| 6,926.00          | 0.0                              | 0.892           | 2.567                           | 0.856             | 2.785                     |
| 6,928.00          | 0.0                              | 1.070           | 2.939                           | 1.959             | 4.745                     |

Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 2 years  
 Storm Event: CO SPRINGS - 2 Year

| Requested Pond Water Surface Elevations |             |
|---|-------------|
| Minimum (Headwater)                     | 6,920.00 ft |
| Increment (Headwater)                   | 0.50 ft     |
| Maximum (Headwater)                     | 6,928.00 ft |

**Outlet Connectivity**

| Structure Type     | Outlet ID   | Direction | Outfall     | E1<br>(ft) | E2<br>(ft) |
|--------------------|-------------|-----------|-------------|------------|------------|
| Inlet Box          | Riser - 1   | Forward   | Culvert - 1 | 6,925.20   | 6,928.00   |
| Orifice-Area       | Orifice - 1 | Forward   | Culvert - 1 | 6,922.70   | 6,928.00   |
| Culvert-Circular   | Culvert - 1 | Forward   | TW          | 6,921.50   | 6,928.00   |
| Tailwater Settings | Tailwater   |           |             | (N/A)      | (N/A)      |

Subsection: Outlet Input Data  
Label: Composite Outlet Structure - 1

Return Event: 2 years  
Storm Event: CO SPRINGS - 2 Year

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|                           |                             |
|---------------------------|-----------------------------|
| Structure ID: Riser - 1   |                             |
| Structure Type: Inlet Box |                             |
| <hr/>                     |                             |
| Number of Openings        | 1                           |
| Elevation                 | 6,925.20 ft                 |
| Orifice Area              | 15.0 ft <sup>2</sup>        |
| Orifice Coefficient       | 0.600                       |
| Weir Length               | 5.00 ft                     |
| Weir Coefficient          | 3.00 (ft <sup>0.5</sup> )/s |
| K Reverse                 | 1.000                       |
| Manning's n               | 0.000                       |
| Key, Charged Riser        | 0.000                       |
| Weir Submergence          | False                       |
| Orifice H to crest        | False                       |

---

Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 2 years  
 Storm Event: CO SPRINGS - 2 Year

|   |             |
|---|-------------|
| <b>Structure ID: Culvert - 1</b>        |             |
| <b>Structure Type: Culvert-Circular</b> |             |
| Number of Barrels                       | 1           |
| Diameter                                | 18.0 in     |
| Length                                  | 450.00 ft   |
| Length (Computed Barrel)                | 450.01 ft   |
| Slope (Computed)                        | 0.008 ft/ft |
| <b>Outlet Control Data</b>              |             |
| Manning's n                             | 0.013       |
| Ke                                      | 0.200       |
| Kb                                      | 0.018       |
| Kr                                      | 0.000       |
| Convergence Tolerance                   | 0.00 ft     |
| <b>Inlet Control Data</b>               |             |
| Equation Form                           | Form 1      |
| K                                       | 0.0045      |
| M                                       | 2.0000      |
| C                                       | 0.0317      |
| Y                                       | 0.6900      |
| T1 ratio (HW/D)                         | 1.091       |
| T2 ratio (HW/D)                         | 1.193       |
| Slope Correction Factor                 | -0.500      |

Use unsubmerged inlet control 0 equation below T1 elevation.  
 Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

|              |             |         |                         |
|--------------|-------------|---------|-------------------------|
| T1 Elevation | 6,923.14 ft | T1 Flow | 7.58 ft <sup>3</sup> /s |
| T2 Elevation | 6,923.29 ft | T2 Flow | 8.66 ft <sup>3</sup> /s |



Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 2 years  
 Storm Event: CO SPRINGS - 2 Year

|   |                           |
|---|---------------------------|
| <b>Structure ID: Orifice - 1</b>            |                           |
| <b>Structure Type: Orifice-Area</b>         |                           |
| Number of Openings                          | 7                         |
| Elevation                                   | 6,922.70 ft               |
| Orifice Area                                | 0.0 ft <sup>2</sup>       |
| Top Elevation                               | 6,925.20 ft               |
| Datum Elevation                             | 6,922.70 ft               |
| Orifice Coefficient                         | 0.600                     |
| <b>Structure ID: TW</b>                     |                           |
| <b>Structure Type: TW Setup, DS Channel</b> |                           |
| Tailwater Type                              | Free Outfall              |
| <b>Convergence Tolerances</b>               |                           |
| Maximum Iterations                          | 30                        |
| Tailwater Tolerance (Minimum)               | 0.01 ft                   |
| Tailwater Tolerance (Maximum)               | 0.50 ft                   |
| Headwater Tolerance (Minimum)               | 0.01 ft                   |
| Headwater Tolerance (Maximum)               | 0.50 ft                   |
| Flow Tolerance (Minimum)                    | 0.001 ft <sup>3</sup> /s  |
| Flow Tolerance (Maximum)                    | 10.000 ft <sup>3</sup> /s |

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 2 years  
 Storm Event: CO SPRINGS - 2 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
 Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)  
 Downstream ID = Culvert - 1 (Culvert-Circular)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (Into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.66                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.00                             | 0.00                                       | 0.00  | 6,921.77                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.84                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.00                             | 0.00                                       | 0.00  | 6,921.91                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.97                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.00                             | 0.00                                       | 0.00  | 6,921.98                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 2.46                             | 6,925.50                                   | Free Outfall                                  | 6,922.52                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 10.73                            | 6,926.00                                   | 6,925.22                                      | 6,925.22                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 22.23                            | 6,926.50                                   | 6,926.50                                      | 6,926.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 36.22                            | 6,927.00                                   | 6,927.00                                      | 6,927.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.50                     | 52.32                            | 6,927.50                                   | 6,927.50                                      | 6,927.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,928.00                     | 70.28                            | 6,928.00                                   | 6,928.00                                      | 6,928.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 Weir: H =0.3ft  
 FULLY CHARGED RISER: ADJUSTED TO  
 WEIR: H =0.8ft

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 2 years  
Storm Event: CO SPRINGS - 2 Year

**RATING TABLE FOR ONE OUTLET TYPE**

Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)  
Downstream ID = Culvert - 1 (Culvert-Circular)

Message

|   |
|---|
| FULLY CHARGED RISER: ADJUSTED TO<br>WEIR: H =1.3ft<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000 |
|---|

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 2 years  
 Storm Event: CO SPRINGS - 2 Year

RATING TABLE FOR ONE OUTLET TYPE  
 Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 9.96 ft<sup>3</sup>/s  
 Upstream ID = Riser - 1, Orifice - 1  
 Downstream ID = Tailwater (Pond Outfall)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.10                             | 6,921.66                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.27                             | 6,921.77                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.43                             | 6,921.84                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.59                             | 6,921.91                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.76                             | 6,921.97                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.83                             | 6,921.98                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 3.35                             | 6,922.52                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 11.19                            | 6,925.22                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.01                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 12.31                            | 6,926.50                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 9.92                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 12.72                            | 6,927.00                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 23.50                                  | (N/A)                             | 0.00                 |
| 6,927.50                     | 13.13                            | 6,927.50                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 39.19                                  | (N/A)                             | 0.00                 |
| 6,928.00                     | 13.53                            | 6,928.00                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 56.75                                  | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 CRIT.DEPTH CONTROL Vh= .039ft  
 Dcr= .116ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .065ft  
 Dcr= .190ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .084ft  
 Dcr= .243ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .100ft  
 Dcr= .286ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .114ft  
 Dcr= .324ft CRIT.DEPTH Hev= .00ft

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 2 years  
Storm Event: CO SPRINGS - 2 Year

RATING TABLE FOR ONE OUTLET TYPE  
Structure ID = Culvert - 1 (Culvert-Circular)

-----  
Mannings open channel maximum capacity: 9.96 ft<sup>3</sup>/s  
Upstream ID = Riser - 1, Orifice - 1  
Downstream ID = Tailwater (Pond Outfall)

Message

|   |
|---|
| CRIT.DEPTH CONTROL Vh= .119ft<br>Dcr= .339ft CRIT.DEPTH Hev= .00ft<br>CRIT.DEPTH CONTROL Vh= .269ft<br>Dcr= .697ft CRIT.DEPTH Hev= .00ft<br>FULL FLOW...Lfull=412.26ft Vh=.623ft<br>HL=5.424ft Hev= .00ft<br>FULL FLOW...Lfull=435.87ft Vh=.754ft<br>HL=6.890ft Hev= .00ft<br>FULL FLOW...Lfull=439.80ft Vh=.806ft<br>HL=7.421ft Hev= .00ft<br>FULL FLOW...Lfull=441.47ft Vh=.859ft<br>HL=7.933ft Hev= .00ft<br>FULL FLOW...Lfull=443.27ft Vh=.911ft<br>HL=8.447ft Hev= .00ft |
|---|

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 2 years  
 Storm Event: CO SPRINGS - 2 Year

RATING TABLE FOR ONE OUTLET TYPE  
 Structure ID = Orifice - 1 (Orifice-Area)

Upstream ID = (Pond Water Surface)  
 Downstream ID = Culvert - 1 (Culvert-Circular)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.10                             | 6,923.00                                   | Free Outfall                                  | 6,921.66                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.27                             | 6,923.50                                   | Free Outfall                                  | 6,921.77                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.43                             | 6,924.00                                   | Free Outfall                                  | 6,921.84                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.60                             | 6,924.50                                   | Free Outfall                                  | 6,921.91                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.76                             | 6,925.00                                   | Free Outfall                                  | 6,921.97                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.83                             | 6,925.20                                   | Free Outfall                                  | 6,921.98                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 0.88                             | 6,925.50                                   | Free Outfall                                  | 6,922.52                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 0.46                             | 6,926.00                                   | 6,925.22                                      | 6,925.22                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 0.00                             | 6,926.50                                   | 6,926.50                                      | 6,926.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 0.00                             | 6,927.00                                   | 6,927.00                                      | 6,927.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.50                     | 0.00                             | 6,927.50                                   | 6,927.50                                      | 6,927.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,928.00                     | 0.00                             | 6,928.00                                   | 6,928.00                                      | 6,928.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 Hi=.30; Ht=2.50; Qt=.12  
 Hi=.80; Ht=2.50; Qt=.12  
 Hi=1.30; Ht=2.50; Qt=.12  
 Hi=1.80; Ht=2.50; Qt=.12  
 Hi=2.30; Ht=2.50; Qt=.12  
 H =2.50  
 H =2.80  
 H =.78

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 2 years  
Storm Event: CO SPRINGS - 2 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
Structure ID = Orifice - 1 (Orifice-Area)

-----  
Upstream ID = (Pond Water Surface)  
Downstream ID = Culvert - 1 (Culvert-Circular)

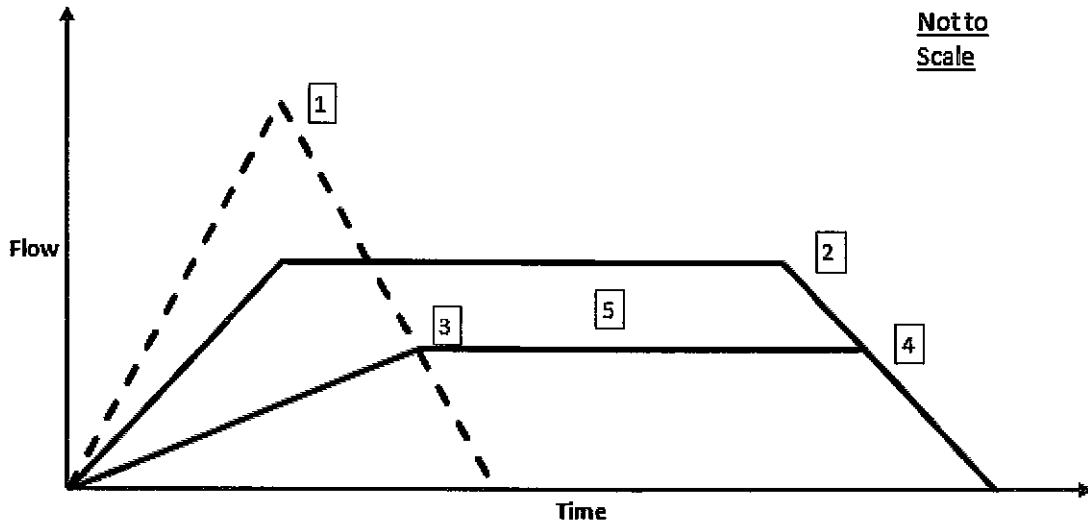
Message

|   |
|---|
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |

Subsection: Modified Rational Graph  
 Label: Basins

Return Event: 2 years  
 Storm Event: CO SPRINGS - 2 Year

|  |             |
|--|-------------|
| Method Type                                    | Method T    |
| Time of Duration (Modified Rational, Critical) | 0.450 hours |



|  |       |                    |  |       |                    |
|--|-------|--------------------|--|-------|--------------------|
| <b>[1]</b>   |       |                    | <b>[2]</b>                                     |       |                    |
| Time of Concentration (Modified Rational, Composite) | 0.282 | hours              | Time of Duration (Modified Rational, Critical) | 0.450 | hours              |
| Intensity (Modified Rational, Peak)                  | 2.393 | in/h               | Intensity (Modified Rational, Critical)        | 1.874 | in/h               |
| Flow (Modified Rational, Peak)                       | 27.72 | ft <sup>3</sup> /s | Flow (Modified Rational, Critical)             | 21.71 | ft <sup>3</sup> /s |

|  |                          |
|--|--------------------------|
| <b>[3]</b>   |                          |
| First Outflow Breakpoint (Modified Rational, Method T) | 0.589 hours              |
| Flow (Modified Rational, Allowable)                    | 11.00 ft <sup>3</sup> /s |

|   |       |                    |  |       |       |
|---|-------|--------------------|--|-------|-------|
| <b>[4]</b>                                    |       |                    | <b>[5]</b>                             |       |       |
| Second Outflow Breakpoint (Modified Rational) | 0.452 | hours              | Storage (Modified Rational, Estimated) | 0.412 | ac-ft |
| Flow (Modified Rational, Allowable)           | 11.00 | ft <sup>3</sup> /s |  |       |       |



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## M

Master Network Summary...2

## P

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---

**Project Summary**

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|          |  |
|----------|--|
| Title    | BENT GRASS<br>EAST<br>COMMERCIAL<br>FILING NO. 2 |
| Engineer | MAW  |
| Company  | CLASSIC<br>CONSULTING                            |
| Date     | 7/22/2014  |

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|       |                  |
|-------|------------------|
| Notes | POND 2<br>5 YEAR |
|-------|------------------|

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Subsection: Master Network Summary

**Catchments Summary**

| Label  | Scenario                | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) |
|--------|-------------------------|----------------------|---------------------------|----------------------|--------------------------------|
| Basins | Post-Development 5 Year | 5                    | 1.208                     | 0.300                | 26.57                          |
| OS-1   | Post-Development 5 Year | 5                    | 0.792                     | 0.650                | 9.75                           |
| OS-2   | Post-Development 5 Year | 5                    | 0.180                     | 0.100                | 2.22                           |
| OS-3   | Post-Development 5 Year | 5                    | 0.175                     | 0.150                | 2.16                           |

**Node Summary**

| Label | Scenario                | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) |
|-------|-------------------------|----------------------|---------------------------|----------------------|--------------------------------|
| O-1   | Post-Development 5 Year | 5                    | 1.686                     | 0.850                | 14.57                          |

**Pond Summary**

| Label        | Scenario                | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|--------------|-------------------------|----------------------|---------------------------|----------------------|--------------------------------|--------------------------------------|------------------------------|
| Pond 2 (IN)  | Post-Development 5 Year | 5                    | 1.208                     | 0.300                | 26.57                          | (N/A)                                | (N/A)                        |
| Pond 2 (OUT) | Post-Development 5 Year | 5                    | 0.539                     | 0.850                | 0.44                           | 6,924.03                             | 1.195                        |

Subsection: I-D-F Table  
Label: CO SPRINGS

Return Event: 5 years  
Storm Event: CO SPRINGS - 5 Year

**I-D-F Curve**

| Time<br>(hours) | Intensity<br>(in/h) |
|-----------------|---------------------|
| 0.083           | 5.100               |
| 0.167           | 4.100               |
| 0.250           | 3.460               |
| 0.333           | 3.010               |
| 0.417           | 2.680               |
| 0.500           | 2.420               |
| 0.583           | 2.210               |
| 0.667           | 2.040               |
| 0.750           | 1.900               |
| 0.833           | 1.780               |
| 0.917           | 1.670               |
| 1.000           | 1.580               |

Subsection: Elevation-Area Volume Curve  
 Label: Pond 2

Return Event: 5 years  
 Storm Event: CO SPRINGS - 5 Year

| Elevation<br>(ft) | Planimeter<br>(ft <sup>2</sup> ) | Area<br>(acres) | A1+A2+sqr<br>(A1*A2)<br>(acres) | Volume<br>(ac-ft) | Volume (Total)<br>(ac-ft) |
|-------------------|----------------------------------|-----------------|---------------------------------|-------------------|---------------------------|
| 6,920.00          | 0.0                              | 0.003           | 0.000                           | 0.000             | 0.000                     |
| 6,922.00          | 0.0                              | 0.289           | 0.321                           | 0.214             | 0.214                     |
| 6,923.00          | 0.0                              | 0.476           | 1.136                           | 0.379             | 0.593                     |
| 6,924.00          | 0.0                              | 0.693           | 1.743                           | 0.581             | 1.174                     |
| 6,925.00          | 0.0                              | 0.820           | 2.267                           | 0.756             | 1.930                     |
| 6,926.00          | 0.0                              | 0.892           | 2.567                           | 0.856             | 2.785                     |
| 6,928.00          | 0.0                              | 1.070           | 2.939                           | 1.959             | 4.745                     |

Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 5 years  
 Storm Event: CO SPRINGS - 5 Year

| Requested Pond Water Surface Elevations |             |
|---|-------------|
| Minimum (Headwater)                     | 6,920.00 ft |
| Increment (Headwater)                   | 0.50 ft     |
| Maximum (Headwater)                     | 6,928.00 ft |

**Outlet Connectivity**

| Structure Type     | Outlet ID   | Direction | Outfall     | E1<br>(ft) | E2<br>(ft) |
|--------------------|-------------|-----------|-------------|------------|------------|
| Inlet Box          | Riser - 1   | Forward   | Culvert - 1 | 6,925.20   | 6,928.00   |
| Orifice-Area       | Orifice - 1 | Forward   | Culvert - 1 | 6,922.70   | 6,928.00   |
| Culvert-Circular   | Culvert - 1 | Forward   | TW          | 6,921.50   | 6,928.00   |
| Tailwater Settings | Tailwater   |           |             | (N/A)      | (N/A)      |

Subsection: Outlet Input Data  
Label: Composite Outlet Structure - 1

Return Event: 5 years  
Storm Event: CO SPRINGS - 5 Year

---

|                                 |                             |
|---------------------------------|-----------------------------|
| Structure ID: Riser - 1         |                             |
| Structure Type: Inlet Box       |                             |
| <hr/>                           |                             |
| Number of Openings              | 1                           |
| Elevation                       | 6,925.20 ft                 |
| Orifice Area                    | 15.0 ft <sup>2</sup>        |
| Orifice Coefficient             | 0.600                       |
| Weir Length                     | 5.00 ft                     |
| Weir Coefficient                | 3.00 (ft <sup>0.5</sup> )/s |
| K Reverse                       | 1.000                       |
| Manning's n                     | 0.000                       |
| Ke <sub>v</sub> , Charged Riser | 0.000                       |
| Weir Submergence                | False                       |
| Orifice H to crest              | False                       |

---



Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 5 years  
 Storm Event: CO SPRINGS - 5 Year

|   |             |
|---|-------------|
| <b>Structure ID: Culvert - 1</b>        |             |
| <b>Structure Type: Culvert-Circular</b> |             |
| Number of Barrels                       | 1           |
| Diameter                                | 18.0 in     |
| Length                                  | 450.00 ft   |
| Length (Computed Barrel)                | 450.01 ft   |
| Slope (Computed)                        | 0.008 ft/ft |
| <b>Outlet Control Data</b>              |             |
| Manning's n                             | 0.013       |
| Ke                                      | 0.200       |
| Kb                                      | 0.018       |
| Kr                                      | 0.000       |
| Convergence Tolerance                   | 0.00 ft     |
| <b>Inlet Control Data</b>               |             |
| Equation Form                           | Form 1      |
| K                                       | 0.0045      |
| M                                       | 2.0000      |
| C                                       | 0.0317      |
| Y                                       | 0.6900      |
| T1 ratio (HW/D)                         | 1.091       |
| T2 ratio (HW/D)                         | 1.193       |
| Slope Correction Factor                 | -0.500      |

Use unsubmerged inlet control 0 equation below T1 elevation.  
 Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

|              |             |         |                         |
|--------------|-------------|---------|-------------------------|
| T1 Elevation | 6,923.14 ft | T1 Flow | 7.58 ft <sup>3</sup> /s |
| T2 Elevation | 6,923.29 ft | T2 Flow | 8.66 ft <sup>3</sup> /s |

Subsection: Outlet Input Data  
Label: Composite Outlet Structure - 1

Return Event: 5 years  
Storm Event: CO SPRINGS - 5 Year

---

|                              |  |
|------------------------------|--|
| Structure ID: Orifice - 1    |  |
| Structure Type: Orifice-Area |  |

---

|                     |                     |
|---------------------|---------------------|
| Number of Openings  | 7                   |
| Elevation           | 6,922.70 ft         |
| Orifice Area        | 0.0 ft <sup>2</sup> |
| Top Elevation       | 6,925.20 ft         |
| Datum Elevation     | 6,922.70 ft         |
| Orifice Coefficient | 0.600               |

---

|                                      |  |
|--------------------------------------|--|
| Structure ID: TW                     |  |
| Structure Type: TW Setup, DS Channel |  |

---

|                |              |
|----------------|--------------|
| Tailwater Type | Free Outfall |
|----------------|--------------|

---

|                        |  |
|------------------------|--|
| Convergence Tolerances |  |
|------------------------|--|

---

|                               |                           |
|-------------------------------|---------------------------|
| Maximum Iterations            | 30                        |
| Tailwater Tolerance (Minimum) | 0.01 ft                   |
| Tailwater Tolerance (Maximum) | 0.50 ft                   |
| Headwater Tolerance (Minimum) | 0.01 ft                   |
| Headwater Tolerance (Maximum) | 0.50 ft                   |
| Flow Tolerance (Minimum)      | 0.001 ft <sup>3</sup> /s  |
| Flow Tolerance (Maximum)      | 10.000 ft <sup>3</sup> /s |

---

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 5 years  
 Storm Event: CO SPRINGS - 5 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
 Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)  
 Downstream ID = Culvert - 1 (Culvert-Circular)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.66                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.00                             | 0.00                                       | 0.00  | 6,921.77                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.84                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.00                             | 0.00                                       | 0.00  | 6,921.91                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.97                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.00                             | 0.00                                       | 0.00  | 6,921.98                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 2.46                             | 6,925.50                                   | Free Outfall                                  | 6,922.52                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 10.73                            | 6,926.00                                   | 6,925.22                                      | 6,925.22                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 22.23                            | 6,926.50                                   | 6,926.50                                      | 6,926.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 36.22                            | 6,927.00                                   | 6,927.00                                      | 6,927.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.50                     | 52.32                            | 6,927.50                                   | 6,927.50                                      | 6,927.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,928.00                     | 70.28                            | 6,928.00                                   | 6,928.00                                      | 6,928.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 Weir: H =0.3ft  
 FULLY CHARGED RISER: ADJUSTED TO  
 WEIR: H =0.8ft

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 5 years  
Storm Event: CO SPRINGS - 5 Year

**RATING TABLE FOR ONE OUTLET TYPE**

Structure ID = Riser - 1 (Inlet Box)

-----  
Upstream ID = (Pond Water Surface)  
Downstream ID = Culvert - 1 (Culvert-Circular)

**Message**

|  |
|--|
| FULLY CHARGED RISER: ADJUSTED TO<br>WEIR: H = 1.3ft<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000 |
|--|

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 5 years  
 Storm Event: CO SPRINGS - 5 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
 Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 9.96 ft<sup>3</sup>/s  
 Upstream ID = Riser - 1, Orifice - 1  
 Downstream ID = Tailwater (Pond Outfall)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (Into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.10                             | 6,921.66                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.27                             | 6,921.77                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.43                             | 6,921.84                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.59                             | 6,921.91                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.76                             | 6,921.97                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.83                             | 6,921.98                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 3.35                             | 6,922.52                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 11.19                            | 6,925.22                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.01                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 12.31                            | 6,926.50                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 9.92                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 12.72                            | 6,927.00                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 23.50                                  | (N/A)                             | 0.00                 |
| 6,927.50                     | 13.13                            | 6,927.50                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 39.19                                  | (N/A)                             | 0.00                 |
| 6,928.00                     | 13.53                            | 6,928.00                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 56.75                                  | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 CRIT.DEPTH CONTROL Vh= .039ft  
 Dcr= .116ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .065ft  
 Dcr= .190ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .084ft  
 Dcr= .243ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .100ft  
 Dcr= .286ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .114ft  
 Dcr= .324ft CRIT.DEPTH Hev= .00ft

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 5 years  
Storm Event: CO SPRINGS - 5 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
Structure ID = Culvert - 1 (Culvert-Circular)

-----  
Mannings open channel maximum capacity: 9.96 ft<sup>3</sup>/s  
Upstream ID = Riser - 1, Orifice - 1  
Downstream ID = Tailwater (Pond Outfall)

Message

|   |
|---|
| CRIT.DEPTH CONTROL Vh= .119ft<br>Dcr= .339ft CRIT.DEPTH Hev= .00ft<br>CRIT.DEPTH CONTROL Vh= .269ft<br>Dcr= .697ft CRIT.DEPTH Hev= .00ft<br>FULL FLOW...Lfull=412.26ft Vh=.623ft<br>HL=5.424ft Hev= .00ft<br>FULL FLOW...Lfull=435.87ft Vh=.754ft<br>HL=6.890ft Hev= .00ft<br>FULL FLOW...Lfull=439.80ft Vh=.806ft<br>HL=7.421ft Hev= .00ft<br>FULL FLOW...Lfull=441.47ft Vh=.859ft<br>HL=7.933ft Hev= .00ft<br>FULL FLOW...Lfull=443.27ft Vh=.911ft<br>HL=8.447ft Hev= .00ft |
|---|

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 5 years  
 Storm Event: CO SPRINGS - 5 Year

RATING TABLE FOR ONE OUTLET TYPE  
 Structure ID = Orifice - 1 (Orifice-Area)

Upstream ID = (Pond Water Surface)  
 Downstream ID = Culvert - 1 (Culvert-Circular)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.10                             | 6,923.00                                   | Free Outfall                                  | 6,921.66                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.27                             | 6,923.50                                   | Free Outfall                                  | 6,921.77                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.43                             | 6,924.00                                   | Free Outfall                                  | 6,921.84                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.60                             | 6,924.50                                   | Free Outfall                                  | 6,921.91                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.76                             | 6,925.00                                   | Free Outfall                                  | 6,921.97                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.83                             | 6,925.20                                   | Free Outfall                                  | 6,921.98                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 0.88                             | 6,925.50                                   | Free Outfall                                  | 6,922.52                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 0.46                             | 6,926.00                                   | 6,925.22                                      | 6,925.22                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 0.00                             | 6,926.50                                   | 6,926.50                                      | 6,926.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 0.00                             | 6,927.00                                   | 6,927.00                                      | 6,927.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.50                     | 0.00                             | 6,927.50                                   | 6,927.50                                      | 6,927.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,928.00                     | 0.00                             | 6,928.00                                   | 6,928.00                                      | 6,928.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 HI=.30; Ht=2.50; Qt=.12  
 HI=.80; Ht=2.50; Qt=.12  
 HI=1.30; Ht=2.50; Qt=.12  
 HI=1.80; Ht=2.50; Qt=.12  
 HI=2.30; Ht=2.50; Qt=.12  
 H =2.50  
 H =2.80  
 H =.78

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 5 years  
Storm Event: CO SPRINGS - 5 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
Structure ID = Orifice - 1 (Orifice-Area)

-----  
Upstream ID = (Pond Water Surface)  
Downstream ID = Culvert - 1 (Culvert-Circular)

Message

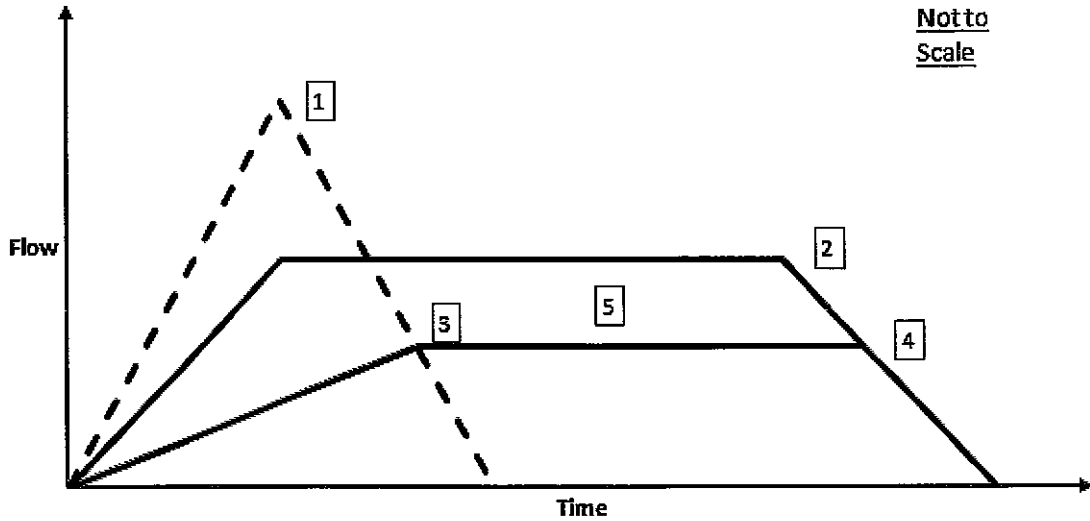
|   |
|---|
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |



Subsection: Modified Rational Graph  
 Label: Basins

Return Event: 5 years  
 Storm Event: CO SPRINGS - 5 Year

|  |             |
|--|-------------|
| Method Type                                    | Method T    |
| Time of Duration (Modified Rational, Critical) | 0.550 hours |



|  |       |                    |  |       |                    |
|--|-------|--------------------|--|-------|--------------------|
| <b>[1]</b>   |       |                    | <b>[2]</b>                                     |       |                    |
| Time of Concentration (Modified Rational, Composite) | 0.282 | hours              | Time of Duration (Modified Rational, Critical) | 0.550 | hours              |
| Intensity (Modified Rational, Peak)                  | 3.287 | in/h               | Intensity (Modified Rational, Critical)        | 2.294 | in/h               |
| Flow (Modified Rational, Peak)                       | 38.07 | ft <sup>3</sup> /s | Flow (Modified Rational, Critical)             | 26.57 | ft <sup>3</sup> /s |

|  |                          |
|--|--------------------------|
| <b>[3]</b>   |                          |
| First Outflow Breakpoint (Modified Rational, Method T) | 0.715 hours              |
| Flow (Modified Rational, Allowable)                    | 11.00 ft <sup>3</sup> /s |

|   |       |                    |  |       |       |
|---|-------|--------------------|--|-------|-------|
| <b>[4]</b>                                    |       |                    | <b>[5]</b>                             |       |       |
| Second Outflow Breakpoint (Modified Rational) | 0.483 | hours              | Storage (Modified Rational, Estimated) | 0.724 | ac-ft |
| Flow (Modified Rational, Allowable)           | 11.00 | ft <sup>3</sup> /s |  |       |       |

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**Project Summary**

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|          |  |
|----------|--|
| Title    | BENT GRASS<br>EAST<br>COMMERCIAL<br>FILING NO. 2 |
| Engineer | MAW  |
| Company  | CLASSIC<br>CONSULTING                            |
| Date     | 7/22/2014  |

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|       |                   |
|-------|-------------------|
| Notes | POND 2<br>10 YEAR |
|-------|-------------------|

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Subsection: Master Network Summary

**Catchments Summary**

| Label  | Scenario                 | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) |
|--------|--------------------------|----------------------|---------------------------|----------------------|--------------------------------|
| Basins | Post-Development 10 Year | 10                   | 1.556                     | 0.300                | 26.89                          |
| OS-1   | Post-Development 10 Year | 10                   | 0.926                     | 0.650                | 11.41                          |
| OS-2   | Post-Development 10 Year | 10                   | 0.210                     | 0.100                | 2.59                           |
| OS-3   | Post-Development 10 Year | 10                   | 0.205                     | 0.150                | 2.53                           |

**Node Summary**

| Label | Scenario                 | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) |
|-------|--------------------------|----------------------|---------------------------|----------------------|--------------------------------|
| O-1   | Post-Development 10 Year | 10                   | 2.106                     | 0.950                | 17.13                          |

**Pond Summary**

| Label        | Scenario                 | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|--------------|--------------------------|----------------------|---------------------------|----------------------|--------------------------------|--------------------------------------|------------------------------|
| Pond 2 (IN)  | Post-Development 10 Year | 10                   | 1.556                     | 0.300                | 26.89                          | (N/A)                                | (N/A)                        |
| Pond 2 (OUT) | Post-Development 10 Year | 10                   | 0.764                     | 1.000                | 0.60                           | 6,924.50                             | 1.535                        |

Subsection: I-D-F Table  
Label: CO SPRINGS

Return Event: 10 years  
Storm Event: CO SPRINGS - 10 Year

**I-D-F Curve**

| Time<br>(hours) | Intensity<br>(in/h) |
|-----------------|---------------------|
| 0.083           | 5.960               |
| 0.167           | 4.790               |
| 0.250           | 4.040               |
| 0.333           | 3.520               |
| 0.417           | 3.130               |
| 0.500           | 2.830               |
| 0.583           | 2.580               |
| 0.667           | 2.390               |
| 0.750           | 2.220               |
| 0.833           | 2.080               |
| 0.917           | 1.950               |
| 1.000           | 1.850               |

Subsection: Elevation-Area Volume Curve  
 Label: Pond 2

Return Event: 10 years  
 Storm Event: CO SPRINGS - 10 Year

| Elevation<br>(ft) | Planimeter<br>(ft <sup>2</sup> ) | Area<br>(acres) | A1+A2+sqr<br>(A1*A2)<br>(acres) | Volume<br>(ac-ft) | Volume (Total)<br>(ac-ft) |
|-------------------|----------------------------------|-----------------|---------------------------------|-------------------|---------------------------|
| 6,920.00          | 0.0                              | 0.003           | 0.000                           | 0.000             | 0.000                     |
| 6,922.00          | 0.0                              | 0.289           | 0.321                           | 0.214             | 0.214                     |
| 6,923.00          | 0.0                              | 0.476           | 1.136                           | 0.379             | 0.593                     |
| 6,924.00          | 0.0                              | 0.693           | 1.743                           | 0.581             | 1.174                     |
| 6,925.00          | 0.0                              | 0.820           | 2.267                           | 0.756             | 1.930                     |
| 6,926.00          | 0.0                              | 0.892           | 2.567                           | 0.856             | 2.785                     |
| 6,928.00          | 0.0                              | 1.070           | 2.939                           | 1.959             | 4.745                     |

Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 10 years  
 Storm Event: CO SPRINGS - 10 Year

| Requested Pond Water Surface Elevations |             |
|---|-------------|
| Minimum (Headwater)                     | 6,920.00 ft |
| Increment (Headwater)                   | 0.50 ft     |
| Maximum (Headwater)                     | 6,928.00 ft |

**Outlet Connectivity**

| Structure Type     | Outlet ID   | Direction | Outfall     | E1<br>(ft) | E2<br>(ft) |
|--------------------|-------------|-----------|-------------|------------|------------|
| Inlet Box          | Riser - 1   | Forward   | Culvert - 1 | 6,925.20   | 6,928.00   |
| Orifice-Area       | Orifice - 1 | Forward   | Culvert - 1 | 6,922.70   | 6,928.00   |
| Culvert-Circular   | Culvert - 1 | Forward   | TW          | 6,921.50   | 6,928.00   |
| Tailwater Settings | Tailwater   |           |             | (N/A)      | (N/A)      |



Subsection: Outlet Input Data  
Label: Composite Outlet Structure - 1

Return Event: 10 years  
Storm Event: CO SPRINGS - 10 Year

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|                           |                             |
|---------------------------|-----------------------------|
| Structure ID: Riser - 1   |                             |
| Structure Type: Inlet Box |                             |
| <hr/>                     |                             |
| Number of Openings        | 1                           |
| Elevation                 | 6,925.20 ft                 |
| Orifice Area              | 15.0 ft <sup>2</sup>        |
| Orifice Coefficient       | 0.600                       |
| Weir Length               | 5.00 ft                     |
| Weir Coefficient          | 3.00 (ft <sup>0.5</sup> )/s |
| K Reverse                 | 1.000                       |
| Manning's n               | 0.000                       |
| Key, Charged Riser        | 0.000                       |
| Weir Submergence          | False                       |
| Orifice H to crest        | False                       |

---

Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 10 years  
 Storm Event: CO SPRINGS - 10 Year

|   |             |
|---|-------------|
| <b>Structure ID: Culvert - 1</b>        |             |
| <b>Structure Type: Culvert-Circular</b> |             |
| Number of Barrels                       | 1           |
| Diameter                                | 18.0 in     |
| Length                                  | 450.00 ft   |
| Length (Computed Barrel)                | 450.01 ft   |
| Slope (Computed)                        | 0.008 ft/ft |
| <b>Outlet Control Data</b>              |             |
| Manning's n                             | 0.013       |
| Ke                                      | 0.200       |
| Kb                                      | 0.018       |
| Kr                                      | 0.000       |
| Convergence Tolerance                   | 0.00 ft     |
| <b>Inlet Control Data</b>               |             |
| Equation Form                           | Form 1      |
| K                                       | 0.0045      |
| M                                       | 2.0000      |
| C                                       | 0.0317      |
| Y                                       | 0.6900      |
| T1 ratio (HW/D)                         | 1.091       |
| T2 ratio (HW/D)                         | 1.193       |
| Slope Correction Factor                 | -0.500      |

Use unsubmerged inlet control 0 equation below T1 elevation.  
 Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control,  
 interpolate between flows at T1 & T2...

|              |             |         |                         |
|--------------|-------------|---------|-------------------------|
| T1 Elevation | 6,923.14 ft | T1 Flow | 7.58 ft <sup>3</sup> /s |
| T2 Elevation | 6,923.29 ft | T2 Flow | 8.66 ft <sup>3</sup> /s |

Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 10 years  
 Storm Event: CO SPRINGS - 10 Year

|                              |                     |
|------------------------------|---------------------|
| Structure ID: Orifice - 1    |                     |
| Structure Type: Orifice-Area |                     |
| Number of Openings           | 7                   |
| Elevation                    | 6,922.70 ft         |
| Orifice Area                 | 0.0 ft <sup>2</sup> |
| Top Elevation                | 6,925.20 ft         |
| Datum Elevation              | 6,922.70 ft         |
| Orifice Coefficient          | 0.600               |

|                                      |              |
|--------------------------------------|--------------|
| Structure ID: TW                     |              |
| Structure Type: TW Setup, DS Channel |              |
| Tailwater Type                       | Free Outfall |

|                               |                           |
|-------------------------------|---------------------------|
| Convergence Tolerances        |                           |
| Maximum Iterations            | 30                        |
| Tailwater Tolerance (Minimum) | 0.01 ft                   |
| Tailwater Tolerance (Maximum) | 0.50 ft                   |
| Headwater Tolerance (Minimum) | 0.01 ft                   |
| Headwater Tolerance (Maximum) | 0.50 ft                   |
| Flow Tolerance (Minimum)      | 0.001 ft <sup>3</sup> /s  |
| Flow Tolerance (Maximum)      | 10.000 ft <sup>3</sup> /s |

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 10 years  
 Storm Event: CO SPRINGS - 10 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
 Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)  
 Downstream ID = Culvert - 1 (Culvert-Circular)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.66                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.00                             | 0.00                                       | 0.00  | 6,921.77                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.84                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.00                             | 0.00                                       | 0.00  | 6,921.91                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.97                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.00                             | 0.00                                       | 0.00  | 6,921.98                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 2.46                             | 6,925.50                                   | Free Outfall                                  | 6,922.52                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 10.73                            | 6,926.00                                   | 6,925.22                                      | 6,925.22                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 22.23                            | 6,926.50                                   | 6,926.50                                      | 6,926.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 36.22                            | 6,927.00                                   | 6,927.00                                      | 6,927.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.50                     | 52.32                            | 6,927.50                                   | 6,927.50                                      | 6,927.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,928.00                     | 70.28                            | 6,928.00                                   | 6,928.00                                      | 6,928.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 Weir: H =0.3ft  
 FULLY CHARGED RISER: ADJUSTED TO  
 WEIR: H =0.8ft

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 10 years  
Storm Event: CO SPRINGS - 10 Year

**RATING TABLE FOR ONE OUTLET TYPE**

Structure ID = Riser - 1 (Inlet Box)

-----  
Upstream ID = (Pond Water Surface)  
Downstream ID = Culvert - 1 (Culvert-Circular)

Message

|   |
|---|
| FULLY CHARGED RISER: ADJUSTED TO<br>WEIR: H =1.3ft<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000 |
|---|

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 10 years  
 Storm Event: CO SPRINGS - 10 Year

RATING TABLE FOR ONE OUTLET TYPE  
 Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 9.96 ft<sup>3</sup>/s  
 Upstream ID = Riser - 1, Orifice - 1  
 Downstream ID = Tailwater (Pond Outfall)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.10                             | 6,921.66                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.27                             | 6,921.77                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.43                             | 6,921.84                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.59                             | 6,921.91                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.76                             | 6,921.97                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.83                             | 6,921.98                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 3.35                             | 6,922.52                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 11.19                            | 6,925.22                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.01                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 12.31                            | 6,926.50                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 9.92                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 12.72                            | 6,927.00                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 23.50                                  | (N/A)                             | 0.00                 |
| 6,927.50                     | 13.13                            | 6,927.50                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 39.19                                  | (N/A)                             | 0.00                 |
| 6,928.00                     | 13.53                            | 6,928.00                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 56.75                                  | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 CRIT.DEPTH CONTROL Vh= .039ft  
 Dcr= .116ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .065ft  
 Dcr= .190ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .084ft  
 Dcr= .243ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .100ft  
 Dcr= .286ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .114ft  
 Dcr= .324ft CRIT.DEPTH Hev= .00ft

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 10 years  
Storm Event: CO SPRINGS - 10 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
Structure ID = Culvert - 1 (Culvert-Circular)

-----  
Mannings open channel maximum capacity: 9.96 ft<sup>3</sup>/s  
Upstream ID = Riser - 1, Orifice - 1  
Downstream ID = Tailwater (Pond Outfall)

Message

|  |
|--|
| CRIT.DEPTH CONTROL Vh= .119ft<br>Dcr= .339ft CRIT.DEPTH Hev= .00ft |
| CRIT.DEPTH CONTROL Vh= .269ft<br>Dcr= .697ft CRIT.DEPTH Hev= .00ft |
| FULL FLOW...Lfull=412.26ft Vh=.623ft<br>HL=5.424ft Hev= .00ft      |
| FULL FLOW...Lfull=435.87ft Vh=.754ft<br>HL=6.890ft Hev= .00ft      |
| FULL FLOW...Lfull=439.80ft Vh=.806ft<br>HL=7.421ft Hev= .00ft      |
| FULL FLOW...Lfull=441.47ft Vh=.859ft<br>HL=7.933ft Hev= .00ft      |
| FULL FLOW...Lfull=443.27ft Vh=.911ft<br>HL=8.447ft Hev= .00ft      |

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 10 years  
 Storm Event: CO SPRINGS - 10 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
 Structure ID = Orifice - 1 (Orifice-Area)

Upstream ID = (Pond Water Surface)  
 Downstream ID = Culvert - 1 (Culvert-Circular)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.10                             | 6,923.00                                   | Free Outfall                                  | 6,921.66                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.27                             | 6,923.50                                   | Free Outfall                                  | 6,921.77                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.43                             | 6,924.00                                   | Free Outfall                                  | 6,921.84                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.60                             | 6,924.50                                   | Free Outfall                                  | 6,921.91                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.76                             | 6,925.00                                   | Free Outfall                                  | 6,921.97                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.83                             | 6,925.20                                   | Free Outfall                                  | 6,921.98                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 0.88                             | 6,925.50                                   | Free Outfall                                  | 6,922.52                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 0.46                             | 6,926.00                                   | 6,925.22                                      | 6,925.22                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 0.00                             | 6,926.50                                   | 6,926.50                                      | 6,926.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 0.00                             | 6,927.00                                   | 6,927.00                                      | 6,927.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.50                     | 0.00                             | 6,927.50                                   | 6,927.50                                      | 6,927.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,928.00                     | 0.00                             | 6,928.00                                   | 6,928.00                                      | 6,928.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 Hi=.30; Ht=2.50; Qt=.12  
 Hi=.80; Ht=2.50; Qt=.12  
 Hi=1.30; Ht=2.50; Qt=.12  
 Hi=1.80; Ht=2.50; Qt=.12  
 Hi=2.30; Ht=2.50; Qt=.12  
 H =2.50  
 H =2.80  
 H =.78



Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 10 years  
Storm Event: CO SPRINGS - 10 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
Structure ID = Orifice - 1 (Orifice-Area)

-----  
Upstream ID = (Pond Water Surface)  
Downstream ID = Culvert - 1 (Culvert-Circular)

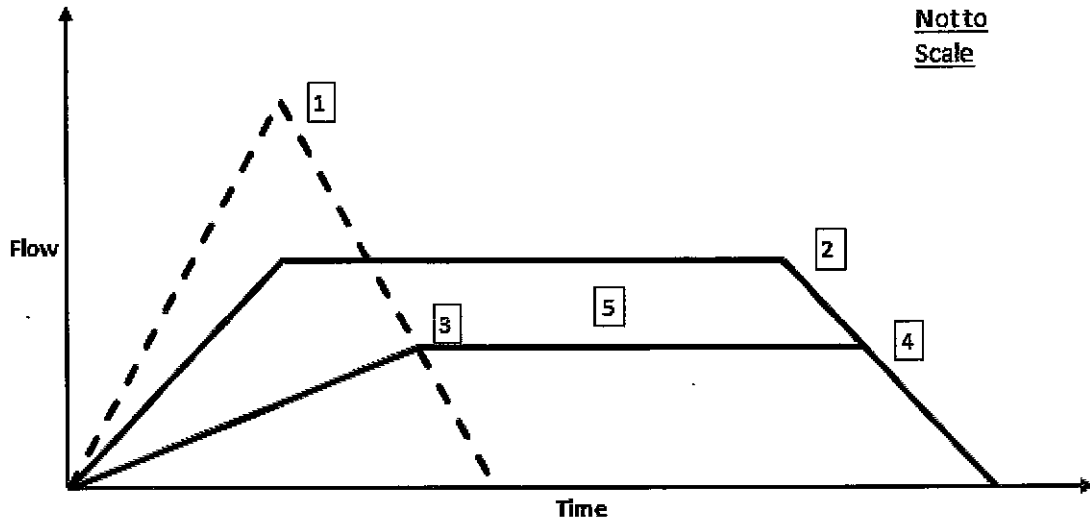
Message

|  |
|--|
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE<br>FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE<br>FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE<br>FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
|--|

Subsection: Modified Rational Graph  
 Label: Basins

Return Event: 10 years  
 Storm Event: CO SPRINGS - 10 Year

|  |             |
|--|-------------|
| Method Type                                    | Method T    |
| Time of Duration (Modified Rational, Critical) | 0.700 hours |



|  |                          |  |                          |
|--|--------------------------|--|--------------------------|
| [1]  | [2]                      |  |                          |
| Time of Concentration (Modified Rational, Composite) | 0.282 hours              | Time of Duration (Modified Rational, Critical) | 0.700 hours              |
| Intensity (Modified Rational, Peak)                  | 3.840 in/h               | Intensity (Modified Rational, Critical)        | 2.322 in/h               |
| Flow (Modified Rational, Peak)                       | 44.48 ft <sup>3</sup> /s | Flow (Modified Rational, Critical)             | 26.89 ft <sup>3</sup> /s |

|  |                          |
|--|--------------------------|
| [3]  |                          |
| First Outflow Breakpoint (Modified Rational, Method T) | 0.867 hours              |
| Flow (Modified Rational, Allowable)                    | 11.00 ft <sup>3</sup> /s |

|   |                          |  |             |
|---|--------------------------|--|-------------|
| [4]   | [5]                      |  |             |
| Second Outflow Breakpoint (Modified Rational) | 0.494 hours              | Storage (Modified Rational, Estimated) | 0.940 ac-ft |
| Flow (Modified Rational, Allowable)           | 11.00 ft <sup>3</sup> /s |  |             |

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**Project Summary**

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|          |  |
|----------|--|
| Title    | BENT GRASS<br>EAST<br>COMMERCIAL<br>FILING NO. 2 |
| Engineer | MAW  |
| Company  | CLASSIC<br>CONSULTING                            |
| Date     | 7/22/2014  |

---

|       |                    |
|-------|--------------------|
| Notes | POND 2<br>100 YEAR |
|-------|--------------------|

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Subsection: Master Network Summary

**Catchments Summary**

| Label  | Scenario                  | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) |
|--------|---------------------------|----------------------|---------------------------|----------------------|--------------------------------|
| Basins | Post-Development 100 Year | 100                  | 2.972                     | 0.300                | 36.61                          |
| OS-1   | Post-Development 100 Year | 100                  | 1.972                     | 0.650                | 24.29                          |
| OS-2   | Post-Development 100 Year | 100                  | 0.338                     | 0.100                | 4.18                           |
| OS-3   | Post-Development 100 Year | 100                  | 0.332                     | 0.150                | 4.10                           |

**Node Summary**

| Label | Scenario                  | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) |
|-------|---------------------------|----------------------|---------------------------|----------------------|--------------------------------|
| O-1   | Post-Development 100 Year | 100                  | 4.513                     | 1.000                | 37.06                          |

**Pond Summary**

| Label        | Scenario                  | Return Event (years) | Hydrograph Volume (ac-ft) | Time to Peak (hours) | Peak Flow (ft <sup>3</sup> /s) | Maximum Water Surface Elevation (ft) | Maximum Pond Storage (ac-ft) |
|--------------|---------------------------|----------------------|---------------------------|----------------------|--------------------------------|--------------------------------------|------------------------------|
| Pond 2 (IN)  | Post-Development 100 Year | 100                  | 2.972                     | 0.300                | 36.61                          | (N/A)                                | (N/A)                        |
| Pond 2 (OUT) | Post-Development 100 Year | 100                  | 1.870                     | 1.200                | 10.20                          | 6,925.94                             | 2.730                        |

Subsection: I-D-F Table  
Label: CO SPRINGS

Return Event: 100 years  
Storm Event: CO SPRINGS - 100 Year

**I-D-F Curve**

| Time<br>(hours) | Intensity<br>(in/h) |
|-----------------|---------------------|
| 0.083           | 9.070               |
| 0.167           | 7.290               |
| 0.250           | 6.160               |
| 0.333           | 5.360               |
| 0.417           | 4.770               |
| 0.500           | 4.310               |
| 0.583           | 3.940               |
| 0.667           | 3.630               |
| 0.750           | 3.380               |
| 0.833           | 3.160               |
| 0.917           | 2.980               |
| 1.000           | 2.810               |

Subsection: Elevation-Area Volume Curve  
 Label: Pond 2

Return Event: 100 years  
 Storm Event: CO SPRINGS - 100 Year

| Elevation<br>(ft) | Planimeter<br>(ft <sup>2</sup> ) | Area<br>(acres) | A1+A2+sq<br>(A1*A2)<br>(acres) | Volume<br>(ac-ft) | Volume (Total)<br>(ac-ft) |
|-------------------|----------------------------------|-----------------|--------------------------------|-------------------|---------------------------|
| 6,920.00          | 0.0                              | 0.003           | 0.000                          | 0.000             | 0.000                     |
| 6,922.00          | 0.0                              | 0.289           | 0.321                          | 0.214             | 0.214                     |
| 6,923.00          | 0.0                              | 0.476           | 1.136                          | 0.379             | 0.593                     |
| 6,924.00          | 0.0                              | 0.693           | 1.743                          | 0.581             | 1.174                     |
| 6,925.00          | 0.0                              | 0.820           | 2.267                          | 0.756             | 1.930                     |
| 6,926.00          | 0.0                              | 0.892           | 2.567                          | 0.856             | 2.785                     |
| 6,928.00          | 0.0                              | 1.070           | 2.939                          | 1.959             | 4.745                     |



Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 100 years  
 Storm Event: CO SPRINGS - 100 Year

| Requested Pond Water Surface Elevations |             |
|---|-------------|
| Minimum (Headwater)                     | 6,920.00 ft |
| Increment (Headwater)                   | 0.50 ft     |
| Maximum (Headwater)                     | 6,928.00 ft |

**Outlet Connectivity**

| Structure Type     | Outlet ID   | Direction | Outfall     | E1<br>(ft) | E2<br>(ft) |
|--------------------|-------------|-----------|-------------|------------|------------|
| Inlet Box          | Riser - 1   | Forward   | Culvert - 1 | 6,925.20   | 6,928.00   |
| Orifice-Area       | Orifice - 1 | Forward   | Culvert - 1 | 6,922.70   | 6,928.00   |
| Culvert-Circular   | Culvert - 1 | Forward   | TW          | 6,921.50   | 6,928.00   |
| Tailwater Settings | Tailwater   |           |             | (N/A)      | (N/A)      |

Subsection: Outlet Input Data  
Label: Composite Outlet Structure - 1

Return Event: 100 years  
Storm Event: CO SPRINGS - 100 Year

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|                           |                             |
|---------------------------|-----------------------------|
| Structure ID: Riser - 1   |                             |
| Structure Type: Inlet Box |                             |
| <hr/>                     |                             |
| Number of Openings        | 1                           |
| Elevation                 | 6,925.20 ft                 |
| Orifice Area              | 15.0 ft <sup>2</sup>        |
| Orifice Coefficient       | 0.600                       |
| Weir Length               | 5.00 ft                     |
| Weir Coefficient          | 3.00 (ft <sup>0.5</sup> )/s |
| K Reverse                 | 1.000                       |
| Manning's n               | 0.000                       |
| Kev, Charged Riser        | 0.000                       |
| Weir Submergence          | False                       |
| Orifice H to crest        | False                       |

---

Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 100 years  
 Storm Event: CO SPRINGS - 100 Year

|                                  |             |
|----------------------------------|-------------|
| Structure ID: Culvert - 1        |             |
| Structure Type: Culvert-Circular |             |
| Number of Barrels                | 1           |
| Diameter                         | 18.0 in     |
| Length                           | 450.00 ft   |
| Length (Computed Barrel)         | 450.01 ft   |
| Slope (Computed)                 | 0.008 ft/ft |
| Outlet Control Data              |             |
| Manning's n                      | 0.013       |
| Ke                               | 0.200       |
| Kb                               | 0.018       |
| Kr                               | 0.000       |
| Convergence Tolerance            | 0.00 ft     |
| Inlet Control Data               |             |
| Equation Form                    | Form 1      |
| K                                | 0.0045      |
| M                                | 2.0000      |
| C                                | 0.0317      |
| Y                                | 0.6900      |
| T1 ratio (HW/D)                  | 1.091       |
| T2 ratio (HW/D)                  | 1.193       |
| Slope Correction Factor          | -0.500      |

Use unsubmerged inlet control 0 equation below T1 elevation.

Use submerged inlet control 0 equation above T2 elevation

In transition zone between unsubmerged and submerged inlet control, interpolate between flows at T1 & T2...

|              |             |         |                         |
|--------------|-------------|---------|-------------------------|
| T1 Elevation | 6,923.14 ft | T1 Flow | 7.58 ft <sup>3</sup> /s |
| T2 Elevation | 6,923.29 ft | T2 Flow | 8.66 ft <sup>3</sup> /s |

Subsection: Outlet Input Data  
 Label: Composite Outlet Structure - 1

Return Event: 100 years  
 Storm Event: CO SPRINGS - 100 Year

| Structure ID: Orifice - 1            |                           |
|--------------------------------------|---------------------------|
| Structure Type: Orifice-Area         |                           |
| Number of Openings                   | 7                         |
| Elevation                            | 6,922.70 ft               |
| Orifice Area                         | 0.0 ft <sup>2</sup>       |
| Top Elevation                        | 6,925.20 ft               |
| Datum Elevation                      | 6,922.70 ft               |
| Orifice Coefficient                  | 0.600                     |
| Structure ID: TW                     |                           |
| Structure Type: TW Setup, DS Channel |                           |
| Tailwater Type                       | Free Outfall              |
| Convergence Tolerances               |                           |
| Maximum Iterations                   | 30                        |
| Tailwater Tolerance (Minimum)        | 0.01 ft                   |
| Tailwater Tolerance (Maximum)        | 0.50 ft                   |
| Headwater Tolerance (Minimum)        | 0.01 ft                   |
| Headwater Tolerance (Maximum)        | 0.50 ft                   |
| Flow Tolerance (Minimum)             | 0.001 ft <sup>3</sup> /s  |
| Flow Tolerance (Maximum)             | 10.000 ft <sup>3</sup> /s |

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 100 years  
 Storm Event: CO SPRINGS - 100 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
 Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)  
 Downstream ID = Culvert - 1 (Culvert-Circular)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.66                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.00                             | 0.00                                       | 0.00  | 6,921.77                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.84                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.00                             | 0.00                                       | 0.00  | 6,921.91                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.00                             | 0.00                                       | 0.00  | 6,921.97                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.00                             | 0.00                                       | 0.00  | 6,921.98                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 2.46                             | 6,925.50                                   | Free Outfall                                  | 6,922.52                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 10.73                            | 6,926.00                                   | 6,925.22                                      | 6,925.22                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 22.23                            | 6,926.50                                   | 6,926.50                                      | 6,926.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 36.22                            | 6,927.00                                   | 6,927.00                                      | 6,927.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.50                     | 52.32                            | 6,927.50                                   | 6,927.50                                      | 6,927.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,928.00                     | 70.28                            | 6,928.00                                   | 6,928.00                                      | 6,928.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 Weir: H =0.3ft  
 FULLY CHARGED RISER: ADJUSTED TO  
 WEIR: H =0.8ft

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 100 years  
Storm Event: CO SPRINGS - 100 Year

**RATING TABLE FOR ONE OUTLET TYPE**

Structure ID = Riser - 1 (Inlet Box)

Upstream ID = (Pond Water Surface)  
Downstream ID = Culvert - 1 (Culvert-Circular)

Message

|   |
|---|
| FULLY CHARGED RISER: ADJUSTED TO<br>WEIR: H =1.3ft<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000<br>FULLY CHARGED RISER,<br>DOWNSTREAM CONTROL: Kev=0.<br>Hev=0.000 |
|---|

Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 100 years  
 Storm Event: CO SPRINGS - 100 Year

RATING TABLE FOR ONE OUTLET TYPE  
 Structure ID = Culvert - 1 (Culvert-Circular)

Mannings open channel maximum capacity: 9.96 ft<sup>3</sup>/s  
 Upstream ID = Riser - 1, Orifice - 1  
 Downstream ID = Tailwater (Pond Outfall)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (Into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.10                             | 6,921.66                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.27                             | 6,921.77                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.43                             | 6,921.84                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.59                             | 6,921.91                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.76                             | 6,921.97                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.83                             | 6,921.98                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 3.35                             | 6,922.52                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 11.19                            | 6,925.22                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 0.01                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 12.31                            | 6,926.50                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 9.92                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 12.72                            | 6,927.00                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 23.50                                  | (N/A)                             | 0.00                 |
| 6,927.50                     | 13.13                            | 6,927.50                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 39.19                                  | (N/A)                             | 0.00                 |
| 6,928.00                     | 13.53                            | 6,928.00                                   | Free Outfall                                  | Free Outfall                              | 0.00                                       | 56.75                                  | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 CRIT.DEPTH CONTROL Vh= .039ft  
 Dcr= .116ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .065ft  
 Dcr= .190ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .084ft  
 Dcr= .243ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .100ft  
 Dcr= .286ft CRIT.DEPTH Hev= .00ft  
 CRIT.DEPTH CONTROL Vh= .114ft  
 Dcr= .324ft CRIT.DEPTH Hev= .00ft

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 100 years  
Storm Event: CO SPRINGS - 100 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
Structure ID = Culvert - 1 (Culvert-Circular)

-----  
Mannings open channel maximum capacity: 9.96 ft<sup>3</sup>/s  
Upstream ID = Riser - 1, Orifice - 1  
Downstream ID = Tailwater (Pond Outfall)

Message

|   |
|---|
| CRIT.DEPTH CONTROL Vh= .119ft<br>Dcr= .339ft CRIT.DEPTH Hev= .00ft<br>CRIT.DEPTH CONTROL Vh= .269ft<br>Dcr= .697ft CRIT.DEPTH Hev= .00ft<br>FULL FLOW...Lfull=412.26ft Vh=.623ft<br>HL=5.424ft Hev= .00ft<br>FULL FLOW...Lfull=435.87ft Vh=.754ft<br>HL=6.890ft Hev= .00ft<br>FULL FLOW...Lfull=439.80ft Vh=.806ft<br>HL=7.421ft Hev= .00ft<br>FULL FLOW...Lfull=441.47ft Vh=.859ft<br>HL=7.933ft Hev= .00ft<br>FULL FLOW...Lfull=443.27ft Vh=.911ft<br>HL=8.447ft Hev= .00ft |
|---|



Subsection: Individual Outlet Curves  
 Label: Composite Outlet Structure - 1

Return Event: 100 years  
 Storm Event: CO SPRINGS - 100 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
 Structure ID = Orifice - 1 (Orifice-Area)

Upstream ID = (Pond Water Surface)  
 Downstream ID = Culvert - 1 (Culvert-Circular)

| Water Surface Elevation (ft) | Device Flow (ft <sup>3</sup> /s) | (Into) Headwater Hydraulic Grade Line (ft) | Converge Downstream Hydraulic Grade Line (ft) | Next Downstream Hydraulic Grade Line (ft) | Downstream Hydraulic Grade Line Error (ft) | Convergence Error (ft <sup>3</sup> /s) | Downstream Channel Tailwater (ft) | Tailwater Error (ft) |
|------------------------------|----------------------------------|--|---|---|--|--|-----------------------------------|----------------------|
| 6,920.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,920.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,921.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.00                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.50                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,922.70                     | 0.00                             | 0.00                                       | 0.00  | 0.00                                      | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.00                     | 0.10                             | 6,923.00                                   | Free Outfall                                  | 6,921.66                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,923.50                     | 0.27                             | 6,923.50                                   | Free Outfall                                  | 6,921.77                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.00                     | 0.43                             | 6,924.00                                   | Free Outfall                                  | 6,921.84                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,924.50                     | 0.60                             | 6,924.50                                   | Free Outfall                                  | 6,921.91                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.00                     | 0.76                             | 6,925.00                                   | Free Outfall                                  | 6,921.97                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.20                     | 0.83                             | 6,925.20                                   | Free Outfall                                  | 6,921.98                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,925.50                     | 0.88                             | 6,925.50                                   | Free Outfall                                  | 6,922.52                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.00                     | 0.46                             | 6,926.00                                   | 6,925.22                                      | 6,925.22                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,926.50                     | 0.00                             | 6,926.50                                   | 6,926.50                                      | 6,926.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.00                     | 0.00                             | 6,927.00                                   | 6,927.00                                      | 6,927.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,927.50                     | 0.00                             | 6,927.50                                   | 6,927.50                                      | 6,927.50                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |
| 6,928.00                     | 0.00                             | 6,928.00                                   | 6,928.00                                      | 6,928.00                                  | 0.00                                       | 0.00                                   | (N/A)                             | 0.00                 |

Message

WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 WS below an invert; no flow.  
 HI=.30; Ht=2.50; Qt=.12  
 HI=.80; Ht=2.50; Qt=.12  
 HI=1.30; Ht=2.50; Qt=.12  
 HI=1.80; Ht=2.50; Qt=.12  
 HI=2.30; Ht=2.50; Qt=.12  
 H =2.50  
 H =2.80  
 H =.78

Subsection: Individual Outlet Curves  
Label: Composite Outlet Structure - 1

Return Event: 100 years  
Storm Event: CO SPRINGS - 100 Year

**RATING TABLE FOR ONE OUTLET TYPE**  
Structure ID = Orifice - 1 (Orifice-Area)

-----  
Upstream ID = (Pond Water Surface)  
Downstream ID = Culvert - 1 (Culvert-Circular)

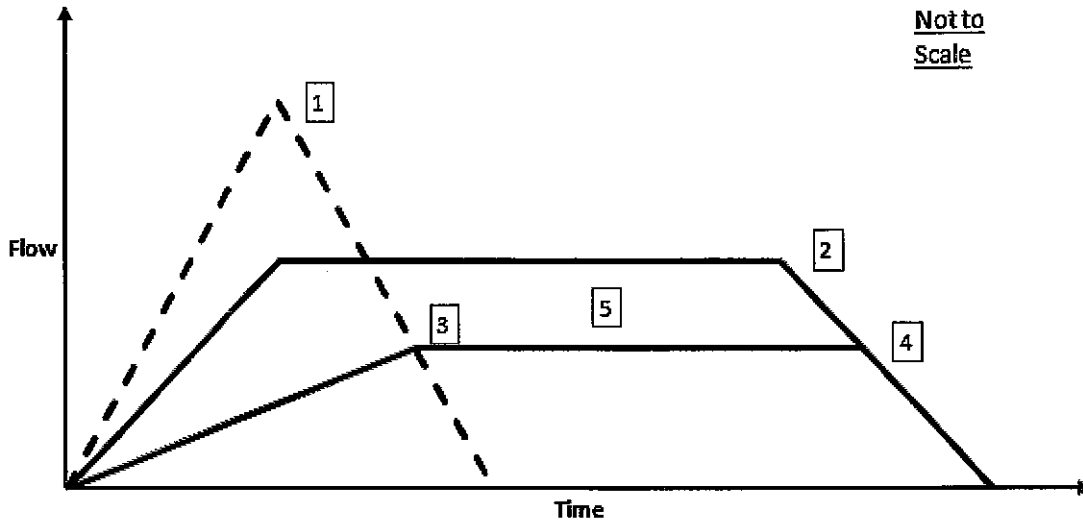
**Message**

|   |
|---|
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |
| FLOW PRECEDENCE SET TO<br>DOWNSTREAM CONTROLLING<br>STRUCTURE |

Subsection: Modified Rational Graph  
 Label: Basins

Return Event: 100 years  
 Storm Event: CO SPRINGS - 100 Year

|  |             |
|--|-------------|
| Method Type                                    | Method T    |
| Time of Duration (Modified Rational, Critical) | 0.983 hours |



|  |                          |  |                          |
|--|--------------------------|--|--------------------------|
| [1]  | [2]                      |  |                          |
| Time of Concentration (Modified Rational, Composite) | 0.282 hours              | Time of Duration (Modified Rational, Critical) | 0.983 hours              |
| Intensity (Modified Rational, Peak)                  | 5.853 in/h               | Intensity (Modified Rational, Critical)        | 2.844 in/h               |
| Flow (Modified Rational, Peak)                       | 75.33 ft <sup>3</sup> /s | Flow (Modified Rational, Critical)             | 36.61 ft <sup>3</sup> /s |

|  |                          |
|--|--------------------------|
| [3]  |                          |
| First Outflow Breakpoint (Modified Rational, Method T) | 1.181 hours              |
| Flow (Modified Rational, Allowable)                    | 11.00 ft <sup>3</sup> /s |

|   |                          |  |             |
|---|--------------------------|--|-------------|
| [4]   | [5]                      |  |             |
| Second Outflow Breakpoint (Modified Rational) | 0.523 hours              | Storage (Modified Rational, Estimated) | 2.101 ac-ft |
| Flow (Modified Rational, Allowable)           | 11.00 ft <sup>3</sup> /s |  |             |

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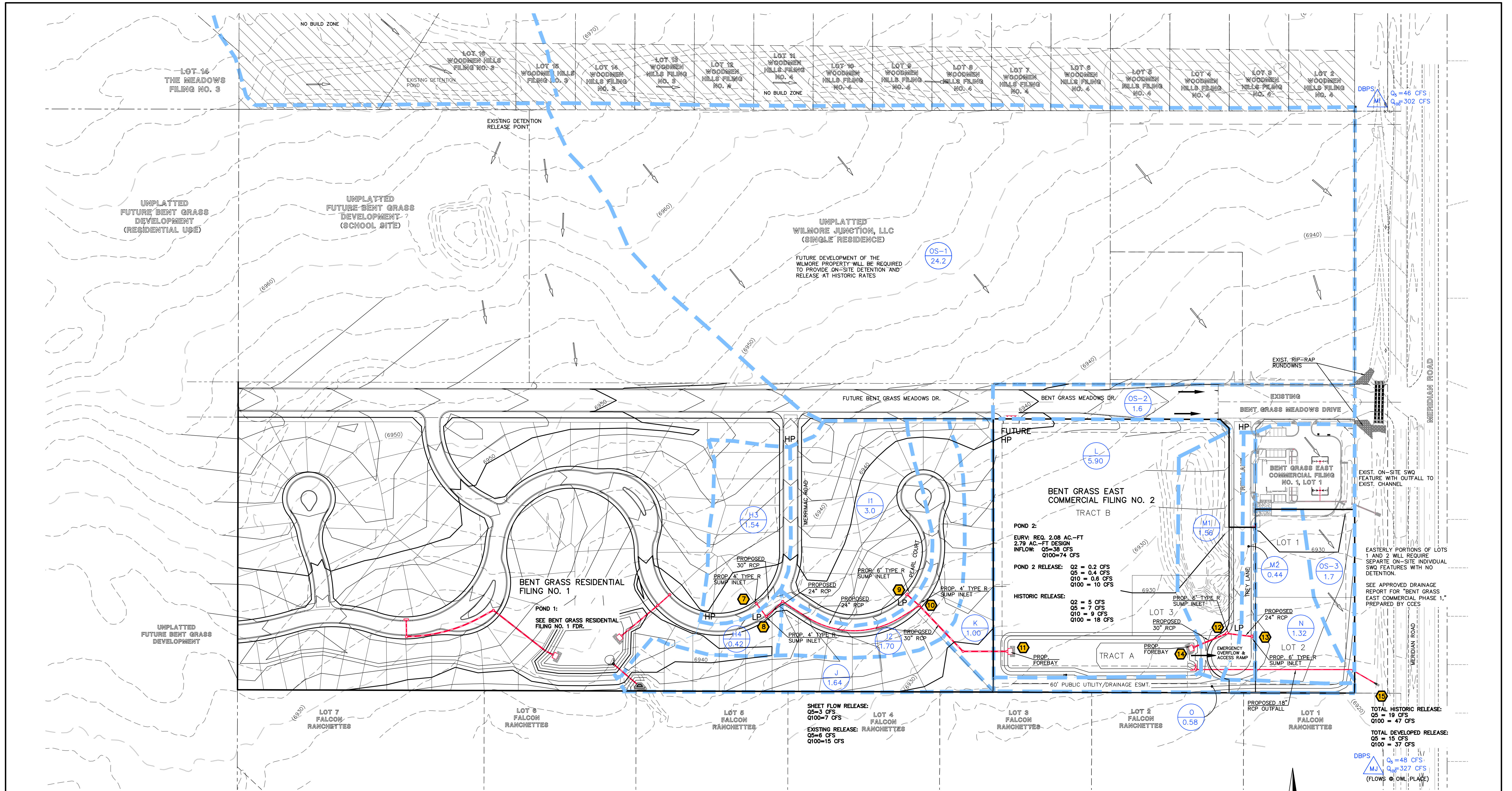
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**LEGEND**

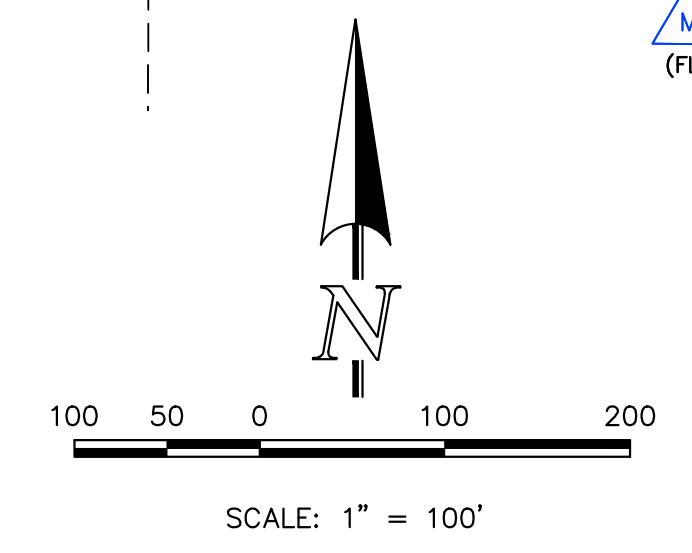
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- PROPOSED BASIN BOUNDARY —
- DIRECTION OF DRAINAGE —
- EXISTING STORM SEWER —
- EXISTING STORM INLET —
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- PROPOSED STORM INLET —
- LOW POINT/HIGH POINT — LP/HP
- BASIN IDENTIFIER AREA IN ACRES —
- DESIGN POINT —

**FINAL DRAINAGE REPORT - BASIN RUNOFF SUMMARY**

| BASIN | WEIGHTED CA(S) | CA(100) | OVERLAND    |             |          | STREET / CHANNEL FLOW |       |                 | Tc (min) | INTENSITY |      |      |       |       |       |       |       |       |       | TOTAL FLOWS |       |      |       |       |       |       |       |       |       |       |       |
|-------|----------------|---------|-------------|-------------|----------|-----------------------|-------|-----------------|----------|-----------|------|------|-------|-------|-------|-------|-------|-------|-------|-------------|-------|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       |                |         | Length (ft) | Height (ft) | Tc (min) | Length (ft)           | Slope | Velocity (ft/s) |          | Tc (min)  | I(2) | I(5) | I(10) | I(15) | I(20) | I(25) | I(30) | I(35) | I(40) | I(45)       | I(50) | Q(5) | Q(10) | Q(15) | Q(20) | Q(25) | Q(30) | Q(35) | Q(40) | Q(45) | Q(50) |
| OS-1  | 0.06           | 0.47    | 0.25        | 60          | 1        | 8.9                   | 150   | 2.0%            | 4.9      | 0.5       | 9.4  | 3.05 | 4.19  | 4.89  | 5.29  | 7.12  | 7.45  | 8.7   | 1.1   | 1.7         | 1.9   | 2.8  | 3.9   | 5.0   | 6.1   | 7.2   | 8.3   | 9.4   | 10.5  | 11.6  | 12.7  |
| OS-2  | 1.38           | 1.46    | 0.25        | 60          | 1        | 8.9                   | 150   | 2.0%            | 4.9      | 0.5       | 9.4  | 3.05 | 4.19  | 4.89  | 5.29  | 7.12  | 7.45  | 8.7   | 1.1   | 1.7         | 1.9   | 2.8  | 3.9   | 5.0   | 6.1   | 7.2   | 8.3   | 9.4   | 10.5  | 11.6  | 12.7  |
| OS-3  | 1.34           | 1.44    | 0.25        | 30          | 0.6      | 6.9                   | 200   | 1.5%            | 4.3      | 0.8       | 7.7  | 3.27 | 4.55  | 5.25  | 6.75  | 7.65  | 8.00  | 9.1   | 1.1   | 1.7         | 1.9   | 2.8  | 3.9   | 5.0   | 6.1   | 7.2   | 8.3   | 9.4   | 10.5  | 11.6  | 12.7  |

**FINAL DRAINAGE REPORT - SURFACE ROUTING SUMMARY**

| Design Point(s) | Contributing Basins                         | Equivalent CA(S) | Equivalent CA(100) | Maximum Tc | Intensity |        | Flow |        | Facility Size        |
|-----------------|---|------------------|--------------------|------------|-----------|--------|------|--------|----------------------|
|                 |   |                  |                    |            | I(S)      | I(100) | Q(S) | Q(100) |                      |
| 7               | H3  | 0.85             | 1.00               | 13.8       | 3.59      | 6.30   | 3    | 6      | 4" TYPE R SUMP INLET |
| 8               | H4  | 0.23             | 0.27               | 9.4        | 4.19      | 7.45   | 1    | 2      | 4" TYPE R SUMP INLET |
| 9               | I1  | 1.85             | 1.95               | 10.8       | 3.98      | 7.06   | 7    | 14     | 6" TYPE R SUMP INLET |
| 10              | I2  | 0.94             | 1.11               | 10.0       | 4.11      | 7.31   | 4    | 8      | 4" TYPE R SUMP INLET |
| 11              | DP 7 - DP 10 (Westerly Flow into Pond 2)    | 3.66             | 4.33               | 16.9       | 3.27      | 5.82   | 12   | 25     | 30" RCP              |
| 12              | M1  | 1.33             | 1.40               | 8.4        | 4.38      | 7.73   | 6    | 11     | 4" TYPE R SUMP INLET |
| 13              | M2 & N                                      | 1.50             | 1.58               | 6.8        | 4.69      | 8.34   | 7    | 13     | 6" TYPE R SUMP INLET |
| 14              | DP 12 & DP 13 (Easterly Flow into Pond 2)   | 2.82             | 2.99               | 8.9        | 4.29      | 7.62   | 12   | 23     | 30" RCP              |
|                 | Total Flow into Pond 2 (incl. Basins K & L) | 11.48            | 12.79              | 16.9       | 3.27      | 5.82   | 38   | 74     | 24 AC-FT, POND 2     |
| 15              | OS-1, OS-2, OS-3, O AND POND 2 RELEASE      | SCS MODEL        |                    |            |           |        | 15   | 37     |                      |



**CLASSIC CONSULTING ENGINEERS & SURVEYORS**

**BENT GRASS EAST COMM. FILING NO. 2**

FINAL DRAINAGE REPORT  
DEVELOPED CONDITIONS MAP

DESIGNED BY: MAW    SCALE: (H) 1" = 100'    DATE: 07-22-14  
DRAWN BY: MAW    (V) 1" = N/A    SHEET: 1 OF 1  
CHECKED BY:    JOB NO.: 2177.53

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