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PRELIMINARY DRAINAGE REPORT FOR FLYING HORSE NORTH PRELIMINARY PLAN AND FINAL DRAINAGE REPORT FOR FLYING HORSE NORTH FILING NO. 1

NOVEMBER 2017
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PRELIMINARY DRAINAGE REPORT
FLYING HORSE NORTH PRELIMINARY PLAN AND
FINAL DRAINAGE REPORT FOR FLYING HORSE NORTH FILING NO. 1

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 County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.

COLORADO REGISTERED MARC ALAN WHORTON 37155 PROFESSIONAL ENGINEER

Marc A. Whorton, P.E. Colorado P.E. #37155 — 6/14/18 Date

OWNER/DEVELOPER'S STATEMENT:
I, the owner/developer, have read and will comply with all of the requirements specified in this drainage report and plan.

Business Name: PRI #2 LLC

By:

Title: V-P

Address: 6385 Corporate Drive, Suite 200

Colorado Springs, CO 80919

EL PASO COUNTY:

Filed in accordance with the requirements of the Drainage Criteria Manual, Volumes 1 and 2, El Paso County Engineering Criteria Manual and Land Development Code as amended.

Jennifer Irvine, P.E. — Date
County Engineer / ECM Administrator

Conditions:

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TABLE OF CONTENTS:

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PURPOSE

The purpose of this Drainage Report is two-fold: first to identify major drainage corridors within this area and recommend preliminary facilities based on the Preliminary Plan layout and secondly to provide specific final design for the necessary facilities within the Filing No. 1 Final Plat area. These proposed facilities will route all developed storm water runoff to adequate outfall facilities. The drainage improvements proposed in this report that are outside of Filing No. 1 are preliminary in nature and future final drainage reports will be required for these areas. The Filing No. 1 design area within the proposed golf course includes the design of a jurisdictional dam facility. This specific facility design is handled in a separate report and submittal package reviewed and approved by the Colorado Dam Safety Board. However, El Paso County Engineering Staff will have the opportunity to review and approved specific aspects of the facility as well.

GENERAL DESCRIPTION

Flying Horse North is a 1,418 acre site located in all of section 36, township 11 south, range 66 west of the sixth principal meridian, and a portion of sections 30 and 31 township 11 south, range 65 west of the sixth principal meridian. The site is bounded on the north by Hodgen Road and the High Forest Ranch Community, to the south by the Cathedral Pines Subdivision and unplatted county land, to the east by Black Forest Road, and to the west by the State Highway 83 and unplatted county land. The site stretches across 2 existing drainage basins, the Black Squirrel Creek Drainage Basin and East Cherry Creek Drainage Basin. Large lot single family residential and a golf course with a club house are included in the proposed Preliminary Plan for this site. A site specific PUD plan and early grading plan for the golf course and associated private access roads was previously approved in the Fall of 2016. Tree removal, grading and erosion control for the golf course and access roads is currently under construction based on this approval.

The average soil condition reflects Hydrologic Group "B" (Brussett Loam, Elbeth Sandy Loam, Kettle Gravelly Loamy Sand, Peyton Sandy Loam, Peyton Pring Complex, Pring Course Sandy Loam, and Tomah-Crowfoot Loamy Sand) as determined by the "Soil Survey of El Paso County Area," prepared by the Soil Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

As described in the MDDP for Flying Horse North, this site sits in the upper reaches of both the Black Squirrel Creek and the East Cherry Creek Drainage Basins. There are approximately 540 acres in the Black Squirrel Creek Drainage Basin and 878 acres of area in the East Cherry Creek Drainage Basin. The majority of the Filing No. 1 area will be within the Black Squirrel Creek Basin, however, all required improvements for Filing No. 1 including the golf course within both basins will be discussed below.

Black Squirrel Creek Drainage Basin

The Flying Horse North property is located at the top of the Black Squirrel Creek Drainage Basin. Currently there are corrugated metal culverts within Hwy. 83 to convey flows across the existing roadway. Existing conditions in this basin are largely forested with rolling hills and natural valleys and swales draining offsite to the southwest. This basin has been previously studied in the "Black Squirrel Creek Drainage Basin Planning Study" prepared by URS Consultants, January 1989. The majority of the runoff from the area located in the Black Squirrel Drainage Basin converges at the main channel of the Black Squirrel Creek located on the adjacent property (Reach 12 and 13). As a part of the MDDP for Flying Horse North, also prepared by Classic consulting, an existing drainage analysis was performed to confirm allowable release rates at key design points along the project boundary. Offsite flows were recreated from surrounding reports that were previously approved. Drainage Criteria has been updated since these reports have been approved. Flow differences will occur due to the updated drainage criteria. Using these previous reports contributing areas, CN values and time of concentrations, this report along with the MDDP have attempted to recreate offsite flows for use in calculating existing conditions. Currently in the Flying Horse North property boundary within the Black Squirrel Drainage basin there are existing stock ponds with berms that retain existing flows from reaching downstream channels until overtopping. There are no records or design plans for these stock ponds. For this existing condition analysis these ponds were removed from the project model.

Along the northern boundary of the property there are numerous locations where off-site flows come onto the site. The High Forest Ranch development has two detention facilities that release concentrated flows directly onto the property. The on-site downstream corridors from these facilities will remain natural to the greatest extent possible and where required improved to accommodate these existing flows. High Forest Ranch Pond 26 releases flows on-site at the northwest corner of the site (DBPS Reach 1) that then travel through the site towards an existing 48" CMP at Hwy. 83. No significant erosion currently exists in this channel and upon development and re-vegetation, no additional erosion is anticipated. The Pre-development flows at this point as presented in the Flying Horse North MDDP (DP 7) equal (Q_2 = 4 cfs Q_5 = 18 cfs, Q_{100} = 153 cfs). The Highway 83 roadway improvements that will be required with this development will formalize the channel design at the approach to the existing 48" CMP. (See Appendix – Section C-C for channel calculations) At this location the majority of the flows are traveling through the site.

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However, the additional development proposed will be routed to an on-site detention/SWQ facility (Pond 1) to properly mitigate any affects to the downstream corridor. High Forest Ranch Pond 16 releases flows on-site approximately 4100 LF east of Hwy. 83 (Reach 6). These flows cross the site and continue to travel in a southwest direction through the Shamrock Ranch property. This is the start of the headwaters of the Black Squirrel Creek Drainage Basin with the majority of the existing flows coming from the High Forest Ranch Development. With little development proposed in this area, there is no significant affect on the downstream corridor.

Section 36 lies approximately 1.5 miles east of Hwy. 83 and this is where the bulk of the Flying Horse North property ownership begins. Several major drainage corridors feeding the Black Squirrel Creek Basin traverse Section 36 and travel in a southwest direction towards the west edge of the property (Reach 12 and 13). Reach 13 is entirely on the Shamrock Ranch property to the west. However, Reach 12 exists within the planned Flying Horse North Golf Course and portions of the Filing No. 1 development. Most of these historic natural drainageways will remain within the Golf Course property and be left as natural as possible with the addition of some private channel improvements (i.e. Permanent TRM with reinforced rock check dams is specified locations) to mitigate the effects of development and minimize erosion transfer potential. These facilities will be contained within proposed drainage easements as shown on the Filing No. 1 final plat. (See Appendix for channel improvement details) The Flying Horse North development remains consistent with the Black Squirrel DBPS assumed land use of 5 acre average over the entire 1400+ acres. This enables even the developed flows within the subdivision to be consistent with what the DBPS anticipated downstream. The DBPS also specified that all developments within the basin that are tributary to the sub-regional detention ponds either, 1) construct a permanent detention facility on-site or 2) construct a temporary detention facility on-site that could later be removed. As seen later in this report, multiple permanent full-spectrum detention/SWQ facilities are proposed to be constructed on-site. More specifically, ponds 4 and 8 will be installed along the west boundary prior to entering existing Reach 13 located just off-site within the Shamrock property. This report has analyzed the downstream corridors below both of these facilities for the pre-development condition (per DBPS hydrology) and post-development condition (per UD-detention designed release) No significant erosion currently exists in these channels and we have been diligently coordinating with the adjacent property owner and his engineer on consistently maintaining proper BMPs along this property boundary. This effort will continue through final construction and revegetation of the permanent detention/SWQ facilities. (See Appendix for Sections A-A and B-B channel calculations) These facilities not only meet all current drainage criteria but also remain consistent with the intent of the DBPS. It is also noted that these facilities release well under the pre-development flows as established by the DBPS. Thus, the downstream corridor within the existing Reach 13 on the adjacent property will not be significantly affected with the installation of these full-spectrum facilities. Portions of the Cathedral Pines Development to the south contributes developed flows to this property. These flows will be accommodated in the various on-site facility designs. A smaller on-site basin at the southeast corner of section 36 releases historic flows onto the Cathedral Pines and the Edmonds Subdivision. An on-site detention/storm water quality facility is planned in this corridor to help mitigate development.

East Cherry Creek Drainage Basin

The Palmer Divide traverses the eastern half of section 36 which defines the major basin line between the Black Squirrel Creek and the East Cherry Creek Basins. The vegetation also changes drastically in this area. The majority of the East Cherry Creek Basin contains very little trees and more grazing prairie land and meadows. This area defines the edge of Black Forest. In general, historic flow patterns in this basin travel in a northeasterly direction towards Hodgen Road. The MDDP designates several major design points along the north boundary. Again, multiple detention/storm water quality facilities are planned for these corridors and to be constructed along with future land development. This report has analyzed the downstream corridors along the north property line for the pre-development condition (per MDDP hydrology) and post-development condition (per UD-detention designed release). No significant erosion currently exists in these channels and we have been consistently maintaining proper BMPs along this property boundary. This effort will continue through final construction and revegetation of the permanent detention/SWQ facilities. (See Appendix for Sections D-D and E-E channel calculations). Portions of the Palmer Divide Subdivision and multiple large unplatted properties the south contribute developed flows to this property. These flows will be accommodated in the various on-site facility designs.

PROPOSED DRAINAGE CONDITIONS

The proposed land development within the Flying Horse North Filing No. 1 and future development within the remaining portions of the Preliminary Plan will be 2.5-5 acre large lot residential with associated paved streets and roadside ditches. The 18-hole private Golf Course with a club house site, driving range and maintenance facility is also planned as a part of Filing No. 1. Based on the current El Paso County ECM Section I.7.1.B. and given the size of the lots within this entire development area, stormwater quality is not required to be provided. However, detention/EURV will still be provided in specific locations on-site to limit the on-site development flow release to remain consistent with pre-development conditions within the major drainage corridors. These proposed facilities will aide in limiting any detrimental effects on downstream corridors. At specific areas where the Filing No. 1 development creates concentrated flows into future development areas, temporary sediment basins will be constructed to minimize sediment transfer downstream and off-site. The Filing No. 1 Final Drainage Report portion of this report will define the permanent facilities providing an Excess Urban Runoff Volume (EURV) in the lower portion of the facility storage volume with an outlet control device. Frequent and infrequent inflows are released at rates approximating undeveloped conditions. This concept provides some mitigation of increased runoff volume by releasing a portion of the increased runoff at a low rate over an extended period of time, up to 72 hours. This means that frequent storms, smaller than the 2 year event, will be reduced to very low flows near or below the sediment carrying threshold value for downstream drainage ways. Also, by incorporating an outlet structure that limits the 100-year runoff to the undeveloped condition rate, the discharge hydrograph for storms between the 2 year and the 100 year event will approximate the hydrograph for the undeveloped conditions and will help effectively mitigate the effects of this development. Again, prior to any land development beyond the Filing No. 1 Final Plat area, additional final drainage reports, final plats and construction plans will be required detailing this criteria.

Given the rural nature of this development, roadside ditches are planned along all roadways. Concrete curb and gutter will only be used at the round-about locations and along the jurisdictional dam embankment as required by the State. The typical roadside ditch will be designed as a V-ditch with a depth of 24 inches. The natural terrain within much of this development creates some steeper slopes on many of the roadways. These slopes range from 1% to 10%. An analysis of the roadside ditches was performed in order to determine the necessary ditch lining required to maintain allowable velocity and shear stress.
The following three basic ditch improvements are recommended throughout the development:
(See Appendix for reference)

1. Revegetation with native seeding (Grass lined only)
   Slope 2% or less and minimal flow

2. Erosion Control Blanket (North American Green SC150 or equiv.) with native seeding Slope 5% or less and max. flow range of 7-43 cfs.
3. Turf Reinforcement Mat (North American Green P300 or equiv.) with natives seeding Slope 10% or less and max. flow of 70 cfs.

The specific ditch lining locations will be shown on the street improvements plans

The following hydrology descriptions will start at the western edge of the Flying Horse North property and move east into the East Cherry Creek Basin, describing the development within the Filing No. 1 area first.

FLYING HORSE NORTH FILING NO. 1

Black Squirrel Creek Drainage Basin

As mentioned previously, Flying Horse North is located in the upper region of the Black Squirrel Creek Drainage Basin. Per the approved DBPS for Black Squirrel Creek, the reaches in this area were proposed to remain as natural as possible. There were no recommendations for detention facilities within the area that is Flying Horse North, but due to current drainage criteria, detention/EURV facilities will be proposed with this development.

High Forest Ranch Detention Pond 26 outfalls onto the property at the very northwest corner of the site. These existing flows will continue to enter the site and travel within the natural channel towards the existing 48" CMP culvert crossing at Hwy. 83. Drainage easements across the proposed lots in this area will be provided on the final plat. The existing stock pond within lots 2 and 3 will be removed with grading of the road in this area. Tract B is platted in order to provide a detention/EURV facility for the lots and public road in this area. This facility will be constructed with Filing No. 1 with ownership and maintenance by the Flying Horse North HOA.

Design Point 1 (Q_2 = 2 cfs Q_5 = 3 cfs, Q_{100} = 11 cfs) represents the existing off-site and on-site developed flows from Basins OS-1A and BS-2B. The combined flow from these basins travel to a low point just east of Stagecoach Road where a proposed 24" RCP culvert will be installed to convey these flows under the road. (See Appendix for culvert design)

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Design Point 2 (Q_2 = 3 cfs Q_5 = 9 cfs, Q_{100} = 35 cfs) represents flows from DP 1 and Basin BS-4. These combined flows are collected at a low point where a proposed 30" RCP culvert will be installed to replace the temporary sediment basin installed with early grading. (See Appendix for culvert design)

The total developed flows entering **Detention Facility 1** including Basin BS-1A equal **(Q_2 = 4 cfs Q_5 = 7 cfs, Q_{100} = 38 cfs)**. These combined flows will travel in the natural drainage corridor across lot 1 within a drainage easement and enter the detention facility. The following describes the design of this facility (See Appendix for UD Detention pond design sheets):

Detention Pond 1 (Full Spectrum – see multiple storm release data below)
0.43 Ac.-ft. EURV required
0.50 Ac.-ft. EURV design with 3:1 max. slopes
1.1 Ac.-ft. 100-yr. Storage

Total In-flow:	**Q_2 = 4 cfs,**	**Q_5 = 7 cfs,**	**Q_{100} = 38 cfs**
Pond Design Release:	**Q_2 = 0.1 cfs,**	**Q_5 = 0.2 cfs,**	**Q_{100} = 21 cfs**
Pre-development Release:	**Q_2 = 0.2 cfs,**	**Q_5 = 0.4 cfs,**	**Q_{100} = 23 cfs**

(Ownership and maintenance by the Flying Horse North HOA)

The downstream corridor from this proposed facility shows no indication of erosion at this time and is anticipated to continue to adequately handle the detained developed flows from this portion of the subdivision.

Design Point 4 (Q_2 = 3 cfs Q_5 = 4 cfs, Q_{100} = 8 cfs) represents existing and developed flows from Basin BS-2 (north side of Stagecoach Rd.) These flows will travel in a side road ditch towards Hwy. 83. A temporary sediment basin will be installed during construction of this portion of the roadway. This development will be required to provide improvements to this intersection and Hwy. 83 per the site traffic study. Upon review/approval from CDOT, these improvements will be constructed along with final design of drainage at this intersection which will include the relocation of the dual 18" ERCP culverts and the removal of the temporary sediment basin.

Design Point 5 (Q_2 = 2 cfs Q_5 = 4 cfs, Q_{100} = 13 cfs) represents existing and developed flows from Basins OS-1B and BS-2A (south side of Stagecoach Rd.) These flows will travel in a side road ditch towards Hwy. 83. A temporary sediment basin will be installed during construction of this portion of the roadway. Upon review/approval from CDOT, these improvements will be constructed along with final design of drainage at this intersection and the removal of the temporary sediment basin at this location.

Design Point 6 (Q_2 = 1 cfs Q_5 = 3 cfs, Q_{100} = 15 cfs) represents flows from Basins OS-2 and BS-3. These combined flows travel via the side road ditch along the east side of the road and then around the cul-de-sac, through lot 3 within a drainage easement towards the existing natural channel to the west. These flows then combine with Basin BS-1B and continue to travel in the existing natural channel towards the existing downstream 48" CMP culvert. **Design Point 3 (Q_2 = 1 cfs Q_5 = 6 cfs, Q_{100} = 39 cfs)** then represents the total flow from this site leaving the property at this location. The pre-development on-site flow at this location equals **Q_2 = 1 cfs Q_5 = 5 cfs, Q_{100} = 41 cfs.** Thus, the downstream facilities will not see a significant change in flows.

Design Point 7 (Q_2 = 2 cfs Q_5 = 8 cfs, Q_{100} = 38 cfs) represents existing and developed flows from Basins OS-3 and BS-5. These flows will travel as sheet flow towards the low point where dual 30" RCP culverts will installed under Stagecoach Road to replace the temporary sediment basin installed with early grading. (See Appendix for culvert design)

High Forest Ranch Detention Pond 16 outfalls onto the property just upstream of Design Point 8. These existing flows will continue to enter the site and travel through proposed triple 48" RCP culverts under Stagecoach Road. (See Appendix for culvert design) **Design Point 8 (Q_2 = 21 cfs Q_5 = 70 cfs, Q_{100} = 284 cfs)** represents the existing and developed flows exiting the property and continuing south within the natural channel on the Shamrock Ranch property. These flows remain consistent with the historic flows at this location.

Design Point 9 (Q_2 = 1 cfs Q_5 = 5 cfs, Q_{100} = 23 cfs) represents existing flows from Basins OS-7 and BS-12. These combined flows are collected at a low point where proposed dual 24" RCP culverts will be installed to replace the temporary sediment basin installed with early grading. (See Appendix for culvert design) **Design Point 10 (Q_2 = 11 cfs Q_5 = 32 cfs, Q_{100} = 143 cfs)** represents existing and developed flows

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from Basins OS-8, OS-10, OS-11, BS-13 and BS-14. These flows will travel to the low point at this location where dual 42" RCP culverts will be installed for the crossing of Stagecoach Road. (See Appendix for culvert design)

Design Point 11 (Q_2 = 5 cfs Q_5 = 12 cfs, Q_{100} = 36 cfs) represents developed flow from Basin BS-16. These flows will travel to the low point at this location where dual 24" RCP culverts will be installed for the crossing of the road. (See Appendix for culvert design) **Design Point 11A (Q_2 = 0.3 cfs Q_5 = 0.64 cfs, Q_{100} = 4.6 cfs)** represents a small 1.0 ac. sub-basin of BS-17 that will travel as ditch flow to a lowpoint where an 18" culvert will convey the developed flows to the south side of Shortwall Dr. into Basin BS-15. (See Appendix for culvert design) **Design Point 12 (Q_2 = 4 cfs Q_5 = 11 cfs, Q_{100} = 44 cfs)** represents the combined developed flow from Basins BS-16 and BS-15. These flows will travel to the low point at this location where a 36" RCP culvert and storm system will be installed to route the collected flows directly into Detention Pond 4 at the south end. (See Appendix for culvert design)

The total developed flows entering **Detention Facility 4**, including Basins OS-9 and BS-17 equal **(Q_2 = 10 cfs Q_5 = 16 cfs, Q_{100} = 217 cfs)**. The major flows enter the facility at the north end through a rock chute. (See Appendix for rock chute and pond design) The following describes the design of this facility:
(See Appendix for UD Detention pond design sheets):

Detention Pond 4 (Full Spectrum – see multiple storm release data below)
0.99 Ac.-ft. EURV required
1.05 Ac.-ft. EURV design with 4:1 max. slopes
5.1 Ac.-ft. 100-yr. Storage

Total In-flow:	**Q_2 = 10 cfs,**	**Q_5 = 16 cfs,**	**Q_{100} = 217 cfs**
Pond Design Release:	**Q_2 = 0.3 cfs,**	**Q_5 = 0.4 cfs,**	**Q_{100} = 142 cfs**
Pre-development Release:	**Q_2 = 1.5 cfs,**	**Q_5 = 2.5 cfs,**	**Q_{100} = 152cfs**

(Ownership and maintenance by the Flying Horse North HOA)

The downstream corridor from this proposed facility shows little indication of erosion at this time and is anticipated to continue to adequately handle the detained developed flows from this portion of the subdivision. In addition, we have been coordinating with the adjacent property owner and his engineering

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consultant on this specific corridor and will continue to do so until the on-site detention facility construction is complete and all disturbed areas are re-established.

Design Point 14 (Q_2 = 4 cfs Q_5 = 12 cfs, Q_{100} = 56 cfs) represents the developed flow from Basin BS-18. These flows will travel to the low point at this location where three 24" RCP culverts will be installed to cross under the road. (See Appendix for culvert design) These flows then enter Basin OS-23 through a drainage easement on the rear of lot 65 and continue to travel towards DP-16. **Design Point 15 (Q_2 = 2 cfs Q_5 = 5 cfs, Q_{100} = 15 cfs)** represents the developed flow from Basin BS-19. These flows will travel to the low point at this location where dual 18" RCP culverts will be installed to cross under the road. (See Appendix for culvert design) These flows then enter Basin OS-22 through a drainage easement across lots 60 and 61 and continue to travel towards the golf course.

Basins BS-20, BS-21, BS-22, BS-23 and BS-23A are relatively large basins that contain both Filing 1 lots, much of the golf course but also future lots that will remain undeveloped at this time. However, these basins all ultimately travel in a southwesterly direction towards the proposed Detention Facility 8. This report analyzes both the "Filing 1 Only" condition as well as the "full build-out condition" in the design of this detention facility. With the development of Filing 1, Detention Facility 8 will be sized and graded for the ultimate design accounting for the future lot development. The outlet structure and emergency overflow weir will also be designed for the ultimate condition. However, we will provide two orifice plate designs for the outlet box. The initial plate will be constructed that will handle the proper release for the Filing 1 development only. Upon the next phase of lot development within these basins (BS-20, BS-21, BS-22, BS-23 and BS-23A) the ultimate plate will be installed to replace this initial plate design. No further changes to the outlet structure or pond will need to take place. Thus, the following describes the two scenarios:

<u>Full Build-out Design (accounting for future lot development)</u>

Design Point 16 (Q_2 = 25 cfs Q_5 = 78 cfs, Q_{100} = 362 cfs) represents the total developed flows from Basins BS-18 thru BS-23 with the fully developed golf course and lots in Filing 1 and the future phases. These flows travel to the low point at this location where dual 60" RCP culverts will be installed to cross under the road. (See Appendix for culvert design) These flows represent the major portion of the flows entering Detention Facility 8 with the remaining flows coming from Basin OS-23A.

The total developed flow entering **Detention Facility 4** includes Basin BS-23A. The following describes the design of this facility: (See Appendix for UD Detention pond – **Full Build-out** design sheets):

Detention Pond 8 (Full Spectrum – see multiple storm release data below)
2.40 Ac.-ft. EURV required
2.45 Ac.-ft. EURV design with 4:1 max. slopes
9.32 Ac.-ft. 100-yr. Storage

Total In-flow:	**Q_2 = 28 cfs,**	**Q_5 = 85 cfs,**	**Q_{100} = 383 cfs**
Pond Design Release:	**Q_2 = 0.8 cfs,**	**Q_5 = 1.0 cfs,**	**Q_{100} = 253 cfs**
Pre-development Release:	**Q_2 = 2.6 cfs,**	**Q_5 = 4.5 cfs,**	**Q_{100} = 274cfs**

(Ownership and maintenance by the Flying Horse North HOA)

Filing 1 Only Design (accounting for golf course and Filing 1 lot development)

Under this scenario, only the golf course and Filing 1 lots are developed and Basins BS-20, BS-21, BS-22, BS-23 and BS-23A have been adjusted to account for only this initial phase of development. The following describes the facility requirements for this design: (See Appendix for UD Detention pond – **Filing 1 Only** design sheets):

****Detention Pond 8 (Full Spectrum – see multiple storm release data below)**
1.13 Ac.-ft. EURV required
2.45 Ac.-ft. EURV design with 4:1 max. slopes
7.76 Ac.-ft. 100-yr. Storage

Total In-flow:	**Q_2 = 9 cfs,**	**Q_5 = 14 cfs,**	**Q_{100} = 301 cfs**
Pond Design Release:	**Q_2 = 0.4 cfs,**	**Q_5 = 0.5 cfs,**	**Q_{100} = 219 cfs**
Pre-development Release:	**Q_2 = 2.2 cfs,**	**Q_5 = 3.9 cfs,**	**Q_{100} = 237cfs**

(Ownership and maintenance by the Flying Horse North HOA)

**Please note that all facility design remains the same as the Full Build-out scenario except for the different orifice plate.

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The downstream corridor from this proposed facility shows little indication of erosion at this time and is anticipated to continue to adequately handle the detained developed flows from this portion of the subdivision. In addition, we have been coordinating with the adjacent property owner and his engineering consultant on this specific corridor and will continue to do so until the on-site detention facility construction is complete and all disturbed areas are re-established.

Basin BS-24 (Q_2 = 0.6 cfs Q_5 = 3 cfs, Q_{100} = 18 cfs) represents sheet flow from three residential lots within Filing No. 1 that will continue to direct release off-site. However, portions of this historic basin area will be routed into Flying Horse North Pond 8, therefore the developed flows from this basin do not significantly change from the pre-development condition. The pre-development flows from the historic basin area equal **Q_2 = 0.2 cfs Q_5 = 2 cfs, Q_{100} = 18 cfs.** Also, given the lot size, no water quality is required.

FLYING HORSE NORTH FILING NO. 1

East Cherry Creek Drainage Basin

The following basins are still tributary to the Filing No. 1 platting area but are within the East Chery Creek Drainage Basin:

Design Point 24 (Q_2 = 2 cfs Q_5 = 8 cfs, Q_{100} = 45 cfs) represents developed flows from Basins CC-4C and CC-5. Basin CC-4C represents the future golf course clubhouse site. Upon future development of this site a site specific detention/SWQ facility will be installed. This future facility will release into the side road ditch on the west side of Allen Ranch Road and travel in a northerly direction. The side road ditch along this stretch of Allen Ranch Road and the south side of Old Stagecoach Road will be sized to handle these flows. The 100-yr. emergency overflow from this future facility will also be into the side road ditch of Allen Ranch Road and not towards any residential lots. For ultimate downstream design purposes this basin is assumed to release pre-development flows. These flows will travel towards Design Point 24 where a 36" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design)

The total developed flows entering **Detention Facility 12**, including Basin CC-6 equals **(Q_2 = 6 cfs Q_5 = 9 cfs, Q_{100} = 85 cfs)**. The following describes the design of this facility:
(See Appendix for UD Detention pond design sheets):

Detention Pond 12 (Full Spectrum – see multiple storm release data below)
0.66 Ac.-ft. EURV required
0.75 Ac.-ft. EURV design with 4:1 max. slopes
2.69 Ac.-ft. 100-yr. Storage
Total In-flow: Q_2 = 6 cfs, Q_5 = 9 cfs, Q_{100} = 85 cfs
Pond Design Release: Q_2 = 0.2 cfs, Q_5 = 0.3 cfs, Q_{100} = 45 cfs
Pre-development Release: Q_2 = 0.5 cfs, Q_5 = 0.9 cfs, Q_{100} = 55 cfs
(Ownership and maintenance by the Flying Horse North HOA)

The downstream corridor from this proposed facility shows no indication of erosion at this time and is anticipated to continue to adequately handle the detained developed flows from this portion of the subdivision.

Design Point 25 (Q_2 = 0.2 cfs Q_5 = 0.3cfs, Q_{100} = 45 cfs) then represents the total flow leaving the site at this location. The pre-development flow at this location equals **Q_2 = 0.5 cfs Q_5 = 0.9 cfs, Q_{100} = 55 cfs.** Thus, the downstream facilities will not see a significant change in flows.

Basins OS-12, OS-13, OS-14, CC-1A, CC-1B, CC-2A, CC-2B, CC-2C, CC-3, CC-4A, CC-4B and CC-9 are all tributary to the proposed Flying Horse North Pond 13. Nearly all the proposed residential lots within these basins are part of future development outside of Filing No. 1 platting. The only structure associated with Filing No. 1 development is the pond embankment/outlet structure crossing Stagecoach Road. However, this facility has been classified by the Colorado Dam Safety Branch (DSB) as a low-hazard, jurisdictional facility. As such, a separate Design Report including hydrology/hydraulic design and embankment/structure design has been prepared for DSB and El Paso County review and approval. Please reference this report for the required detention/SWQ design for this facility.

Design Point 26 (Q_2 = 3 cfs Q_5 = 16 cfs, Q_{100} = 102 cfs) represents the full build-out developed flows from Basins CC-8 and CC-10. Basin CC-8 represents future residential lots and CC-10 mostly future passive park area. These flows will continue to sheet flow towards the low-point where a 48" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) After crossing Stagecoach Road, these flows will continue to flow directly into the existing stock pond just north of the roadway. This facility will provided sediment control for the small developed roadway area. Upon future development and plating of the lots planned within these basins, this stock pond will be formally designed into a detention facility.

Basin CC-15 (Q_2 = 1 cfs Q_5 = 4 cfs, Q_{100} = 20 cfs) represents the full build-out developed flows from the future residential lots tributary to this basin. These flows will continue to sheet flow towards the low-point where a 30" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Basin CC-16 (Q_2 = 1 cfs Q_5 = 5 cfs, Q_{100} = 24 cfs) represents the full build-out developed flows from the future residential lots tributary to this basin. These flows will continue to sheet flow towards the low-point at the southwest corner of Old Stagecoach Road and Rubble Drive where a 24" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Design Point 30 (Q_2 = 0.7 cfs Q_5 = 2 cfs, Q_{100} = 10 cfs) represents the full build-out developed flows from Basin CC-18. This Basin represents future residential lots. The flows will continue to sheet flow towards the low-point where a 24" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

Design Point 31 (Q_2 = 0.9 cfs Q_5 = 3 cfs, Q_{100} = 15 cfs) represents the full build-out developed flows from Basin CC-19 and the upstream release from DP-30. This Basin represents future residential 5 ac. lots. The flows will continue to sheet flow within a proposed drainage easement towards the existing low-point where an existing 24" CMP culvert will adequately handle the fully developed flows at this location.

Design Point 32 (Q_2 = 2 cfs Q_5 = 8 cfs, Q_{100} = 40 cfs) represents the full build-out developed flows from Basins OS-16 and CC-17. Basin CC-17 represents future residential lots and OS-16 unplatted, 5-ac. zoned residential property. These flows will continue to sheet flow towards the low-point where a 36" RCP culvert is sized to handle the fully developed flows at this location. (See Appendix for culvert design) A downstream sediment basin will be installed to provide sediment control for the small developed roadway area.

FLYING HORSE NORTH PRELIMINARY PLAN (Future Platting)

Black Squirrel Creek Drainage Basin

The following basins are in the Black Squirrel Creek Drainage Basin but are not a part of Filing 1 lot development. These areas will require future final drainage report(s) upon future lot development.

Design Point 18 (Q_2 = 5 cfs Q_5 = 22 cfs, Q_{100} = 115 cfs) represents developed flows from Basins BS-28, BS-29, BS-30 and OS-18. Portions of basins BS-28 and BS-29 include golf course development taking place with Filing No. 1. However, the majority of these basins include forested future residential lots with basin OS-18 being existing 2.5 ac. minimum lots. Future developed flows will be routed to this location where a future detention facility will be installed. This facility will be sized to meet EURV requirements and release pre-development flow quantities into the future side road ditch and through future drainage easements towards the future detention facility at Design Point 19. These future facilities will be further analyzed as ponds in series and emergency overflow paths well defined with the future final drainage report. In the interim, with only the golf course construction, a temporary sediment basin located within the future roadway in basin BS-28 will be installed to provide sediment control from the developed golf course area.

Design Point 19 (Q_2 = 4 cfs Q_5 = 17 cfs, Q_{100} = 126 cfs) represents developed flows from Basins BS-27 and OS-17. These basins include forested future residential lots with basin OS-17 being existing 2.5 ac. minimum lots. Future developed flows will be routed to this location where a future detention facility will be installed to meet EURV requirements and release pre-development flow quantities. Both of these future facilities will be constructed in tracts with ownership and maintenance by the Flying Horse North HOA.

Basin BS-26 (Q_2 = 0.04 cfs Q_5 = 0.4 cfs, Q_{100} = 3 cfs) represents sheet flow from the extreme rear portion of a future residential lot. This area of the lot will likely not be built upon, therefore not significantly changing the drainage conditions from the pre-development condition. The pre-development flow from the historic basin area equals **Q_2 = 0.04 cfs Q_5 = 0.4 cfs, Q_{100} = 3 cfs.** Also, given the lot size, no water quality is required.

Basins BS-31 (Q_2 = 0.3 cfs Q_5 = 2 cfs, Q_{100} = 12 cfs), BS-32 (Q_2 = 0.3 cfs Q_5 = 2 cfs, Q_{100} = 9 cfs) and BS-33 (Q_2 = 0.8 cfs Q_5 = 3 cfs, Q_{100} = 15 cfs) represent smaller basins that will continue to sheet flow off-site to the south. These basins represent some golf course development and multiple future residential lots. Given the lot size, no water quality is required. However, permanent sediment basins will be installed downstream of the golf course development to provide sediment control. Developed flows released from these basins will not be significantly different than the pre-development flows.

East Cherry Creek Drainage Basin

The following basins are not tributary to the Filing No. 1 platting area but are within the East Chery Creek Drainage Basin and planned for future residential lot development.

Design Point 28 (Q_2 = 5 cfs Q_5 = 20 cfs, Q_{100} = 110 cfs) represents the full build-out developed flows from Basins OS-13 and CC-13A. Basin CC-13A represents future residential lots and OS-13 platted, 5-ac. zoned residential property. These flows will continue to sheet flow towards the low-point where a future culvert will be installed to handle the fully developed flows at this location. The flows are then conveyed in the natural channel towards Design Point 29.

Design Point 29 (Q_2 = 6 cfs Q_5 = 27 cfs, Q_{100} = 155 cfs) represents the full build-out developed flows from Basins CC-13B, CC-13C and release from DP-28. These basins represent future residential lots. At this location, a future detention facility will be installed to meet EURV requirements and release pre-development flow quantities. This future facility will be constructed in a tract with ownership and maintenance by the Flying Horse North HOA.

Basin CC-13D (Q_2 = 2 cfs Q_5 = 6 cfs, Q_{100} = 29 cfs) represents future residential lots that will continue to sheet flow off-site. Given the lot size, no water quality is required. However, a permanent sediment basin will be installed just prior to release off-site to provide sediment control. Developed flows released from this basin will not be significantly different than the pre-development flows.

Basin CC-14 (Q_2 = 0.4 cfs Q_5 = 2 cfs, Q_{100} = 8 cfs) represents sheet flow from the rear portion of two future residential lots. The majority of this area is not anticipated to be developed, therefore not significantly changing the drainage conditions from the pre-development condition. Also, given the lot size, no water quality is required.

Design Point 27 (Q_2 = 4 cfs Q_5 = 17 cfs, Q_{100} = 81 cfs) represents the full build-out developed flows from the previously described basin CC-15 and CC-20. These basins represent future residential lots. At this location, a future detention facility will be installed to meet EURV requirements and release pre-development flow quantities. This future facility will be constructed in a tract with ownership and maintenance by the Flying Horse North HOA.

Basins CC-21 (Q_2 = 0.1 cfs Q_5 = 1 cfs, Q_{100} = 9 cfs) and CC-22 (Q_2 = 1 cfs Q_5 = 5 cfs, Q_{100} = 21 cfs) represent future residential 5 ac. lots and park area that will continue to sheet flow off-site. Given the lot size, no water quality is required. However, a permanent sediment basin will be installed just prior to release off-site to provide sediment control. Developed flows released from this basin will not be significantly different than the pre-development flows.

Basins CC-23 (Q_2 = 0.4 cfs Q_5 = 1 cfs, Q_{100} = 8 cfs) and CC-24 (Q_2 = 3 cfs Q_5 = 13 cfs, Q_{100} = 62 cfs) represent future 5 ac. residential lots that will continue to sheet flow off-site. Given the lot size, no water quality is required. Given that the proposed lots are planned for 5 ac. residential, the developed flows released from this basin will not be significantly different than the pre-development flows. However, multiple permanent sediment basins may be installed just prior to release off-site to provide sediment control. This basin also contains a portion of the adjacent Franktown/Parker Reservoir emergency spillway crossing two proposed lots. This existing facility, which doesn't appear to be within any existing easement, will be further analyzed with a final drainage report for this area. Appropriate drainage easements may be provided at time of final plating.

Basin CC-25 (Q_2 = 0.3 cfs Q_5 = 1 cfs, Q_{100} = 6 cfs) represents a small portion of two future residential 5 ac. lots that will continue to sheet flow off-site. Given that the proposed lots are planned for 5 ac. residential, the developed flows released from this basin will not be significantly different than the pre-development flows.

Design Point 34 (Q_2 = 6 cfs Q_5 = 24 cfs, Q_{100} = 168 cfs) represents the full build-out developed flows from Basins CC-26, CC-27, CC-28, release from CC-16 and release from DP-32. These basins represent future residential lots and park area. At this location, a future detention facility will be installed and likely replace the existing stock pond to meet EURV requirements and release pre-development flow quantities. The downstream existing culvert under Hodgen Road will be further analyzed with future final drainage reports. This future facility will be constructed in a tract with ownership and maintenance by the Flying Horse North HOA.

FACILITY MAINTENANCE

All proposed drainage structures within the platted County ROW will be owned and maintained by El Paso County. All proposed drainage structures within easements or tracts will be owned and maintained by the Flying Horse North HOA of Golf Course owner.

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, revised in November 1991 and October 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014. Detention storage and storm sewer conveyance to Black Squirrel Creek Drainage Basin was established with the Black Squirrel DBPS, previously referenced. The IDF curves from Figure 6-5 of the City of Colorado Springs/El Paso County DCM was used to estimate storm water runoff anticipated from design storms for the 2 year, 5 year and 100 year recurrence interval. (See Appendix)

The City of Colorado Springs/El Paso County DCM requires the Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainage ways, and implementing long-term source controls. The Four Step Process pertains to management of smaller, frequently occurring storm events, as opposed to larger storms for which drainage and flood control infrastructure are sized. Implementation of these four steps helps to achieve storm water permit requirements. This site adheres to this **Four Step Process** as follows:

1. **Employ Runoff Reduction Practices:** Development of project site is proposed large lot single family residential (2.5 ac. min.) with homes and associated landscaping along with a private golf course. Proposed impervious areas (roof tops, patios) will sheet flow across landscaped ground, through open space areas and across the golf course to slow runoff and increase time of concentration prior to being conveyed to the proposed public streets. This will minimize directly connected impervious areas within the project site.

2. **Stabilize Drainageways:** This site will utilize roadside ditches with culvert crossings throughout the site and channel stabilization and grade control structures installed within some of the historic natural channels. These facilities will then direct the on-site development flows to the multiple detention/SWQ ponds mentioned above, designed to release at or below historic rates into Black Squirrel and East Cherry Creek. Based upon the proposed reduction in released flows compared to the pre-developed flows, no impact to downstream drainageways is anticipated.

3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV in multiple permanent Extended Detention Basins designed per current El Paso County drainage criteria.

4. **Consider need for Industrial and Commercial BMPs**: No industrial or commercial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative was previously approved for this development in October 2016 (PUD-16-002). Details such as site specific source control construction BMP's as well as permanent BMP's were detailed in this plan and narrative to protect receiving waters. Much of these BMP's are currently constructed and being maintained as the majority of the development has been graded and erosion control methods employed.

FLOODPLAIN STATEMENT

A small portion of the Preliminary Plan (future lots not platted at this time) is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C 0295F, 0841C 0315F, 04081C 0325F effective date, March 17, 1997 (See Appendix). However, no portion of property proposed to be platted with Filing No. 1 is within the floodplain.

DRAINAGE AND BRIDGE FEES

FLYING HORSE NORTH FILING NO. 1

The East Cherry Creek Basin does not currently have a Drainage Basin Fee. However, the following fees for the Filing No. 1 platted area within the Black Squirrel Creek Basin are due prior to platting:

The fees are calculated using the following impervious acreage method approved by El Paso County. The acreage for Flying Horse Filing No. 1 within the Black Squirrel Creek Basin is 342.7 acres. This total area is broken into two uses: 2.5 ac. lots (including roads and tracts) and golf course. The 2.5 ac. lot area equals 234.4 acres and the golf course area equals 108.3 acres. Thus, the percent imperviousness for this subdivision is calculated as follows (See Figure 1.1 for Basin Area Exhibit):

2.5 ac. lots (incl. roads and tracts)

(Per El Paso County Percent Impervious Chart: 11%)

234.4 Ac. x 11% = **25.78 Impervious Ac.**

Golf Course Development

(Per El Paso County Percent Impervious Chart for greenbelts: 2%)

108.3 Ac. x 2% = **2.17 Impervious Ac.**

Total Impervious Acreage for Filing 1: 27.95 Imp. Ac.

The following calculations are based on the 2018 drainage/bridge fees for the Black Squirrel Creek Drainage Basin:

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FILING 1 FEE TOTALS (prior to reduction):

Bridge Fees

$ 492.00 x 27.95 Impervious Ac. = $ 13,751.40

Drainage Fees

$ 7,808.00 x 27.95 Impervious Ac. = $ 218,233.60

Per the ECM 3.10.4a, this development requests a reduction of drainage fees based on the three on-site full spectrum detention/SWQ facilities proposed within the Black Squirrel Creek Drainage Basin to be constructed with Filing 1 rather than utilizing a reduction for low density lots. The following facilities within the Black Squirrel Creek basin meet the required six criteria as follows:

1. No downstream regional facility in place yet.
2. All three proposed facilities are less than 15 ac-ft. in volume
3. The proposed on-site facilities are not part of a regional plan.
4. The proposed outlets are designed to release to full-spectrum criteria.
5. Proposed facilities are per County criteria and will gain County approval.
6. All three proposed facilities will be private with ownership and maintenance by HOA.

Detention Pond 1	1.1 ac-ft. full spectrum	$ 24,448 x 50% =	$ 12,224.00
Detention Pond 4	4.5 ac-ft. full spectrum	$ 130,270 x 50% =	$ 65,135.00
Detention Pond 8	9.4 ac-ft. full spectrum	$ 111,320 x 50% =	$ 55,660.00
Total Reduction			**$ 133,019.00**

FILING 1 FEE TOTALS:

Bridge Fees

$ 492.00 x 20.96 Impervious Ac.	=	$ 13,751.40

Drainage Fees

$ 218,233.60 - 133,019.00	=	$ 85,214.60

SUMMARY

This proposed development remains consistent with the previously approved Flying Horse North MDDP and Preliminary Drainage Report for Flying Horse North (Golf Course grading and private access roads). The proposed storm facilities have been sized to adequately handle the 100-yr. developed flows. All proposed detention facilities meet current criteria and provide full spectrum design. Upon future development outside of Filing No. 1, final drainage reports will be required finalizing final design of the proposed future drainage facilities. The proposed development will not adversely impact surrounding developments.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

Maw/109611/reports/109611PDR.doc

CLASSIC CONSULTING ENGINEERS & SURVEYORS

REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual, as revised in November 1991 and 1994 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014.

2. "Master Development Drainage Plan for Flying Horse North", Classic Consulting, dated September 2016.

3. "Preliminary Drainage Report for Flying Horse North (Golf Course Grading and Private Access Roads)", Classic Consulting, dated September 2016.

4. "Final Drainage Report High Forest Ranch Filing No. 1" JR Engineering, dated March 2001.

5. "Final Drainage Report for High Forest Ranch Filing No. 2 and High Forest Ranch Filing No. 3" Classic Consulting Engineers and Surveyors dated May 2001.

6. "Final Drainage Report and Plan for Cathedral Pines Subdivision Filing No. 2," Leigh Whitehead & Associates, dated March 2005.

7. "Final Drainage Report and Plan for Cathedral Pines Subdivision Filing No. 3," Stillwater Engineering, dated July 2006.

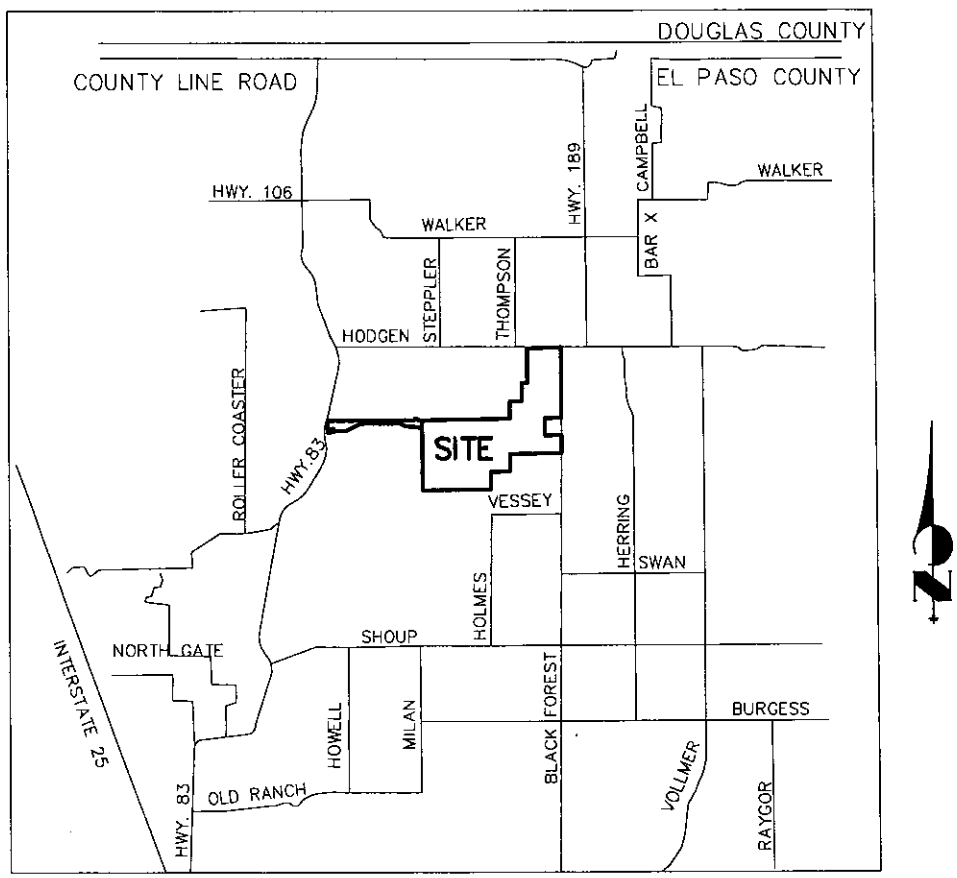
8. "Black Squirrel Creek Drainage Basin Planning Study," URS Corporation, dated August 1987.

9. "Final Drainage Report for Country View Estates" Associated Design Professionals Inc, dated October 1998.

10. "Urban Storm Drainage Criteria Manual Volume 1, 2 & 3" Urban Drainage and Flood Control District, dated January 2016.

APPENDIX

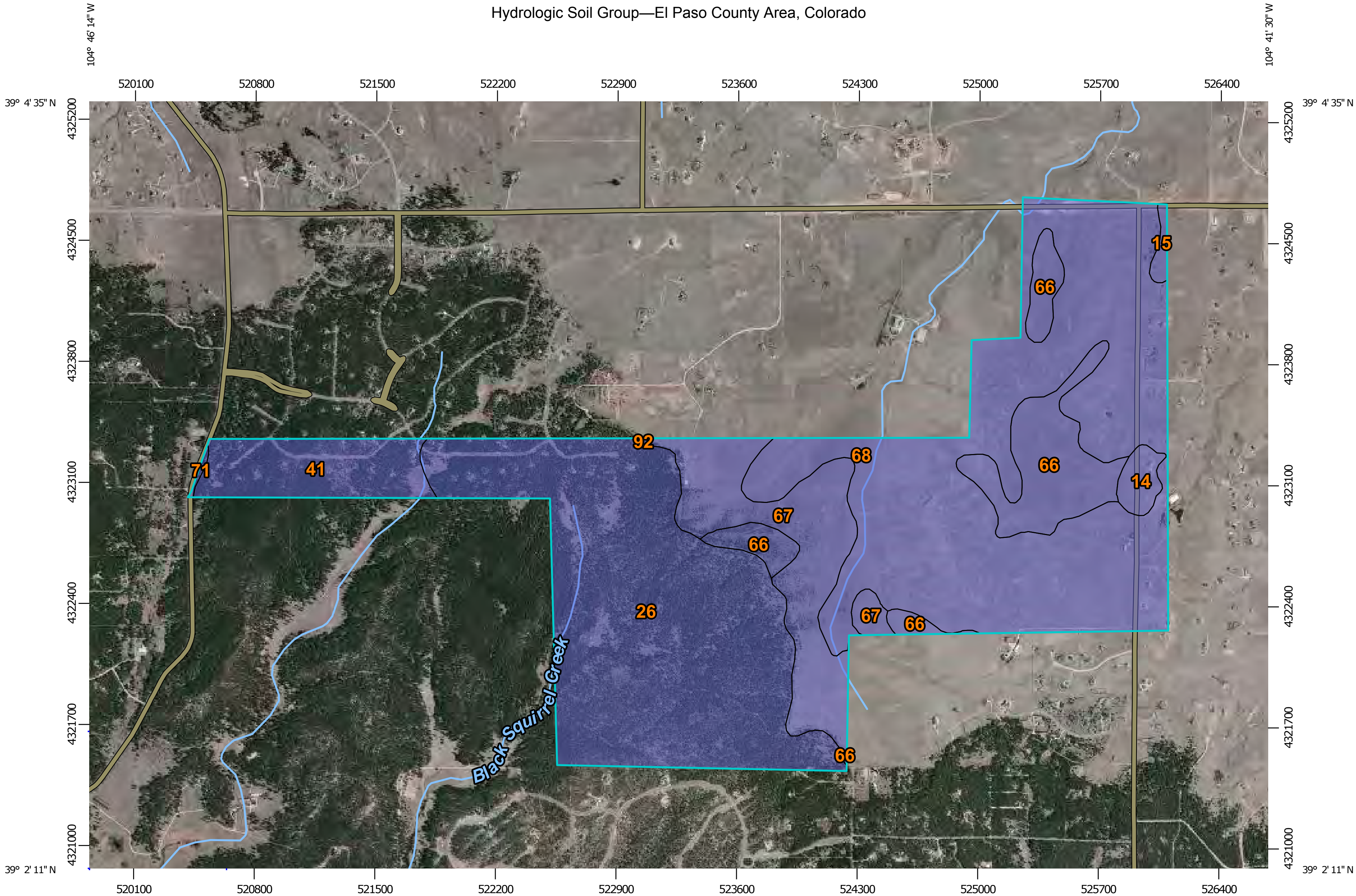
VICINITY MAP



VICINITY MAP

NTS

SOILS MAP (WEB SOIL SURVEY)



Map Scale: 1:31,300 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0, 450, 900, 1800, 2700

Feet: 0, 1500, 3000, 6000, 9000

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

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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 13, Sep 22, 2015

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
14	Brussett loam, 1 to 3 percent slopes	B	19.6	1.1%
15	Brussett loam, 3 to 5 percent slopes	B	7.0	0.4%
26	Elbeth sandy loam, 8 to 15 percent slopes	B	615.7	33.6%
41	Kettle gravelly loamy sand, 8 to 40 percent slopes	B	109.3	6.0%
66	Peyton sandy loam, 1 to 5 percent slopes	B	160.6	8.8%
67	Peyton sandy loam, 5 to 9 percent slopes	B	198.8	10.8%
68	Peyton-Pring complex, 3 to 8 percent slopes	B	719.7	39.3%
71	Pring coarse sandy loam, 3 to 8 percent slopes	B	1.7	0.1%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	B	0.8	0.0%
Totals for Area of Interest			**1,833.2**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

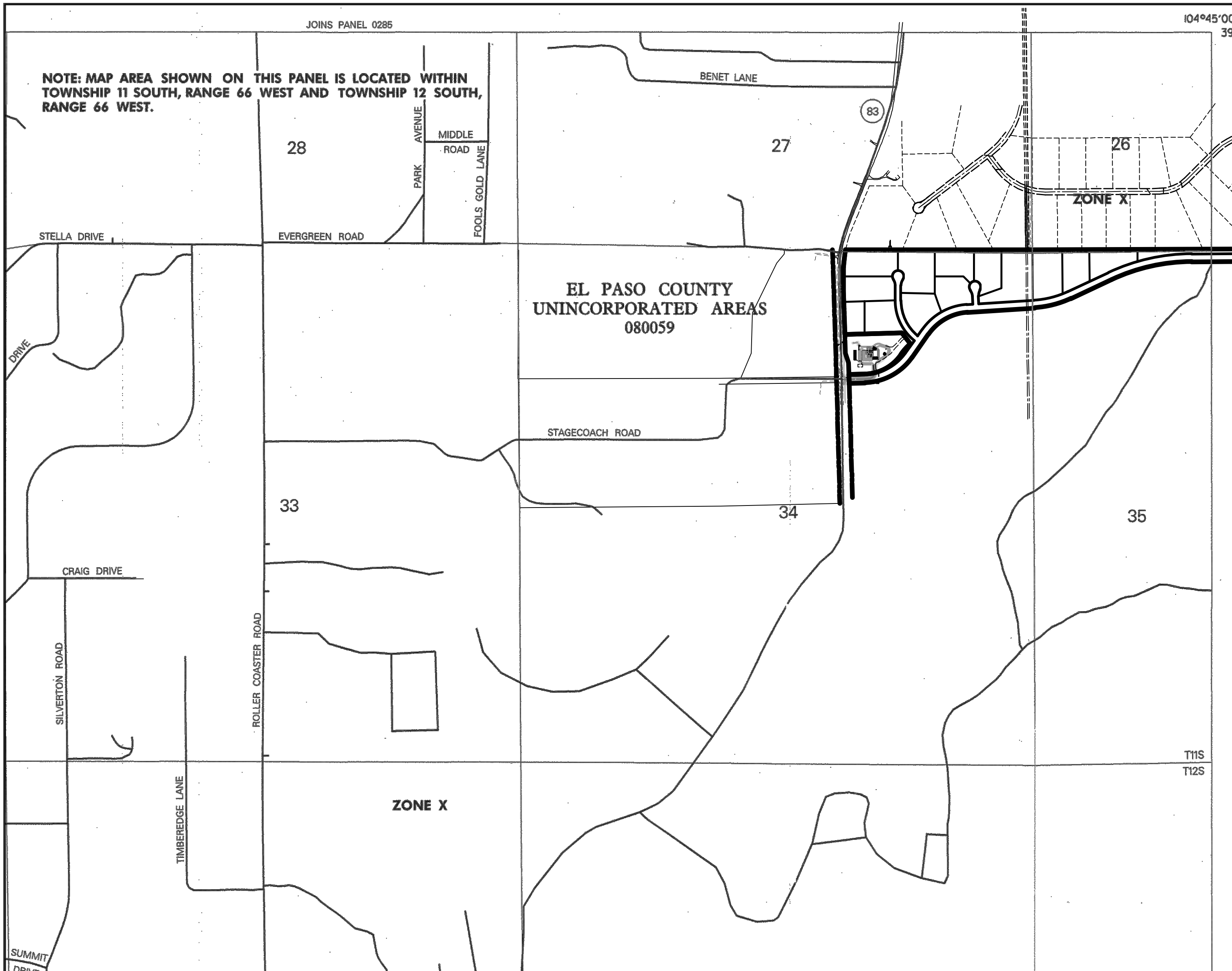
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

F.E.M.A. MAP



APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 295 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

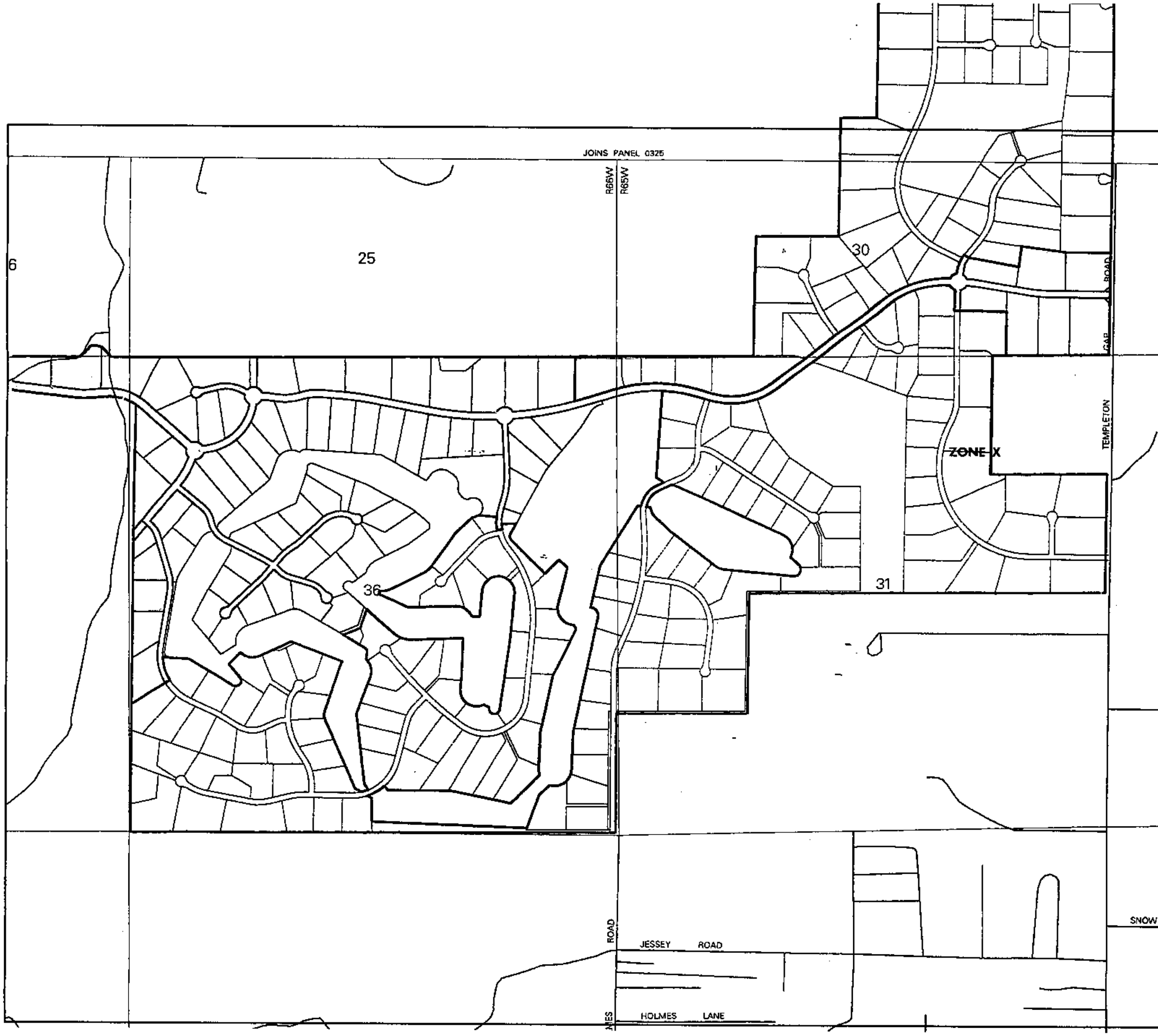
COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0295	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0295	F

MAP NUMBER 08041C0295 F

EFFECTIVE DATE: MARCH 17, 1997

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY,
COLORADO AND
INCORPORATED AREAS

PANEL 315 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

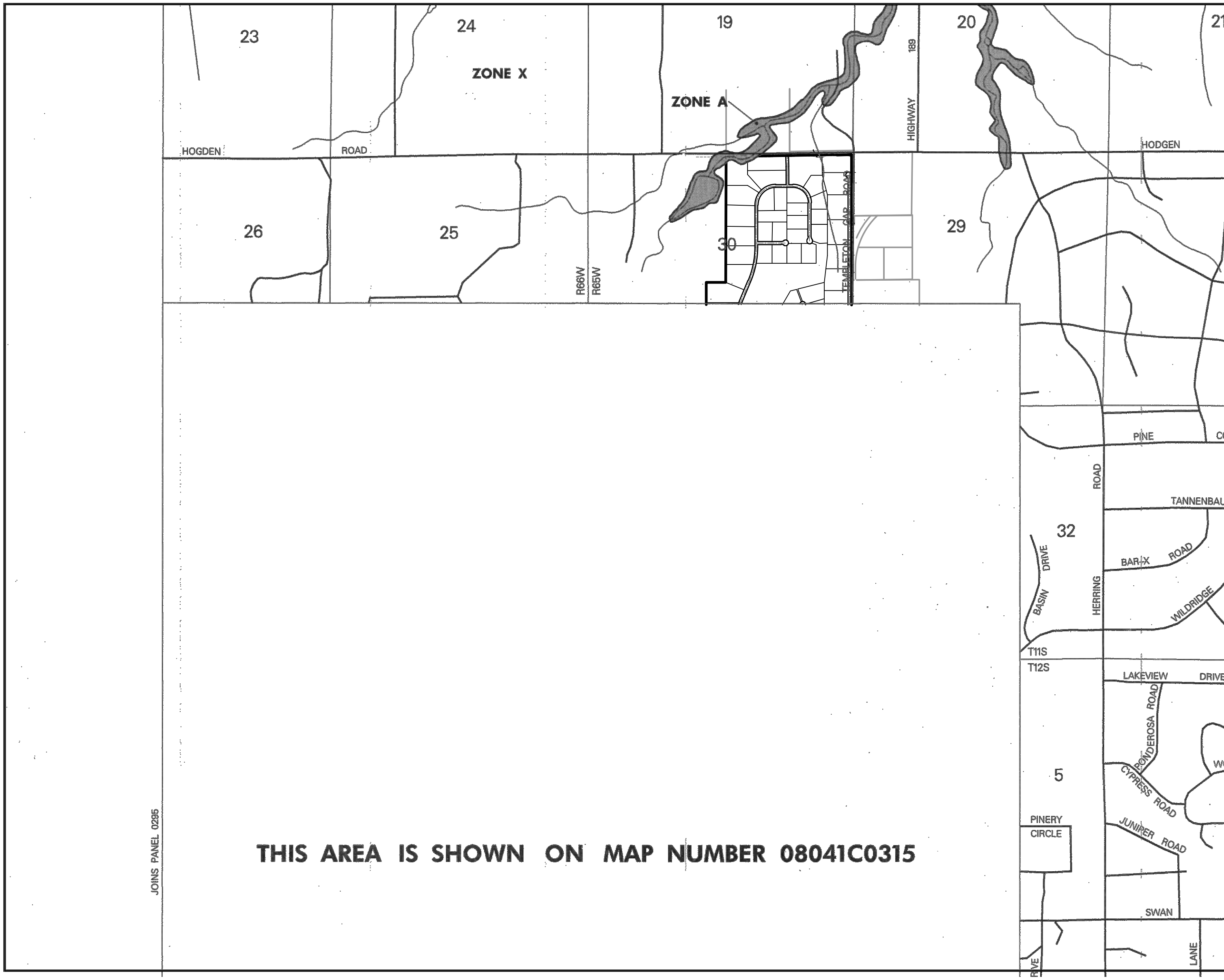
COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0315	

MAP NUMBER
08041C0315 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



APPROXIMATE SCALE IN FEET

2000 0 2000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 325 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0325	F

MAP NUMBER
08041C0325 F

EFFECTIVE DATE:
MARCH 17, 1997

Federal Emergency Management Agency

HYDROLOGY / HYDRAULIC CALCULATIONS

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS, UNDEVELOPED WOODS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

C_N VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	**GOLF COURSE / WOODS (B)**		**2 AC. RESIDENTIAL (B)**		**COMPOSITE** C_N
		CN	AREA (Ac.)	CN	AREA (Ac.)	
OS-1A	4.4	61	4.4	65	0.0	**61.0**
OS-1B	5.6	61	5.6	65	0.0	**61.0**
EX-DP-3 (Pre-Dev.)	36.0	60	36.0	65	0.0	**60.0**
OS-2	2.9	61	2.9	65	0.0	**61.0**
OS-3	10.2	61	0.0	65	10.2	**65.0**
OS-4	32.9	61	0.0	65	32.9	**65.0**
OS-5	29.7	61	0.0	65	29.7	**65.0**
OS-6	9.2	61	0.0	65	9.2	**65.0**
OS-7	5.0	61	0.0	65	5.0	**65.0**
OS-8	14.2	61	0.0	65	14.2	**65.0**
OS-9	9.8	60	9.8	65	0.0	**60.0**
OS-10	4.1	61	0.0	65	4.1	**65.0**
OS-11	28.0	61	0.0	65	28.0	**65.0**
OS-12	68.1	61	40.0	65	28.1	**62.7**
OS-13	36.9	61	18.0	65	18.9	**63.0**
OS-14	26.4	61	20.0	65	6.4	**62.0**
OS-15	70.8	61	20.0	65	50.8	**63.9**
OS-16	4.5	61	0.0	65	4.5	**65.0**
OS-17	15.8	61	0.0	65	15.8	**65.0**
OS-18	13.0	61	0.0	65	13.0	**65.0**

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS, UNDEVELOPED WOODS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

C_N VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	**GOLF COURSE / WOODS (B)**		**2 AC. RESIDENTIAL (B)**		**COMPOSITE** C_N
		CN	AREA (Ac.)	CN	AREA (Ac.)	
BS-1A	3.5	61	0.0	65	3.5	**65.0**
BS-1B	8.9	61	0.0	65	8.9	**65.0**
BS-2	1.9	61	0.0	89	1.9	**89.0**
BS-2A	0.8	61	0.0	89	0.8	**89.0**
BS-2B	0.9	61	0.0	89	0.9	**89.0**
BS-3	6.2	61	0.0	65	6.2	**65.0**
BS-4	13.0	61	0.0	67	13.0	**67.0**
BS-5	11.2	61	0.0	65	11.2	**65.0**
BS-6	1.2	61	0.0	89	1.2	**89.0**
BS-7	2.9	61	0.0	65	2.9	**65.0**
BS-8	1.0	61	0.0	89	1.0	**89.0**
BS-9	1.5	61	0.0	89	1.5	**89.0**
BS-10	4.5	61	0.0	65	4.5	**65.0**
BS-11	0.9	61	0.0	89	0.9	**89.0**
BS-12	7.7	61	0.0	65	7.7	**65.0**
BS-13	25.6	61	0.0	65	25.6	**65.0**
BS-14	13.4	61	0.0	65	13.4	**65.0**
BS-15	5.3	61	0.0	65	5.3	**65.0**
BS-16	21.6	61	0.0	65	21.6	**65.0**
BS-17	12.1	61	0.0	65	12.1	**65.0**
BS-18	33.8	61	12.1	65	21.7	**63.6**
BS-19	6.3	61	0.0	65	6.3	**65.0**
BS-20	73.9	61	30.2	65	43.7	**63.4**
BS-21	69.5	61	12.1	65	57.4	**64.3**
BS-22	18.1	61	2.5	65	15.6	**64.4**
BS-23	37.1	61	15.4	65	21.7	**63.3**
BS-23A	16.3	61	2.5	65	13.8	**64.4**
BS-24	10.9	60	4.3	65	6.6	**63.0**
EX-24 (Pre-Dev.)	13.2	60	13.2	65	0.0	**60.0**
BS-25	12.7	60	5.0	65	7.7	**63.0**
BS-26	2.5	60	2.5	65	0.0	**60.0**
BS-27	23.3	61	0.0	65	23.3	**65.0**
BS-28	36.9	61	5.6	65	31.3	**64.4**
BS-29	27.7	61	7.2	65	20.5	**64.0**
BS-30	6.7	61	0.0	65	6.7	**65.0**
BS-31	8.4	60	4.2	65	4.2	**62.5**
BS-32	6.2	60	3.0	65	3.2	**62.6**
BS-33	8.9	60	0.6	65	8.3	**64.7**

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS, UNDEVELOPED WOODS OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

C_N VALUES - DEVELOPED CONDITIONS

BASIN (label)	BASIN AREA (Ac)	**GOLF COURSE / WOODS (B)**		**2 AC. RESIDENTIAL (B)**		**COMPOSITE** C_N
		CN	AREA (Ac.)	CN	AREA (Ac.)	
CC-1A	9.8	61	0.0	65	9.8	**65.0**
CC-1B	12.6	61	0.5	65	12.1	**64.8**
CC-2A	11.0	61	0.0	65	11.0	**65.0**
CC-2B	20.8	61	0.0	65	20.8	**65.0**
CC-2C	6.4	61	0.0	65	6.4	**65.0**
CC-3	52.5	61	25.0	65	27.5	**63.1**
CC-4A	108.7	61	65.0	65	43.7	**62.6**
CC-4B	8.1	85	4.5	65	3.6	**76.1**
CC-4C (Pre-Dev.)	7.4	61	7.4	65	0.0	**61.0**
CC-5	22.4	61	0.0	65	22.4	**65.0**
CC-6	27.8	61	0.0	65	27.8	**65.0**
CC-7	18.4	61	0.0	65	18.4	**65.0**
CC-8	7.7	61	0.0	65	7.7	**65.0**
CC-9	5.6	61	0.0	65	5.6	**65.0**
CC-10	85.6	61	51.0	65	34.6	**62.6**
CC-11	18.6	61	9.0	65	9.6	**63.1**
CC-12	12.2	61	0.0	65	12.2	**65.0**
CC-13A	19.3	61	0.0	65	19.3	**65.0**
CC-13B	25.5	61	0.0	65	25.5	**65.0**
CC-13C	9.9	61	0.0	65	9.9	**65.0**
CC-13D	18.8	61	0.0	65	18.8	**65.0**
CC-14	4.6	61	0.0	65	4.6	**65.0**
CC-15	12.8	61	0.0	65	12.8	**65.0**
CC-16	16.3	61	0.0	65	16.3	**65.0**
CC-17	25.0	61	0.0	65	25.0	**65.0**
CC-18	6.2	65	5.8	89	0.4	**66.5**
CC-19	3.7	61	0.0	65	3.7	**65.0**
CC-20	39.3	61	0.0	65	39.3	**65.0**
CC-21	6.2	61	6.2	65	0.0	**61.0**
CC-22	13.8	61	0.0	65	13.8	**65.0**
CC-23	5.7	61	0.4	65	5.3	**64.7**
CC-24	39.6	61	0.0	65	39.6	**65.0**
CC-25	3.5	61	0.0	65	3.5	**65.0**
CC-26	16.7	61	0.0	65	16.7	**65.0**
CC-27	18.9	61	3.0	65	15.9	**64.4**
CC-28	154.8	61	23.0	65	131.8	**64.4**

TIME OF CONCENTRATION - DEVELOPED

BASIN	COMPOSITE Cn	C(5)	Length (ft)	OVERLAND Height (ft)	Tc (min)	STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25) Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	Tc LAG (0.6tc) (min)	Tc LAG (0.6tc) (hr)
OS-1A	61.0	0.08	300	20	17.1	150	4.0%	1.0	2.5	19.6	11.7	0.20
OS-1B	61.0	0.08	300	20	17.1	300	8.0%	1.4	3.6	20.6	12.4	0.21
EX-DP-3 (Pre-Dev.)	60.0	0.08	300	20	17.1	900	5.0%	1.9	7.9	25.0	15.0	0.25
OS-2	61.0	0.08	300	20	17.1	300	6.0%	2.0	2.5	19.6	11.7	0.20
OS-3	65.0	0.08	300	22	16.5	275	6.2%	2.0	2.3	18.8	11.3	0.19
OS-4	65.0	0.08	300	18	17.7	420	4.3%	1.3	5.4	23.0	13.8	0.23
OS-5	65.0	0.08	300	12	20.2	1200	2.5%	1.1	19.0	39.2	23.5	0.39
OS-6	65.0	0.08	300	17	18.0	300	5.5%	1.9	2.6	20.6	12.4	0.21
OS-7	65.0	0.08	300	20	17.1	180	6.5%	2.1	1.4	18.5	11.1	0.18
OS-8	65.0	0.08	300	14	19.2	260	5.5%	0.6	7.5	26.7	16.0	0.27
OS-9	60.0	0.08	300	12	20.2	500	3.5%	0.5	16.7	36.9	22.1	0.37
OS-10	65.0	0.08	300	19	17.3					17.3	10.4	0.17
OS-11	65.0	0.08	300	14	19.2	600	6.5%	0.7	15.4	34.6	20.7	0.35
OS-12	62.7	0.08	300	10	21.4	1400	2.5%	1.5	15.6	37.0	22.2	0.37
OS-13	63.0	0.08	300	10	21.4	1000	3.0%	1.5	11.1	32.6	19.5	0.33
OS-14	62.0	0.08	300	8	23.1	1000	5.0%	2.1	7.9	31.0	18.6	0.31
OS-15	63.9	0.08	300	16	18.4	2200	4.0%	1.9	19.3	37.7	22.6	0.38
OS-16	65.0	0.08	300	7	24.1					24.1	14.5	0.24
OS-17	65.0	0.08	300	20	17.1	350	6.0%	2.5	2.3	19.4	11.6	0.19
OS-18	65.0	0.08	300	18	17.7	300	6.0%	2.5	2.0	19.7	11.8	0.20
BS-1A	65.0	0.08	300	19	17.3					17.3	10.4	0.17
BS-1B	65.0	0.08	300	18	17.7	200	2.5%	1.2	2.8	20.4	12.3	0.20
BS-2	89.0	0.08	300	16	18.4	630	7.0%	0.7	16.2	34.5	20.7	0.35
BS-2A	89.0	0.08	30	1.5	5.9	700	6.5%	1.7	6.9	12.8	7.7	0.13
BS-2B	89.0	0.08	30	1.5	5.9	800	6.5%	2.2	6.1	12.0	7.2	0.12
BS-3	65.0	0.08	300	18	17.7	300	5.3%	2.2	2.3	19.9	12.0	0.20
BS-4	67.0	0.08	300	22	16.5	960	7.0%	2.4	6.7	23.2	13.9	0.23
BS-5	65.0	0.08	300	20	17.1	150	7.0%	2.4	1.0	18.1	10.9	0.18
BS-6	89.0	0.08	10	0.2	4.6	700	7.0%	2.4	4.9	9.5	5.7	0.09

TIME OF CONCENTRATION - DEVELOPED

BASIN	COMPOSITE Cn	C(5)	Length *(ft)*	OVERLAND Height *(ft)*	Tc *(min)*	STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25) Length *(ft)*	Slope *(%)*	Velocity *(fps)*	Tc *(min)*	Tc TOTAL *(min)*	Tc LAG (0.6tc) *(min)*	Tc LAG (0.6tc) *(hr)*
BS-7	65.0	0.08	90	6	9.3	400	2.0%	2.0	3.3	12.7	7.6	0.13
BS-8	89.0	0.08	10	0.2	4.6	960	7.0%	2.3	7.0	11.6	7.0	0.12
BS-9	89.0	0.08	10	0.2	4.6	1100	5.0%	2.2	8.3	13.0	7.8	0.13
BS-10	65.0	0.08	300	16	18.4	800	5.0%	2.2	6.1	24.4	14.7	0.24
BS-11	89.0	0.08	10	0.2	4.6	300	3.0%	1.6	3.1	7.8	4.7	0.08
BS-12	65.0	0.08	300	18	17.7	180	3.0%	1.8	1.7	19.3	11.6	0.19
BS-13	65.0	0.08	300	16	18.4	630	7.0%	2.5	4.2	22.6	13.5	0.23
BS-14	65.0	0.08	300	14	19.2	700	8.0%	2.8	4.2	23.4	14.0	0.23
BS-15	65.0	0.08	300	26	15.6	250	5.0%	2.0	2.1	17.7	10.6	0.18
BS-16	65.0	0.08	300	18	17.7	1500	3.0%	1.5	16.7	34.3	20.6	0.34
BS-17	65.0	0.08	300	14	19.2	250	5.0%	2.0	2.1	21.3	12.8	0.21
BS-18	63.6	0.08	300	26	15.6	1800	3.0%	1.2	25.0	40.6	24.4	0.41
BS-19	65.0	0.08	300	16	18.4					18.4	11.0	0.18
BS-20	63.4	0.08	300	18	17.7	1650	6.5%	2.0	13.8	31.4	18.8	0.31
BS-21	64.3	0.08	300	30	14.9	2000	5.0%	1.7	19.6	34.5	20.7	0.35
BS-22	64.4	0.08	300	21	16.8	500	4.0%	1.5	5.6	22.3	13.4	0.22
BS-23	63.3	0.08	300	14	19.2	800	4.0%	1.0	13.3	32.5	19.5	0.33
BS-23A	64.4	0.08	300	14	19.2	1200	4.0%	2.0	10.0	29.2	17.5	0.29
BS-24	63.0	0.08	300	22	16.5					16.5	9.9	0.17
EX-24 (Pre-Dev.)	60.0	0.08	300	22	16.5					16.5	9.9	0.17
BS-25	63.0	0.08	300	10	21.4	200	5.0%	2.1	1.6	23.0	13.8	0.23
BS-26	60.0	0.08	300	20	17.1	100	4.0%	2.0	0.8	17.9	10.7	0.18
BS-27	65.0	0.08	300	22	16.5	900	8.0%	2.8	5.4	21.9	13.1	0.22
BS-28	64.4	0.08	300	16	18.4	1500	3.0%	1.8	13.9	32.2	19.3	0.32
BS-29	64.0	0.08	300	18	17.7	1900	4.5%	2.1	15.1	32.7	19.6	0.33
BS-30	65.0	0.08	300	20	17.1	400	6.0%	2.3	2.9	20.0	12.0	0.20
BS-31	62.5	0.08	300	12	20.2	300	4.0%	2.0	2.5	22.7	13.6	0.23
BS-32	62.6	0.08	300	18	17.7	200	5.0%	1.7	2.0	19.6	11.8	0.20
BS-33	64.7	0.08	300	22	16.5	350	6.0%	2.3	2.5	19.1	11.4	0.19

TIME OF CONCENTRATION - DEVELOPED

BASIN	COMPOSITE Cn	C(5)	Length *(ft)*	OVERLAND Height *(ft)*	Tc *(min)*	STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25) Length *(ft)*	Slope *(%)*	Velocity *(fps)*	Tc *(min)*	Tc TOTAL *(min)*	Tc LAG (0.6tc) *(min)*	Tc LAG (0.6tc) *(hr)*
CC-1A	65.0	0.08	300	16	18.4	500	5.0%	1.7	4.9	23.3	14.0	0.23
CC-1B	64.8	0.08	300	14	19.2	700	4.0%	2.0	5.8	25.0	15.0	0.25
CC-2A	65.0	0.08	300	14	19.2	250	3.0%	1.5	2.8	22.0	13.2	0.22
CC-2B	65.0	0.08	300	14	19.2	280	3.0%	1.5	3.1	22.3	13.4	0.22
CC-2C	65.0	0.08	300	18	17.7					17.7	10.6	0.18
CC-3	63.1	0.08	300	18	17.7	2300	3.0%	1.5	25.6	43.2	25.9	0.43
CC-4A	62.6	0.08	300	14	19.2	2700	2.0%	1.8	25.0	44.2	26.5	0.44
CC-4B	76.1	0.08	300	12	20.2	600	3.0%	1.6	6.3	26.4	15.9	0.26
CC-4C (Pre-Dev.)	61.0	0.08	40	0.8	9.3	350	3.0%	1.5	3.9	13.2	7.9	0.13
CC-5	65.0	0.08	300	18	17.7	1000	4.0%	2.0	8.3	26.0	15.6	0.26
CC-6	65.0	0.08	300	14	19.2	550	2.5%	1.6	5.7	24.9	14.9	0.25
CC-7	65.0	0.08	300	16	18.4	1000	3.0%	1.6	10.4	28.8	17.3	0.29
CC-8	65.0	0.08	300	10	21.4	250	2.0%	1.2	3.5	24.9	14.9	0.25
CC-9	65.0	0.08	300	18	17.7	100	2.0%	1.2	1.4	19.0	11.4	0.19
CC-10	62.6	0.08	300	22	16.5	2400	3.0%	1.8	22.2	38.7	23.2	0.39
CC-11	63.1	0.08	300	18	17.7	450	5.0%	2.1	3.6	21.2	12.7	0.21
CC-12	65.0	0.08	300	11	20.8	650	4.0%	2.0	5.4	26.2	15.7	0.26
CC-13A	65.0	0.08	300	14	19.2	1400	4.0%	2.0	11.7	30.9	18.5	0.31
CC-13B	65.0	0.08	300	18	17.7	1300	3.0%	1.6	13.5	31.2	18.7	0.31
CC-13C	65.0	0.08	300	14	19.2	350	4.0%	2.0	2.9	22.1	13.3	0.22
CC-13D	65.0	0.08	300	20	17.1	900	4.0%	2.0	7.5	24.6	14.7	0.25
CC-14	65.0	0.08	300	10	21.4					21.4	12.9	0.21
CC-15	65.0	0.08	300	14	19.2	550	3.0%	1.8	5.1	24.3	14.6	0.24
CC-16	65.0	0.08	300	10	21.4	650	2.5%	1.3	8.3	29.8	17.9	0.30
CC-17	65.0	0.08	300	9	22.2	950	2.0%	1.2	13.2	35.4	21.2	0.35
CC-18	66.5	0.08	300	7	24.1	400	2.0%	1.2	5.6	29.7	17.8	0.30
CC-19	65.0	0.08	300	8	23.1	100	2.0%	1.0	1.7	24.7	14.8	0.25
CC-20	65.0	0.08	300	9	22.2	350	6.0%	2.2	2.7	24.8	14.9	0.25
CC-21	61.0	0.08	300	18	17.7	200	3.0%	1.8	1.9	19.5	11.7	0.20
CC-22	65.0	0.08	300	14	19.2	700	4.0%	2.0	5.8	25.0	15.0	0.25
CC-23	64.7	0.08	300	10	21.4	850	2.0%	1.2	11.8	33.2	19.9	0.33
CC-24	65.0	0.08	300	20	17.1	900	4.0%	1.9	7.9	25.0	15.0	0.25
CC-25	65.0	0.08	300	16	18.4	500	3.0%	1.8	4.6	23.0	13.8	0.23
CC-26	65.0	0.08	300	14	19.2	900	5.0%	2.1	7.1	26.3	15.8	0.26
CC-27	64.4	0.08	300	14	19.2	1300	3.0%	1.8	12.0	31.2	18.7	0.31
CC-28	64.4	0.08	300	14	19.2	4700	3.0%	1.8	43.5	62.7	37.6	0.63

BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-1A	4.40	61.0	0.20	0.4	1.6	7.7
OS-1B	5.60	61.0	0.21	0.5	1.9	9.4
EX-DP-3 (Pre-Dev.)	36.00	60.0	0.25	0.5	4.8	41.3
OS-2	2.90	61.0	0.20	0.1	0.6	4.0
OS-3	10.20	65.0	0.19	1.0	3.8	17.9
OS-4	32.90	65.0	0.23	2.8	11.2	53.6
OS-5	29.70	65.0	0.39	1.9	7.1	37.0
OS-6	9.20	65.0	0.21	0.9	3.2	15.5
OS-7	5.00	65.0	0.18	0.5	2.0	9.0
OS-8	14.20	65.0	0.27	2.1	6.2	24.7
OS-9	9.80	60.0	0.37	0.1	1.0	9.1
OS-10	4.10	65.0	0.17	0.7	2.1	8.2
OS-11	28.00	65.0	0.35	2.4	8.2	38.7
OS-12	68.10	62.7	0.37	2.2	11.9	75.8
OS-13	36.90	63.0	0.33	1.4	7.4	45.0
OS-14	26.40	62.0	0.31	0.7	4.6	31.0
OS-15	70.80	63.9	0.38	3.3	14.8	84.2
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6

BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
BS-1A	3.50	65.0	0.17	0.4	1.4	6.3
BS-1B	8.90	65.0	0.20	0.4	2.4	13.8
BS-2	1.90	89.0	0.35	2.9	4.2	8.4
BS-2A	0.80	89.0	0.13	1.2	1.8	3.5
BS-2B	0.90	89.0	0.12	1.4	2.0	4.0
BS-3	6.20	65.0	0.20	0.6	2.3	10.8
BS-4	13.00	67.0	0.23	1.9	5.5	23.6
BS-5	11.20	65.0	0.18	1.1	4.4	20.1
BS-6	1.20	89.0	0.09	1.9	2.8	5.4
BS-7	2.90	65.0	0.13	4.4	6.4	12.8
BS-8	1.00	89.0	0.12	1.6	2.2	4.5
BS-9	1.50	89.0	0.13	2.3	3.3	6.6
BS-10	4.50	65.0	0.24	6.0	8.7	17.5
BS-11	0.90	89.0	0.08	1.5	2.1	4.1
BS-12	7.70	65.0	0.19	0.8	3.0	13.8
BS-13	25.60	65.0	0.23	3.7	10.2	40.7
BS-14	13.40	65.0	0.23	2.6	6.8	26.5
BS-15	5.30	65.0	0.18	1.6	3.7	12.2
BS-16	21.60	65.0	0.34	4.6	11.8	44.1
BS-17	12.10	65.0	0.21	3.1	7.7	26.7
BS-18	33.80	63.6	0.41	3.5	12.4	56.0
BS-19	6.30	65.0	0.18	2.1	4.6	15.0
BS-20	73.90	63.4	0.31	7.4	24.6	112.4
BS-21	69.50	64.3	0.35	7.8	23.9	103.0
BS-22	18.10	64.4	0.22	3.7	9.6	36.5
BS-23	37.10	63.3	0.33	4.5	13.6	58.2
BS-23A	16.30	64.4	0.29	5.5	12.0	38.3
BS-24	10.90	63.0	0.17	0.6	3.3	17.6
EX-24 (Pre-Dev.)	13.20	60.0	0.17	0.2	2.2	17.8
BS-25	12.70	63.0	0.23	0.4	2.7	17.3
BS-26	2.50	60.0	0.18	0.0	0.4	3.4
BS-27	23.30	65.0	0.22	2.1	8.0	38.8
BS-28	36.90	64.4	0.32	2.2	9.3	49.4
BS-29	27.70	64.0	0.33	1.4	6.5	35.9
BS-30	6.70	65.0	0.20	0.7	2.4	11.7
BS-31	8.40	62.5	0.23	0.3	1.9	11.8
BS-32	6.20	62.6	0.20	0.3	1.6	9.4
BS-33	8.90	64.7	0.19	0.8	3.2	15.3

BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-2C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev.)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0
CC-8	7.70	65.0	0.25	0.6	2.5	12.0
CC-9	5.60	65.0	0.19	0.6	2.1	9.8
CC-10	85.60	62.6	0.39	2.6	14.1	91.9
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	**Contributing Basins**	**Q** **2 Yr.** Q (cfs)	**Q** **5 Yr.** Q (cfs)	**Q** **100 Yr.** Q (cfs)
DP-1 DEV	OS-1A, BS-2B	1.6	3.4	11
DP-2 DEV	DP-1, BS-4	3.2	8.8	35
TOTAL INFLOW TO POND 1 (UD Detention hydrograph)	**DP-1, DP-2, BS-1A**	**4**	**7**	**38**
DP-3 DEV (Pond Pack routing)	**OS-2, BS-3, BS-1B, Release from FHN Pond 1**	**1**	**6**	**39**
DP-4 DEV	BS-2	2.9	4.2	8
DP-5 DEV	OS-1B, BS-2A	1.5	3.5	13
DP-6 DEV	OS-2, BS-3	0.6	2.8	15
DP-7 DEV	OS-3, BS-5	2.1	8.2	38
DP-8 DEV	OS-4, OS-5, OS-6, BS-7, BS-10, Release from Exist. HFR Pond 16	20.9	70.4	284
DP-9 DEV	OS-7, BS-12	1.3	5.0	23
DP-10 DEV	OS-8, OS-10, OS-11, BS-13, BS-14	10.7	32.0	143
DP-11 DEV	BS-16	4.6	11.8	36
DP-12 DEV	DP-11, 1.0 Ac. Portion of BS-17 and BS-15	4.2	11.8	46
TOTAL INFLOW TO POND 4 (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**10**	**16**	**217**
DP-13 DEV	**Release from FHN Pond 4**	**0.3**	**0.3**	**142**
DP-14 DEV	BS-18	3.5	12.4	56
DP-15 DEV	BS-19	2.1	4.6	15
DP-16 DEV	DP-14, DP-15, BS-20, BS-21, BS-22, BS-23	25.0	78.0	362
TOTAL INFLOW TO FHN POND 8 (Full Build-out) (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**24**	**37**	**390**
DP-17 DEV (Full Build-out)	**Release from FHN Pond 8**	**0.8**	**1.0**	**253**
TOTAL INFLOW TO FHN POND 8 (Filing 1 Only) (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**9**	**14**	**301**
DP-17 DEV (Filing 1 Only)	**Release from FHN Pond 8**	**0.4**	**0.5**	**219**

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	**Contributing Basins**	Q **2 Yr.** Q (cfs)	Q **5 Yr.** Q (cfs)	Q **100 Yr.** Q (cfs)
DP-18 DEV	BS-28, BS-29, BS-30, OS-18	5.0	21.6	115
DP-19 DEV	BS-27, OS-17, Release from DP-18	3.8	16.8	126
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev.), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	**CC-4C, CC-5, CC-6**	**6**	**9**	**85**
DP-25 DEV	**Release from FHN Pond 12**	**0.2**	**0.3**	**45**
DP-26 DEV	CC-8, CC-10	3.0	15.9	102
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168

ALL LAND ASSUMED 2 ACRE RESIDENTIAL LOTS, UNDEVELOPED WOODS (FUTURE FILING) OR
GOOD CONDITION OPEN SPACE (LAWNS, PARKS GOLF COURSES, CEMETARIES ETC.)

C_N VALUES - DEVELOPED CONDITIONS (FILING 1 ONLY)

BASIN (label)	BASIN AREA (Ac)	**GOLF COURSE (B)**		**2 AC. RESIDENTIAL (B)**		**UNDEVELOPED WOODS (B)**		**COMPOSITE** C_N
		CN	AREA (Ac.)	CN	AREA (Ac.)	CN	AREA (Ac.)	
BS-20	73.9	61	30.2	60	1.0	60	42.7	**60.4**
BS-21	69.5	61	12.1	65	34.4	60	23.0	**62.6**
BS-22	18.1	61	2.5	65	5.1	60	10.5	**61.5**
BS-23	37.1	61	15.4	65	20.2	60	1.5	**63.1**
BS-23A	16.3	61	0.0	65	2.5	60	13.8	**60.8**

TIME OF CONCENTRATION DEVELOPED (FILING 1 ONLY)

BASIN	COMPOSITE Cn	C(5)	Length (ft)	OVERLAND Height (ft)	Tc (min)	STREET / CHANNEL FLOW (DCM Vol. 1 Fig. 6-25) Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	Tc LAG (0.6tc) (min)	Tc LAG (0.6tc) (hr)
BS-20	60.4	0.08	1000	60	32.2					32.2	19.3	0.32
BS-21	62.6	0.08	1000	30	40.5	500	4.0%	1.7	4.9	45.4	27.3	0.45
BS-22	61.5	0.08	300	21	16.8	500	4.0%	1.5	5.6	22.3	13.4	0.22
BS-23	63.1	0.08	300	14	19.2	800	4.0%	1.0	13.3	32.5	19.5	0.33
BS-23A	60.8	0.08	1000	64	31.6	200	2.0%	1.5	2.2	33.8	20.3	0.34

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Monday, Nov 20 2017

DP 1 CULVERT

Invert Elev Dn (ft)	= 7436.00
Pipe Length (ft)	= 60.00
Slope (%)	= 1.67
Invert Elev Up (ft)	= 7437.00
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

Embankment

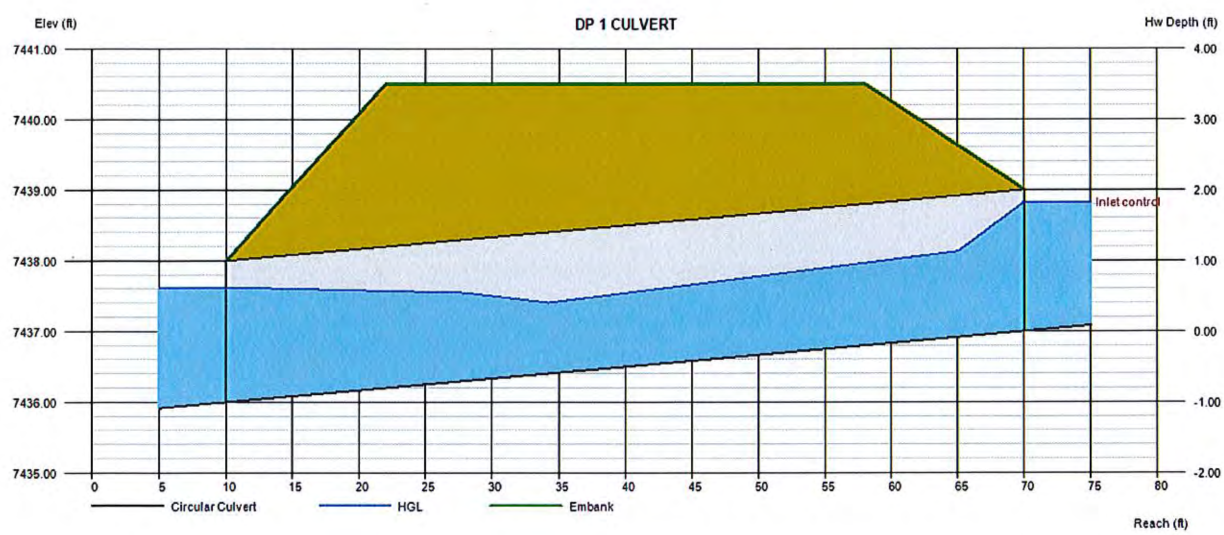
Top Elevation (ft)	= 7440.50
Top Width (ft)	= 36.00
Crest Width (ft)	= 60.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 12.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 12.00
Qpipe (cfs)	= 12.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.40
Veloc Up (ft/s)	= 5.85
HGL Dn (ft)	= 7437.62
HGL Up (ft)	= 7438.24
Hw Elev (ft)	= 7438.82
Hw/D (ft)	= 0.91
Flow Regime	= Inlet Control



Culvert Report

DP 2 CULVERT

Invert Elev Dn (ft)	=	7417.60
Pipe Length (ft)	=	90.00
Slope (%)	=	6.00
Invert Elev Up (ft)	=	7423.00
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

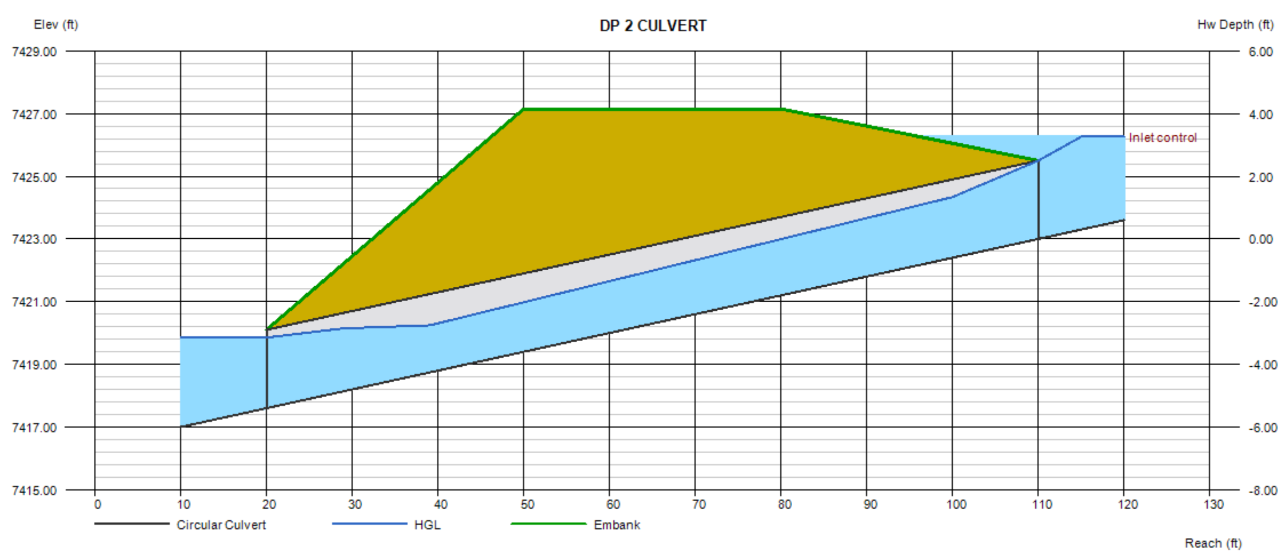
Top Elevation (ft)	=	7427.15
Top Width (ft)	=	30.00
Crest Width (ft)	=	60.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	35.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	35.00
Qpipe (cfs)	=	35.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.51
Veloc Up (ft/s)	=	8.28
HGL Dn (ft)	=	7419.85
HGL Up (ft)	=	7425.01
Hw Elev (ft)	=	7426.26
Hw/D (ft)	=	1.30
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 29 2018

CULVERT @ FIRE STATION DRIVEWAY

Invert Elev Dn (ft)	= 7412.00
Pipe Length (ft)	= 60.00
Slope (%)	= 8.33
Invert Elev Up (ft)	= 7417.00
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end projecting (C)
Coeff. K,M,c,Y,k	= 0.0045, 2, 0.0317, 0.69, 0.2

Embankment

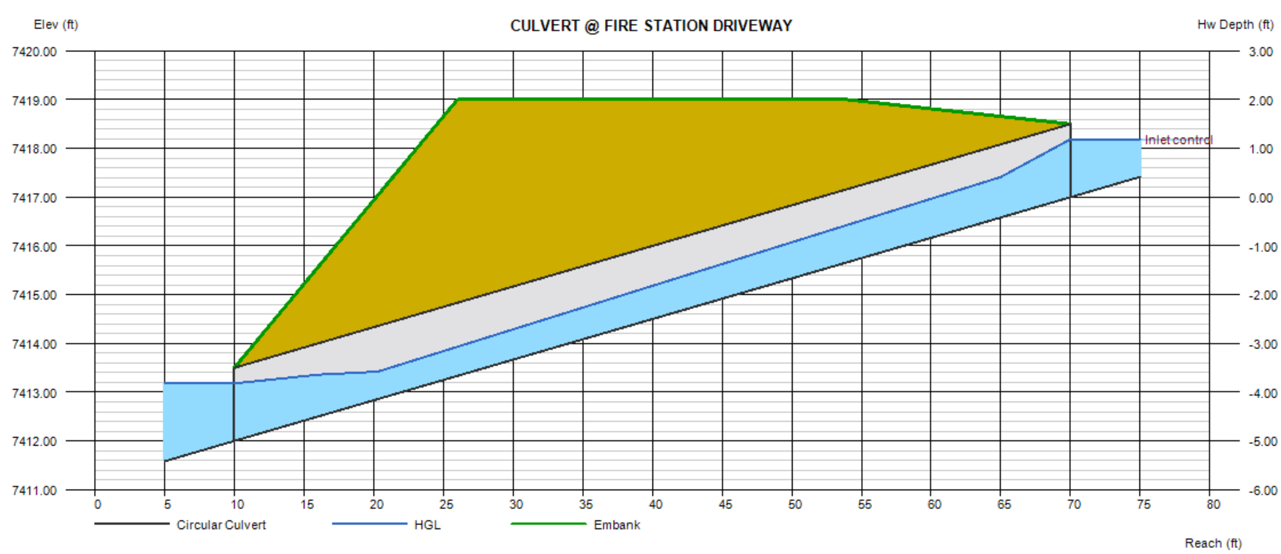
Top Elevation (ft)	= 7419.00
Top Width (ft)	= 28.00
Crest Width (ft)	= 60.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 5.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 5.00
Qpipe (cfs)	= 5.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.35
Veloc Up (ft/s)	= 4.77
HGL Dn (ft)	= 7413.18
HGL Up (ft)	= 7417.86
Hw Elev (ft)	= 7418.19
Hw/D (ft)	= 0.79
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 29 2018

DP 7 CULVERT

Invert Elev Dn (ft)	=	7453.00
Pipe Length (ft)	=	66.00
Slope (%)	=	4.00
Invert Elev Up (ft)	=	7455.64
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

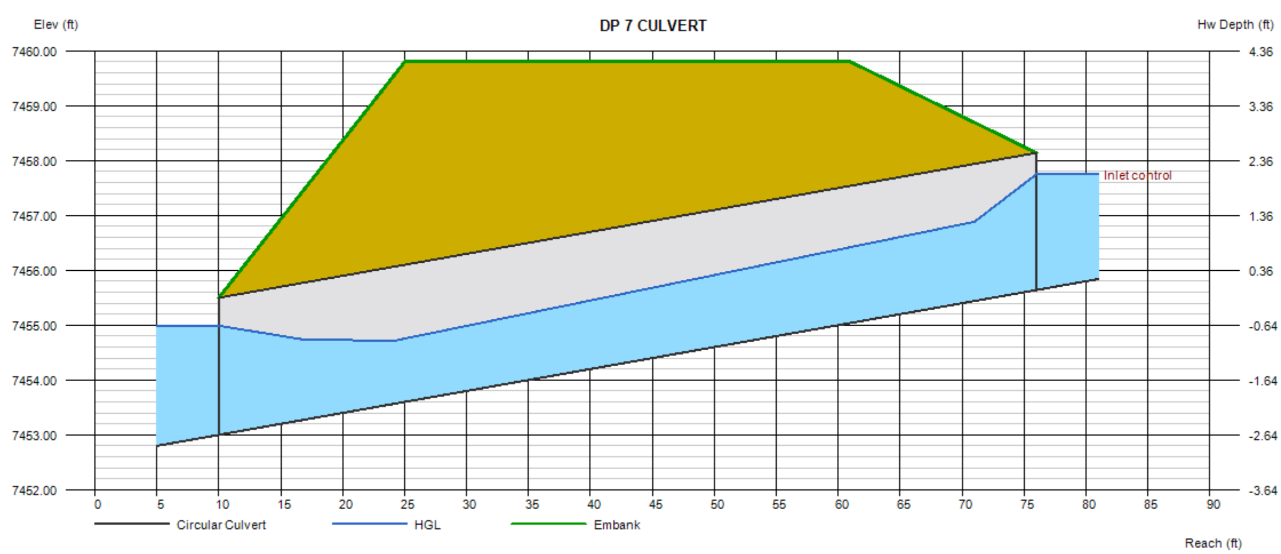
Top Elevation (ft)	=	7459.80
Top Width (ft)	=	36.00
Crest Width (ft)	=	60.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	38.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	38.00
Qpipe (cfs)	=	38.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.54
Veloc Up (ft/s)	=	6.30
HGL Dn (ft)	=	7454.99
HGL Up (ft)	=	7457.12
Hw Elev (ft)	=	7457.75
Hw/D (ft)	=	0.84
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 29 2018

DP 8 CULVERTS

Invert Elev Dn (ft)	=	7438.30
Pipe Length (ft)	=	100.00
Slope (%)	=	5.70
Invert Elev Up (ft)	=	7444.00
Rise (in)	=	48.0
Shape	=	Circular
Span (in)	=	48.0
No. Barrels	=	3
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

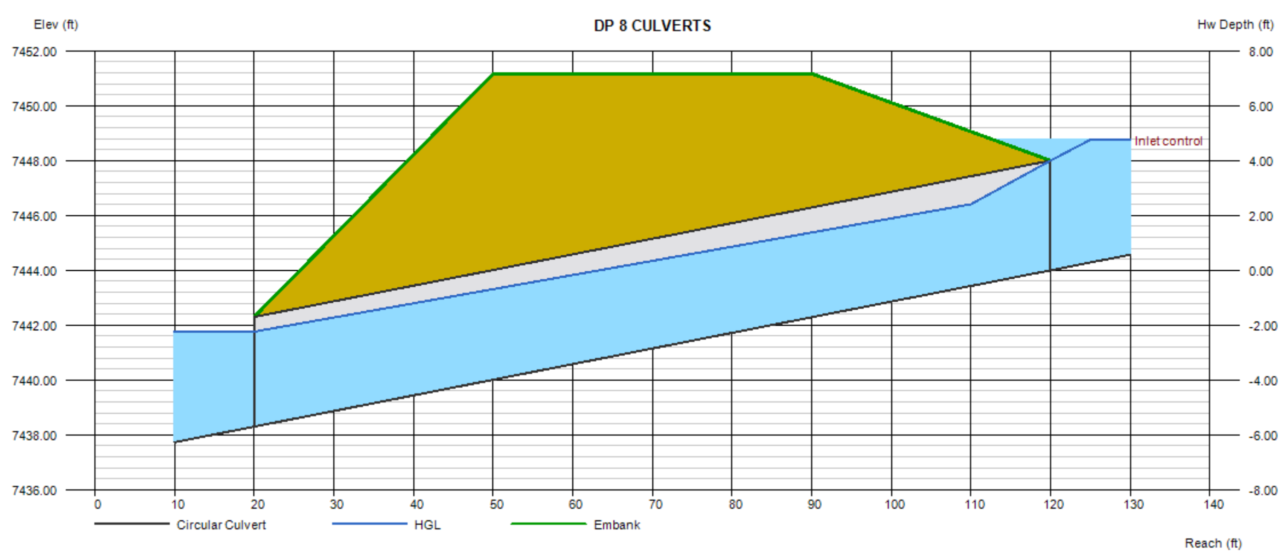
Top Elevation (ft)	=	7451.17
Top Width (ft)	=	40.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	280.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	280.00
Qpipe (cfs)	=	280.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	8.07
Veloc Up (ft/s)	=	9.47
HGL Dn (ft)	=	7441.76
HGL Up (ft)	=	7446.93
Hw Elev (ft)	=	7448.76
Hw/D (ft)	=	1.19
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Mar 29 2018

DP 9 CULVERTS

Invert Elev Dn (ft)	=	7486.10
Pipe Length (ft)	=	60.00
Slope (%)	=	2.30
Invert Elev Up (ft)	=	7487.48
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

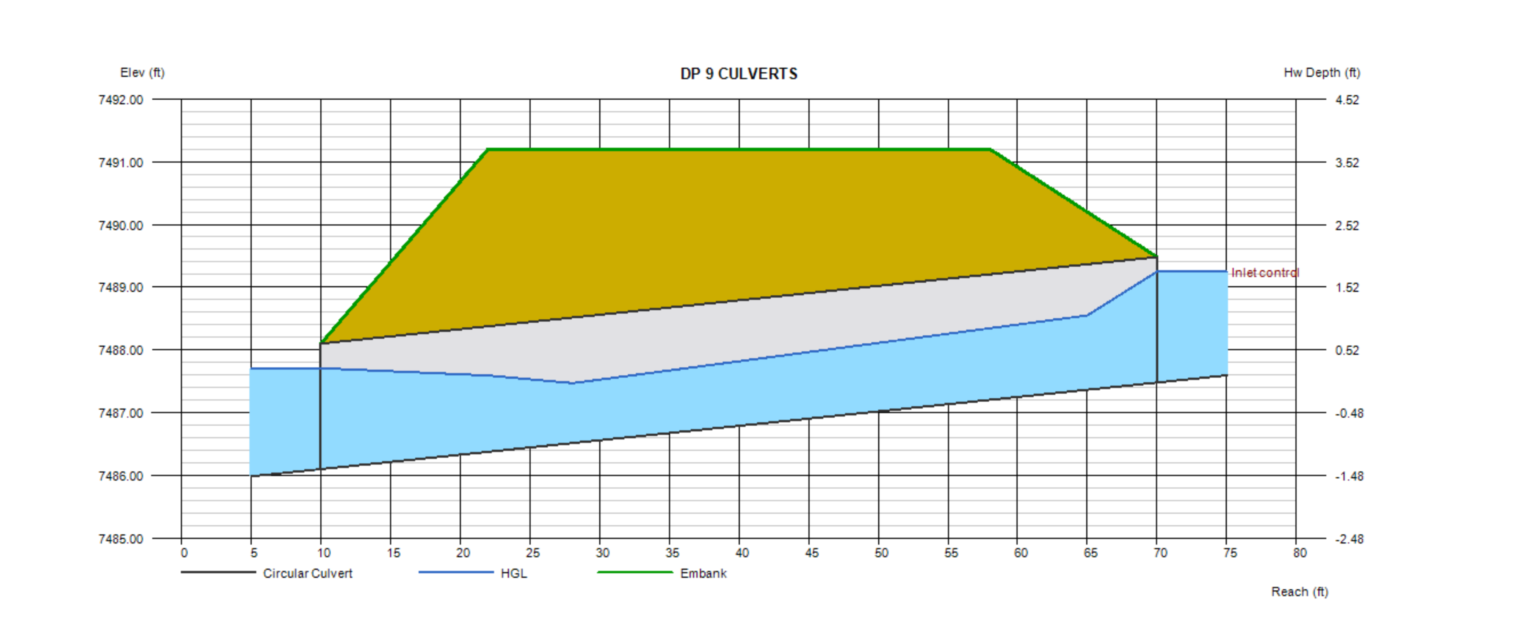
Top Elevation (ft)	=	7491.20
Top Width (ft)	=	36.00
Crest Width (ft)	=	60.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	23.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	23.00
Qpipe (cfs)	=	23.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.25
Veloc Up (ft/s)	=	5.75
HGL Dn (ft)	=	7487.71
HGL Up (ft)	=	7488.70
Hw Elev (ft)	=	7489.25
Hw/D (ft)	=	0.88
Flow Regime	=	Inlet Control

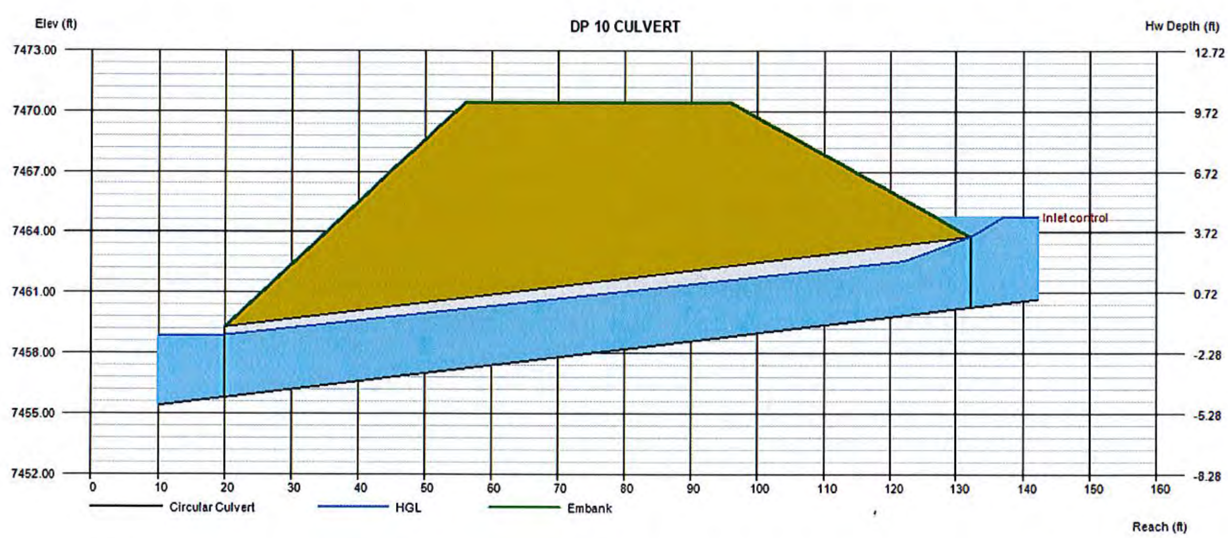


Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 30 2017

DP 10 CULVERT

Invert Elev Dn (ft)	= 7455.80	**Calculations**	
Pipe Length (ft)	= 112.07	Qmin (cfs)	= 0.00
Slope (%)	= 4.00	Qmax (cfs)	= 144.00
Invert Elev Up (ft)	= 7460.28	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 42.0		
Shape	= Circular	**Highlighted**	
Span (in)	= 42.0	Qtotal (cfs)	= 144.00
No. Barrels	= 2	Qpipe (cfs)	= 144.00
n-Value	= 0.013	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 8.03
Culvert Entrance	= Square edge w/headwall (C)	Veloc Up (ft/s)	= 9.19
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 7458.88
		HGL Up (ft)	= 7462.94
Embankment		Hw Elev (ft)	= 7464.78
Top Elevation (ft)	= 7470.42	Hw/D (ft)	= 1.29
Top Width (ft)	= 40.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 50.00		



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 30 2017

DP 11 CULVERT

Invert Elev Dn (ft)	=	7451.50
Pipe Length (ft)	=	75.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7453.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

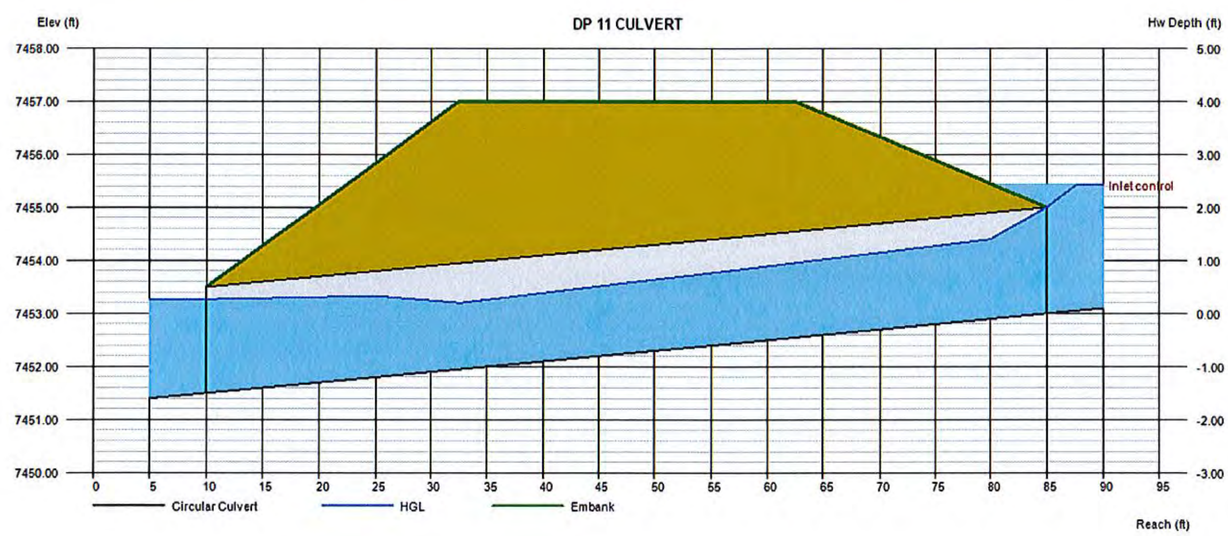
Top Elevation (ft)	=	7457.00
Top Width (ft)	=	30.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	36.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	36.00
Qpipe (cfs)	=	36.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.14
Veloc Up (ft/s)	=	6.99
HGL Dn (ft)	=	7453.26
HGL Up (ft)	=	7454.53
Hw Elev (ft)	=	7455.42
Hw/D (ft)	=	1.21
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Monday, Jun 11 2018

18 IN CULVERT CROSSING SHORTWALL DR. (1.0 AC. PORTION OF BASIN BS 17)

Invert Elev Dn (ft)	= 7446.00
Pipe Length (ft)	= 118.00
Slope (%)	= 3.39
Invert Elev Up (ft)	= 7450.00
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

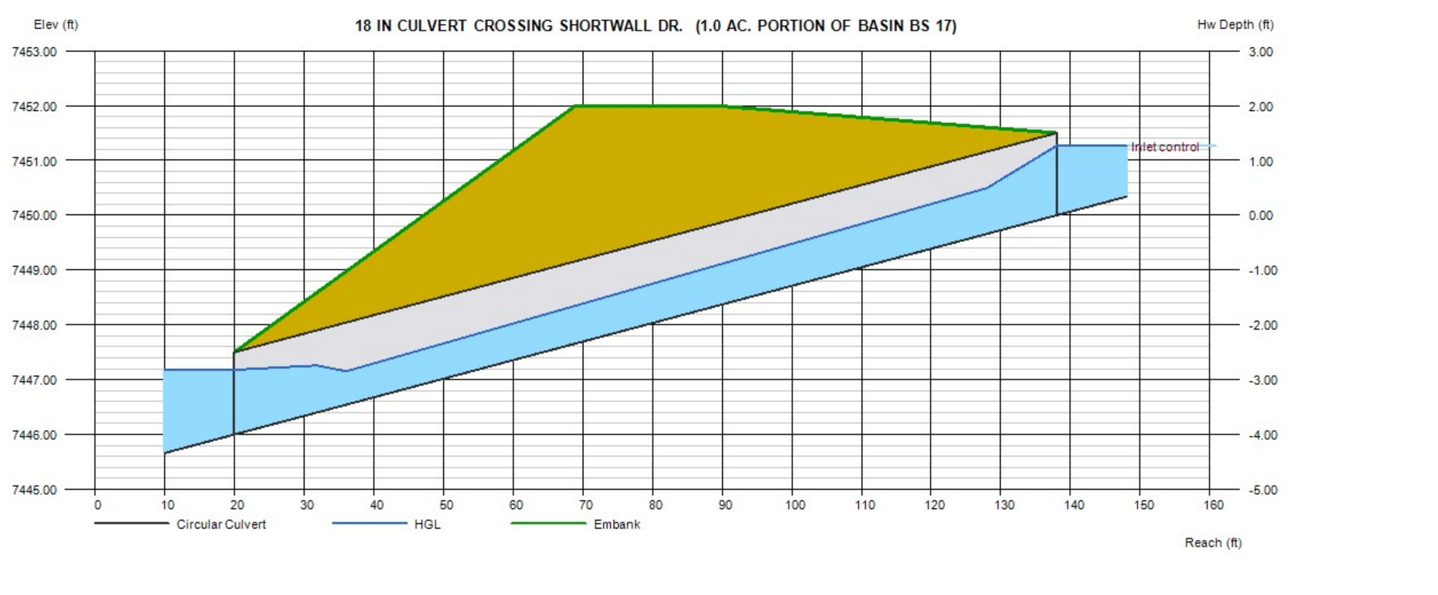
Top Elevation (ft)	= 7452.00
Top Width (ft)	= 20.00
Crest Width (ft)	= 40.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 5.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 5.00
Qpipe (cfs)	= 5.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.35
Veloc Up (ft/s)	= 4.77
HGL Dn (ft)	= 7447.18
HGL Up (ft)	= 7450.86
Hw Elev (ft)	= 7451.27
Hw/D (ft)	= 0.84
Flow Regime	= Inlet Control



Culvert Report

DP 12 CULVERT

Invert Elev Dn (ft)	=	7426.00
Pipe Length (ft)	=	130.00
Slope (%)	=	1.15
Invert Elev Up (ft)	=	7427.50
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Groove end projecting (C)
Coeff. K,M,c,Y,k	=	0.0045, 2, 0.0317, 0.69, 0.2

Embankment

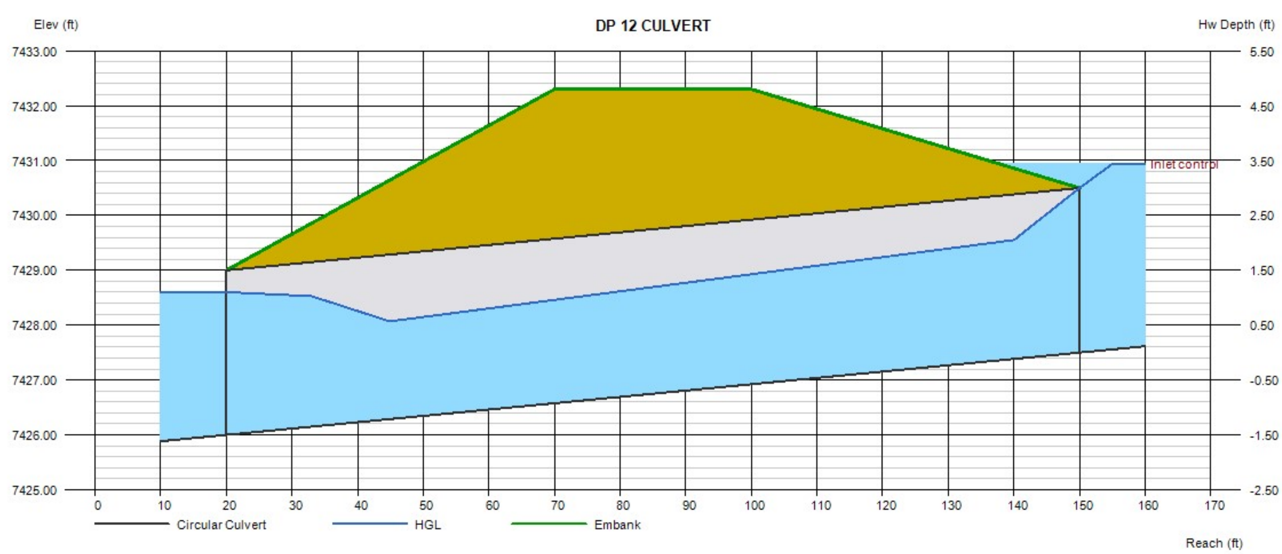
Top Elevation (ft)	=	7432.30
Top Width (ft)	=	30.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	46.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	46.00
Qpipe (cfs)	=	46.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.06
Veloc Up (ft/s)	=	8.25
HGL Dn (ft)	=	7428.60
HGL Up (ft)	=	7429.71
Hw Elev (ft)	=	7430.94
Hw/D (ft)	=	1.15
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Thursday, Nov 30 2017

DP 14 CULVERT

Invert Elev Dn (ft)	= 7448.18
Pipe Length (ft)	= 111.84
Slope (%)	= 3.92
Invert Elev Up (ft)	= 7452.57
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 3
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

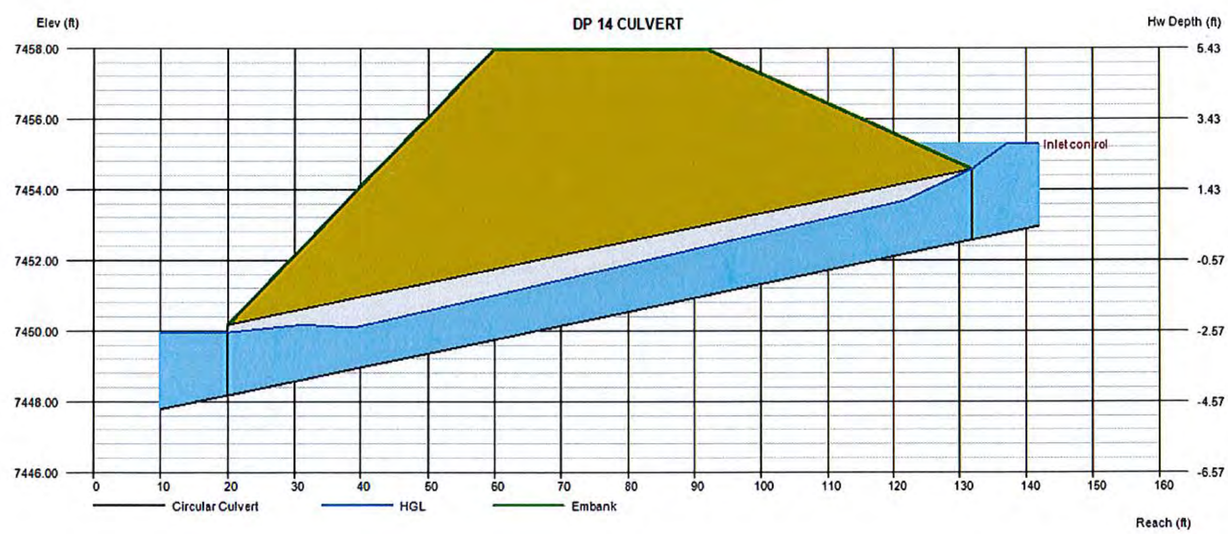
Top Elevation (ft)	= 7457.97
Top Width (ft)	= 32.00
Crest Width (ft)	= 40.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 56.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 56.00
Qpipe (cfs)	= 56.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 6.33
Veloc Up (ft/s)	= 7.13
HGL Dn (ft)	= 7449.96
HGL Up (ft)	= 7454.12
Hw Elev (ft)	= 7455.28
Hw/D (ft)	= 1.35
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 30 2017

DP 15 CULVERT

Invert Elev Dn (ft)	= 7465.95
Pipe Length (ft)	= 61.74
Slope (%)	= 1.15
Invert Elev Up (ft)	= 7466.66
Rise (in)	= 18.0
Shape	= Circular
Span (in)	= 18.0
No. Barrels	= 2
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

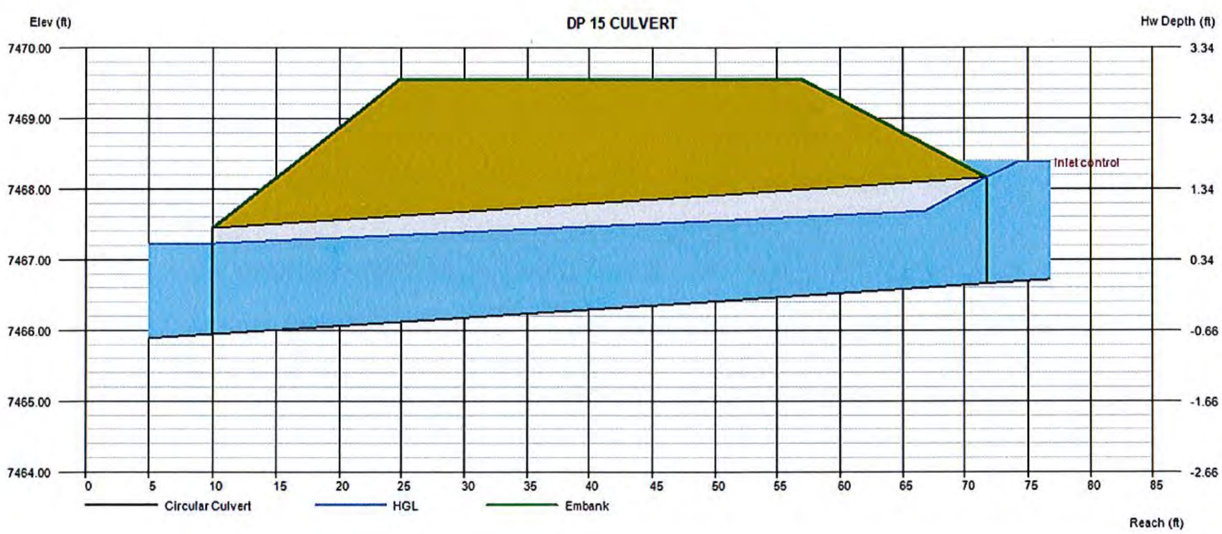
Top Elevation (ft)	= 7469.55
Top Width (ft)	= 32.00
Crest Width (ft)	= 40.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 15.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 15.00
Qpipe (cfs)	= 15.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.67
Veloc Up (ft/s)	= 5.62
HGL Dn (ft)	= 7467.23
HGL Up (ft)	= 7467.72
Hw Elev (ft)	= 7468.38
Hw/D (ft)	= 1.15
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 30 2017

DP 16 CULVERT

Invert Elev Dn (ft)	= 7373.00
Pipe Length (ft)	= 200.00
Slope (%)	= 6.00
Invert Elev Up (ft)	= 7385.00
Rise (in)	= 60.0
Shape	= Circular
Span (in)	= 60.0
No. Barrels	= 2
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Groove end w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0018, 2, 0.0292, 0.74, 0.2

Embankment

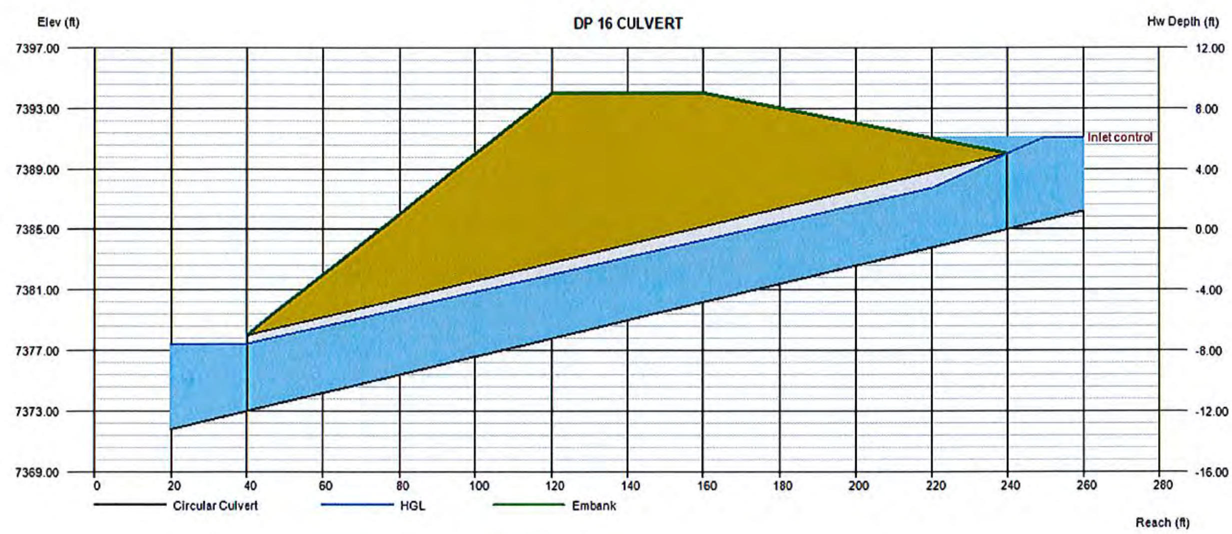
Top Elevation (ft)	= 7394.00
Top Width (ft)	= 40.00
Crest Width (ft)	= 80.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 365.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 365.00
Qpipe (cfs)	= 365.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 9.92
Veloc Up (ft/s)	= 11.21
HGL Dn (ft)	= 7377.43
HGL Up (ft)	= 7388.87
Hw Elev (ft)	= 7391.07
Hw/D (ft)	= 1.21
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 30 2017

DP 24 CULVERT

Invert Elev Dn (ft)	= 7562.87
Pipe Length (ft)	= 89.81
Slope (%)	= 3.49
Invert Elev Up (ft)	= 7566.00
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

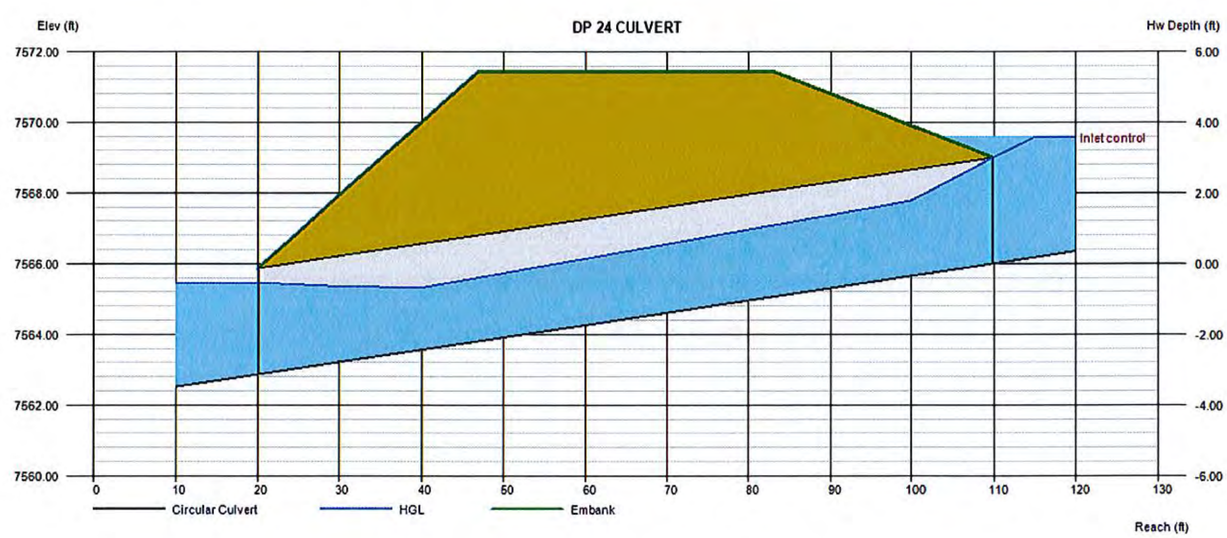
Top Elevation (ft)	= 7571.44
Top Width (ft)	= 36.00
Crest Width (ft)	= 40.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 45.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 45.00
Qpipe (cfs)	= 45.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 6.93
Veloc Up (ft/s)	= 8.16
HGL Dn (ft)	= 7565.46
HGL Up (ft)	= 7568.18
Hw Elev (ft)	= 7569.57
Hw/D (ft)	= 1.19
Flow Regime	= Inlet Control

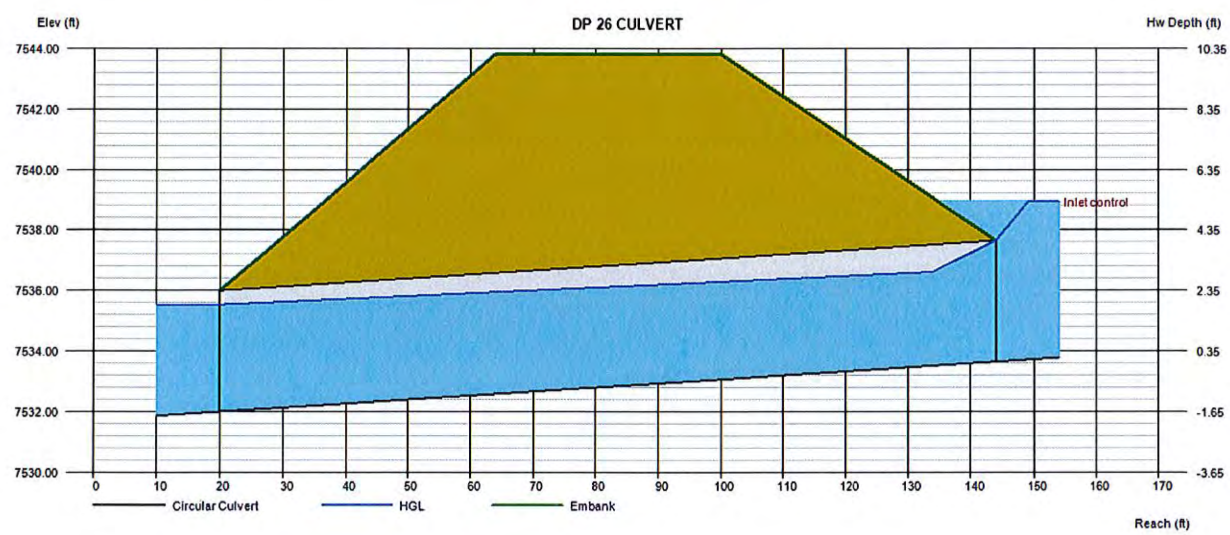


Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. | Thursday, Nov 30 2017

DP 26 CULVERT

Invert Elev Dn (ft)	= 7532.00	**Calculations**	
Pipe Length (ft)	= 123.98	Qmin (cfs)	= 0.00
Slope (%)	= 1.33	Qmax (cfs)	= 102.00
Invert Elev Up (ft)	= 7533.65	Tailwater Elev (ft)	= (dc+D)/2
Rise (in)	= 48.0		
Shape	= Circular	**Highlighted**	
Span (in)	= 48.0	Qtotal (cfs)	= 102.00
No. Barrels	= 1	Qpipe (cfs)	= 102.00
n-Value	= 0.012	Qovertop (cfs)	= 0.00
Culvert Type	= Circular Concrete	Veloc Dn (ft/s)	= 8.69
Culvert Entrance	= Square edge w/headwall (C)	Veloc Up (ft/s)	= 9.90
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5	HGL Dn (ft)	= 7535.53
		HGL Up (ft)	= 7536.71
Embankment		Hw Elev (ft)	= 7538.93
Top Elevation (ft)	= 7543.81	Hw/D (ft)	= 1.32
Top Width (ft)	= 36.00	Flow Regime	= Inlet Control
Crest Width (ft)	= 50.00		



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 30 2017

BASIN CC-15 CULVERT

Invert Elev Dn (ft)	= 7564.75
Pipe Length (ft)	= 82.63
Slope (%)	= 4.54
Invert Elev Up (ft)	= 7568.50
Rise (in)	= 30.0
Shape	= Circular
Span (in)	= 30.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

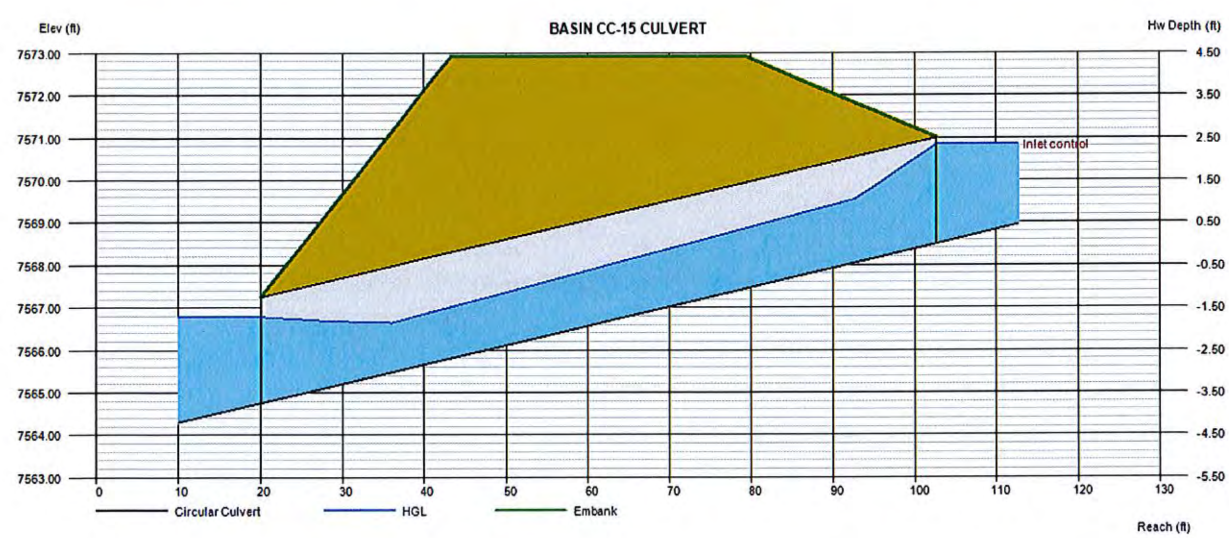
Top Elevation (ft)	= 7572.92
Top Width (ft)	= 36.00
Crest Width (ft)	= 50.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 21.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 21.00
Qpipe (cfs)	= 21.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.92
Veloc Up (ft/s)	= 6.54
HGL Dn (ft)	= 7566.78
HGL Up (ft)	= 7570.06
Hw Elev (ft)	= 7570.84
Hw/D (ft)	= 0.94
Flow Regime	= Inlet Control



Culvert Report

BASIN CC-16 CULVERT

Invert Elev Dn (ft)	=	7568.00
Pipe Length (ft)	=	100.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7569.00
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

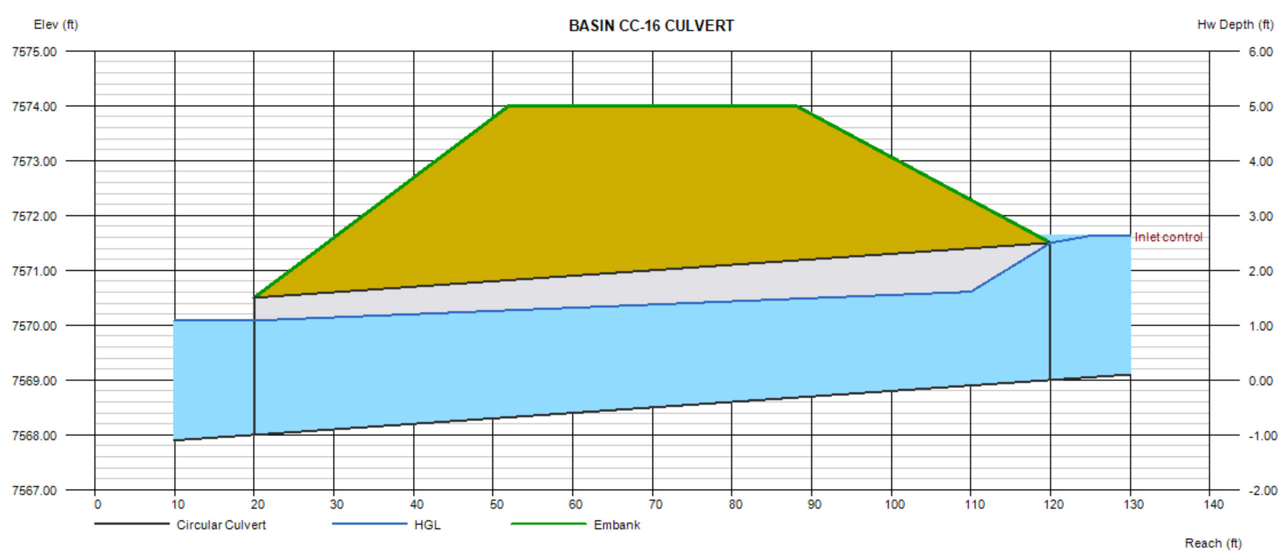
Top Elevation (ft)	=	7574.00
Top Width (ft)	=	36.00
Crest Width (ft)	=	50.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	24.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	24.00
Qpipe (cfs)	=	24.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.49
Veloc Up (ft/s)	=	6.90
HGL Dn (ft)	=	7570.08
HGL Up (ft)	=	7570.67
Hw Elev (ft)	=	7571.63
Hw/D (ft)	=	1.05
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Apr 4 2018

DP 30 CULVERT

Invert Elev Dn (ft)	= 7565.50
Pipe Length (ft)	= 100.00
Slope (%)	= 0.50
Invert Elev Up (ft)	= 7566.00
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

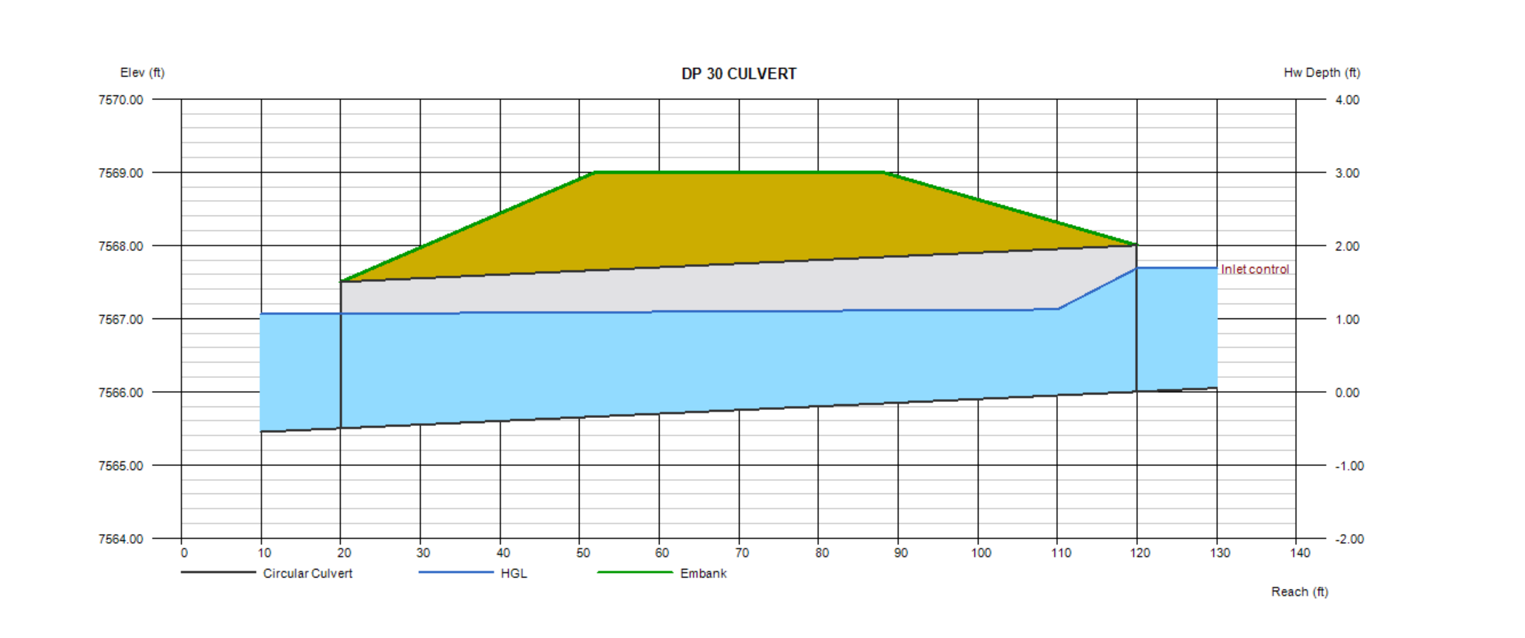
Top Elevation (ft)	= 7569.00
Top Width (ft)	= 36.00
Crest Width (ft)	= 40.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 10.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 10.00
Qpipe (cfs)	= 10.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 3.79
Veloc Up (ft/s)	= 5.46
HGL Dn (ft)	= 7567.07
HGL Up (ft)	= 7567.13
Hw Elev (ft)	= 7567.69
Hw/D (ft)	= 0.84
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Monday, Jun 4 2018

DP 31 CULVERT

Invert Elev Dn (ft)	=	7537.00
Pipe Length (ft)	=	50.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7537.50
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

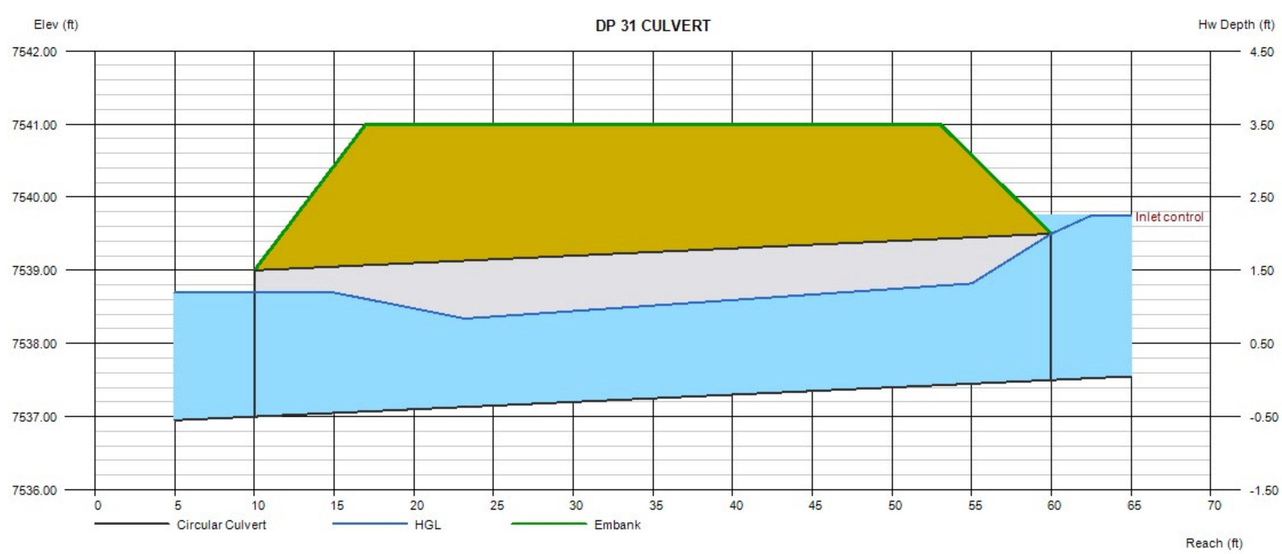
Top Elevation (ft)	=	7541.00
Top Width (ft)	=	36.00
Crest Width (ft)	=	40.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	15.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	15.00
Qpipe (cfs)	=	15.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.28
Veloc Up (ft/s)	=	6.41
HGL Dn (ft)	=	7538.70
HGL Up (ft)	=	7538.90
Hw Elev (ft)	=	7539.75
Hw/D (ft)	=	1.12
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Nov 30 2017

DP 32 CULVERT

Invert Elev Dn (ft)	= 7543.08
Pipe Length (ft)	= 83.29
Slope (%)	= 2.91
Invert Elev Up (ft)	= 7545.50
Rise (in)	= 36.0
Shape	= Circular
Span (in)	= 36.0
No. Barrels	= 1
n-Value	= 0.012
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

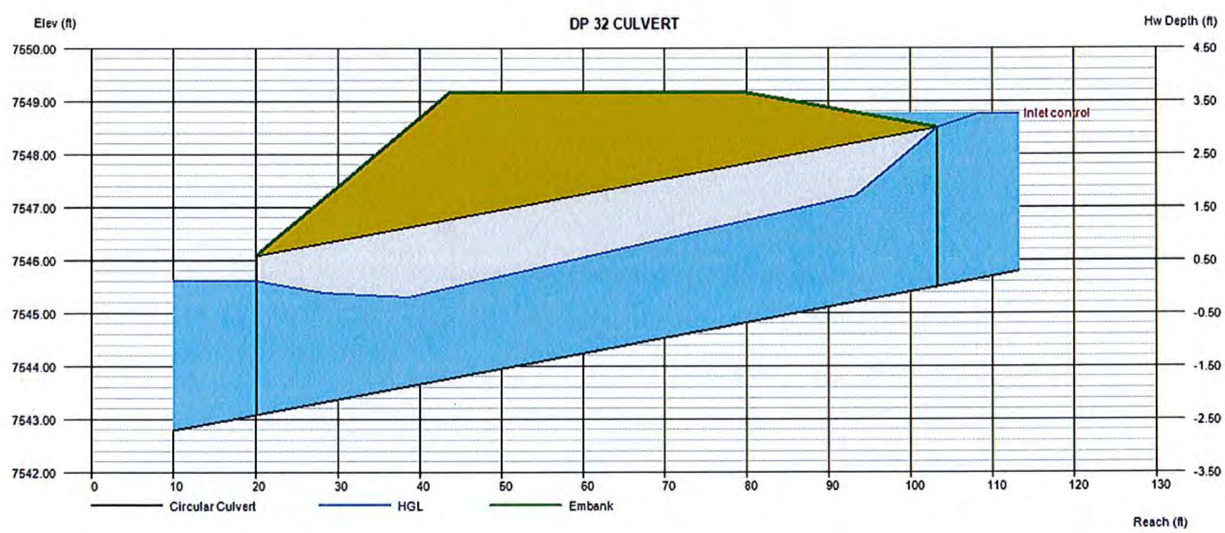
Top Elevation (ft)	= 7549.16
Top Width (ft)	= 36.00
Crest Width (ft)	= 40.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 40.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 40.00
Qpipe (cfs)	= 40.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 6.29
Veloc Up (ft/s)	= 7.74
HGL Dn (ft)	= 7545.61
HGL Up (ft)	= 7547.56
Hw Elev (ft)	= 7548.76
Hw/D (ft)	= 1.09
Flow Regime	= Inlet Control



Rock Chute Design Data

(Version 4.01 - 04/23/03, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: *Flying Horse Filing No. 1 (Pond 4)* **County:** *EL Paso*
Designer: *Marc Whorton* **Checked by:**
Date: 11/30/2017 **Date:**

Input Channel Geometry

Inlet Channel	Chute	Outlet Channel
Bw = *20.0* ft.	Bw = *15.0* ft.	Bw = *18.0* ft.
Side slopes = *4.0* (m:1)	Factor of safety = *1.20* (F_s)	Side slopes = *4.0* (m:1)
n-value = *0.035*	Side slopes = *4.0* (m:1) → ***2.0:1 max.***	n-value = *0.035*
Bed slope = *0.0100* ft./ft.	Bed slope (4:1) = *0.250* ft./ft. → ***2.5:1 max.***	Bed slope = *0.0100* ft./ft.
Freeboard = *2.0* ft.	Outlet apron depth, d = *1.5* ft.	Base flow = *40.0* cfs

Design Storm Data (Table 2, NHCP, NRCS Grade Stabilization Structure No. 410)

Drainage area = acres Rainfall = ○ 0 - 3 in. ◉ 3 - 5 in. ○ 5+ in.

Apron elev. --- Inlet = *7436.0* ft. --- Outlet = *7426.0* ft. --- (H_{drop} = 8.5 ft.)

Chute capacity = Q10-year
Total capacity = Q25-year
Minimum capacity (based on a 5-year, 24-hour storm with a 3 - 5 inch rainfall)

Q_{high} = *170.0* cfs High flow storm through chute → Tw (ft.) = *Program*

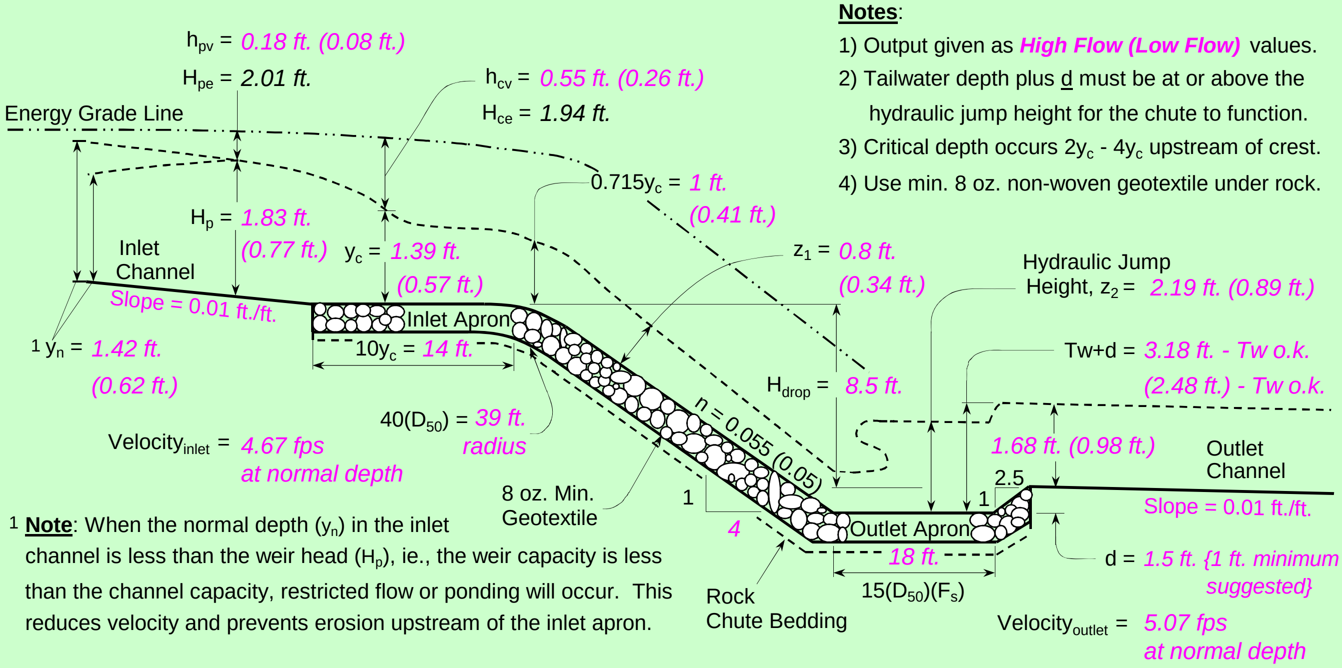
Q_{low} = *40.0* cfs Low flow storm through chute → Tw (ft.) = *Program*

***Note**: The total required capacity is routed through the chute (principal spillway) or in combination with an auxiliary spillway.*

***Input tailwater (Tw)**:*

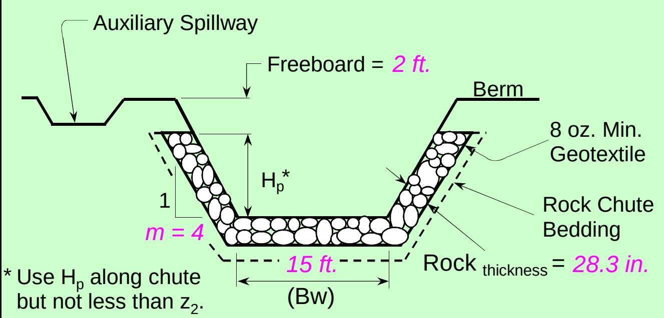
Profile and Cross Section (Output)

Notes:
1) Output given as ***High Flow (Low Flow)*** values.
2) Tailwater depth plus d must be at or above the hydraulic jump height for the chute to function.
3) Critical depth occurs $2y_c$ - $4y_c$ upstream of crest.
4) Use min. 8 oz. non-woven geotextile under rock.



[1] **Note**: When the normal depth (y_n) in the inlet channel is less than the weir head (H_p), ie., the weir capacity is less than the channel capacity, restricted flow or ponding will occur. This reduces velocity and prevents erosion upstream of the inlet apron.

Profile Along Centerline of Chute



* Use H_p along chute but not less than z_2.

Typical Cross Section

q_t =	*9.32 cfs/ft.*	Equivalent unit discharge
F_S =	*1.20*	Factor of safety (multiplier)
z_1 =	*0.8 ft.*	Normal depth in chute
n-value =	*0.055*	Manning's roughness coefficient
$D_{50}(F_s)$ =	*14.2 in. (207 lbs. - 50% round / 50% angular)*	
$2(D_{50})(F_s)$ =	*28.3 in.*	Rock chute thickness
Tw + d =	*3.18 ft.*	Tailwater above outlet apron
z_2 =	*2.19 ft.*	Hydraulic jump height
****** The outlet***	***will***	***function adequately***

High Flow Storm Information

Rock Chute Design - Plan Sheet

(Version 4.0 - 07/10/00, Based on Design of Rock Chutes by Robinson, Rice, Kadavy, ASAE, 1998)

Project: Flying Horse Filing No. 1 (Pond 4) **County:** EL Paso
Designer: Marc Whorton **Checked by:** ______
Date: 11/30/2017 **Date:** ______

Design Values

Angular D_{50} dia. = *14.2* in.
$Rock_{chute}$ thickness = *28.3* in.
Inlet apron length = *14* ft.
Outlet apron length = *18* ft.
Radius = *39* ft.
Will bedding be used? *Yes* ---------- Depth (in.) = *6.0*

Rock Gradation Envelope

% Passing		*Diameter, in. (weight, lbs.)*
D_{100}	---------	21 - 28 (704 - 1669)
D_{85}	---------	18 - 26 (458 - 1217)
D_{50}	---------	14 - 21 (209 - 704)
D_{10}	---------	11 - 18 (107 - 458)

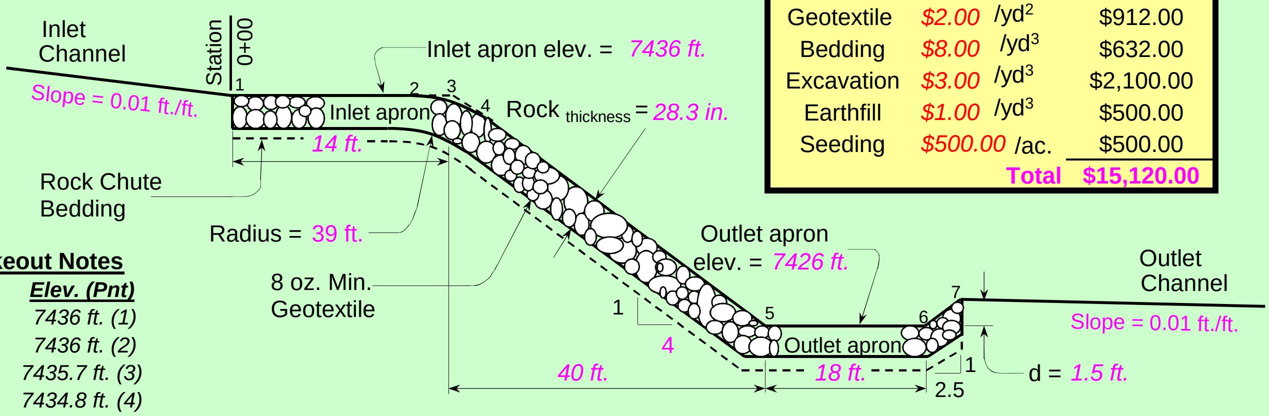
Quantities [a]

Angular Rock = 291 yd^3
Geotextile (8 oz.)[b] = 456 yd^2
Bedding (6 in.) = 79 yd^3
Excavation = *700* yd^3
Earthfill = *500* yd^3
Seeding = *1.0* acres

Notes: [a] *Rock, bedding, and geotextile quantities are determined from the x-section below (neglect radius).*
[b] *Geotextile shall be overlapped (18-in. min.) and anchored (18-in. min. along sides and 24-in. min. on the ends).*

Rock Chute Cost Estimate

Unit	*Unit Cost*	*Cost*
Rock	*$36.00* $/yd^3$	$10,476.00
Geotextile	*$2.00* $/yd^2$	$912.00
Bedding	*$8.00* $/yd^3$	$632.00
Excavation	*$3.00* $/yd^3$	$2,100.00
Earthfill	*$1.00* $/yd^3$	$500.00
Seeding	*$500.00* /ac.	$500.00
	Total	**$15,120.00**

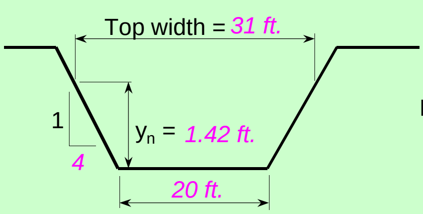


Profile Along Centerline of Rock Chute

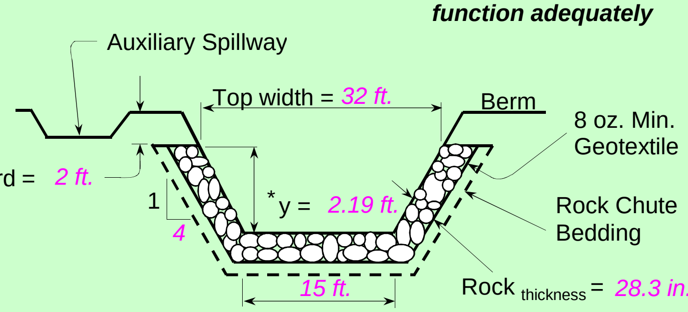
***Note**: The outlet *will* function adequately*

Stakeout Notes

Sta.	***Elev. (Pnt)***
0+00	*7436 ft. (1)*
0+9.2	*7436 ft. (2)*
0+14	*7435.7 ft. (3)*
0+18.7	*7434.8 ft. (4)*
0+54	*7426 ft. (5)*
0+72	*7426 ft. (6)*
0+75.8	*7427.5 ft. (7)*

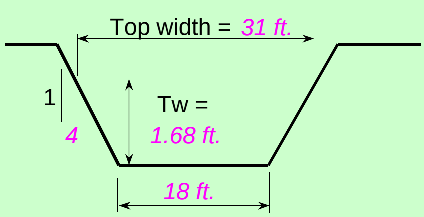


Inlet Channel Cross Section



Rock Chute Cross Section

* Use H_p throughout chute but not less than z_2.



Outlet Channel Cross Section

Profile, Cross Sections, and Quantities

Project: Flying Horse Filing No. 1 (Pond 4)	
Location: EL Paso County	
U.S. Department of Agriculture Natural Resources Conservation Service	
Designed: Marc Whorton	Approved by: ______
Drawn: NRCS Standard Dwg.	Title: ______
	Title: ______
Traced: ______	Sheet No. ___ of ___ / Drawing No.
Checked: ______	

$$H_a = \frac{(H + Y_n)}{2}$$ Equation 9-19

Where the maximum value of H_a shall not exceed H, and:

D_a = parameter to use in place of D in Figure 9-38 when flow is supercritical (ft)

D_c = diameter of circular culvert (ft)

H_a = parameter to use in place of H in Figure 9-39 when flow is supercritical (ft)

H = height of rectangular culvert (ft)

Y_n = normal depth of supercritical flow in the culvert (ft)

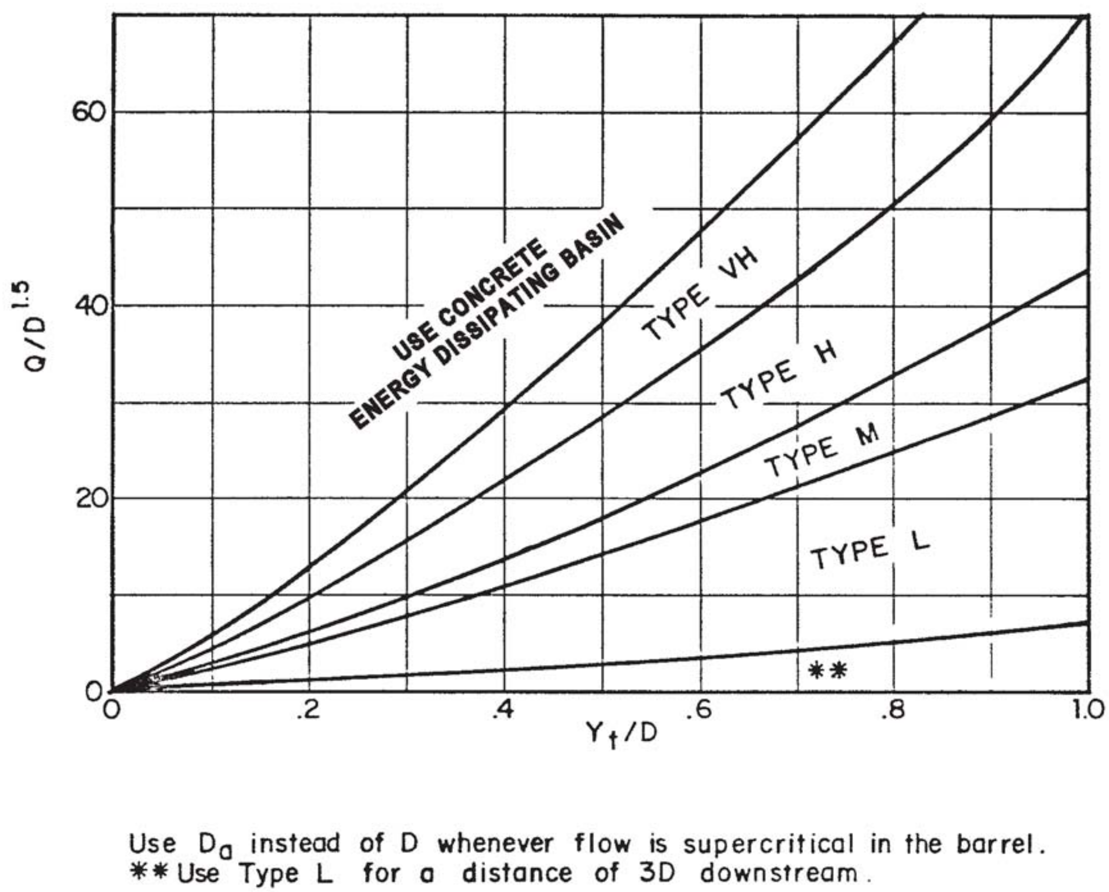


Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for Q/D2.5 ≤ 6.0)

RIP-RAP CALCULATIONS

Design Point	Flow (cfs)	Tailwater Depth (ft.) (See Culvert Reports)	Pipe Diameter (ft.)	$Q / D^{1.5}$	Y_t / D	Rock Type (See Fig. 9-38)	Rock Size (d50) (in.)
DP-1	11	1.62	2.0	3.9	0.8	Type L	9"
DP-2	35	2.25	2.5	8.9	0.9	Type L	9"
Fire Station Dwy.	5	1.18	1.5	2.7	0.8	Type L	9"
DP-4	11	1.40	1.5	6.0	0.9	Type L	9"
DP-5	15	1.45	1.5	8.2	1.0	Type L	9"
DP-7	38	1.99	2.5	9.6	0.8	Type L	9"
DP-8	284	3.46	4.0	35.5	0.9	Type M	12"
DP-9	23	1.61	2.0	8.1	0.8	Type L	9"
DP-10	144	3.08	3.5	22.0	0.9	Type L	9"
DP-11	36	1.76	2.0	12.7	0.9	Type L	9"
DP-12	44	2.58	3.0	8.5	0.9	Type L	9"
DP-14	56	1.78	2.0	19.8	0.9	Type L	9"
DP-15	15	1.28	1.5	8.2	0.9	Type L	9"
DP-24	45	2.59	3.0	8.7	0.9	Type L	9"
DP-26	102	3.53	4.0	12.8	0.9	Type L	9"
Basin CC-15	21	2.03	2.5	5.3	0.8	Type L	9"
Basin CC-16	24	2.08	2.5	6.1	0.8	Type L	9"
DP-30	10	1.57	2.0	3.5	0.8	Type L	9"
DP-32	40	2.53	3.0	7.7	0.8	Type L	9"

CHANNEL/DITCH/DRIVEWAY CULVERT CALCULATIONS

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September 2005

U.S. Department of Transportation

Federal Highway Administration

Hydraulic Engineering Circular No. 15, Third Edition

Design of Roadside Channels with Flexible Linings

National Highway Institute

Table 2.1. Typical Roughness Coefficients for Selected Linings

Lining Category	Lining Type	Manning's n[1] Maximum	Typical	Minimum
Rigid	Concrete	0.015	0.013	0.011
	Grouted Riprap	0.040	0.030	0.028
	Stone Masonry	0.042	0.032	0.030
	Soil Cement	0.025	0.022	0.020
	Asphalt	0.018	0.016	0.016
Unlined	Bare Soil[2]	0.025	0.020	0.016
	Rock Cut (smooth, uniform)	0.045	0.035	0.025
RECP	Open-weave textile	0.028	0.025	0.022
	Erosion control blankets	0.045	0.035	0.028
	Turf reinforcement mat	0.036	0.030	0.024

[1]Based on data from Kouwen, et al. (1980), Cox, et al. (1970), McWhorter, et al. (1968) and Thibodeaux (1968).
[2]Minimum value accounts for grain roughness. Typical and maximum values incorporate varying degrees of form roughness.

Table 2.2. Typical Roughness Coefficients for Riprap, Cobble, and Gravel Linings

Lining Category	Lining Type	Manning's n for Selected Flow Depths[1] 0.15 m (0.5 ft)	0.50 m (1.6 ft)	1.0 m (3.3 ft)
Gravel Mulch	D_{50} = 25 mm (1 in.)	0.040	0.033	0.031
	D_{50} = 50 mm (2 in.)	0.056	0.042	0.038
Cobbles	D_{50} = 0.10 m (0.33 ft)	--[2]	0.055	0.047
Rock Riprap	D_{50} = 0.15 m (0.5 ft)	--[2]	0.069	0.056
	D_{50} = 0.30 m (1.0 ft)	--[2]	--[2]	0.080

[1]Based on Equation 6.1 (Blodgett and McConaughy, 1985). Manning's n estimated assuming a trapezoidal channel with 1:3 side slopes and 0.6 m (2 ft) bottom width.
[2]Shallow relative depth (average depth to D_{50} ratio less than 1.5) requires use of Equation 6.2 (Bathurst, et al., 1981) and is slope-dependent. See Section 6.1.

2.2 SHEAR STRESS

2.2.1 Equilibrium Concepts

Most highway drainage channels cannot tolerate bank instability and possible lateral migration. Stable channel design concepts focus on evaluating and defining a channel configuration that will perform within acceptable limits of stability. Methods for evaluation and definition of a stable configuration depend on whether the channel boundaries can be viewed as:

- essentially rigid (static)
- movable (dynamic).

In the first case, stability is achieved when the material forming the channel boundary effectively resists the erosive forces of the flow. Under such conditions the channel bed and banks are in protected. Therefore permissible shear stress is not significantly affected by the erodibility of the underlying soil. However, if the lining moves, the underlying soil will be exposed to the erosive force of the flow.

Table 2.3 provides typical examples of permissible shear stress for selected lining types. Representative values for different soil types are based on the methods found in Chapter 4 while those for gravel mulch and riprap are based on methods found in Chapter 7. Vegetative and RECP lining performance relates to how well they protect the underlying soil from shear stresses so these linings do not have permissible shear stresses independent of soil types. Chapters 4 (vegetation) and 5 (RECPs) describe the methods for analyzing these linings. Permissible shear stress for gabion mattresses depends on rock size and mattress thickness as is described in Section 7.2.

Table 2.3. Typical Permissible Shear Stresses for Bare Soil and Stone Linings

		Permissible Shear Stress	
Lining Category	Lining Type	N/m^2	lb/ft^2
Bare Soil[1] Cohesive (PI = 10)	Clayey sands	1.8-4.5	0.037-0.095
	Inorganic silts	1.1-4.0	0.027-0.11
	Silty sands	1.1-3.4	0.024-0.072
Bare Soil[1] Cohesive (PI $\geq$ 20)	Clayey sands	4.5	0.094
	Inorganic silts	4.0	0.083
	Silty sands	3.5	0.072
	Inorganic clays	6.6	0.14
Bare Soil[2] Non-cohesive (PI < 10)	Finer than coarse sand D_{75}<1.3 mm (0.05 in)	1.0	0.02
	Fine gravel D_{75}=7.5 mm (0.3 in)	5.6	0.12
	Gravel D_{75}=15 mm (0.6 in)	11	0.24
Gravel Mulch[3]	Coarse gravel D_{50} = 25 mm (1 in)	19	0.4
	Very coarse gravel D_{50} = 50 mm (2 in)	38	0.8
Rock Riprap[3]	D_{50} = 0.15 m (0.5 ft)	113	2.4
	D_{50} = 0.30 m (1.0 ft)	227	4.8

[1]Based on Equation 4.6 assuming a soil void ratio of 0.5 (USDA, 1987).
[2]Based on Equation 4.5 derived from USDA (1987)
[3]Based on Equation 6.7 with Shield's parameter equal to 0.047.

2.3 DESIGN PARAMETERS

2.3.1 Design Discharge Frequency

Design flow rates for permanent roadside and median drainage channel linings usually have a 5 or 10-year return period. A lower return period flow is allowable if a transitional lining is to be used, typically the mean annual storm (approximately a 2-year return period, i.e., 50 percent probability of occurrence in a year). Transitional channel linings are often used during the establishment of vegetation. The probability of damage during this relatively short time is low,

TABLE 10-1

COMPOSITE ROUGHNESS COEFFICIENTS FOR UNLINED OPEN CHANNELS
(Reference: Chow, Ven Te, 1959; Open-Channel Hydraulics)

$$n = (n_o + n_1 + n_2 + n_3 + n_4)m \qquad (10\text{-}2)$$

	Channel Conditions	Value
Material Type n_o	Earth	0.020
	Fine Gravel	0.024
	Coarse Gravel	0.028
Degree of Irregularity n_1	Smooth	0.000
	Minor	0.005
	Moderate	0.010
	Severe	0.020
Variation of Channel Cross Section n_2	Gradual	0.000
	Alternating Occasionally	0.005
	Alternating Frequently	0.010 - 0.015
Relative Effect of Obstructions n_3	Negligible	0.000
	Minor	0.010 - 0.015
	Appreciable	0.020 - 0.030
	Severe	0.040 - 0.060
Vegetation n_4	Low	0.005 - 0.010
	Medium	0.010 - 0.025
	High	0.025 - 0.050
	Very High	0.050 - 0.100
Degree of Meandering m	Minor	1.000 - 1.200
	Appreciable	1.200 - 1.500
	Severe	1.500

- significant uncertainty regarding the design discharge
- consequences of failure are high

The basic procedure for flexible lining design consists of the following steps and is summarized in Figure 3.1. (An alternative process for determining an allowable discharge given slope and shape is presented in Section 3.6.)

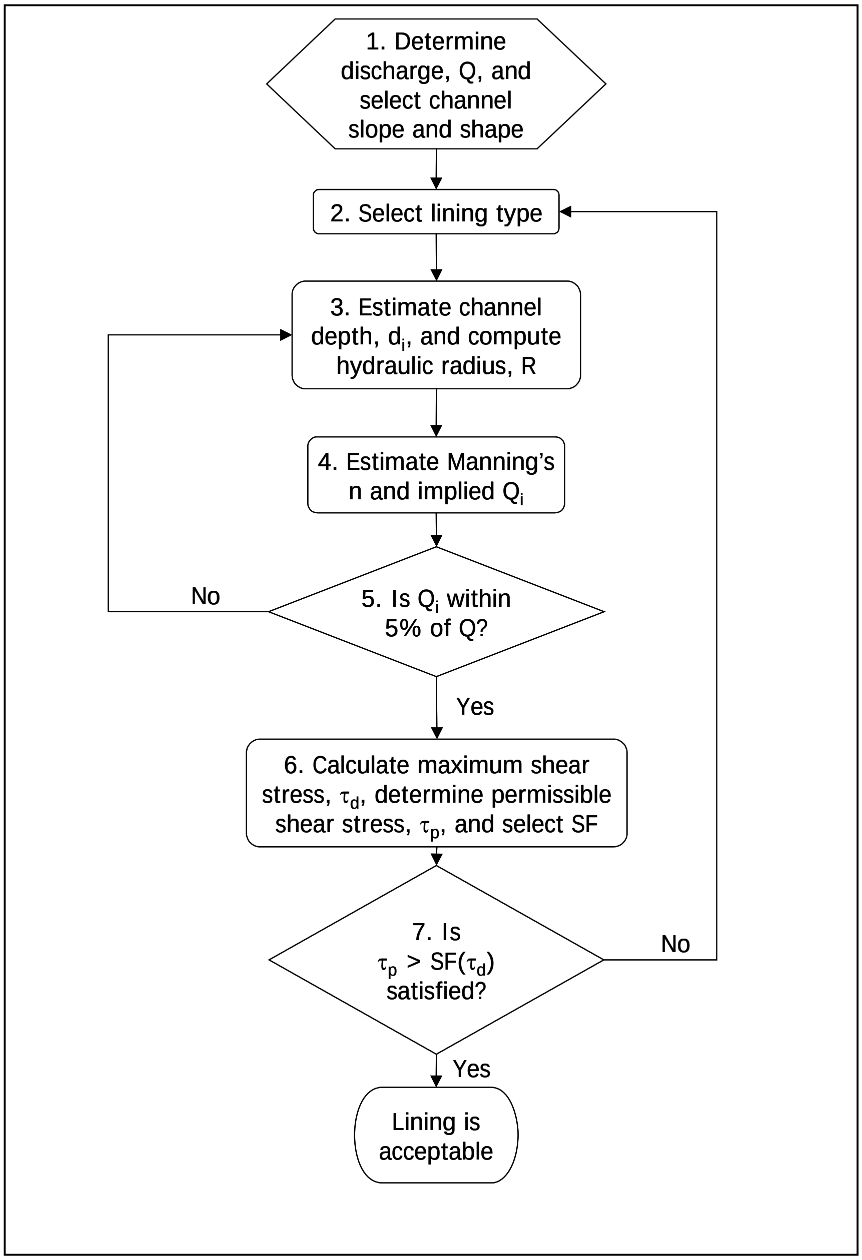
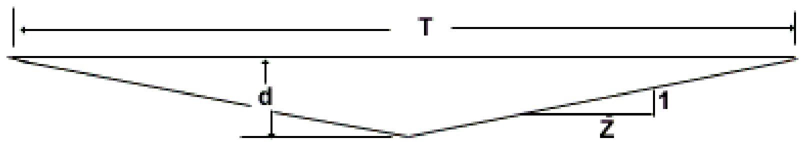


Figure 3.1. Flexible Channel Lining Design Flow Chart

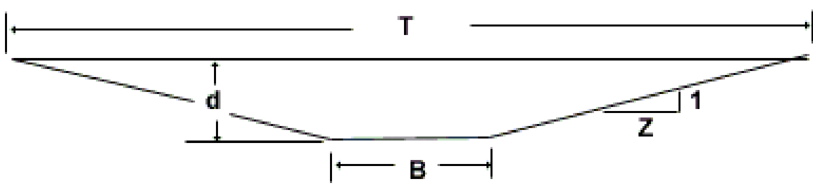
APPENDIX B: CHANNEL GEOMETRY EQUATIONS

V- SHAPE



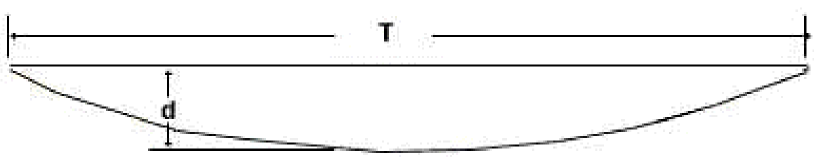
$$A = Zd^2$$
$$p = 2d\sqrt{Z^2 + 1}$$
$$T = 2dZ$$

TRAPEZOIDAL



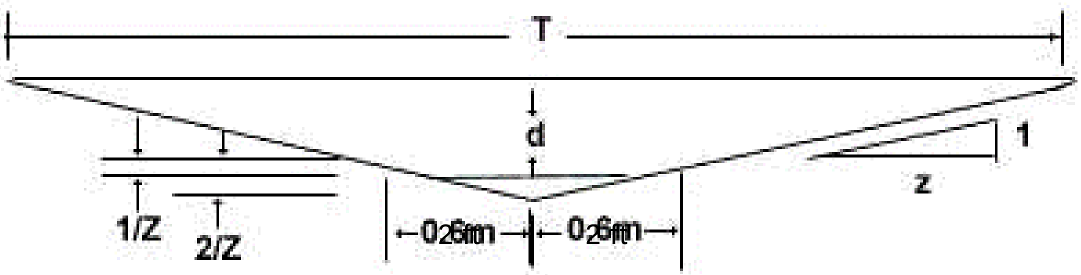
$$A = Bd + Zd^2$$
$$P = B + 2d\sqrt{z^2 + 1}$$
$$T = B + 2dZ$$

PARABOLIC



$$A = \frac{2}{3}Td$$
$$P = \frac{1}{2}\sqrt{16d^2 + T^2} + \left(\frac{T^2}{8d}\right)\ln_e\left(\frac{4d + \sqrt{16d^2 + T^2}}{T}\right)$$
$$T = 1.5\frac{A}{d}$$

V-SHAPE WITH ROUNDED BOTTOM



2 CASES

No. 1

If $d \leq 1/Z$, then:

$$A = \frac{8}{3} d \sqrt{dZ}$$

$$P = 2Z \ln_e \left(\sqrt{\frac{d}{Z}} + \sqrt{1 + \frac{d}{Z}} \right) + 2\sqrt{d^2 + dZ}$$

$$T = 4\sqrt{dZ}$$

No. 2

If $d > 1/Z$, then:

$$A = \frac{8}{3} d + 4\left(d - \frac{1}{Z} \right) + Z\left(d - \frac{1}{Z} \right)^2$$

$$P = 2Z \ln_e \left(\frac{1 + \sqrt{Z^2 + 1}}{Z} \right) + 2\frac{\sqrt{Z^2 + 1}}{Z} + 2\left(d - \frac{1}{Z} \right)\sqrt{1 + Z^2}$$

$$T = 4 + 2Z\left(d - \frac{1}{Z} \right)$$

Note: The equations for V-shape with rounded bottom only apply in customary units for a channel with a 4 ft wide rounded bottom.

ROADSIDE DITCH CALCUALTIONS

Limits of specific Ditch Lining relative to max. slope

		Erosion Control Blanket (ECB)		**Turf Reinforcement Mat (TRM)**		**Revegetation - Grass lined**
		(North American Green - SC150)		**(North American Green - P300)**		**(Native Seed Mix)**
	Given:	**(Temporary - 24 months)**		**(Permanent)**		
	Max. Design Flow (cfs)	7.4		70.0		4.3
	Permissible Shear (lbs/ft.^{2})	2.0		8.0		2.0
	Permissible Velocity (ft./sec.)	8.0		16.0		3.0
	Safety Factor	1		1		1
	Max. Ditch Slope	5%		10%		2%
	Ditch Section (24 in. depth)	V-Ditch		V-Ditch		V-Ditch
	Flow Area (ft.^{2})	1.69		6.25		1.44
	Wetted Perimeter (ft.)	5.37		10.33		4.96
	Hydraulic Radius	0.31		0.61		0.29
	Mannings n	0.035		0.030		0.030
	Depth of Flow (max.)	0.65		1.25		0.60
	Calculations:					
	Shear Stress (lbs/ft.^{2})	2.0		7.8		0.7
	Velocity (ft./sec.)	4.4		11.2		3.0
	Allowed Flow (cfs)	7.4		70.2		4.4

ROADSIDE DITCH CALCUALTIONS

Limits of specific Ditch Lining relative to max. flow

		Erosion Control Blanket (ECB)		**Turf Reinforcement Mat (TRM)**		**Revegetation - Grass lined**
		(North American Green - SC150)		**(North American Green - P300)**		**(Native Seed Mix)**
	Given:	**(Temporary - 24 months)**		**(Permanent)**		
	Max. Design Flow (cfs)	43.8		70.0		4.3
	Permissible Shear (lbs/ft.^{2})	2.0		8.0		2.0
	Permissible Velocity (ft./sec.)	8.0		16.0		3.0
	Safety Factor	1		1		1
	Max. Ditch Slope	2%		10%		2%
	Ditch Section (24 in. depth)	V-Ditch		V-Ditch		V-Ditch
	Flow Area (ft.^{2})	9.00		6.25		1.44
	Wetted Perimeter (ft.)	12.39		10.33		4.96
	Hydraulic Radius	0.73		0.61		0.29
	Mannings n	0.035		0.030		0.030
	Depth of Flow (max.)	1.50		1.25		0.60
	Calculations:					
	Shear Stress (lbs/ft.^{2})	1.9		7.8		0.7
	Velocity (ft./sec.)	4.9		11.2		3.0
	Allowed Flow (cfs)	43.8		70.2		4.4

ROLLMAX™
ROLLED EROSION CONTROL

ROLLED
EROSION CONTROL

SYSTEMS BROCHURE

NORTH AMERICAN GREEN®

Temporary RollMax™ Solutions

Erosion control has never been so simple yet effective. North American Green RollMax™ temporary Erosion Control Blankets (ECBs) provide immediate erosion protection and vegetation establishment assistance, then degrade once the vegetation's root and stem systems are mature enough to stabilize the soil.

Our high-quality temporary solutions are available in varying functional longevities and materials:

- Short-term photodegradable blankets with a functional longevity of 45 days up to 12 months
- Extended-term and long-term photodegradable blankets for protection up to 36 months
- Short-term biodegradable blankets for protection up to 12 months
- Extended-term and long-term biodegradable products for protection and mulching from 18 to 24 months

ERONET™ EROSION CONTROL BLANKETS

North American Green EroNet™ ECBs incorporate photodegradable nettings, which means they are broken down by the ultraviolet rays in sunlight. These temporary products can be used in a variety of scenarios, including moderate to steep slopes, medium-to high-flow channels, shorelines and other areas needing protection until permanent vegetation establishment.

EroNet™ C125® Long-Term Photodegradable Double-Net Coconut Blanket

The C125® ECB is made of 100% coconut fiber stitched between heavyweight UV-stabilized polypropylene nets. It offers excellent durability, erosion control and longevity for severe slopes, steep embankments, high-flow channels and other areas where vegetation may take up to 36 months to grow in.

The EroNet temporary ECBs are designed to provide immediate erosion protection and vegetation establishment assistance, and then degrade after the vegetation is mature enough to permanently stabilize the underlying soil. Both short-term and extended-term ECBs are available.

EroNet™ SC150® Extended-Term Photodegradable Double-Net Straw/Coconut Blanket

With a layer of 70% straw and 30% coconut fiber stitched between a heavyweight UV-stabilized polypropylene top net and a lightweight photodegradable polypropylene bottom net, the SC150® ECB has increased durability, erosion control capabilities and longevity. It is suitable for steeper slopes, medium-flow channels and other areas where it may take vegetation up to 24 months to grow in.

EroNet™ S150® Short-Term Photodegradable Double-Net Straw Blanket

The S150 ECB is made with a 100% straw fiber matrix stitched between lightweight photodegradable polypropylene top and bottom nets. The S150 ECB's double-net construction has greater structural integrity than single net blankets for use on steeper slopes and in channels with moderate water flow. It provides erosion protection and mulching for up to 12 months.

EroNet™ DS150™ Ultra Short-Term Photodegradable Double-Net Straw Blanket

The DS150™ ECB is suitable for high maintenance areas where close mowing will occur soon after installation. Special additives in the thread and top and bottom net ensure it degrades in adequate sunlight within 60 days.

EroNet™ S75® Short-Term Photodegradable Single-Net Straw Blanket

The S75® ECB protects and mulches moderate slopes and low-flow channels in low maintenance areas for up to 12 months. It is constructed of 100% straw fiber stitched with degradable thread to a lightweight photodegradable polypropylene top net.

EroNet™ DS75™ Ultra Short-Term Photodegradable Single-Net Straw Blanket

Designed for high maintenance areas where close mowing will occur soon after installation, the DS75™ ECB degrades within 45 days because of special additives in the thread and top net that facilitate rapid breakdown in adequate sunlight.

Every site has its own unique characteristics and challenges. EroNet Erosion Control Blankets are available in varying longevities to suit a variety of scenarios and conditions.

With our Erosion Control Materials Design Software (ECMDS), you can select either short-term, extended-term or long-term EroNet blankets based on your specific design needs.

Permanent RollMax™ Solutions

Back in the day, rock riprap, articulated concrete blocks and poured concrete were the only way to deal with erosion in high-flow channels, on shorelines and other areas where water and/or wind exceed the shear limits of unreinforced vegetation.

Not anymore. North American Green permanent Turf Reinforcement Mats (TRMs) use 100% synthetic components or a composite of synthetic and natural materials for long-term erosion protection and vegetation establishment. Whether com-pared to rock riprap or concrete, the RollMax™ Systems' permanent TRMs offer a number of significant advantages:

- Prevent loss of precious topsoil to wind and water erosion
- Permanently reinforce vegetation root and stem structures
- Provide excellent conditions for quick, healthy vegetation growth
- Stabilize slopes from erosion to keep roadways safe and clean
- Protect water quality in lakes, rivers and streams
- Protect dormant seeding during winter months
- Easily conform to landscape features
- Lightweight for easy handling and transportation

VMAX® COMPOSITE TURF REINFORCEMENT MATS

VMax® C-TRMs combine three-dimensional matting with fiber matrix material for permanent erosion control on severe slopes, spillways, stream banks, shorelines and in high- to extreme-flow channels. These extensively tested products provide maximum performance through all three phases of reinforced vegetative lining development: unvegetated, establishment, and maturity. Incorporating the best performance features of temporary and permanent North American Green erosion control products, VMax C-TRMs deliver these tangible benefits:

- Surface-applied for the highest level of immediate soil protection
- Less than one third of the installed cost of rock or concrete
- No heavy equipment needed to install
- More attractive and effective "Green" alternative than rock riprap or concrete

VMax® High-Performance TRMs (HPTRMs)

VMax® HPTRMs utilize patent-pending woven 3-D structures that are soil-filled for use in areas experiencing high stress and strain. The VMax HPTRMs are designed to provide appropriate thickness and open area for effective erosion and vegetation reinforcement against high flow induced shear forces. Our HPTRMs are excellent for increased bearing capacity of vegetated soils subjected to heavy loads from maintenance equipment and other vehicular traffic.

The TRMs easily conform to various landscape features to prevent the loss of precious topsoil.

The RollMax TRMs are installed in a one-step operation directly over the prepared seedbed saving time and money and ensuring the highest level of erosion control and vegetation reinforcement.

VMAx® TMaxTM Permanent HPTRM

The TMax HPTRM woven polypropylene technology is designed to provide appropriate thickness and open area for effective erosion and vegetation reinforcement against high flow induced shear forces up to 15 pfs (kN/m2), and with the highest tensile strength on the market up to 5,000 lbs/ft (73 kN/m). TMax maybe used as an alternative to hard armor system in extreme erosion control applications.

VMax® P550® Permanent TRM

P550® TRM has a polypropylene fiber matrix augmenting the permanent netting structure with permanent mulching and erosion control performance. Unvegetated, the P550 TRM reduces soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 4.0 lbs/ft² (191 Pa). The ultra-strong structure drives the vegetated shear resistance up to 14 lbs/ft² (672 Pa). The P550 TRM may be used as an alternative for poured concrete or articulated concrete blocks in extreme erosion control projects.

VMax® C350® Permanent TRM

A 100% coconut fiber matrix supplements the C350's permanent three-dimensional netting structure with initial mulching and erosion control performance for up to 36 months. Unvegetated, the C350® TRM reduces soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.2 lbs/ft² (153 Pa) and boosts permanent vegetation performance up to 12 lbs/ft² (576 Pa). This environmentally friendly alternative to 30 in. (76 cm) or larger rock riprap is ideal for severe erosion control projects.

VMax® SC250® Permanent TRM

The SC250® permanent TRM has a 70% straw/30% coconut fiber matrix to enhance initial mulching and erosion control performance for up to 24 months. Unvegetated, SC250 TRMs reduce soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.0 lbs/ft², and increases permanent vegetation performance up to 10 lbs/ft² (480 Pa) for a green alternative to rock riprap.

ERONET™ PERMANENT EROSION CONTROL BLANKETS

The EroNet™ Permanent ECB provides immediate erosion protection and vegetation establishment assistance until vegetation roots and stems mature.

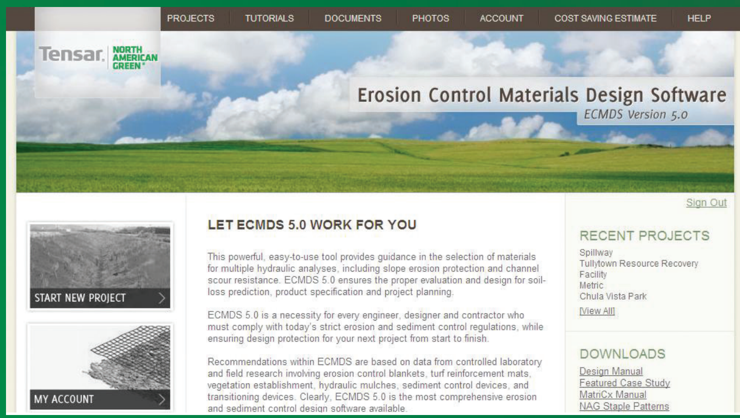
EroNet™ P300® Permanent Erosion Control Blankets

The P300® permanent erosion control blanket consists of UV-stabilized polypropylene fiber stitched between heavy-weight UV-stabilized polypropylene top and bottom nets. These mats reduce soil loss and protect vegetation from being washed away or uprooted, even under high stress. Unvegetated, they reduce soil loss to less than 0.5 in. (12.7 mm) under shear stress up to 3.0 lbs/ft² (144 Pa), and protect vegetation from being washed away or uprooted when exposed to shear stresses up to 8 lbs/ft² (383 Pa).

To boost performance of the VMax turf reinforcement mats in critical applications, combine with our ShoreMax® flexible transition mat to create a system that can dramatically elevate the permissible shear stress and velocity protection beyond many hard armor solutions.

VMax Mats are perfect for pipe outlets, channel bottoms, shoreline transition zones, and other areas subjected to highly turbulent water flows.

Design and Installation Tools



SHIFT, CONTROL, ENTER

Professional guidance on RECP selection, design and project planning is at your fingertips with Tensar's proprietary Erosion Control Materials Design Software (ECMDS®). This web-based program incorporates design methodologies from the Federal Highway Administration and United States Department of Agriculture to analyze your specific site conditions, and make quantified recommendations based on data from controlled laboratory and field research. ECMDS is a must-have if you face tough erosion and sediment control regulations. Best of all, it's free of charge, compliments of North American Green. To learn more and access the software directly, go to **www.ECMDS.com**.

INSTRUCTIONS INCLUDED

Proper anchoring patterns and rates must be used to achieve optimal results in RECP installation. View our installation guides for stapling patterns. Site specific staple pattern recommendations based on soil type and severity of application may be acquired through our ECMDS.

HOLD ON TIGHT

When under the pressure of severe conditions, even the best erosion control products can't function to their full potential without proper installation and anchoring. North American Green supplies a wide variety of fastener options for nearly every application and soil type.

For use in cohesive soils, wire staples are a cost-effective means to fasten RECPs. Available in 6 in., 8 in., 10 in. and 12 in. lengths, our U-shaped staples can reach to various depths to ensure adequate pull-out resistance. For installation using our handy Pin Pounder installation tool, 6 in. V-top staples or 6 in. circle top pins are available.

Our biodegradable BioStakes® are available in 4 in. and 6 in. lengths and provide an environmentally friendly alternative to metal staples. For an even more durable, deeper reaching yet all-natural anchoring option, our wood EcoStakes® are available in 6 in., 12 in., 18 in. and 24 in. lengths.

For severe applications needing the ultimate, long-lasting hold, try our 12 and 18 in. rebar staples, our 12 in. plastic ShoreMax® stakes, or our complete line of percussion earth anchors. The Tensar earth anchors reach deep into the soil strata to offer enhanced anchoring in the worst conditions. Our variety of earth anchors are designed for durability and holding power under extreme hydraulic stresses and adverse soil conditions *(Table 1)*.

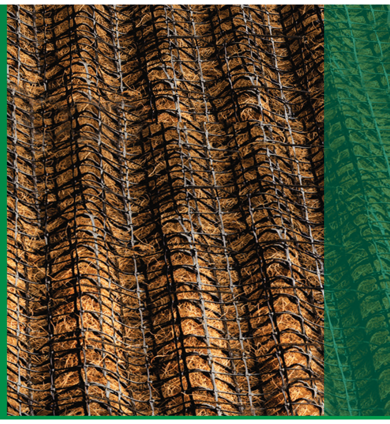
For more information on the RollMax Systems or other systems within the North American Green Erosion Control Solutions, call **800-772-2040** or visit **nagreen.com**.

Earth Anchor Options

					EA 400		EA 680	
	Tendon Type (3/32 in. x 36 in.)	**Assembly Description**	Fast Install	Economic Anchor	Stainless	Galvanized	Stainless	Galvanized
End Piece Options with a PVC Face Plate	**Copper Stop Sleeve** with Stainless Steel Washer	Manually crimped to the stainless steel cable to secure the face plate.		X	X		X	
	Grip End Piece with Stainless Steel Washer	Three-dimensional, self-securing metal end piece that does not require manual crimping for tendon tensioning.	X	X	X	X	X	X
	Wedge Grip Piece	Self-securing end piece that installs flush to the face plate. Does not require manual crimping for tendon tensioning.	X		X	X	X	X
	Aluminum Stop Sleeve with Stainless Steel Washer	Manually crimped to the galvanized cable to secure the face plate.		X		X		X

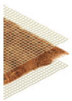
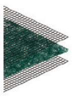
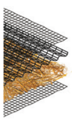
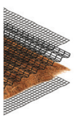
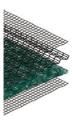
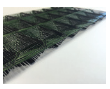
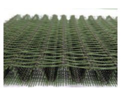
TABLE 1

The complete line of RollMax™ products offers a variety of options for both short-term and permanent erosion control needs. Reference the RollMax Products Chart below to find the right solution for your next project.

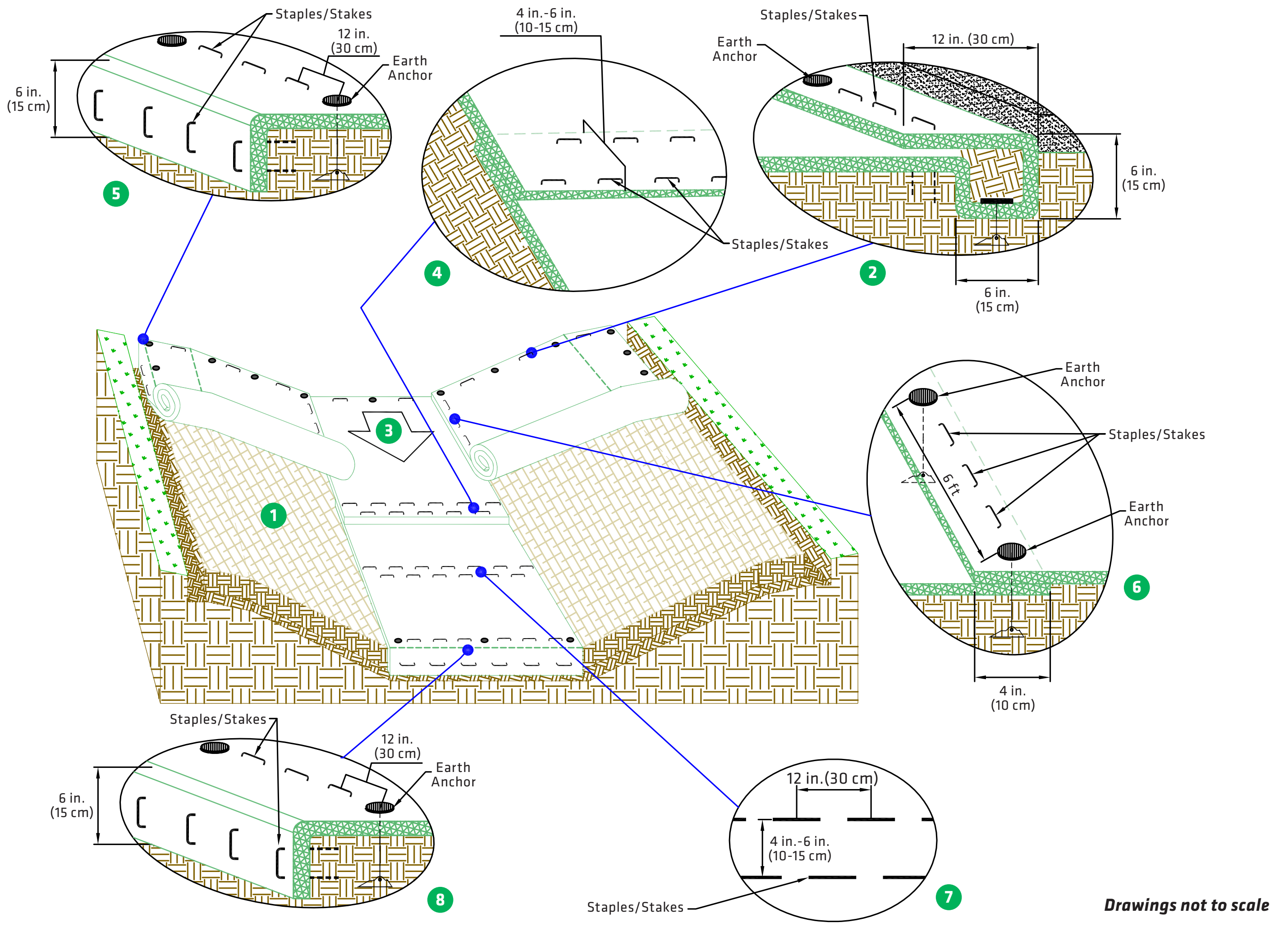


RollMax Product Selection Chart

	Product Description	Longevity	Applications	Design Permissible Shear Stress lbs/ft² (Pa)	Design Permissible Velocity ft/s (m/s)
TEMPORARY					
ERONET					
DS75	1.5 lb., accelerated photodegradable, polypropylene top net, 100% straw fiber matrix	45 days	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.55 (74)	Unvegetated 5.0 (1.52)
DS150	1.5 lb., photodegradable, polypropylene top & bottom net, 100% straw fiber matrix	60 days	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.75 (84)	Unvegetated 6.0 (1.83)
S75	1.5 lb., photodegradable, polypropylene top net, 100% straw fiber matrix	12 months	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.55 (74)	Unvegetated 5.0 (1.52)
S150	1.5 lb., photodegradable, polypropylene top & bottom net, 100% straw fiber matrix	12 months	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.75 (84)	Unvegetated 6.0 (1.83)
SC150	2.9 lb., UV-stable polypropylene top net, 70% straw/30% coconut fiber matrix, 1.5 lb., photodegradable polypropylene bottom net	24 months	Medium Flow Channels 2:1 - 1:1 Slopes	Unvegetated 2.0 (96)	Unvegetated 8.0 (2.44)
C125	2.9 lb., UV stable polypropylene top & bottom nets, 100% coconut fiber matrix	36 months	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.25 (108)	Unvegetated 10.0 (3.05)
BIONET					
S75BN	9.3 lb., leno woven biodegradable jute top net, 100% straw fiber matrix	12 months	Low Flow Channels 4:1 - 3:1 Slopes	Unvegetated 1.60 (76)	Unvegetated 5.0 (1.52)
S150BN	9.3 lb., leno woven biodegradable jute top net, 100% straw fiber matrix, 7.7 lb., woven biodegradable jute bottom net	12 months	Moderate Flow Channels 3:1 - 2:1 Slopes	Unvegetated 1.85 (88)	Unvegetated 6.0 (1.83)
SC150BN	9.3 lb., leno woven biodegradable jute top net, 70% straw/30% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	18 months	Medium Flow Channels 2:1 - 1:1 Slopes	Unvegetated 2.10 (100)	Unvegetated 8.0 (2.44)

	Product Description	Longevity	Applications	Design Permissible Shear Stress lbs/ft² (Pa)	Design Permissible Velocity ft/s (m/s)
TEMPORARY					
BIONET CONT'D					
 C125BN	9.3 lb., leno woven biodegradable jute top net, 100% coconut fiber matrix, 7.7 lb., woven biodegradable jute bottom net	24 mo.	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.35 (112)	Unvegetated 10.0 (3.05)
 C700BN	143 lb., (700 g) woven biodegradable coir top net, 100% coconut fiber matrix, 7.7 lb., woven biodegrdable jute bottom net	36 mo.	High Flow Channels 1:1 and Greater Slopes	Unvegetated 2.35 (112)	Unvegetated 10.0 (3.05)
PERMANENT					
ERONET					
 P300	5.0 lb., UV-stable polypropylene top net, 100% polypropylene fiber matrix, 3.0 lb., UV-stable polypropylene bottom net	Permanent	High Flow Channels 1:1 Slopes	Unvegetated 3.0 (144) Vegetated 8.0 (383)	Unvegetated 9.0 (2.7) Vegetated 16.0 (4.9)
VMAX					
 SC250	5.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 70% straw/30% coconut fiber matrix	Permanent	High Flow Channels 1:1 and Greater Slopes	Unvegetated 3.0 (144) Vegetated 10.0 (480)	Unvegetated 9.5 (2.9) Vegetated 15.0 (4.6)
 C350	8.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 100% coconut fiber matrix	Permanent	High Flow Channels 1:1 and Greater Slopes	Unvegetated 3.2 (153) Vegetated 12.0 (576)	Unvegetated 10.5 (3.2) Vegetated 20.0 (6.0)
 P550	24.0 lb., UV-stable polypropylene top & bottom nets, 24.0 lb., UV-stable polypropylene corrugated center net, 100% polypropylene fiber matrix	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Unvegetated 4.0 (191) Vegetated 14.0 (672)	Unvegetated 12.5 (3.8) Vegetated 25.0 (7.6)
 TMax	100% UV-stable polypropylene monofilament yarns, woven into a 3-D structure	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Vegetated 15.0 (718)	Vegetated 25.0 (7.6)
 W3000	100% UV-stable polypropylene monofilament yarns, woven into a 3-D structure	Permanent	Extreme High Flow Channels 1:1 and Greater Slopes	Vegetated 16.0 (766)	Vegetated 25.0 (7.6)

Channel Installation Detail

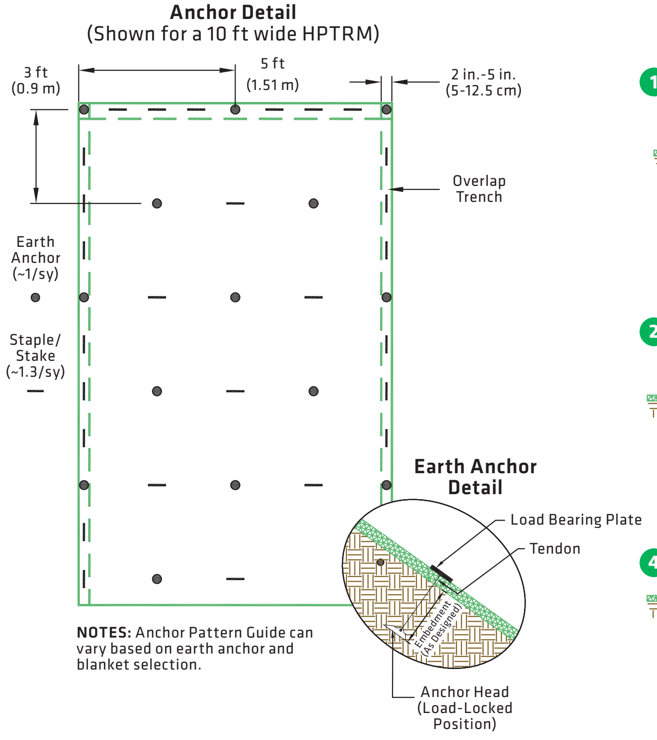


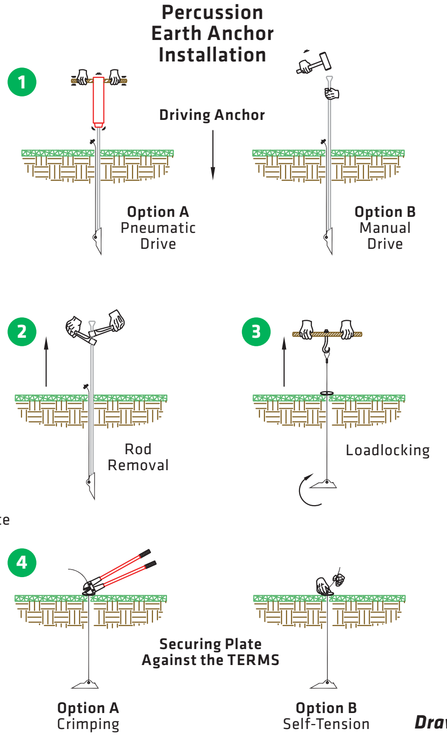
Drawings not to scale

GENERAL INSTALLATION

1. Prepare soil before installing the HPTRM, including any necessary application of soil amendments such as lime or fertilizer. See seeding and vegetating section for details regarding preseeding, overseeding or use with sod.
2. Begin at the top of the channel by anchoring the HPTRM in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench with approximately 12 in. (30 cm) of HPTRM extended beyond the upslope portion of the trench. Anchor the HPTRM with a row of anchors/staples/ stakes spaced approximately 12 in. (30 cm) apart in the bottom of the trench. Backfill and compact the trench after stapling. Compact soil and fold remaining 12 in.(30 cm) portion of HPTRM back over compacted soil. Secure HPTRM over soil with a row of anchors/staples/stakes spaced approximately 12 in. (30 cm) across the width of the HPTRM.
3. Roll center HPTRM in direction of water flow in bottom of channel. HPTRMs will unroll with appropriate side against the soil surface. All HPTRMs must be securely fastened to soil surface by placing anchors/staples/stakes in appropriate locations as shown in the anchoring detail.
4. Place consecutive HPTRMs end over end (shingle style) with a 4 in. x 6 in. (10 cm-15 cm) overlap. Use a double row of staples/ stakes staggered 12 in. (30 cm) apart and 12 in. (30 cm) on center to secure HPTRMs.
5. Full length edge of HPTRMs at top of side slopes must be anchored with a row of staples/stakes approximately 12 in. (30 cm) apart in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench. Backfill and compact the trench after stapling.
6. Adjacent HPTRMs must be overlapped approximately 4 in. (10 cm) and fastened.
7. In high flow channel applications, a staple/stake check slot is recommended at 30 ft to 40 ft (9 m-12 m) intervals. Use a double row of staples/stakes staggered 4 in. (10 cm) apart and 12 in. (30 cm) on center over entire width of the channel.
8. The terminal end of the HPTRMs must be anchored with a row of staples/stakes approximately 12 in. (30 cm) apart in a 6 in. (15 cm) deep x 6 in. (15 cm) wide trench. Backfill and compact the trench after stapling.

Anchoring Detail





Drawings not to scale

ANCHORING DETAIL

The performance of ground anchoring devices is highly dependent on numerous site/project specific variables. It is the sole responsibility of the project engineer and/or contractor to select the appropriate anchor type and length. Anchoring shall be selected to hold the mat in intimate contact with the soil subgrade and resist pullout in accordance with the project's design intent.

1. Staples and/or stakes should be at least 6 in. (15 cm) in length and with sufficient ground penetration to resist pullout. Longer staples and/or stakes may be needed in looser soils.
2. The percussion earth anchor assembly consists of an anchor head, a tendon, a faceplate, and an end-piece device. See North American Green® Earth Anchor specification for detailed information on assembly components and associated pull-out strength.

PERCUSSION EARTH ANCHOR INSTALLATION

1. Insert the drive rod into the assembly's anchor head then use either a sledge hammer or vibratory hammer to drive the anchor to their desired depth.
2. After the desired anchor depth is achieved, retract the drive rod.
3. Lock the anchor assembly by swiftly pulling the cable upwards until the anchor head rotates as signaled by sudden resistance to pulling. A hooked setting tool may be used to aid in this step.

NOTE: *Larger anchors may require more force to set the anchor. This can be achieved through using simple mechanical equipment for greater leverage, such as a fulcrum, manual or hydraulic jack, winch, or post puller.*

4. Secure the faceplate to the High-performance Turf Reinforcement Mat (HPTRM) surface by locking the end-piece. If using a copper or aluminum stop, crimp the ferrule to secure. If using a self-tensioning end-piece (grip or wedge grip) set by simply tightening the end-piece against the faceplate. If desired, cut the remaining cable assembly, above end-piece, to desired length.

SEEDING AND VEGETATING

When using a Composite Turf Reinforcement Mat (C-TRM) with fiber components:

1. Pre-seed prepared soils prior to the installation of the C-TRM. Install matting as directed. C-TRM does not require soil infill or a top dressing of seed. Overseeding may be done as a secondary form of seeding.
2. Sod may be installed in place of seeding on top of the C-TRM. Additional staking of sod is recommended in high-flow conditions. Sodded areas should be irrigated until rooting through the mat and into subgrade occurs.

When using a woven HPTRM:

1. Install the HPTRM as directed prior to seed and soil filling.
2. Place seed into the installed HPTRM. After seeding, spread a layer of fine soil into the mat. Using the flat side of a rake, broom or other tool, completely fill the voids. Smooth soil-fill in order to just expose the top of the HPTRM matrix. Do not place excessive soil above the mat.
3. Additional seed, hydraulic mulching of the use of a temporary Erosion Control Blanket (ECB) can be applied over the soil-filled mat for increased protection.
4. Sod may be installed in place of seeding. Install HPTRM, and soil-fill as outlined above. Place sod directly onto the soil-filled HPTRM. Additional staking of sod is recommended in high-flow conditions. Sodded areas should be irrigated until rooting through the mat and into subgrade occurs.
5. Consult with a manufacturer's technical representative for installation assistance if unique conditions apply.

Description

Check dams are temporary grade control structures placed in drainage channels to limit the erosivity of stormwater by reducing flow velocity. Check dams are typically constructed from rock, gravel bags, sand bags, or sometimes, proprietary devices. Reinforced check dams are typically constructed from rock and wire gabion. Although the primary function of check dams is to reduce the velocity of concentrated flows, a secondary benefit is sediment trapping upstream of the structure.

Photograph CD-1. Rock check dams in a roadside ditch. Photo courtesy of WWE.

Appropriate Uses

Use as a grade control for temporary drainage ditches or swales until final soil stabilization measures are established upstream and downstream. Check dams can be used on mild or moderately steep slopes. Check dams may be used under the following conditions:

- As temporary grade control facilities along waterways until final stabilization is established.
- Along permanent swales that need protection prior to installation of a non-erodible lining.
- Along temporary channels, ditches or swales that need protection where construction of a non-erodible lining is not practicable.
- Reinforced check dams should be used in areas subject to high flow velocities.

Design and Installation

Place check dams at regularly spaced intervals along the drainage swale or ditch. Check dams heights should allow for pools to develop upstream of each check dam, extending to the downstream toe of the check dam immediately upstream.

When rock is used for the check dam, place rock mechanically or by hand. Do not dump rocks into the drainage channel. Where multiple check dams are used, the top of the lower dam should be at the same elevation as the toe of the upper dam.

When reinforced check dams are used, install erosion control fabric under and around the check dam to prevent erosion on the upstream and downstream sides. Each section of the dam should be keyed in to reduce the potential for washout or undermining. A rock apron upstream and downstream of the dam may be necessary to further control erosion.

Check Dams	
Functions	
Erosion Control	Yes
Sediment Control	Moderate
Site/Material Management	No

Design details with notes are provided for the following types of check dams:

- Rock Check Dams (CD-1)
- Reinforced Check Dams (CD-2)

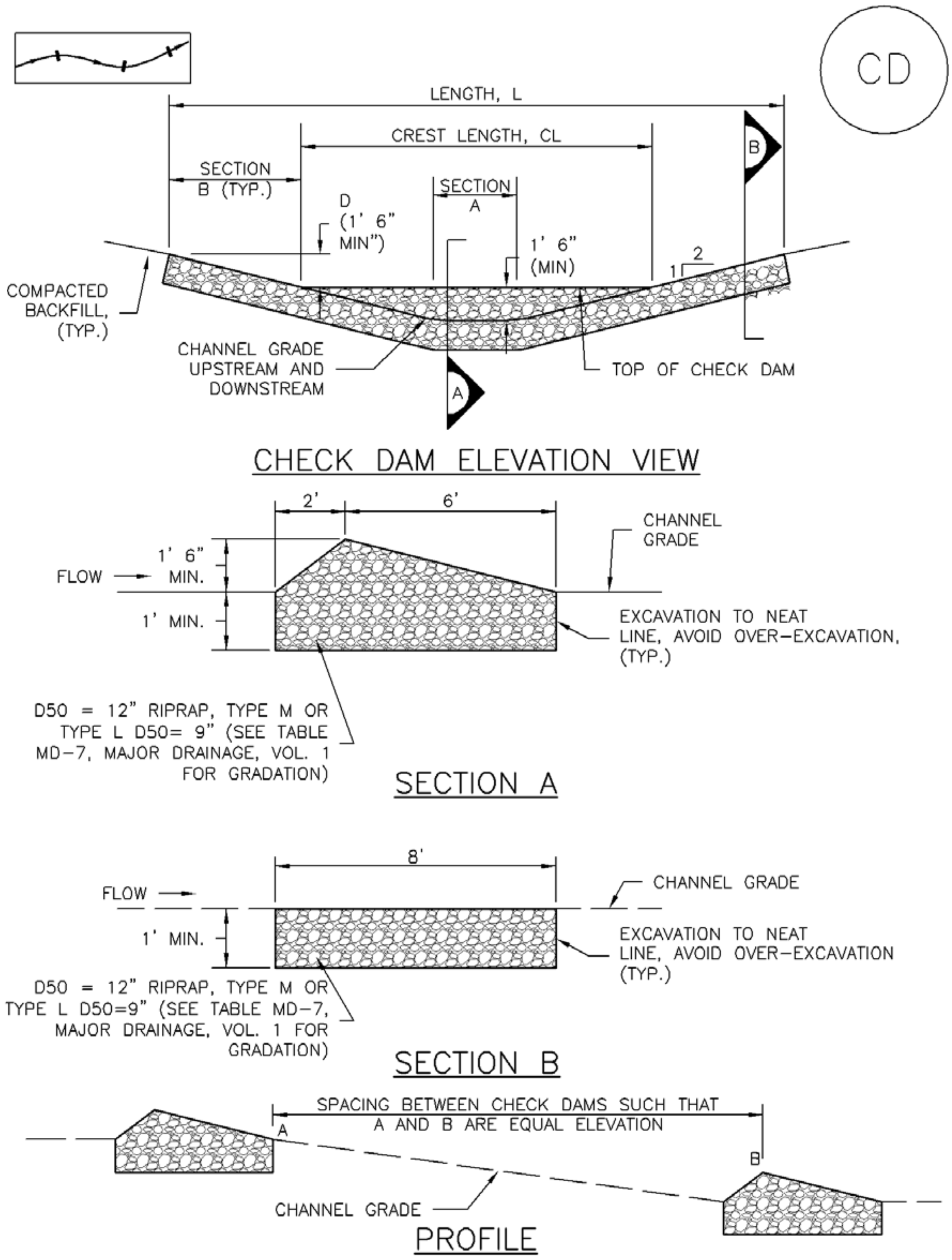
Sediment control logs may also be used as check dams; however, silt fence is not appropriate for use as a check dam. Many jurisdictions also prohibit or discourage use of straw bales for this purpose.

Maintenance and Removal

Replace missing rocks causing voids in the check dam. If gravel bags or sandbags are used, replace or repair torn or displaced bags.

Remove accumulated sediment, as needed to maintain BMP effectiveness, typically before the sediment depth upstream of the check dam is within ½ of the crest height. Remove accumulated sediment prior to mulching, seeding, or chemical soil stabilization. Removed sediment can be incorporated into the earthwork with approval from the Project Engineer, or disposed of at an alternate location in accordance with the standard specifications.

Check dams constructed in permanent swales should be removed when perennial grasses have become established, or immediately prior to installation of a non-erodible lining. All of the rock and accumulated sediment should be removed, and the area seeded and mulched, or otherwise stabilized.



CD-1. CHECK DAM

CHECK DAM INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - LOCATION OF CHECK DAMS.
   - CHECK DAM TYPE (CHECK DAM OR REINFORCED CHECK DAM).
   - LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).

2. CHECK DAMS INDICATED ON INITIAL SWMP SHALL BE INSTALLED AFTER CONSTRUCTION FENCE, BUT PRIOR TO ANY UPSTREAM LAND DISTURBING ACTIVITIES.

3. RIPRAP UTILIZED FOR CHECK DAMS SHOULD BE OF APPROPRIATE SIZE FOR THE APPLICATION. TYPICAL TYPES OF RIPRAP USED FOR CHECK DAMS ARE TYPE M (D50 12") OR TYPE L (D50 9").

4. RIPRAP PAD SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1'.

5. THE ENDS OF THE CHECK DAM SHALL BE A MINIMUM OF 1' 6" HIGHER THAN THE CENTER OF THE CHECK DAM.

CHECK DAM MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

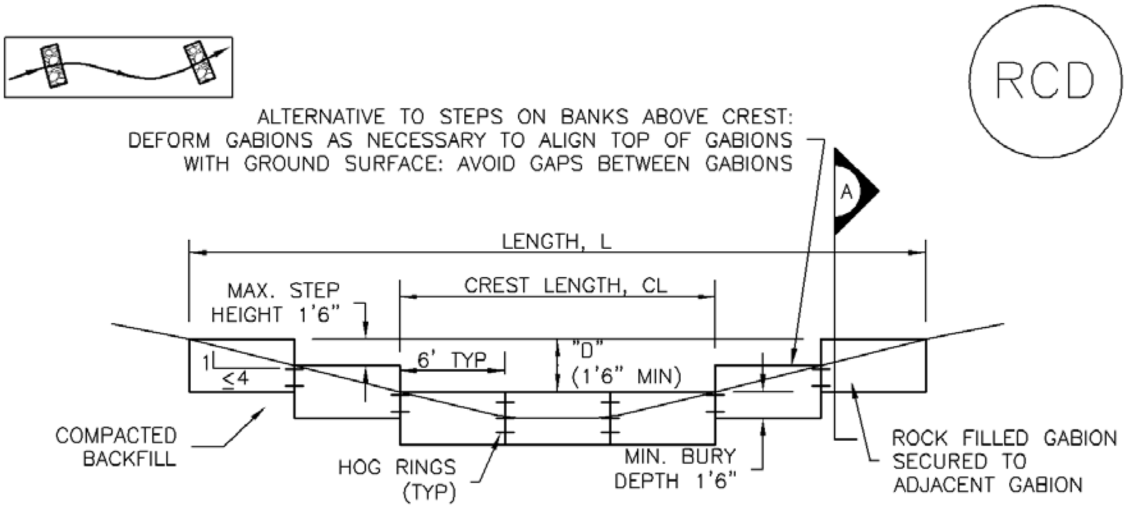
4. SEDIMENT ACCUMULATED UPSTREAM OF THE CHECK DAMS SHALL BE REMOVED WHEN THE SEDIMENT DEPTH IS WITHIN ½ OF THE HEIGHT OF THE CREST.

5. CHECK DAMS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

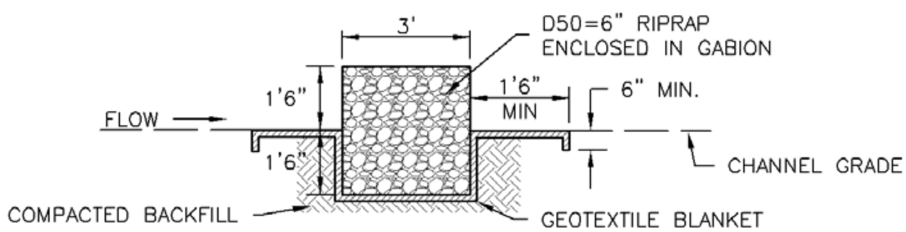
6. WHEN CHECK DAMS ARE REMOVED, EXCAVATIONS SHALL BE FILLED WITH SUITABLE COMPACTED BACKFILL. DISTURBED AREA SHALL BE SEEDED AND MULCHED AND COVERED WITH GEOTEXTILE OR OTHERWISE STABILIZED IN A MANNER APPROVED BY THE LOCAL JURISDICTION.

(DETAILS ADAPTED FROM DOUGLAS COUNTY, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.



REINFORCED CHECK DAM ELEVATION VIEW



SECTION A

REINFORCED CHECK DAM INSTALLATION NOTES

1. SEE PLAN VIEW FOR:
   - LOCATIONS OF CHECK DAMS.
   - CHECK DAM TYPE (CHECK DAM OR REINFORCED CHECK DAM).
   - LENGTH (L), CREST LENGTH (CL), AND DEPTH (D).

2. CHECK DAMS INDICATED ON THE SWMP SHALL BE INSTALLED PRIOR TO AN UPSTREAM LAND-DISTURBING ACTIVITIES.

3. REINFORCED CHECK DAMS, GABIONS SHALL HAVE GALVANIZED TWISTED WIRE NETTING WITH A MAXIMUM OPENING DIMENSION OF 4½" AND A MINIMUM WIRE THICKNESS OF 0.10". WIRE "HOG RINGS" AT 4" SPACING OR OTHER APPROVED MEANS SHALL BE USED AT ALL GABION SEAMS AND TO SECURE THE GABION TO THE ADJACENT SECTION.

4. THE CHECK DAM SHALL BE TRENCHED INTO THE GROUND A MINIMUM OF 1' 6".

5. GEOTEXTILE BLANKET SHALL BE PLACED IN THE REINFORCED CHECK DAM TRENCH EXTENDING A MINIMUM OF 1' 6" ON BOTH THE UPSTREAM AND DOWNSTREAM SIDES OF THE REINFORCED CHECK DAM.

CD-2. REINFORCED CHECK DAM

REINFORCED CHECK DAM MAINTENANCE NOTES

1. INSPECT BMPs EACH WORKDAY, AND MAINTAIN THEM IN EFFECTIVE OPERATING CONDITION. MAINTENANCE OF BMPs SHOULD BE PROACTIVE, NOT REACTIVE. INSPECT BMPs AS SOON AS POSSIBLE (AND ALWAYS WITHIN 24 HOURS) FOLLOWING A STORM THAT CAUSES SURFACE EROSION, AND PERFORM NECESSARY MAINTENANCE.

2. FREQUENT OBSERVATIONS AND MAINTENANCE ARE NECESSARY TO MAINTAIN BMPs IN EFFECTIVE OPERATING CONDITION. INSPECTIONS AND CORRECTIVE MEASURES SHOULD BE DOCUMENTED THOROUGHLY.

3. WHERE BMPs HAVE FAILED, REPAIR OR REPLACEMENT SHOULD BE INITIATED UPON DISCOVERY OF THE FAILURE.

4. SEDIMENT ACCUMULATED UPSTREAM OF REINFORCED CHECK DAMS SHALL BE REMOVED AS NEEDED TO MAINTAIN THE EFFECTIVENESS OF BMP, TYPICALLY WHEN THE UPSTREAM SEDIMENT DEPTH IS WITHIN ½ THE HEIGHT OF THE CREST.

5. REPAIR OR REPLACE REINFORCED CHECK DAMS WHEN THERE ARE SIGNS OF DAMAGE SUCH AS HOLES IN THE GABION OR UNDERCUTTING.

6. REINFORCED CHECK DAMS ARE TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND APPROVED BY THE LOCAL JURISDICTION.

7. WHEN REINFORCED CHECK DAMS ARE REMOVED, ALL DISTURBED AREAS SHALL BE COVERED WITH TOPSOIL, SEEDED AND MULCHED, AND COVERED WITH A GEOTEXTILE BLANKET, OR OTHERWISE STABILIZED AS APPROVED BY LOCAL JURISDICTION.

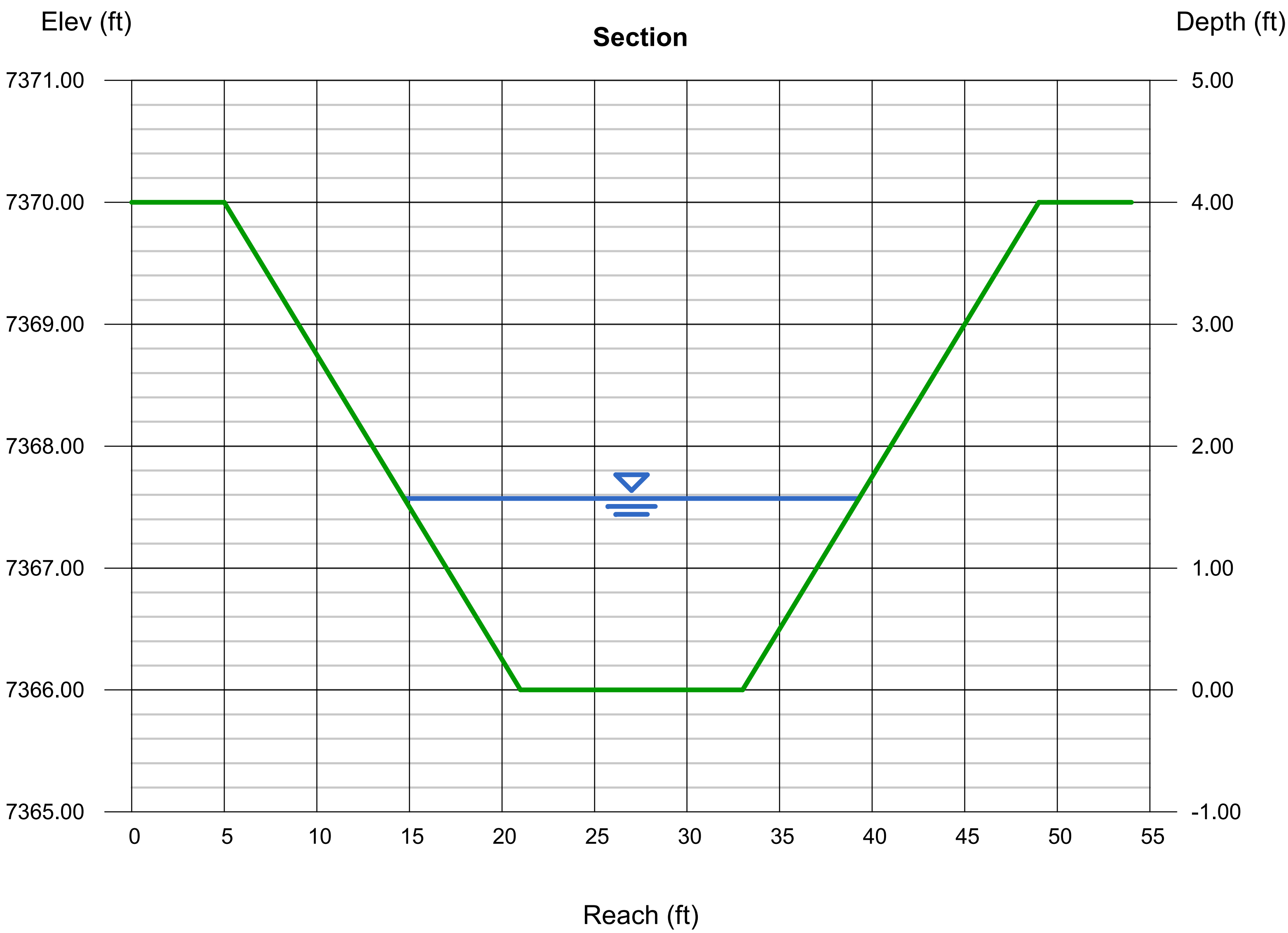
(DETAIL ADAPTED FROM DOUGLAS COUNTY, COLORADO AND CITY OF AURORA, COLORADO, NOT AVAILABLE IN AUTOCAD)

NOTE: MANY JURISDICTIONS HAVE BMP DETAILS THAT VARY FROM UDFCD STANDARD DETAILS. CONSULT WITH LOCAL JURISDICTIONS AS TO WHICH DETAIL SHOULD BE USED WHEN DIFFERENCES ARE NOTED.

Channel Report

SECTION C-C Exist. Channel downstream of Pond 1 (Pre-development)

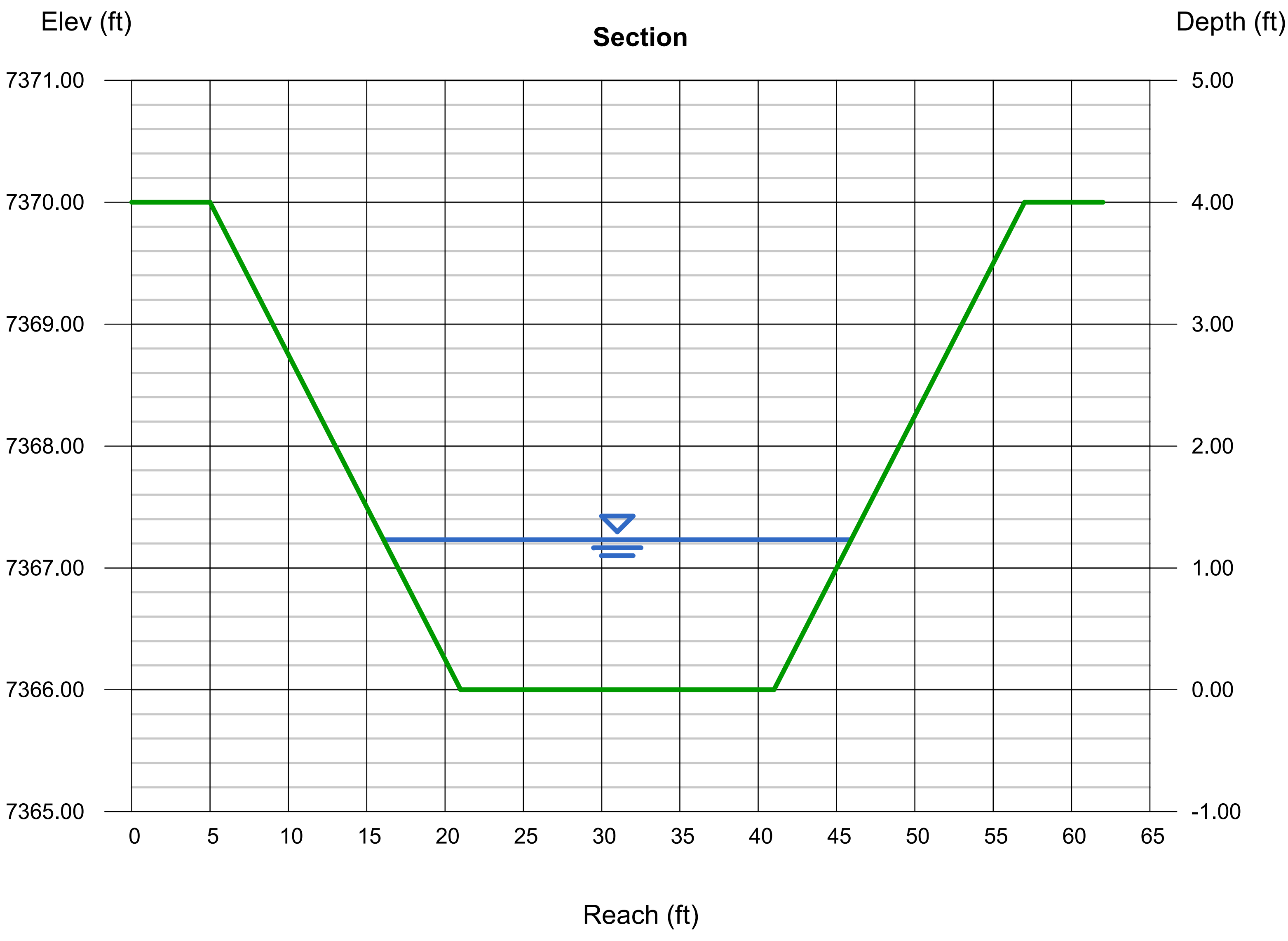
Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 12.00	Depth (ft)	= 1.57
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 153.00
Total Depth (ft)	= 4.00	Area (sqft)	= 28.70
Invert Elev (ft)	= 7366.00	Velocity (ft/s)	= 5.33
Slope (%)	= 2.20	Wetted Perim (ft)	= 24.95
N-Value	= 0.045	Crit Depth, Yc (ft)	= 1.45
		Top Width (ft)	= 24.56
Calculations		EGL (ft)	= 2.01
Compute by:	Known Q	Froude No.	= 0.87
Known Q (cfs)	= 153.00		



Channel Report

SECTION C-C Exist. Channel downstream of Pond 1 (Post-development)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 20.00	Depth (ft)	= 1.23
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 150.00
Total Depth (ft)	= 4.00	Area (sqft)	= 30.65
Invert Elev (ft)	= 7366.00	Velocity (ft/s)	= 4.89
Slope (%)	= 2.20	Wetted Perim (ft)	= 30.14
N-Value	= 0.045	Crit Depth, Yc (ft)	= 1.12
		Top Width (ft)	= 29.84
Calculations		EGL (ft)	= 1.60
Compute by:	Known Q	Froude No.	= 0.85
Known Q (cfs)	= 150.00		

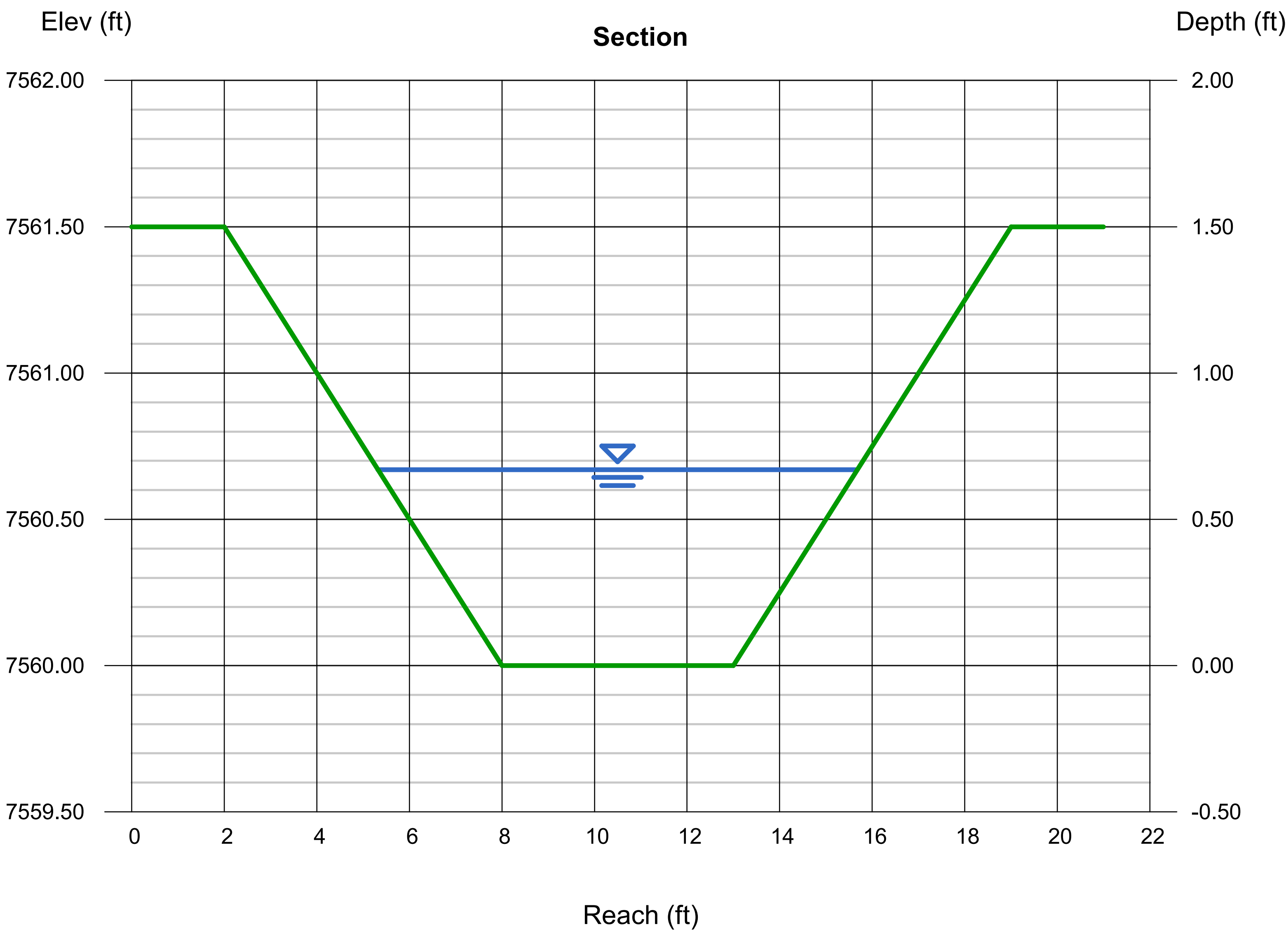


Channel Report

Permanent TRM Channel from DP 2

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 5.00	Depth (ft)	= 0.67
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 35.00
Total Depth (ft)	= 1.50	Area (sqft)	= 5.15
Invert Elev (ft)	= 7560.00	Velocity (ft/s)	= 6.80
Slope (%)	= 5.00	Wetted Perim (ft)	= 10.52
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.91
		Top Width (ft)	= 10.36
Calculations		EGL (ft)	= 1.39
Compute by:	Known Q		
Known Q (cfs)	= 35.00		

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or equiv.



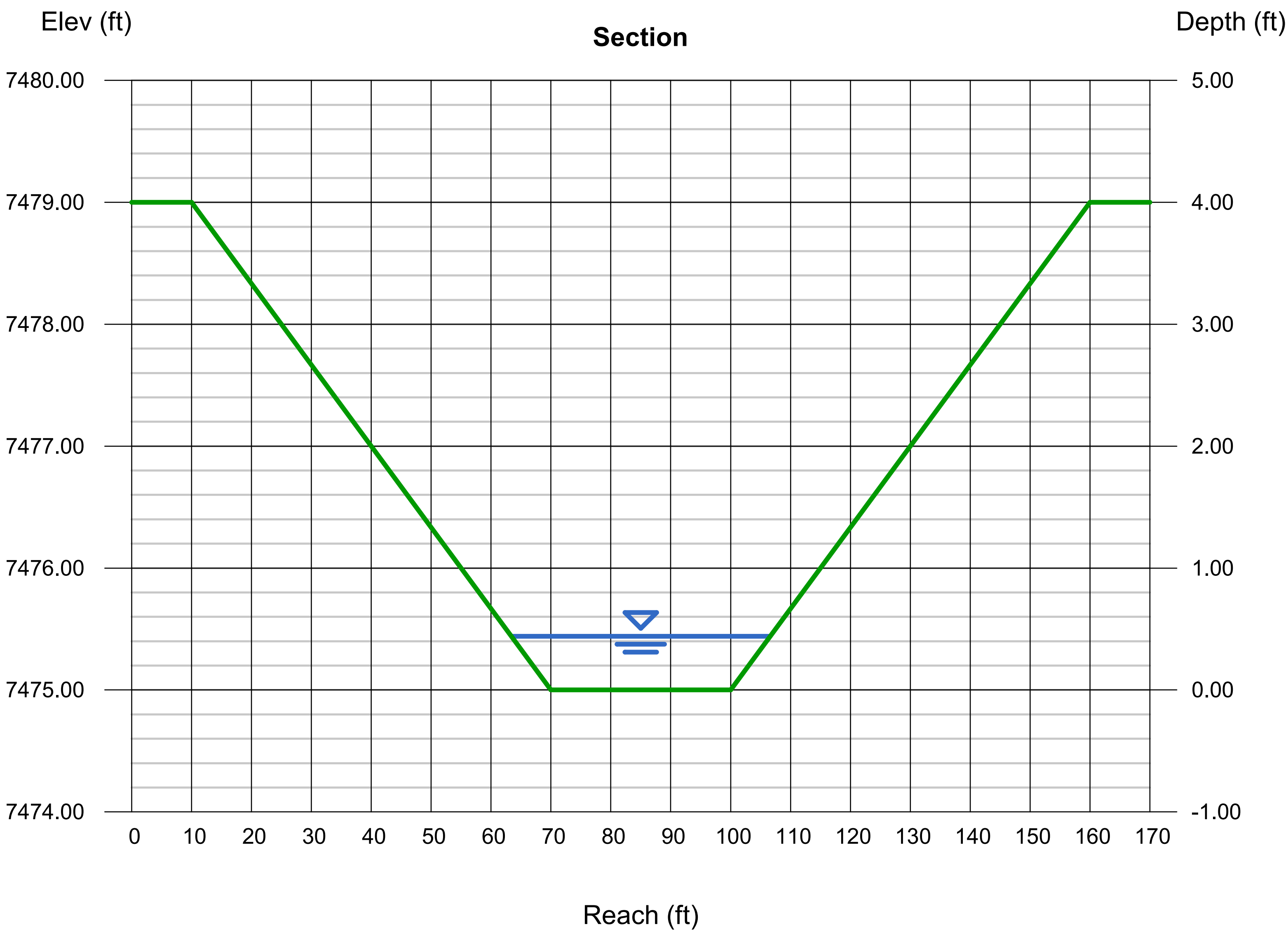
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Permanent TRM Channel between lots 17-18

Trapezoidal			**Highlighted**	
Bottom Width (ft)	= 30.00		Depth (ft)	= 0.44
Side Slopes (z:1)	= 15.00, 15.00		Q (cfs)	= 60.00
Total Depth (ft)	= 4.00		Area (sqft)	= 16.10
Invert Elev (ft)	= 7475.00		Velocity (ft/s)	= 3.73
Slope (%)	= 5.00		Wetted Perim (ft)	= 43.23
N-Value	= 0.045		Crit Depth, Yc (ft)	= 0.47
			Top Width (ft)	= 43.20
Calculations			EGL (ft)	= 0.66
Compute by:	Known Q			
Known Q (cfs)	= 60.00			

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.



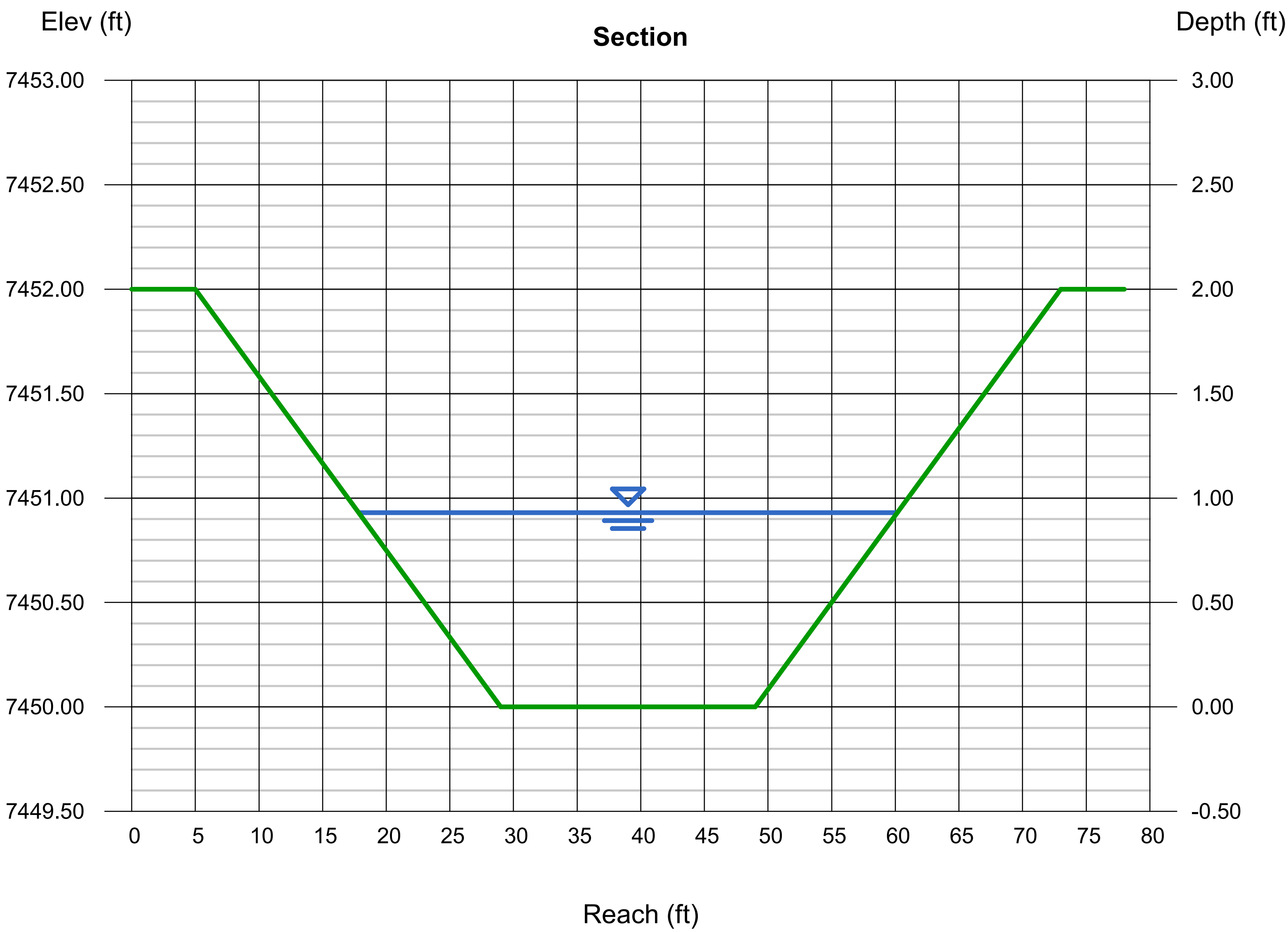
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Permanent TRM Channel from DP 10

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 20.00	Depth (ft)	= 0.93
Side Slopes (z:1)	= 12.00, 12.00	Q (cfs)	= 143.00
Total Depth (ft)	= 2.00	Area (sqft)	= 28.98
Invert Elev (ft)	= 7450.00	Velocity (ft/s)	= 4.93
Slope (%)	= 3.80	Wetted Perim (ft)	= 42.40
N-Value	= 0.045	Crit Depth, Yc (ft)	= 0.96
		Top Width (ft)	= 42.32
Calculations		EGL (ft)	= 1.31
Compute by:	Known Q		
Known Q (cfs)	= 143.00		

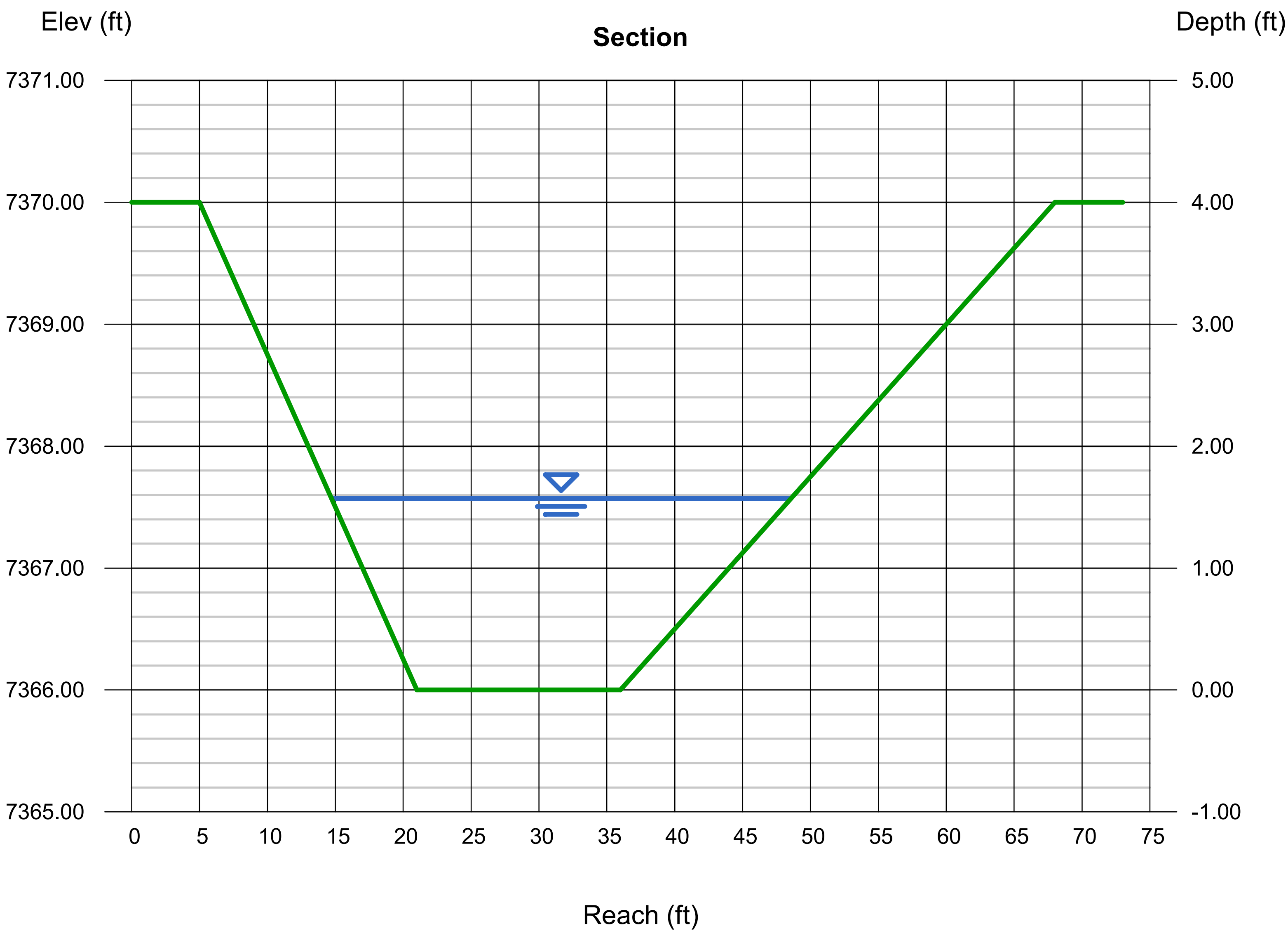
Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.



Channel Report

SECTION A-A Exist. Channel downstream of Pond 4 (Pre-development)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 15.00	Depth (ft)	= 1.57
Side Slopes (z:1)	= 4.00, 8.00	Q (cfs)	= 202.00
Total Depth (ft)	= 4.00	Area (sqft)	= 38.34
Invert Elev (ft)	= 7366.00	Velocity (ft/s)	= 5.27
Slope (%)	= 2.20	Wetted Perim (ft)	= 34.13
N-Value	= 0.045	Crit Depth, Yc (ft)	= 1.46
		Top Width (ft)	= 33.84
Calculations		EGL (ft)	= 2.00
Compute by:	Known Q	Froude No.	= 0.87
Known Q (cfs)	= 202.00		

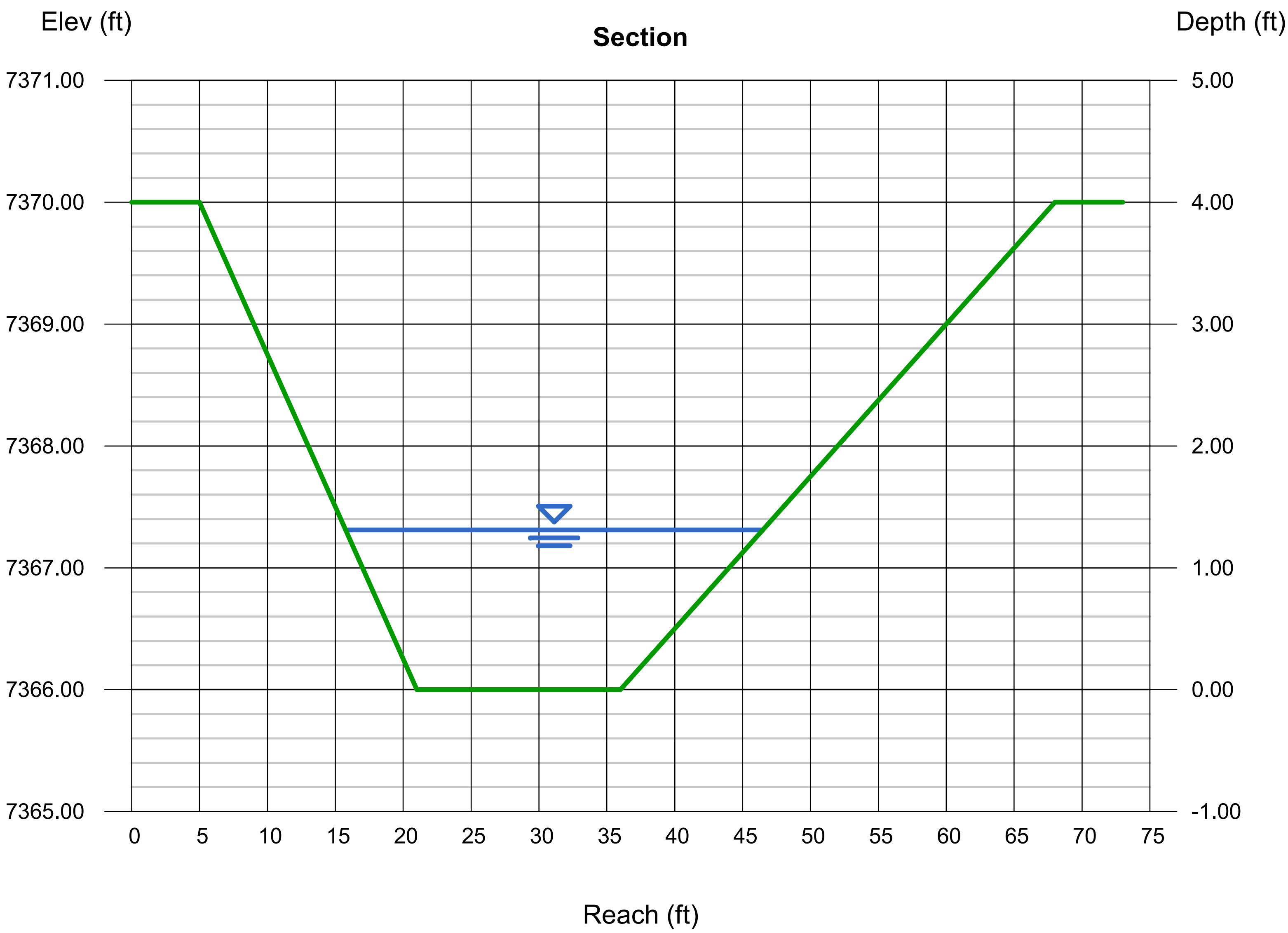


Channel Report

SECTION A-A Exist. Channel downstream of Pond 4 (Post-development)

Trapezoidal	
Bottom Width (ft)	= 15.00
Side Slopes (z:1)	= 4.00, 8.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 7366.00
Slope (%)	= 2.20
N-Value	= 0.045
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 142.00

Highlighted	
Depth (ft)	= 1.31
Q (cfs)	= 142.00
Area (sqft)	= 29.95
Velocity (ft/s)	= 4.74
Wetted Perim (ft)	= 30.96
Crit Depth, Yc (ft)	= 1.20
Top Width (ft)	= 30.72
EGL (ft)	= 1.66
Froude No.	= 0.85

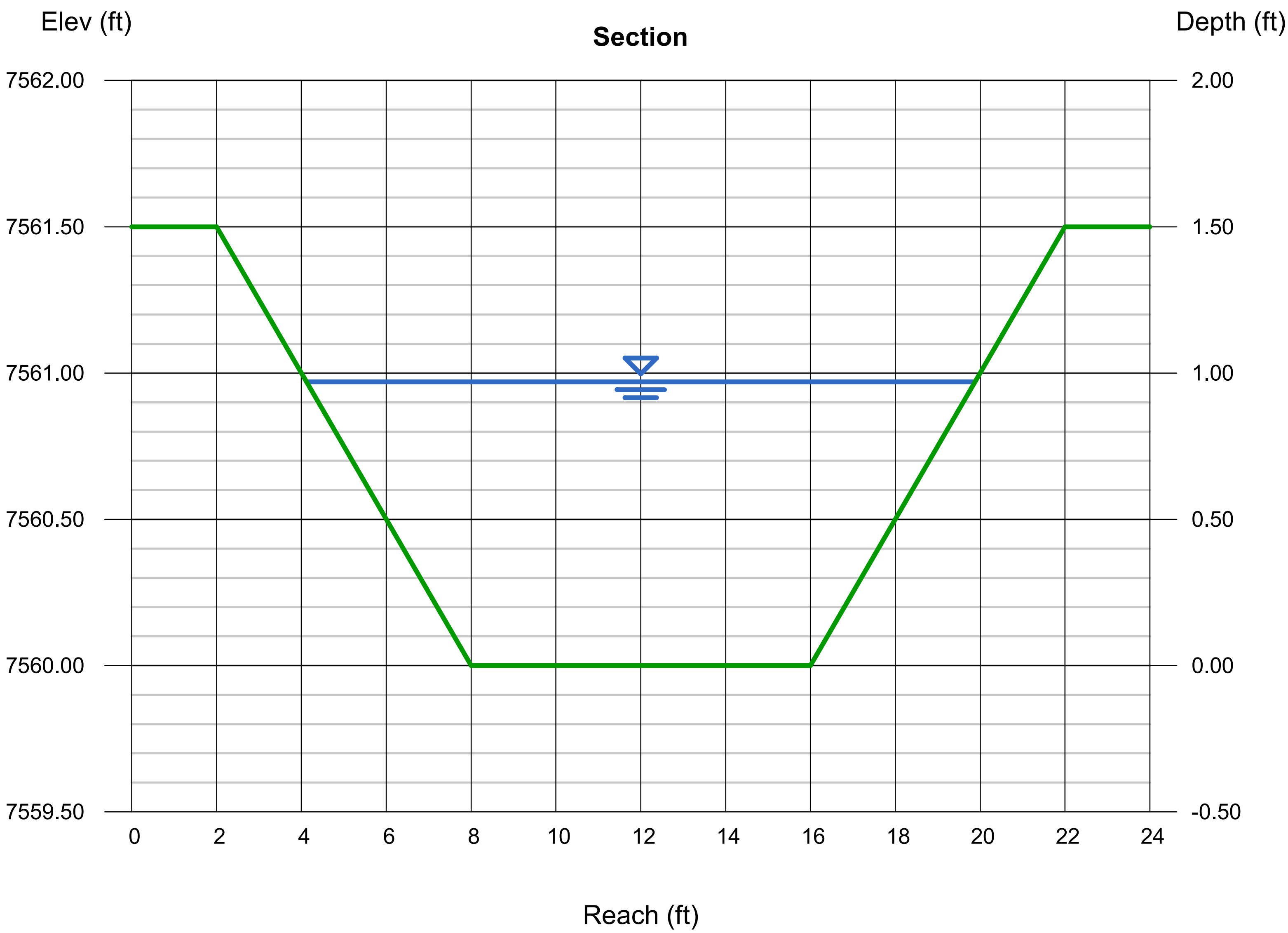


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Natural Channel to Pond 12 (Just north of Stagecoach Rd.)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 8.00	Depth (ft)	= 0.97
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 45.00
Total Depth (ft)	= 1.50	Area (sqft)	= 11.52
Invert Elev (ft)	= 7560.00	Velocity (ft/s)	= 3.91
Slope (%)	= 1.00	Wetted Perim (ft)	= 16.00
N-Value	= 0.030	Crit Depth, Yc (ft)	= 0.86
		Top Width (ft)	= 15.76
Calculations		EGL (ft)	= 1.21
Compute by:	Known Q	Froude No.	= 0.81
Known Q (cfs)	= 45.00		



Channel Report

Natural Channel to Pond 12 (channel approaching pond)

Trapezoidal

Bottom Width (ft)	= 8.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7560.00
Slope (%)	= 2.70
N-Value	= 0.040

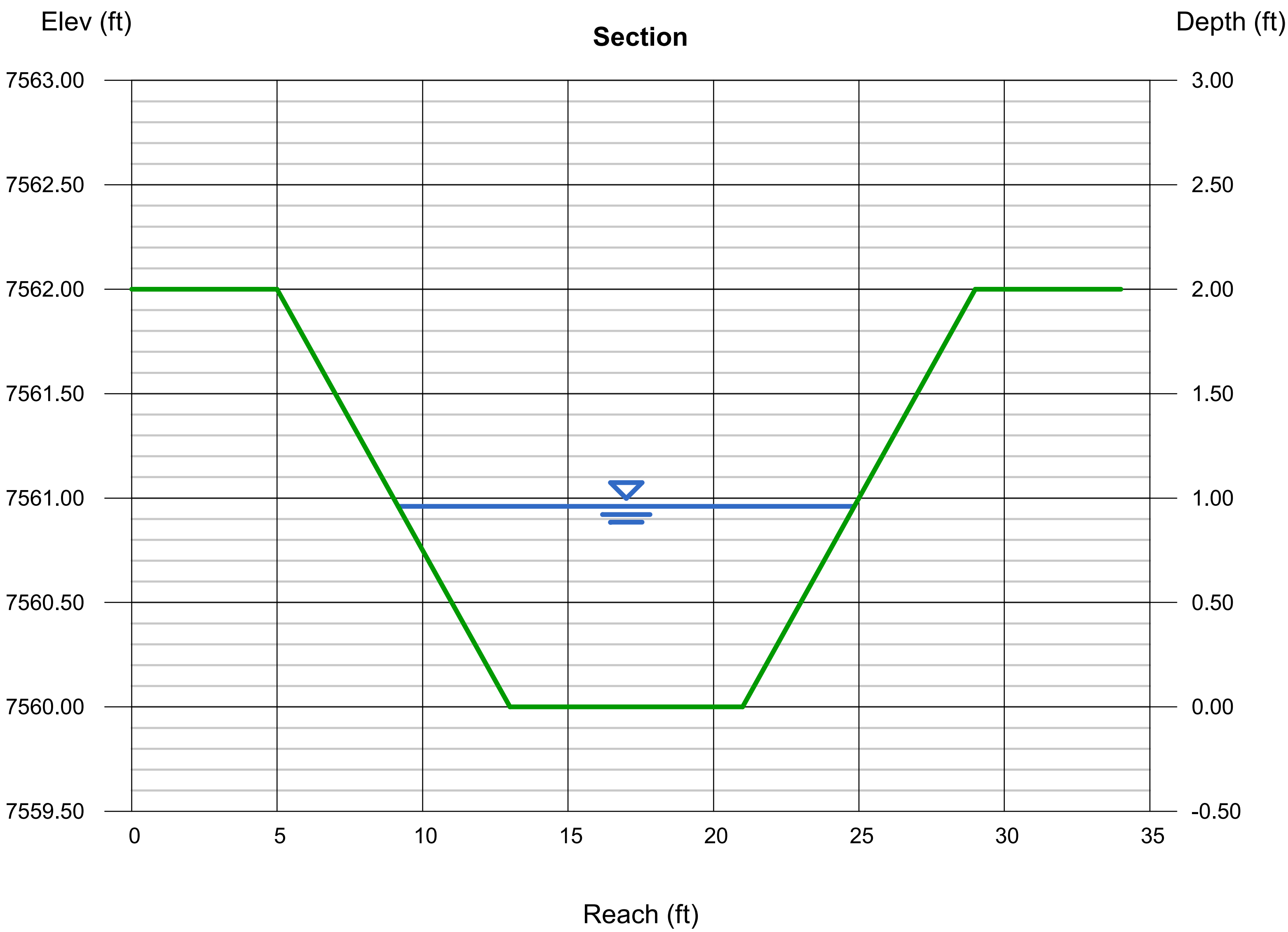
Calculations

Compute by:	Known Q
Known Q (cfs)	= 55.00

Highlighted

Depth (ft)	= 0.96
Q (cfs)	= 55.00
Area (sqft)	= 11.37
Velocity (ft/s)	= 4.84
Wetted Perim (ft)	= 15.92
Crit Depth, Yc (ft)	= 0.97
Top Width (ft)	= 15.68
EGL (ft)	= 1.32
Froude No.	= 1.00

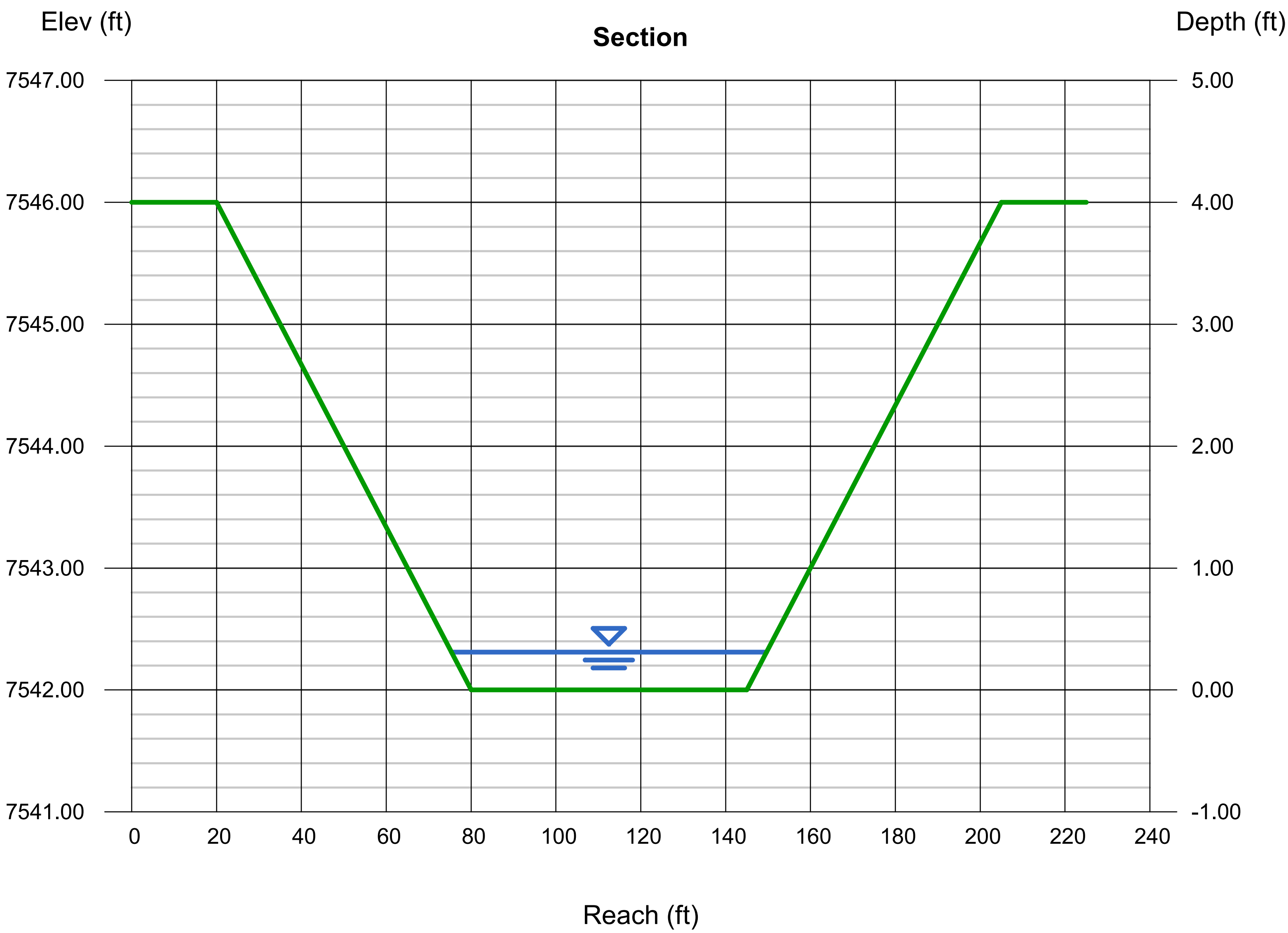
Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.



Channel Report

SECTION D-D Exist. Channel downstream of Pond 12 (Pre-development)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 65.00	Depth (ft)	= 0.31
Side Slopes (z:1)	= 15.00, 15.00	Q (cfs)	= 55.00
Total Depth (ft)	= 4.00	Area (sqft)	= 21.59
Invert Elev (ft)	= 7542.00	Velocity (ft/s)	= 2.55
Slope (%)	= 2.00	Wetted Perim (ft)	= 74.32
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.28
		Top Width (ft)	= 74.30
Calculations		EGL (ft)	= 0.41
Compute by:	Known Q	Froude No.	= 0.83
Known Q (cfs)	= 55.00		

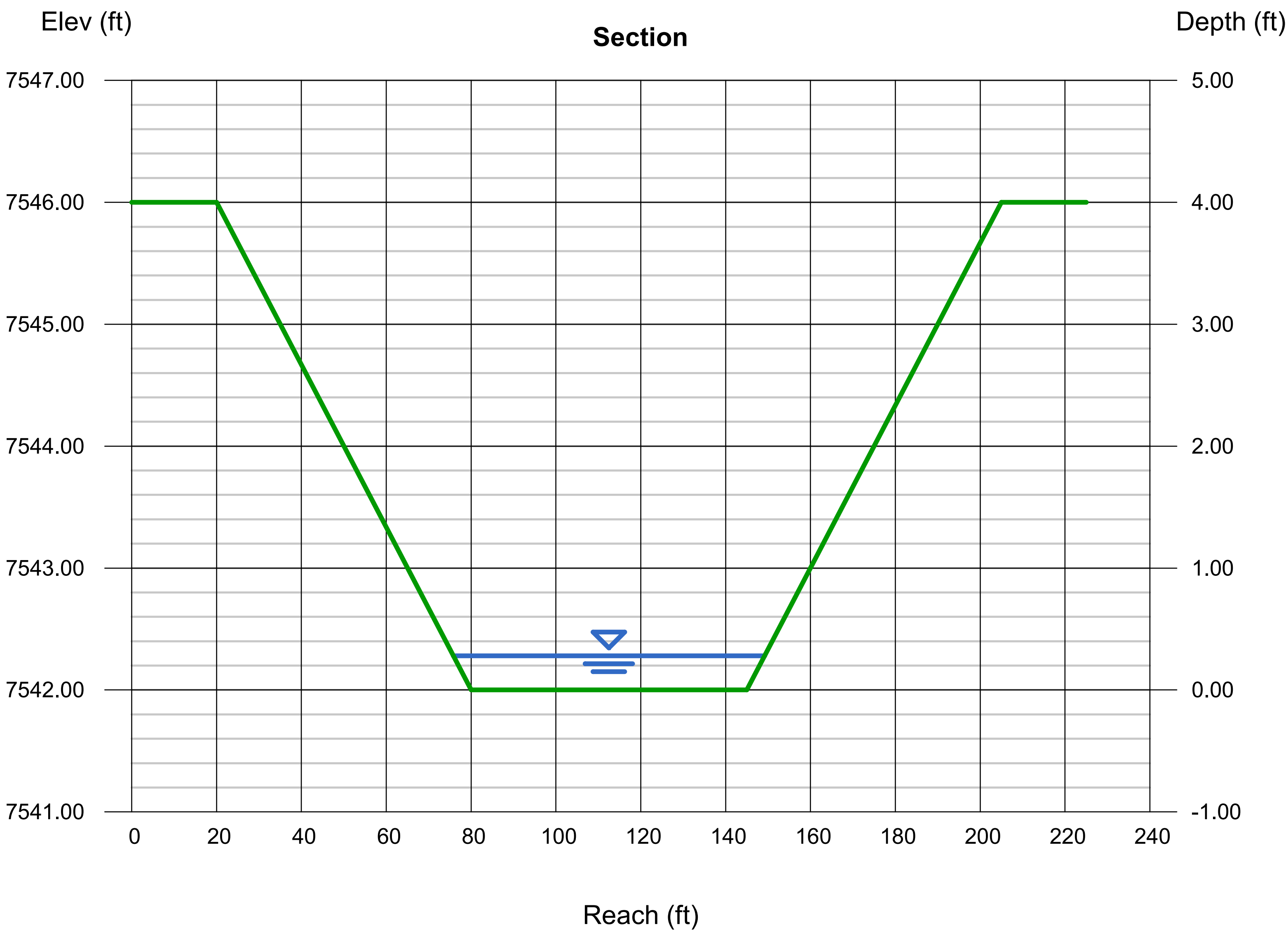


Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

SECTION D-D Exist. Channel downstream of Pond 12 (Post-development)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 65.00	Depth (ft)	= 0.28
Side Slopes (z:1)	= 15.00, 15.00	Q (cfs)	= 45.00
Total Depth (ft)	= 4.00	Area (sqft)	= 19.38
Invert Elev (ft)	= 7542.00	Velocity (ft/s)	= 2.32
Slope (%)	= 2.00	Wetted Perim (ft)	= 73.42
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.25
		Top Width (ft)	= 73.40
Calculations		EGL (ft)	= 0.36
Compute by:	Known Q	Froude No.	= 0.80
Known Q (cfs)	= 45.00		



Channel Report

Permanent TRM Channel from DP 14

Trapezoidal

Bottom Width (ft)	= 20.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 7450.00
Slope (%)	= 4.50
N-Value	= 0.040

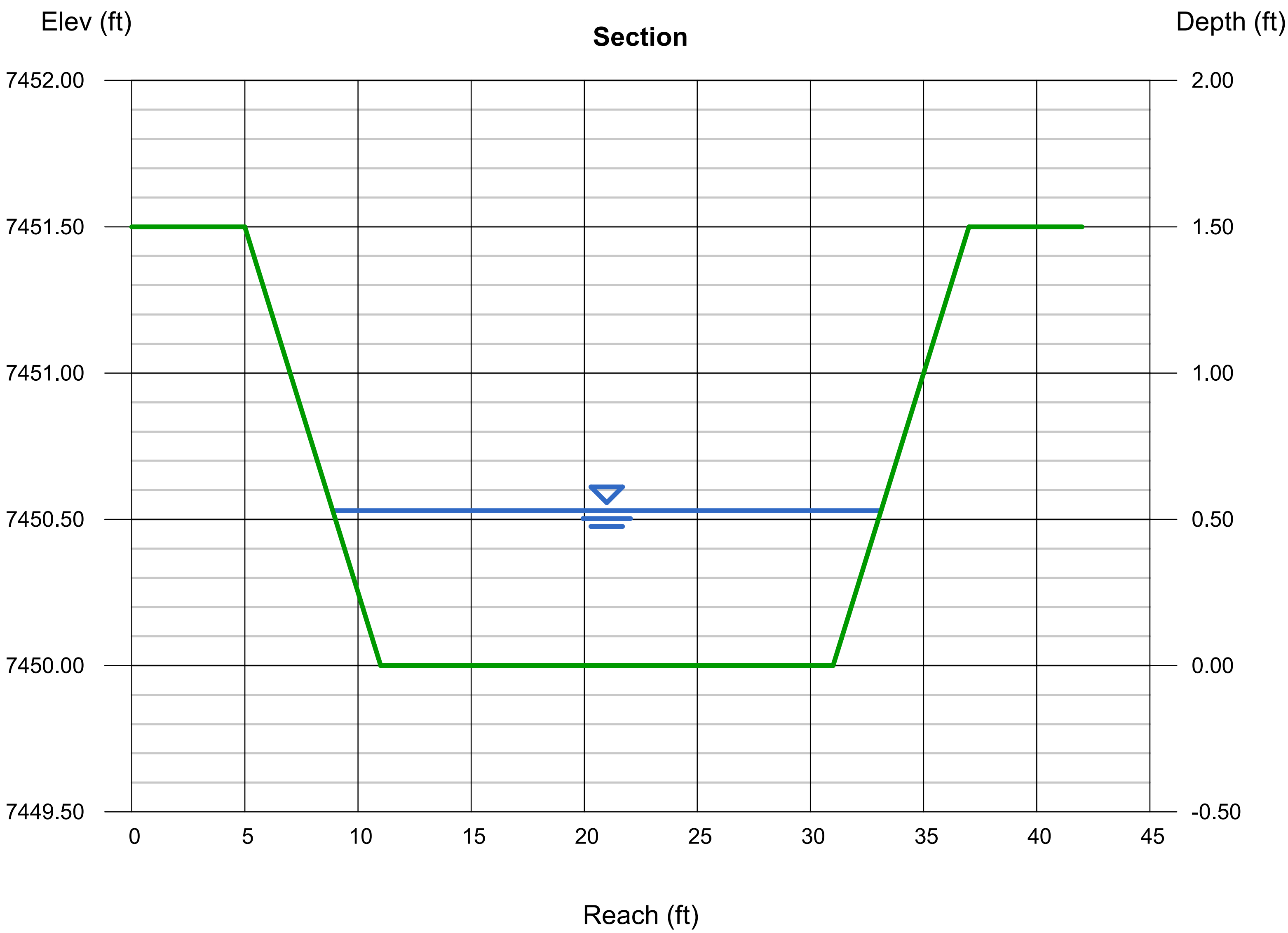
Calculations

Compute by:	Known Q
Known Q (cfs)	= 56.00

Highlighted

Depth (ft)	= 0.53
Q (cfs)	= 56.00
Area (sqft)	= 11.72
Velocity (ft/s)	= 4.78
Wetted Perim (ft)	= 24.37
Crit Depth, Yc (ft)	= 0.60
Top Width (ft)	= 24.24
EGL (ft)	= 0.88
Froude No.	= 1.21

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement
Mat
P300 or Equiv.



Channel Report

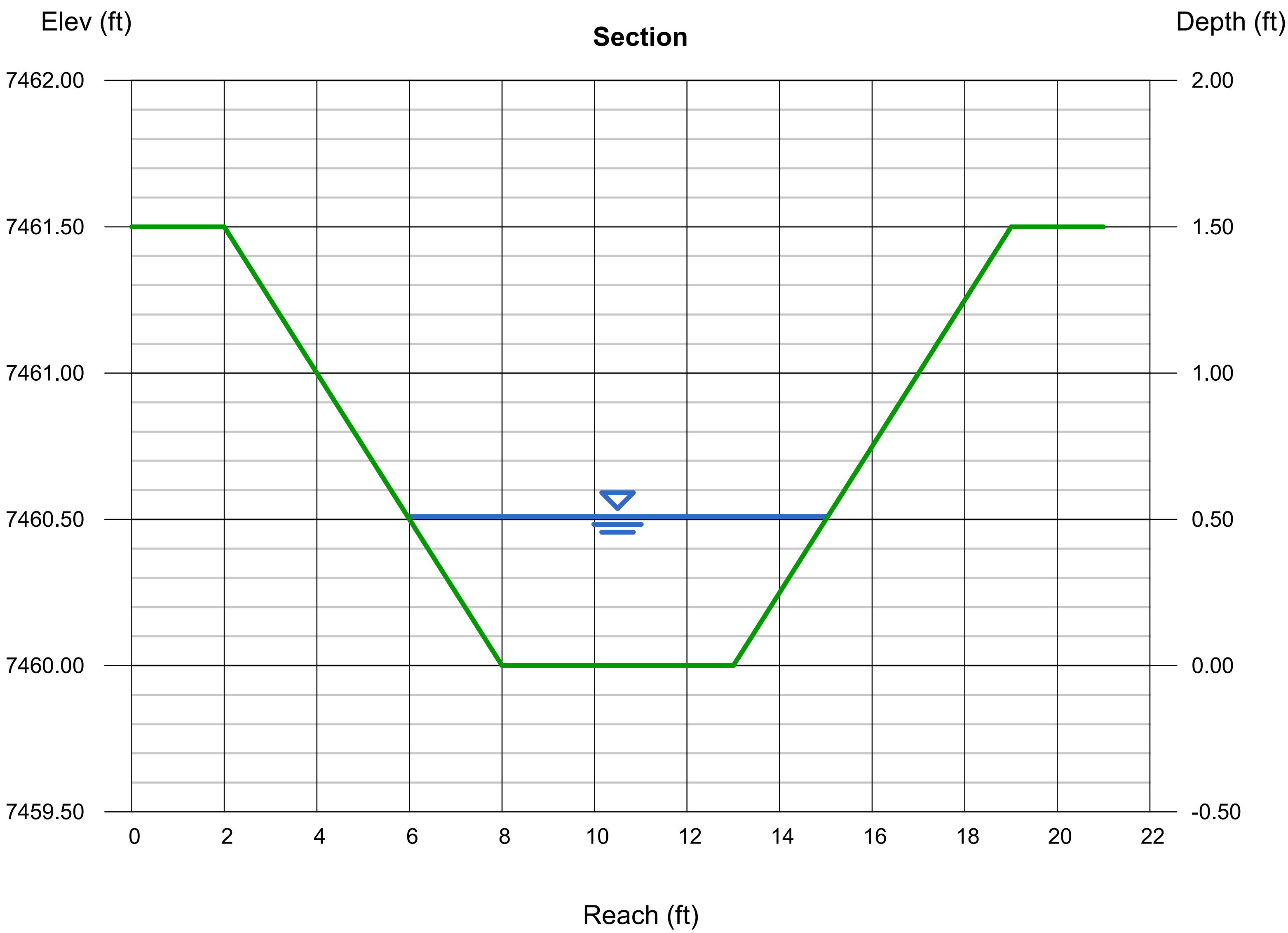
Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Permanent TRM Channel from DP 15

Trapezoidal	
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 7460.00
Slope (%)	= 4.50
N-Value	= 0.040
Calculations	
Compute by:	Known Q
Known Q (cfs)	= 15.00

Highlighted	
Depth (ft)	= 0.51
Q (cfs)	= 15.00
Area (sqft)	= 3.59
Velocity (ft/s)	= 4.18
Wetted Perim (ft)	= 9.21
Crit Depth, Yc (ft)	= 0.56
Top Width (ft)	= 9.08
EGL (ft)	= 0.78
Froude No.	= 1.17

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.



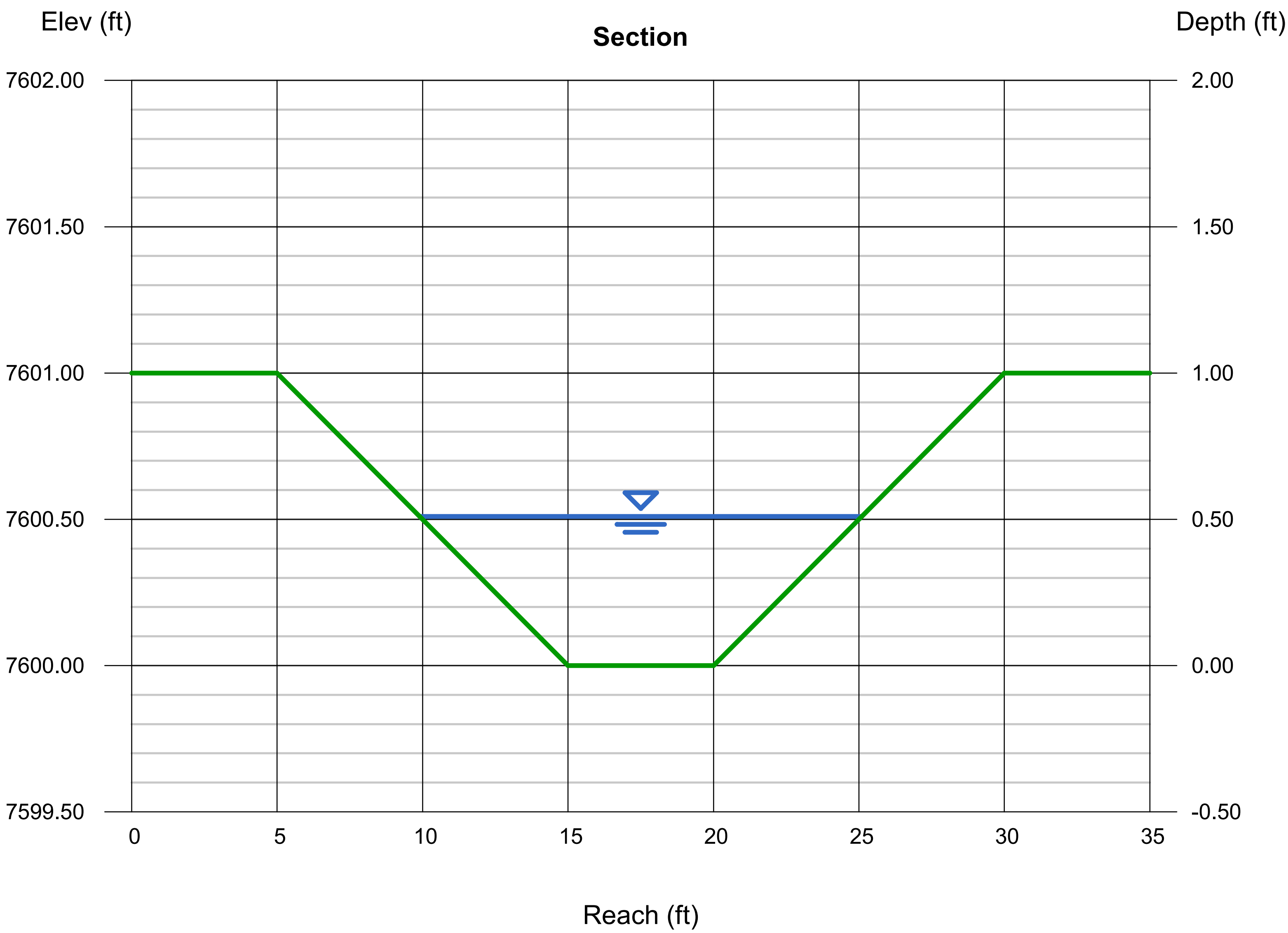
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Natural Channel with TRM running through lots 46-50

Trapezoidal			**Highlighted**	
Bottom Width (ft)	= 5.00		Depth (ft)	= 0.51
Side Slopes (z:1)	= 10.00, 10.00		Q (cfs)	= 22.00
Total Depth (ft)	= 1.00		Area (sqft)	= 5.15
Invert Elev (ft)	= 7600.00		Velocity (ft/s)	= 4.27
Slope (%)	= 6.00		Wetted Perim (ft)	= 15.25
N-Value	= 0.040		Crit Depth, Yc (ft)	= 0.59
			Top Width (ft)	= 15.20
Calculations			EGL (ft)	= 0.79
Compute by:	Known Q		Froude No.	= 1.29
Known Q (cfs)	= 22.00			

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Natural Channel with TRM running through lots 52-54

Trapezoidal

Bottom Width (ft)	= 20.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 1.00
Invert Elev (ft)	= 7600.00
Slope (%)	= 5.50
N-Value	= 0.040

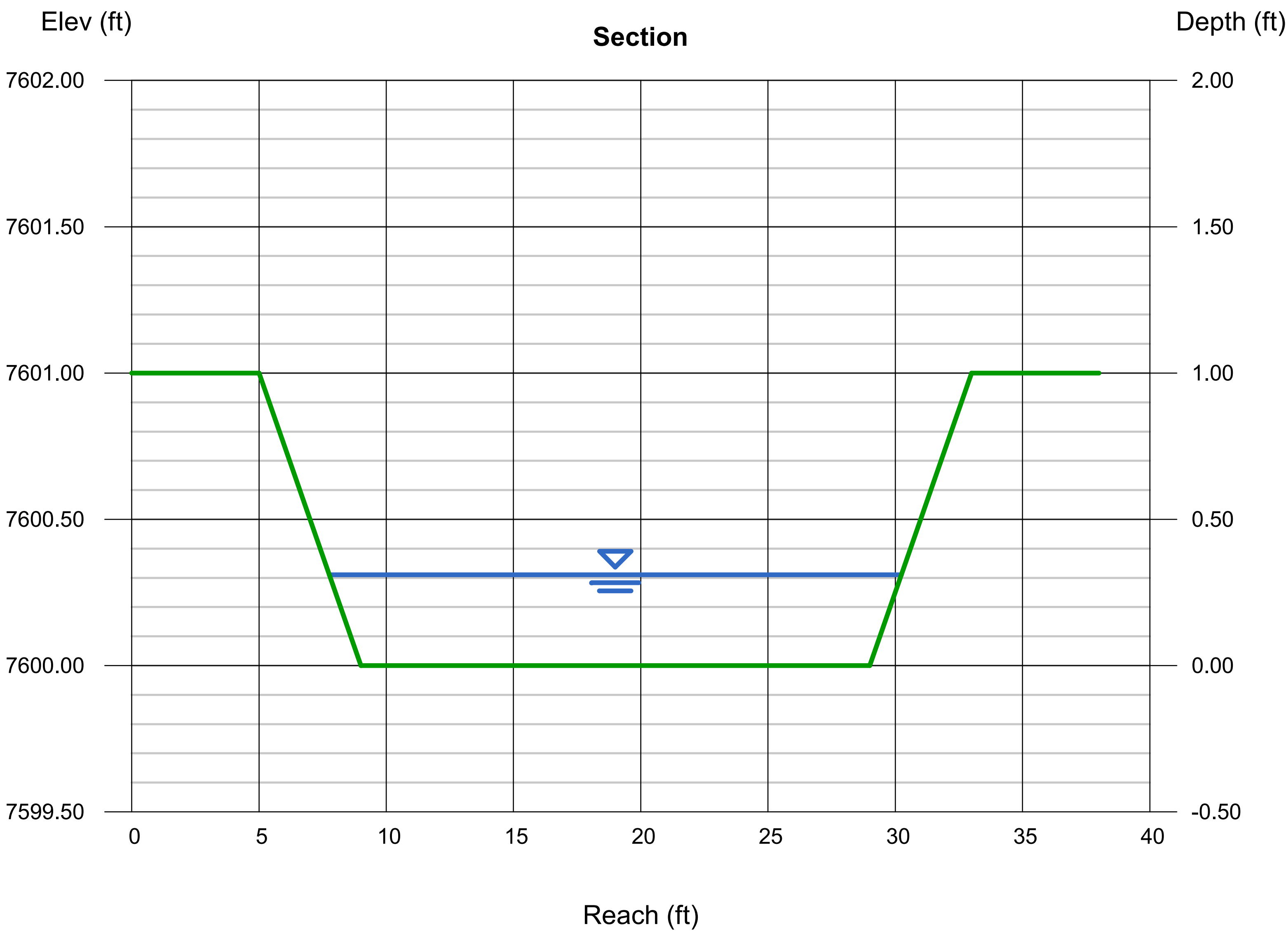
Calculations

Compute by:	Known Q
Known Q (cfs)	= 25.00

Highlighted

Depth (ft)	= 0.31
Q (cfs)	= 25.00
Area (sqft)	= 6.58
Velocity (ft/s)	= 3.80
Wetted Perim (ft)	= 22.56
Crit Depth, Yc (ft)	= 0.36
Top Width (ft)	= 22.48
EGL (ft)	= 0.53
Froude No.	= 1.24

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement
Mat
P300 or Equiv.



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

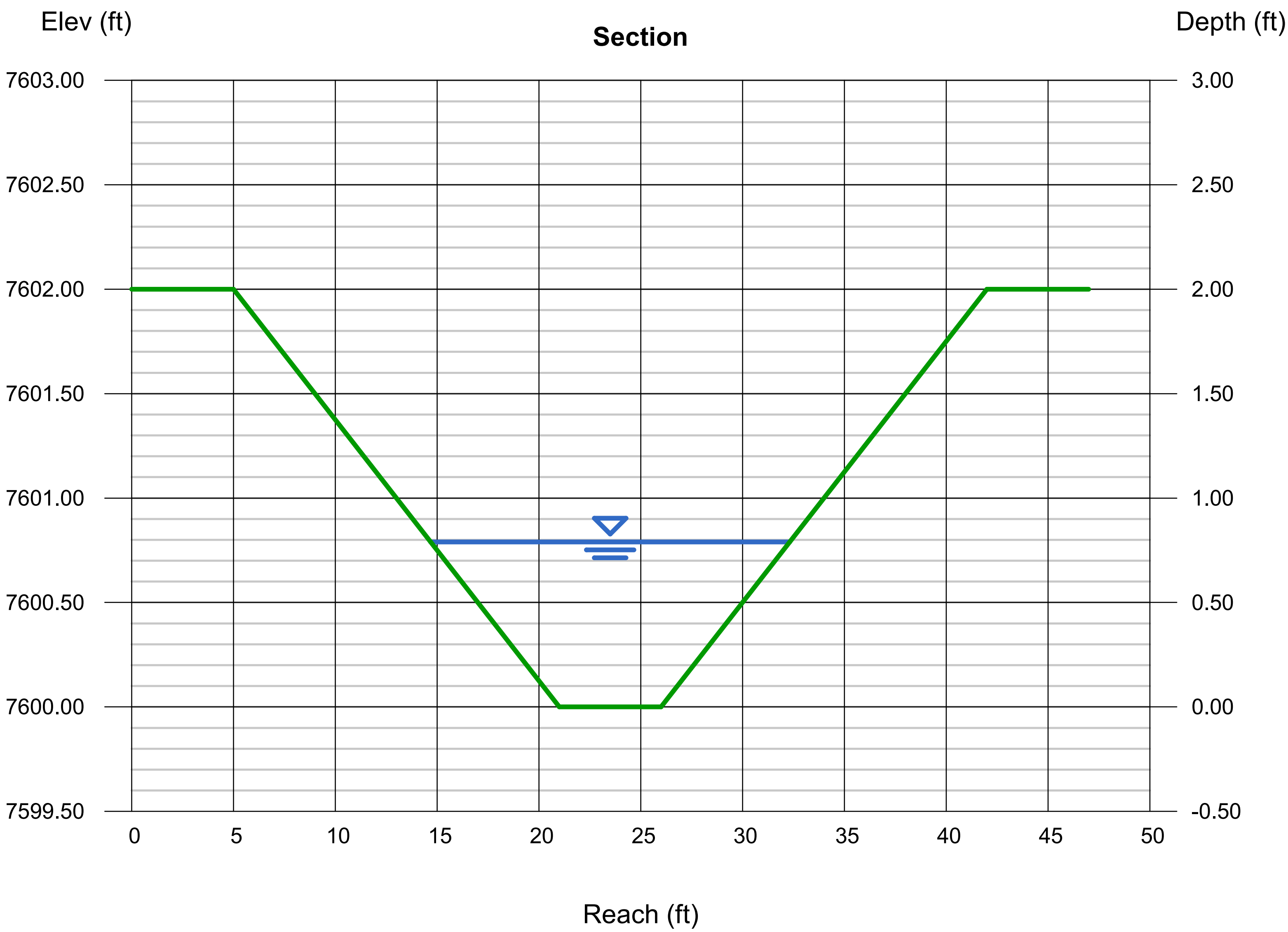
Natural Channel with TRM running through lots 58-59

Trapezoidal	
Bottom Width (ft)	= 5.00
Side Slopes (z:1)	= 8.00, 8.00
Total Depth (ft)	= 2.00
Invert Elev (ft)	= 7600.00
Slope (%)	= 5.00
N-Value	= 0.040

Calculations	
Compute by:	Known Q
Known Q (cfs)	= 46.00

Highlighted	
Depth (ft)	= 0.79
Q (cfs)	= 46.00
Area (sqft)	= 8.94
Velocity (ft/s)	= 5.14
Wetted Perim (ft)	= 17.74
Crit Depth, Yc (ft)	= 0.90
Top Width (ft)	= 17.64
EGL (ft)	= 1.20
Froude No.	= 1.27

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.

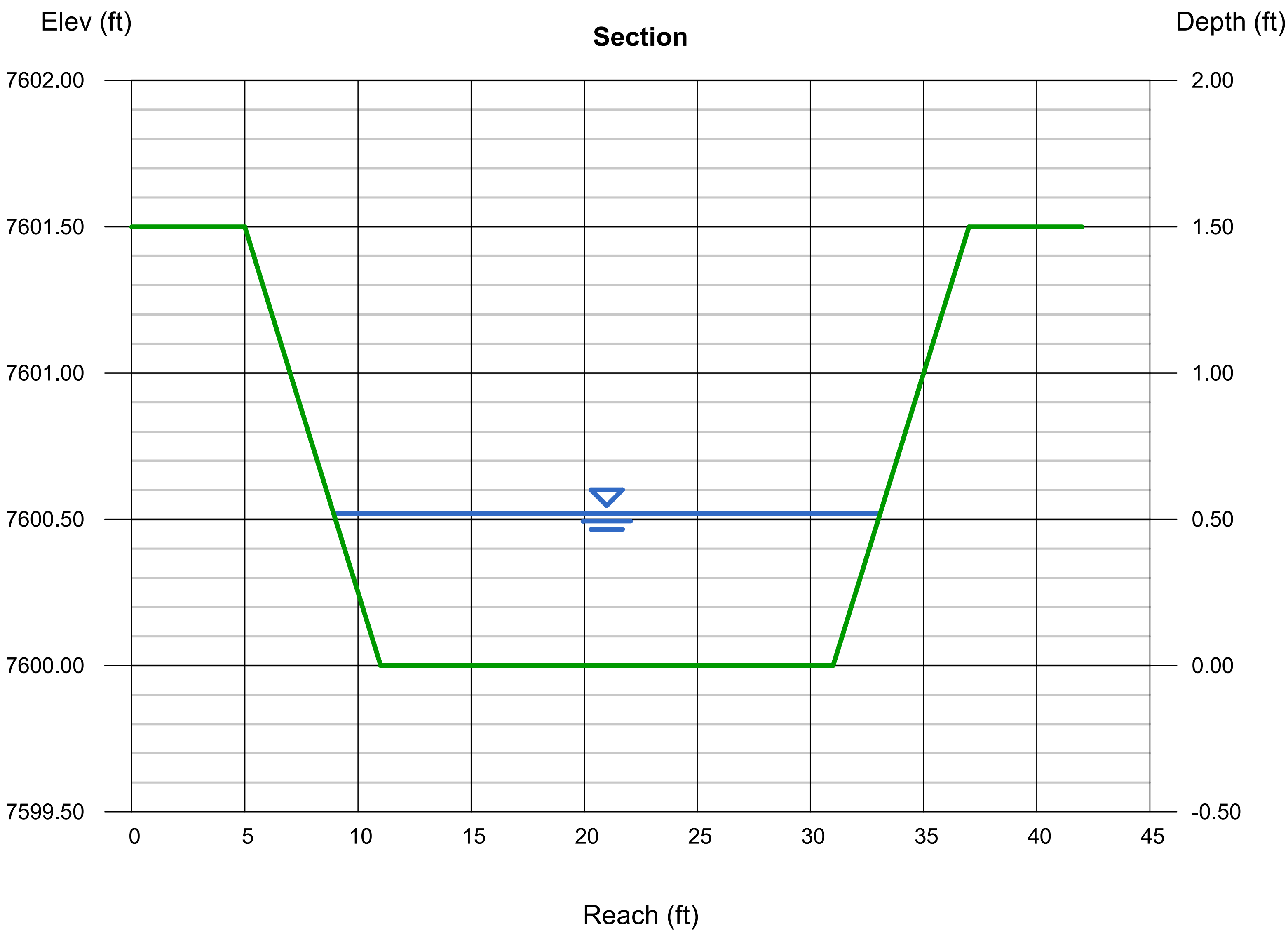


Channel Report

Natural Channel with TRM south of Hole 2

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 20.00	Depth (ft)	= 0.52
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 60.00
Total Depth (ft)	= 1.50	Area (sqft)	= 11.48
Invert Elev (ft)	= 7600.00	Velocity (ft/s)	= 5.23
Slope (%)	= 5.50	Wetted Perim (ft)	= 24.29
N-Value	= 0.040	Crit Depth, Yc (ft)	= 0.63
		Top Width (ft)	= 24.16
Calculations		EGL (ft)	= 0.94
Compute by:	Known Q	Froude No.	= 1.34
Known Q (cfs)	= 60.00		

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.



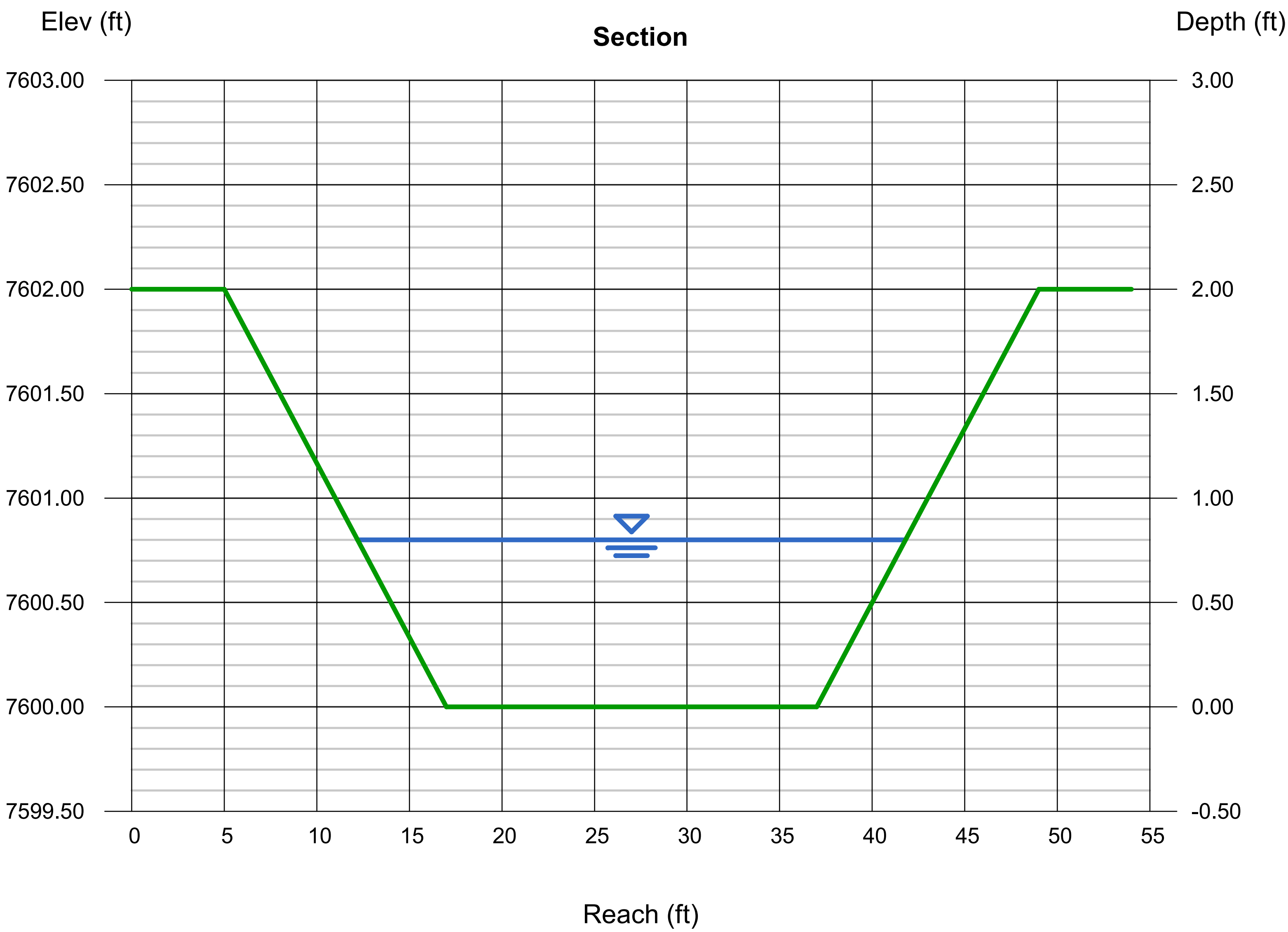
Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Natural Channel with TRM south of Hole 14

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 20.00	Depth (ft)	= 0.80
Side Slopes (z:1)	= 6.00, 6.00	Q (cfs)	= 120.00
Total Depth (ft)	= 2.00	Area (sqft)	= 19.84
Invert Elev (ft)	= 7600.00	Velocity (ft/s)	= 6.05
Slope (%)	= 4.60	Wetted Perim (ft)	= 29.73
N-Value	= 0.040	Crit Depth, Yc (ft)	= 0.95
		Top Width (ft)	= 29.60
Calculations		EGL (ft)	= 1.37
Compute by:	Known Q	Froude No.	= 1.30
Known Q (cfs)	= 120.00		

Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.

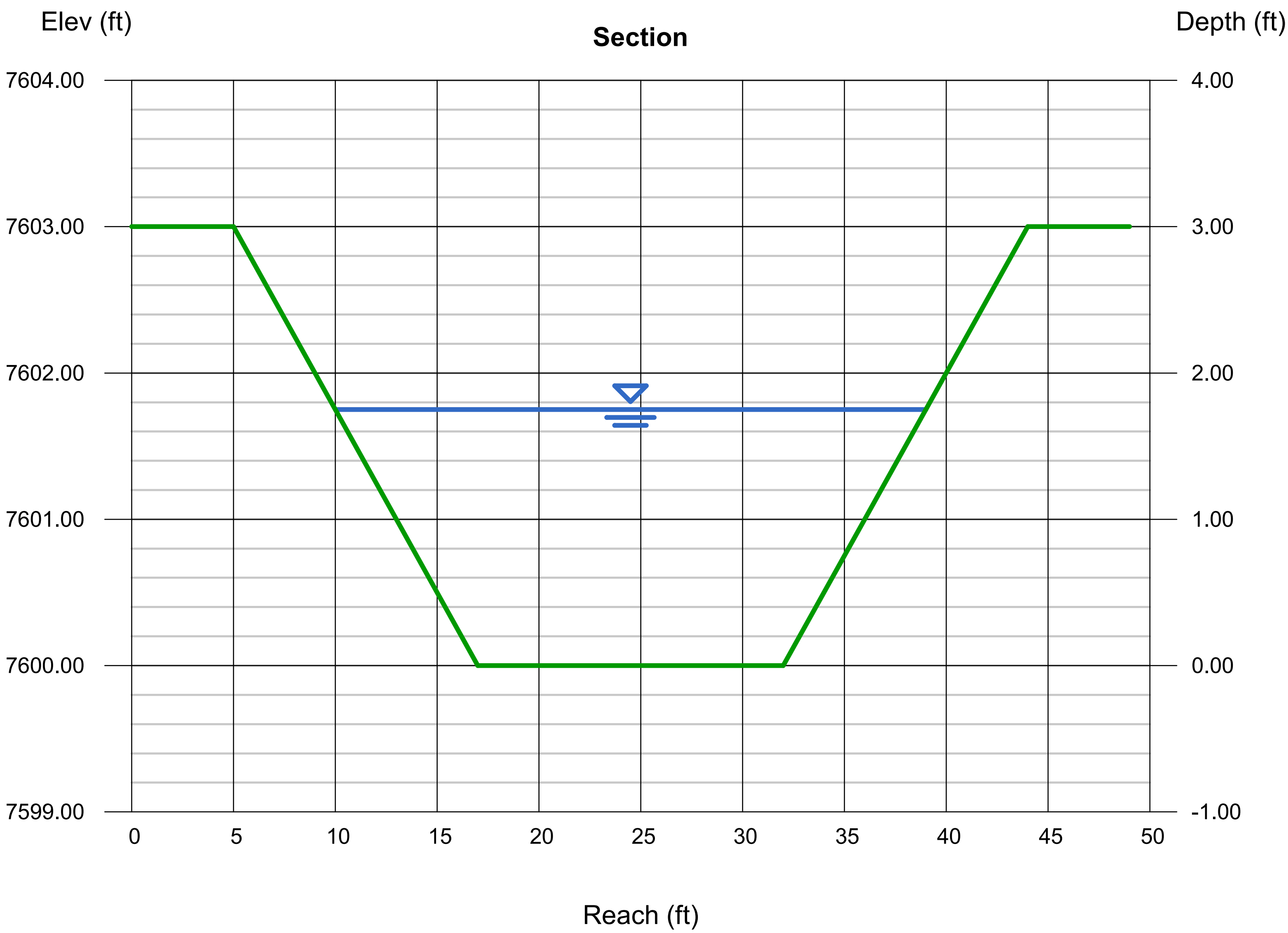


Channel Report

Channel with TRM north of Hole 15

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 15.00	Depth (ft)	= 1.75
Side Slopes (z:1)	= 4.00, 4.00	Q (cfs)	= 362.00
Total Depth (ft)	= 3.00	Area (sqft)	= 38.50
Invert Elev (ft)	= 7600.00	Velocity (ft/s)	= 9.40
Slope (%)	= 4.50	Wetted Perim (ft)	= 29.43
N-Value	= 0.040	Crit Depth, Yc (ft)	= 2.16
		Top Width (ft)	= 29.00
Calculations		EGL (ft)	= 3.12
Compute by:	Known Q	Froude No.	= 1.44
Known Q (cfs)	= 362.00		

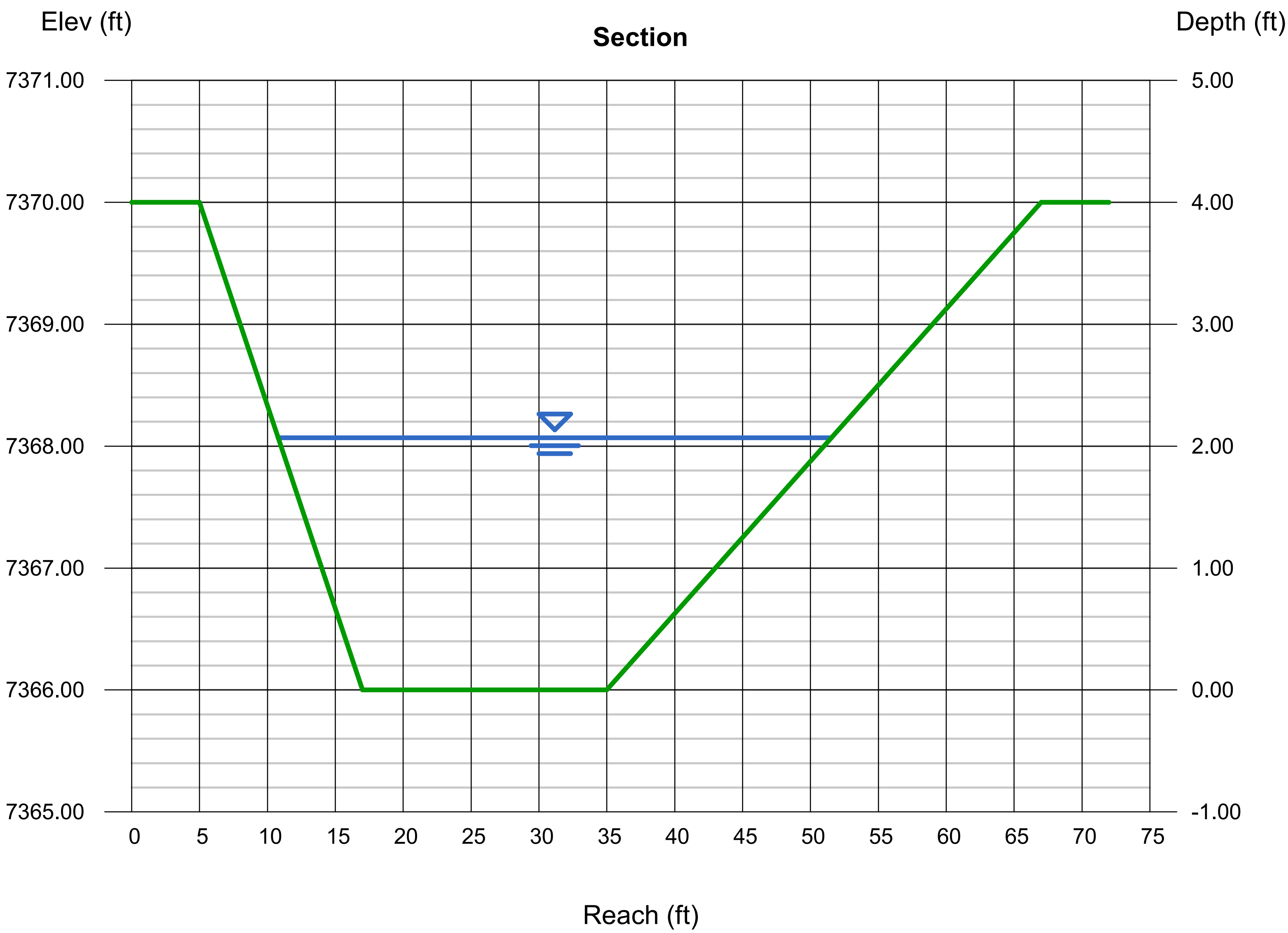
Permissible Velocity (ft/s) = 9.0 - 16.0
North American Green
Rollmax Permanent Turf Reinforcement Mat
P300 or Equiv.



Channel Report

SECTION B-B Exist. Channel downstream of Pond 8 (Pre-development)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 18.00	Depth (ft)	= 2.07
Side Slopes (z:1)	= 3.00, 8.00	Q (cfs)	= 366.00
Total Depth (ft)	= 4.00	Area (sqft)	= 60.83
Invert Elev (ft)	= 7366.00	Velocity (ft/s)	= 6.02
Slope (%)	= 2.00	Wetted Perim (ft)	= 41.23
N-Value	= 0.045	Crit Depth, Yc (ft)	= 1.92
		Top Width (ft)	= 40.77
Calculations		EGL (ft)	= 2.63
Compute by:	Known Q	Froude No.	= 0.87
Known Q (cfs)	= 366.00		



Channel Report

SECTION B-B Exist. Channel downstream of Pond 8 (Post-development)

Trapezoidal

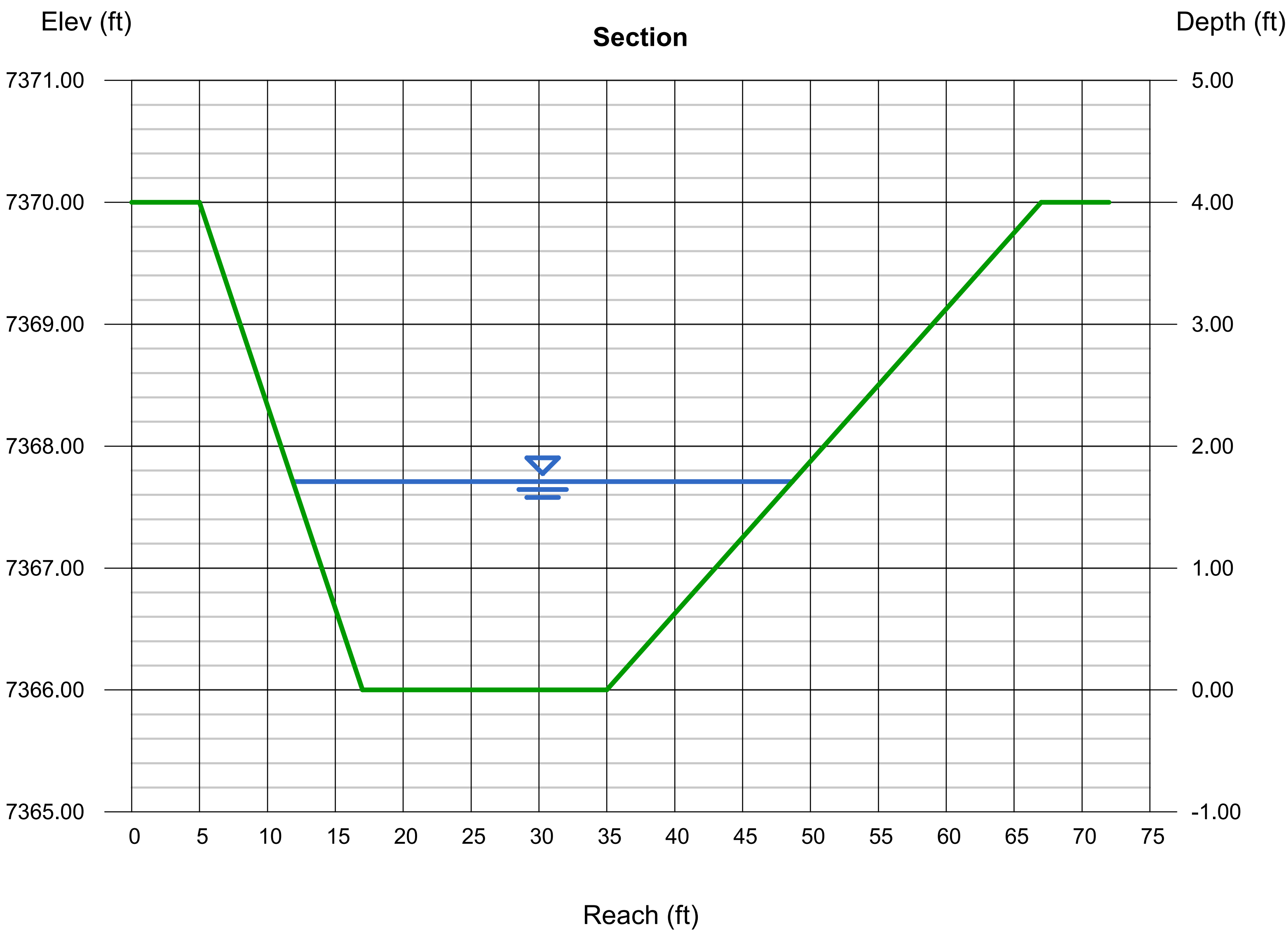
Bottom Width (ft)	= 18.00
Side Slopes (z:1)	= 3.00, 8.00
Total Depth (ft)	= 4.00
Invert Elev (ft)	= 7366.00
Slope (%)	= 2.00
N-Value	= 0.045

Calculations

Compute by:	Known Q
Known Q (cfs)	= 253.00

Highlighted

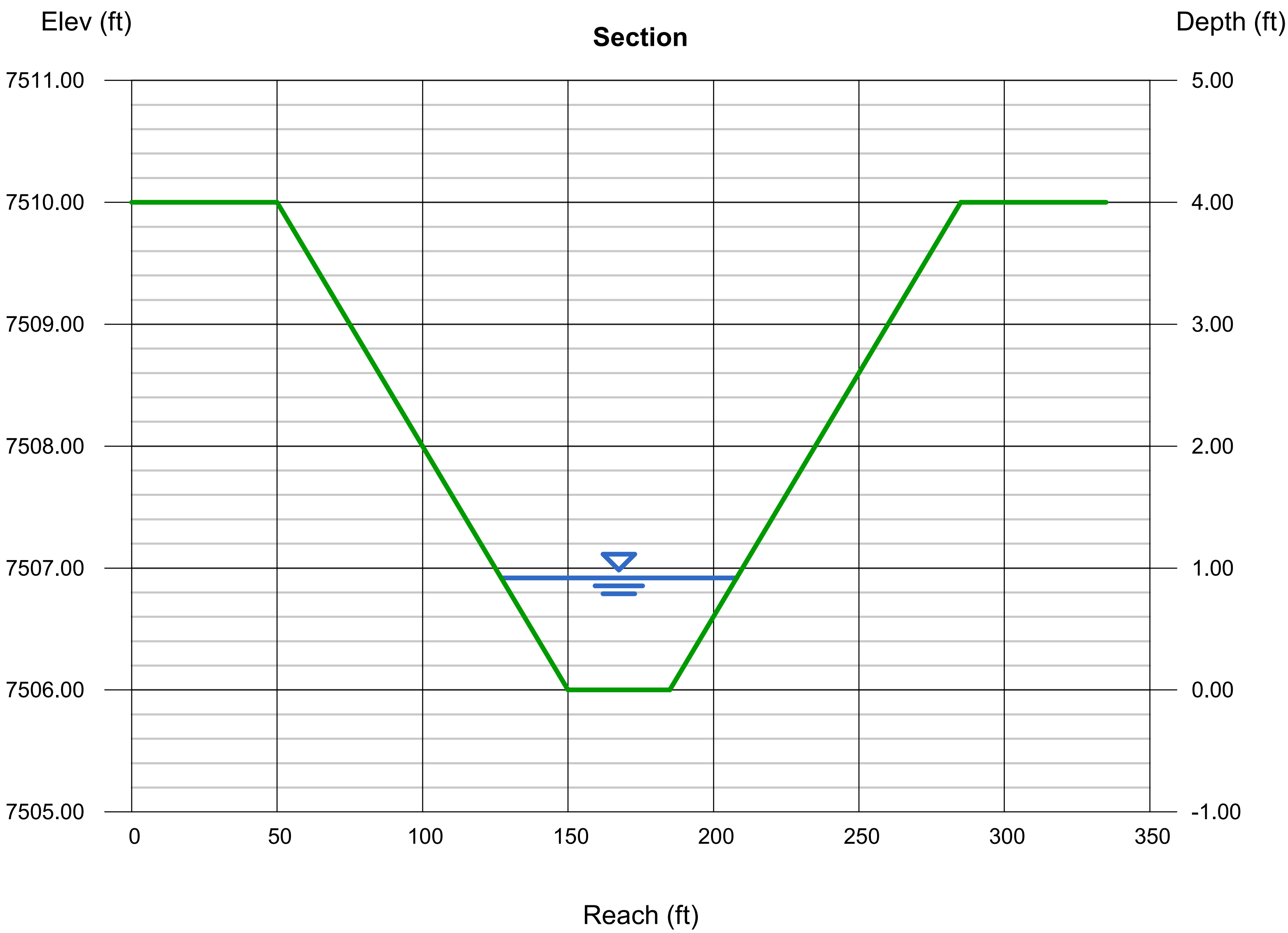
Depth (ft)	= 1.71
Q (cfs)	= 253.00
Area (sqft)	= 46.86
Velocity (ft/s)	= 5.40
Wetted Perim (ft)	= 37.19
Crit Depth, Yc (ft)	= 1.56
Top Width (ft)	= 36.81
EGL (ft)	= 2.16
Froude No.	= 0.84



Channel Report

SECTION E-E Exist. Channel downstream of Pond 13 (Pre-development)

Trapezoidal		**Highlighted**	
Bottom Width (ft)	= 35.00	Depth (ft)	= 0.92
Side Slopes (z:1)	= 25.00, 25.00	Q (cfs)	= 221.00
Total Depth (ft)	= 4.00	Area (sqft)	= 53.36
Invert Elev (ft)	= 7506.00	Velocity (ft/s)	= 4.14
Slope (%)	= 1.70	Wetted Perim (ft)	= 81.04
N-Value	= 0.035	Crit Depth, Yc (ft)	= 0.87
		Top Width (ft)	= 81.00
Calculations		EGL (ft)	= 1.19
Compute by:	Known Q	Froude No.	= 0.90
Known Q (cfs)	= 221.00		



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

SECTION E-E Exist. Channel downstream of Pond 13 (Post-development)

Trapezoidal

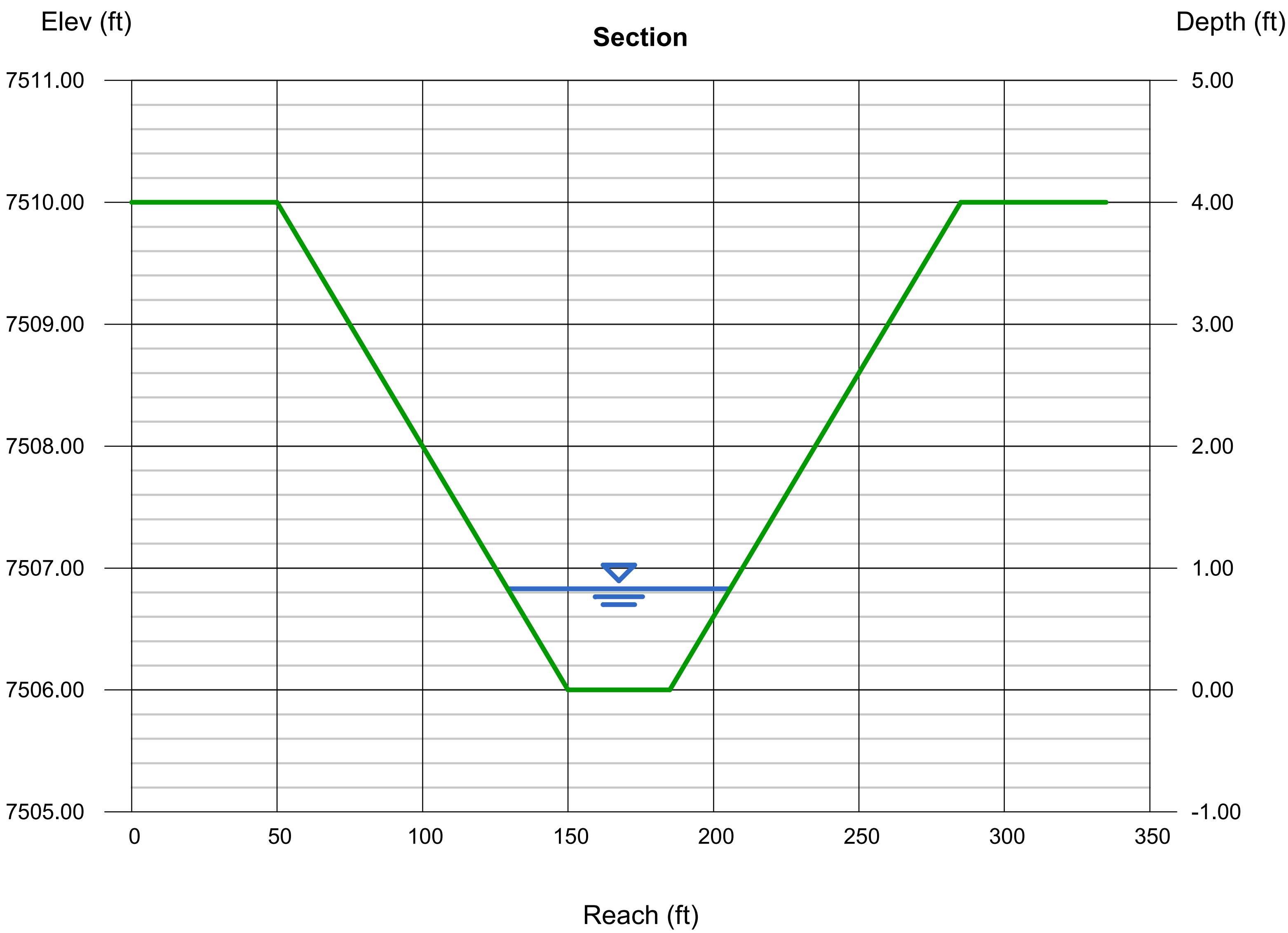
Bottom Width (ft)	=	35.00
Side Slopes (z:1)	=	25.00, 25.00
Total Depth (ft)	=	4.00
Invert Elev (ft)	=	7506.00
Slope (%)	=	1.70
N-Value	=	0.035

Calculations

Compute by:		Known Q
Known Q (cfs)	=	182.00

Highlighted

Depth (ft)	=	0.83
Q (cfs)	=	182.00
Area (sqft)	=	46.27
Velocity (ft/s)	=	3.93
Wetted Perim (ft)	=	76.53
Crit Depth, Yc (ft)	=	0.78
Top Width (ft)	=	76.50
EGL (ft)	=	1.07
Froude No.	=	0.89



DRIVEWAY CULVERT SIZING CALCULATIONS

Lot Number	100 yr. Flow (cfs)	Culvert Size (in.)	Anticipated Driveway Location (24' width max.)	Notes (See Appendix for non-std. driveway culvert calculations)
1	N/A	N/A	North end of lot	No ditch on west side of roadway
2	N/A	N/A	Middle of lot	No ditch on west side of roadway
3	143	Triple 36	North end of cul-de-sac bulb	Need Triple 36" culverts to cross natural ravine within lot to allow for the HFR Pond 26 Outfall
4	2	18	South end of lot	
5	2	18	Middle of lot, north of 30" culvert crossing	Driveway access to Billings Ct. only
6	3	18	Flag stem of Lot 7	Lots 6, 7 & 8 have single shared driveway access directly to Stagecoach Rd. per Final Plat and deviation 18003
7	3	18	Flag stem	Lots 6, 7 & 8 have single shared driveway access directly to Stagecoach Rd. per Final Plat and deviation 18003
8	3	18	Flag stem of Lot 7	Lots 6, 7 & 8 have single shared driveway access directly to Stagecoach Rd. per Final Plat and deviation 18003
9	2	18	West side of lot, near high point of roadway	Allowed direct drieway access to Stagecoach Rd. per deviation 18003
10	7	18	Middle of lot	Allowed direct drieway access to Stagecoach Rd. per deviation 18003
11	10	24	Middle of lot	Allowed direct drieway access to Stagecoach Rd. per deviation 18003
12	4	18	West side of lot	Allowed direct drieway access to Stagecoach Rd. per deviation 18003
13	4	18	Middle of lot	Allowed direct drieway access to Stagecoach Rd. per deviation 18003
14	7	18	West side of lot	Allowed direct drieway access to Stagecoach Rd. per deviation 18003
15	8	18	Middle of lot, west of natural ravne	Allowed direct drieway access to Stagecoach Rd. per deviation 18003
16	65	Dual 30	North end of cul-de-sac	Driveway access to Old Stagecoach Rd. Cul-de-sac only. Crossing of natural ravine within drainage esmt.
17	65	Dual 30	South end of cul-de-sac	Driveway access to Old Stagecoach Rd. Cul-de-sac only. Crossing of natural ravine within drainage esmt.
18	3	18	Middle of lot	Driveway access to Old Stagecoach Rd. Cul-de-sac only.
19	2	18	Middle of lot	Driveway access to Old Stagecoach Rd. Cul-de-sac only.
20	30	Dual 24	Middle of lot	Large off-site basins tributary to driveway culvert
21	4	18	East side of lot	
22	2	18	East side of lot	
23	4	18	Middle of lot	
24	N/A	N/A	Middle of lot	No ditch on north side of roadway
25	N/A	N/A	Middle of lot	No ditch on north side of roadway
26	N/A	N/A	Middle of lot	No ditch on north side of roadway
27	2	18	East side of lot	
28	3	18	Middle of lot	
29	5	18	East side of lot	Driveway access to Old Stagecoach Rd. only
30	2	18	Middle of lot	
31	N/A	N/A	North side of lot	No ditch on east side of roadway
32	12	24	South end of lot	Anticipated driveway acces to Allen Ranch Rd.
33	18	24	Middle of lot	
34	23	Dual 24	Middle of lot	
35	30	Dual 24	Middle of lot	
36	Not used			
37	3	18	West side of lot	
38	2	18	West side of lot	
39	2	18	East side of lot	
40	4	18	West side of lot	
41	8	18	West side of lot	Driveway access to Stagecoach Rd. only

DRIVEWAY CULVERT SIZING CALCULATIONS

Lot Number	100 yr. Flow (cfs)	Culvert Size (in.)	Anticipated Driveway Location (24' width max.)	Notes (See Appendix for non-std. driveway culvert calculations)
42	15	24	North side of lot	
43	22	Dual 24	South side of lot	
44	32	Dual 24	West side of lot	
45	2	18	Middle of lot off of Longwall Ct.	Driveway access required to be at highpoint of Longwall Ct.
46	28	Dual 24	Middle of lot off of Longwall Ct.	
47	7	18	Southwest corner of lot	
48	5	18	Northeast corner of lot	
49	3	18	East side of lot	
50	2	18	West side of lot	
51	2	18	Middle of lot	
52	7	18	End of Cul-de-sac bulb	
53	7	18	End of Cul-de-sac bulb	Culvert at end of Cul-de-sac bulb
53	16	24	Within lot at natural ravine	Need 24" culvert to cross natural ravine within lot
54	8	18	End of Cul-de-sac bulb	
55	3	18	Middle of lot	
56	7	18	Middle of lot off of Gold Run Ct.	
57	15	24	Middle of lot	
58	18	24	End of Cul-de-sac bulb	Culvert at end of Cul-de-sac bulb (If Required)
58	47	Dual 30	Within lot at natural ravine	Need Dual 30" culverts to cross natural ravine within lot
59	2	18	End of Cul-de-sac bulb	
60	N/A	N/A	East side of lot off of Longwall Ct.	No ditch on south side of roadway
61	3	18	North end of lot	
62	5	18	Off of Cul-de-sac bulb	
63	5	18	Off of Cul-de-sac bulb	
64	3	18	North end of lot	
65	N/A	N/A	Middle of lot off of Longwall Ct.	No ditch on south side of roadway
66	2	18	Middle of lot off of Longwall Ct.	Driveway access required to be at highpoint of Longwall Ct.
67	3	18	Middle of lot off of Longwall Ct.	
68	3	18	Middle of lot	
69	N/A	N/A	Middle of lot	No ditch on west side of roadway
70	3	18	Middle of lot	
71	5	18	Middle of lot	
72	5	18	South side of lot off of Shortwall Dr.	
73	N/A	N/A	Middle of lot	Allowed direct drieway access to Stagecoach Rd. per deviation 18003
74	3	18	Middle of lot	
75	5	18	West side of lot	
76	3	18	West side of lot	
77	2	18	West side of lot	
78	19	24	West side of lot	
79	15	24	Middle of lot	
80	8	18	Middle of lot	
81	6	18	Middle of lot	

Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Lot 3 Driveway culvert crossing of Natural Channel (Ex. Pond Outfall - HFR Pond 26)

Invert Elev Dn (ft)	=	7415.50
Pipe Length (ft)	=	50.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7416.00
Rise (in)	=	36.0
Shape	=	Circular
Span (in)	=	36.0
No. Barrels	=	3
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

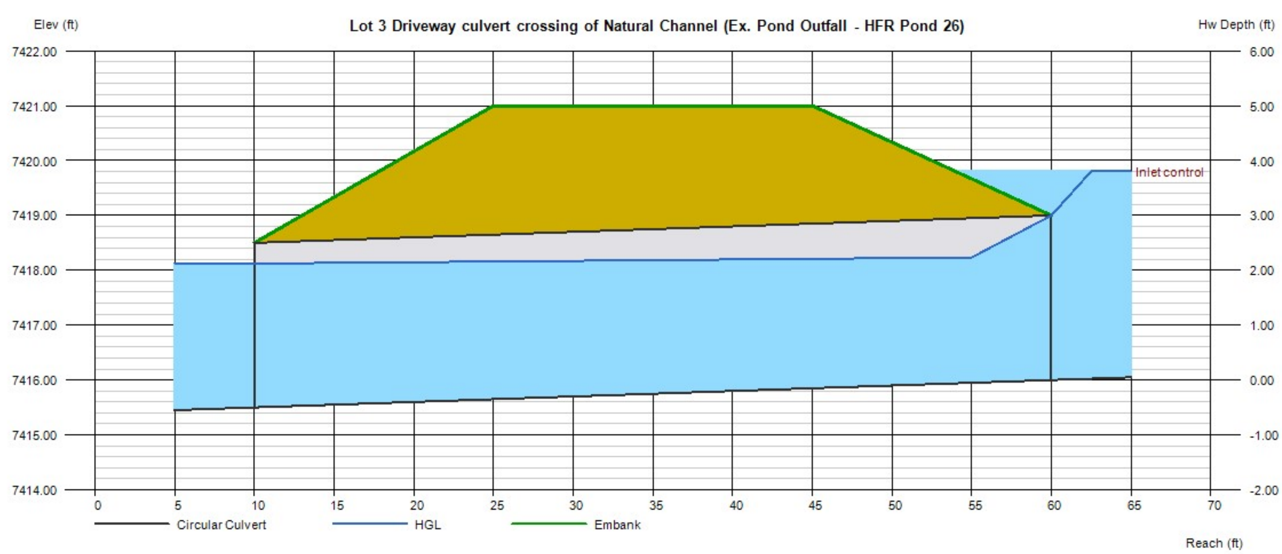
Top Elevation (ft)	=	7421.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	143.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	143.00
Qpipe (cfs)	=	143.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	7.27
Veloc Up (ft/s)	=	8.39
HGL Dn (ft)	=	7418.12
HGL Up (ft)	=	7418.25
Hw Elev (ft)	=	7419.81
Hw/D (ft)	=	1.27
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Lot 11 Driveway culvert - 24 in.

Invert Elev Dn (ft)	=	7458.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.50
Invert Elev Up (ft)	=	7459.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

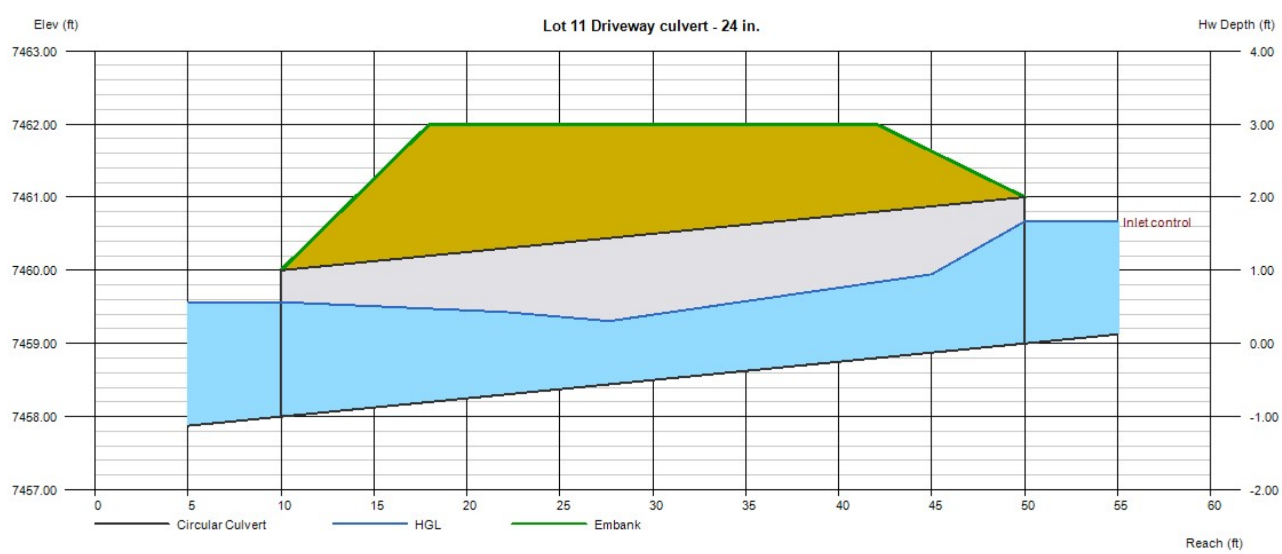
Top Elevation (ft)	=	7462.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	10.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	10.00
Qpipe (cfs)	=	10.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	3.79
Veloc Up (ft/s)	=	5.46
HGL Dn (ft)	=	7459.57
HGL Up (ft)	=	7460.13
Hw Elev (ft)	=	7460.67
Hw/D (ft)	=	0.83
Flow Regime	=	Inlet Control



Culvert Report

Lots 16 & 17 Driveway culverts - Dual 30 in.

Invert Elev Dn (ft)	= 7483.00
Pipe Length (ft)	= 40.00
Slope (%)	= 2.50
Invert Elev Up (ft)	= 7484.00
Rise (in)	= 30.0
Shape	= Circular
Span (in)	= 30.0
No. Barrels	= 2
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

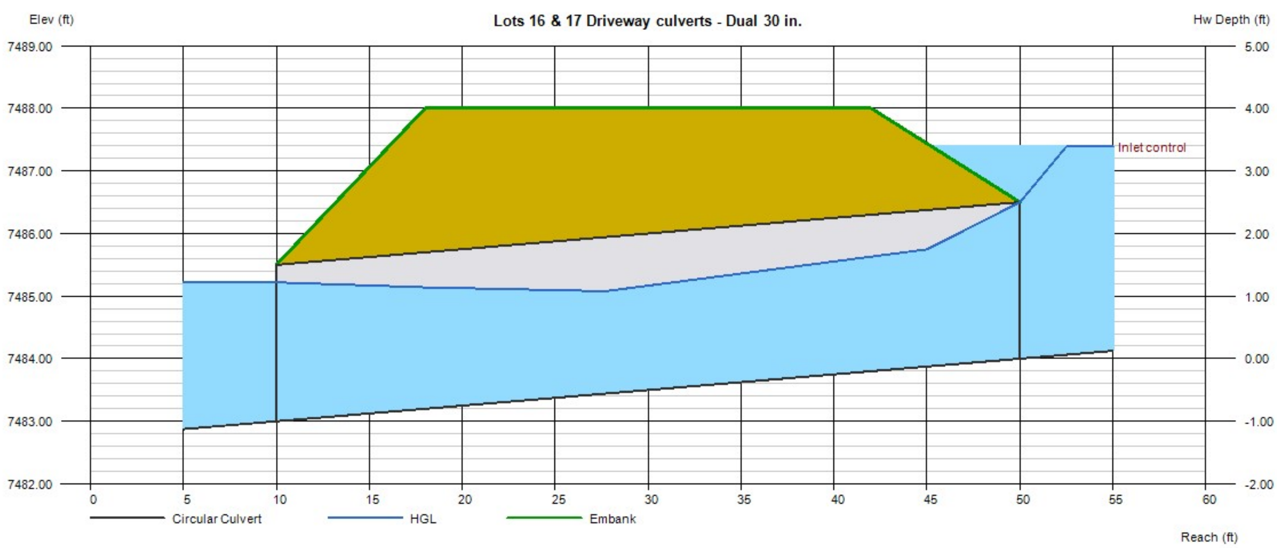
Top Elevation (ft)	= 7488.00
Top Width (ft)	= 24.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 65.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 65.00
Qpipe (cfs)	= 65.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 7.05
Veloc Up (ft/s)	= 7.95
HGL Dn (ft)	= 7485.22
HGL Up (ft)	= 7485.94
Hw Elev (ft)	= 7487.39
Hw/D (ft)	= 1.36
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Lot 20 Driveway culverts - Dual 24 in.

Invert Elev Dn (ft)	=	7483.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.50
Invert Elev Up (ft)	=	7484.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

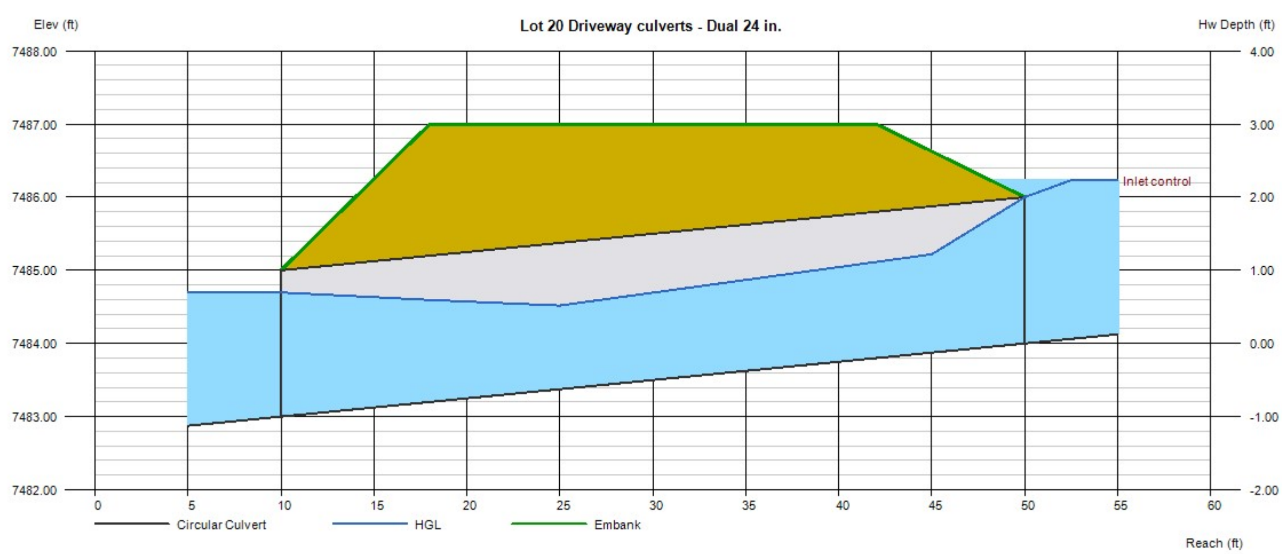
Top Elevation (ft)	=	7487.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	30.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	30.00
Qpipe (cfs)	=	30.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.28
Veloc Up (ft/s)	=	6.41
HGL Dn (ft)	=	7484.70
HGL Up (ft)	=	7485.40
Hw Elev (ft)	=	7486.23
Hw/D (ft)	=	1.12
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Lot 32 Driveway culvert - 24 in.

Invert Elev Dn (ft)	= 7597.00
Pipe Length (ft)	= 40.00
Slope (%)	= 2.50
Invert Elev Up (ft)	= 7598.00
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 1
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

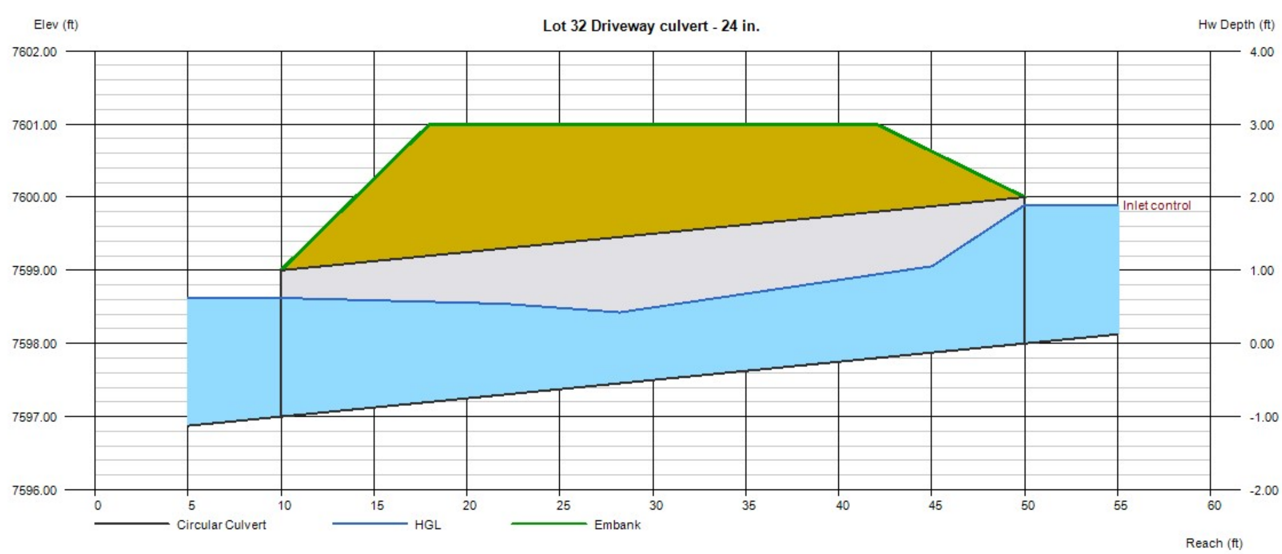
Top Elevation (ft)	= 7601.00
Top Width (ft)	= 24.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 12.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 12.00
Qpipe (cfs)	= 12.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.40
Veloc Up (ft/s)	= 5.85
HGL Dn (ft)	= 7598.62
HGL Up (ft)	= 7599.24
Hw Elev (ft)	= 7599.89
Hw/D (ft)	= 0.95
Flow Regime	= Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Lot 33 Driveway culvert - 24 in.

Invert Elev Dn (ft)	=	7583.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7583.80
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

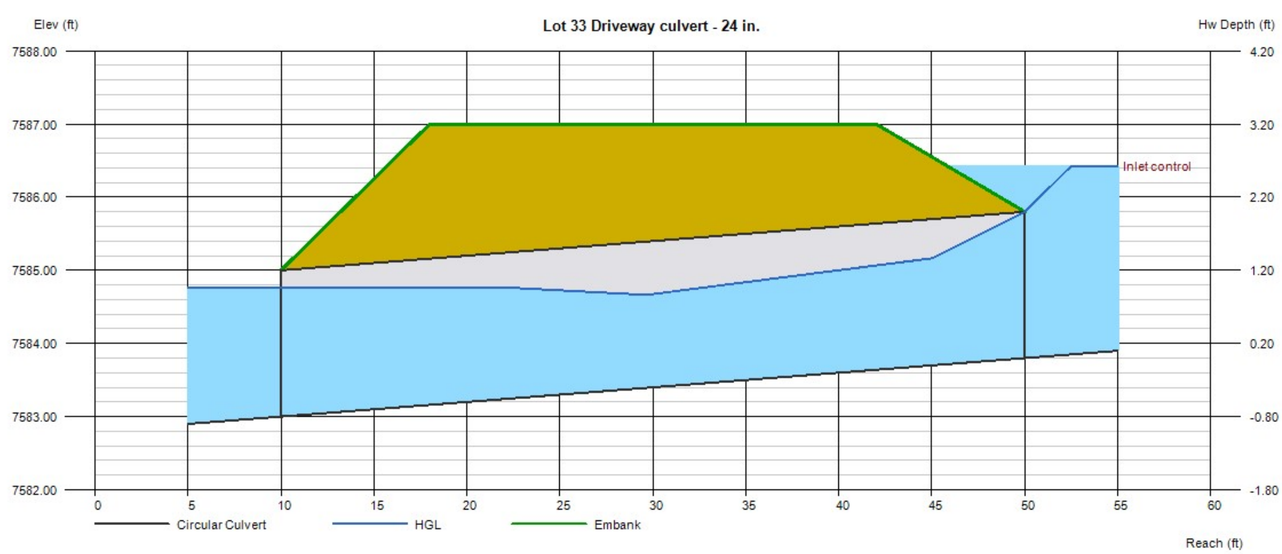
Top Elevation (ft)	=	7587.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	18.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	18.00
Qpipe (cfs)	=	18.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.14
Veloc Up (ft/s)	=	6.99
HGL Dn (ft)	=	7584.76
HGL Up (ft)	=	7585.33
Hw Elev (ft)	=	7586.43
Hw/D (ft)	=	1.31
Flow Regime	=	Inlet Control



Culvert Report

Lot 34 Driveway culverts - Dual 24 in.

Invert Elev Dn (ft)	=	7577.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7577.80
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

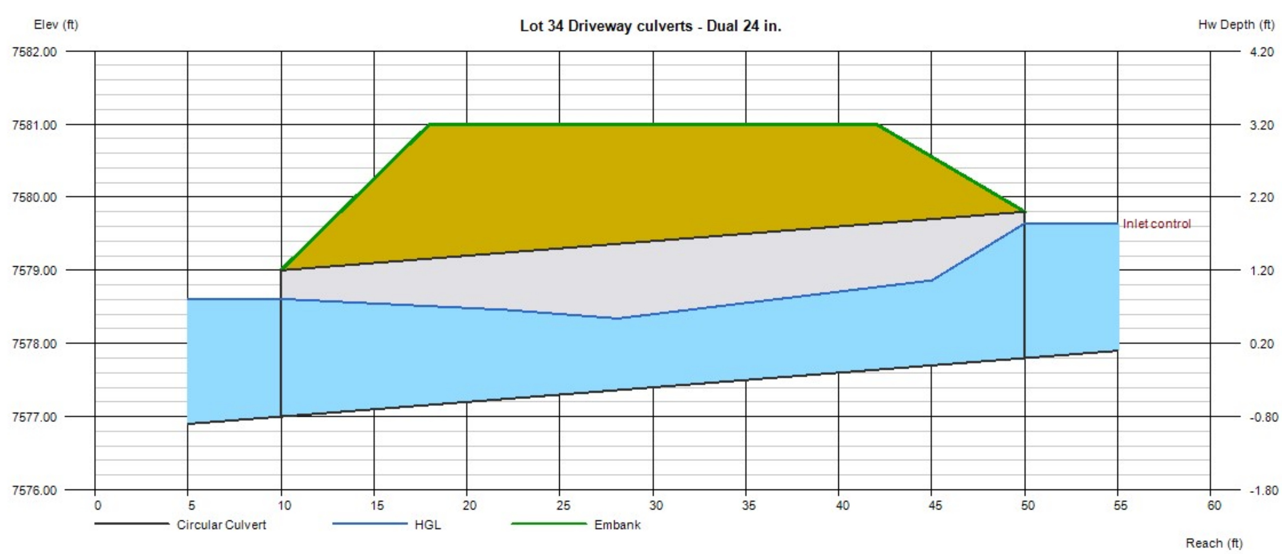
Top Elevation (ft)	=	7581.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	23.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	23.00
Qpipe (cfs)	=	23.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	4.25
Veloc Up (ft/s)	=	5.75
HGL Dn (ft)	=	7578.61
HGL Up (ft)	=	7579.02
Hw Elev (ft)	=	7579.64
Hw/D (ft)	=	0.92
Flow Regime	=	Inlet Control



Culvert Report

Lot 35 Driveway culverts - Dual 24 in.

Invert Elev Dn (ft)	=	7571.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7571.80
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

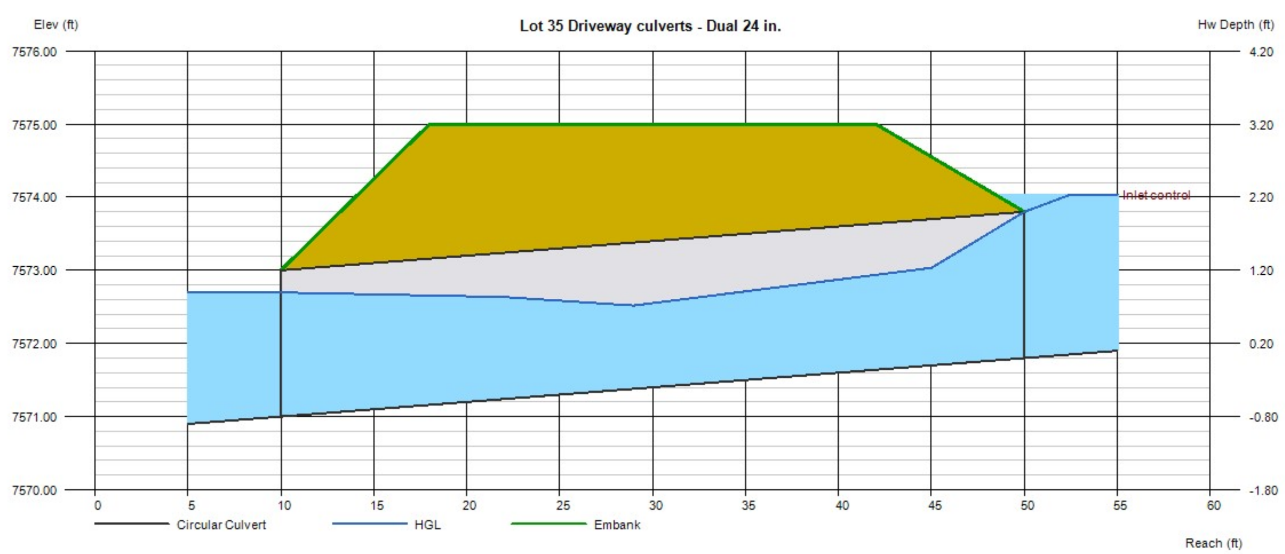
Top Elevation (ft)	=	7575.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	30.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	30.00
Qpipe (cfs)	=	30.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.28
Veloc Up (ft/s)	=	6.41
HGL Dn (ft)	=	7572.70
HGL Up (ft)	=	7573.19
Hw Elev (ft)	=	7574.04
Hw/D (ft)	=	1.12
Flow Regime	=	Inlet Control



Culvert Report

Lot 42 Driveway culvert - 24 in.

Invert Elev Dn (ft)	=	7623.00
Pipe Length (ft)	=	40.00
Slope (%)	=	10.00
Invert Elev Up (ft)	=	7627.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

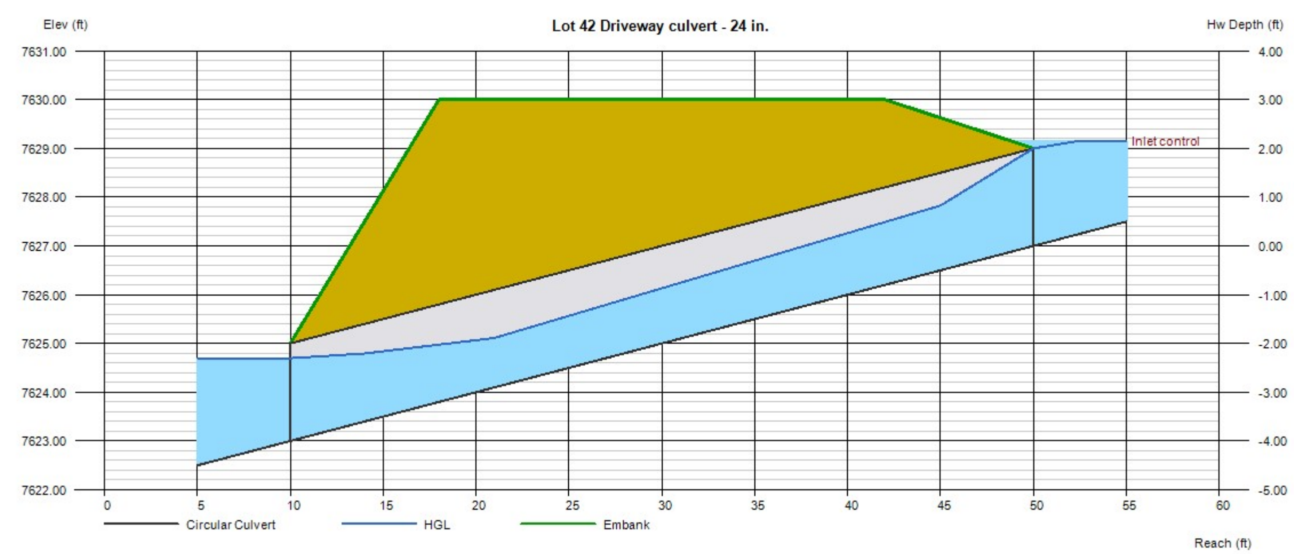
Top Elevation (ft)	=	7630.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	15.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	15.00
Qpipe (cfs)	=	15.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.28
Veloc Up (ft/s)	=	6.41
HGL Dn (ft)	=	7624.70
HGL Up (ft)	=	7628.40
Hw Elev (ft)	=	7629.16
Hw/D (ft)	=	1.08
Flow Regime	=	Inlet Control



Culvert Report

Lot 43 Driveway culverts - Dual 24 in.

Invert Elev Dn (ft)	=	7492.50
Pipe Length (ft)	=	40.00
Slope (%)	=	7.00
Invert Elev Up (ft)	=	7495.30
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

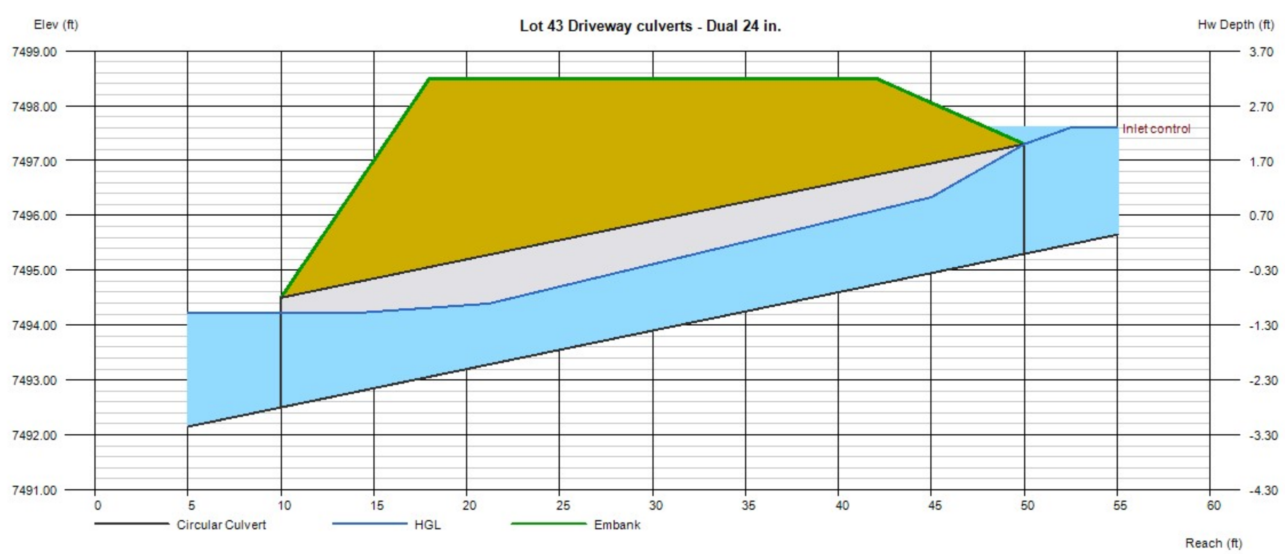
Top Elevation (ft)	=	7498.50
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	32.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	32.00
Qpipe (cfs)	=	32.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.56
Veloc Up (ft/s)	=	6.60
HGL Dn (ft)	=	7494.22
HGL Up (ft)	=	7496.74
Hw Elev (ft)	=	7497.60
Hw/D (ft)	=	1.15
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Tuesday, Jun 12 2018

Lot 44 Driveway culverts - Dual 24 in.

Invert Elev Dn (ft)	=	7478.50
Pipe Length (ft)	=	40.00
Slope (%)	=	6.00
Invert Elev Up (ft)	=	7480.90
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

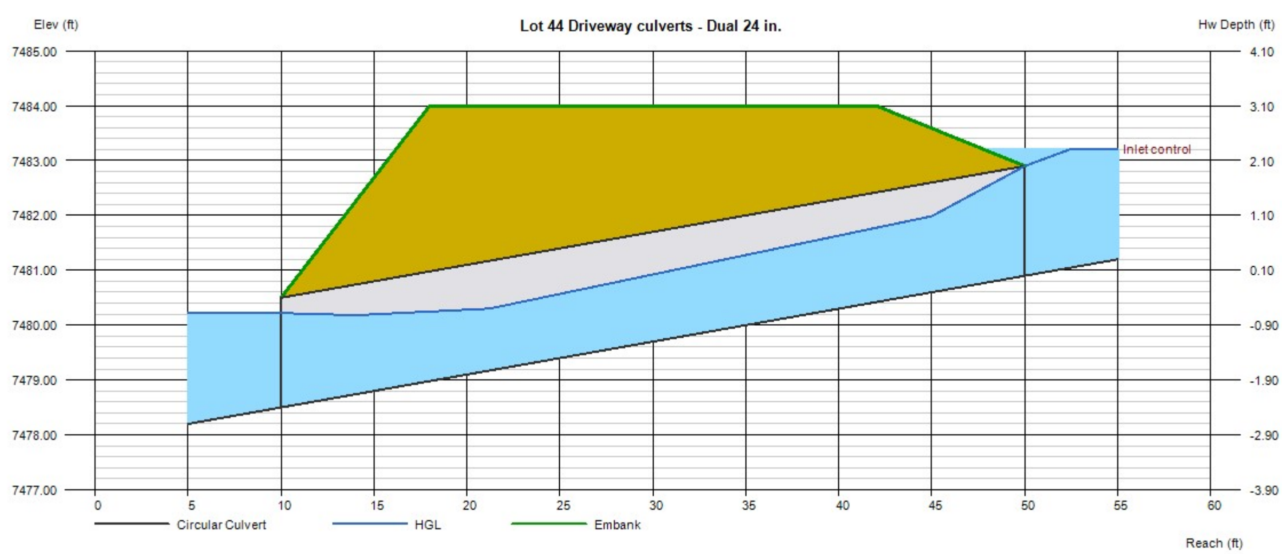
Top Elevation (ft)	=	7484.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	32.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	32.00
Qpipe (cfs)	=	32.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.56
Veloc Up (ft/s)	=	6.60
HGL Dn (ft)	=	7480.22
HGL Up (ft)	=	7482.34
Hw Elev (ft)	=	7483.21
Hw/D (ft)	=	1.16
Flow Regime	=	Inlet Control



Culvert Report

Lot 46 Driveway culverts - Dual 24 in.

Invert Elev Dn (ft)	= 7459.00
Pipe Length (ft)	= 40.00
Slope (%)	= 2.00
Invert Elev Up (ft)	= 7459.80
Rise (in)	= 24.0
Shape	= Circular
Span (in)	= 24.0
No. Barrels	= 2
n-Value	= 0.013
Culvert Type	= Circular Concrete
Culvert Entrance	= Square edge w/headwall (C)
Coeff. K,M,c,Y,k	= 0.0098, 2, 0.0398, 0.67, 0.5

Embankment

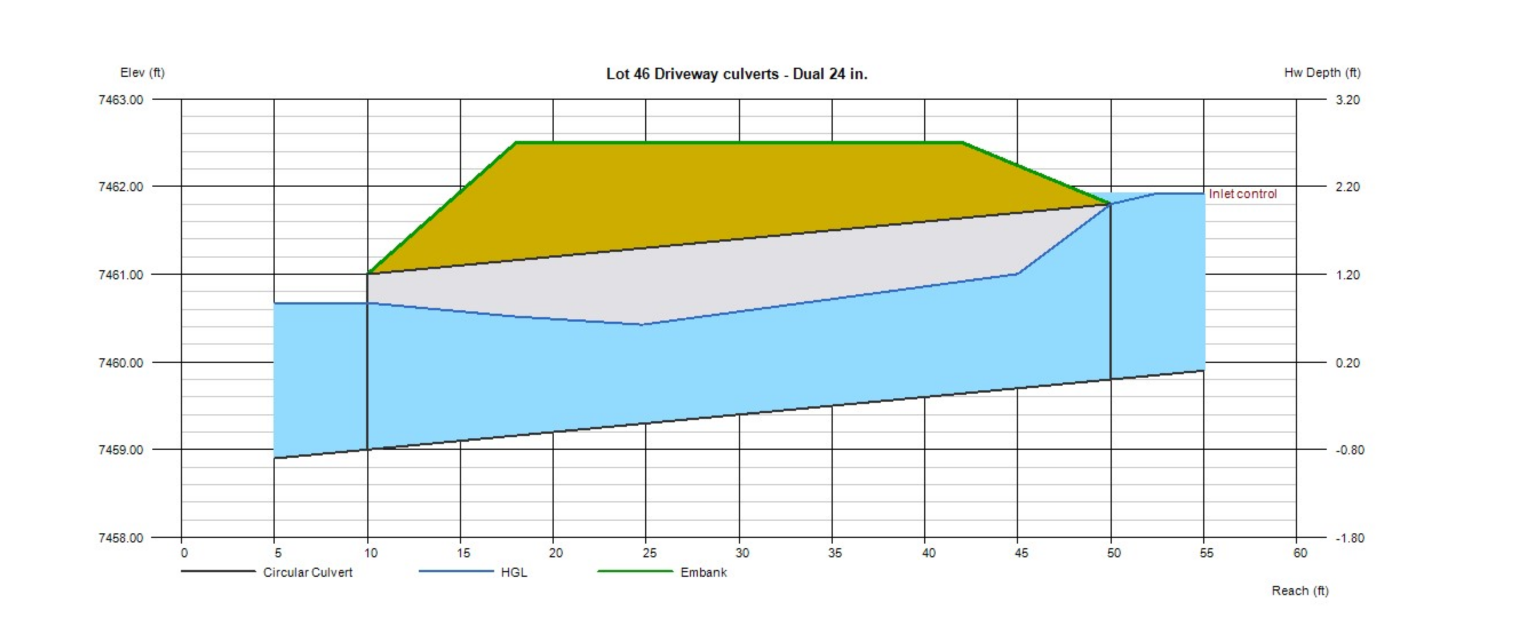
Top Elevation (ft)	= 7462.50
Top Width (ft)	= 24.00
Crest Width (ft)	= 20.00

Calculations

Qmin (cfs)	= 0.00
Qmax (cfs)	= 28.00
Tailwater Elev (ft)	= (dc+D)/2

Highlighted

Qtotal (cfs)	= 28.00
Qpipe (cfs)	= 28.00
Qovertop (cfs)	= 0.00
Veloc Dn (ft/s)	= 4.99
Veloc Up (ft/s)	= 6.22
HGL Dn (ft)	= 7460.67
HGL Up (ft)	= 7461.15
Hw Elev (ft)	= 7461.92
Hw/D (ft)	= 1.06
Flow Regime	= Inlet Control



Culvert Report

Lot 53 Driveway culvert - 24 in.

Invert Elev Dn (ft)	=	7530.00
Pipe Length (ft)	=	40.00
Slope (%)	=	5.00
Invert Elev Up (ft)	=	7532.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

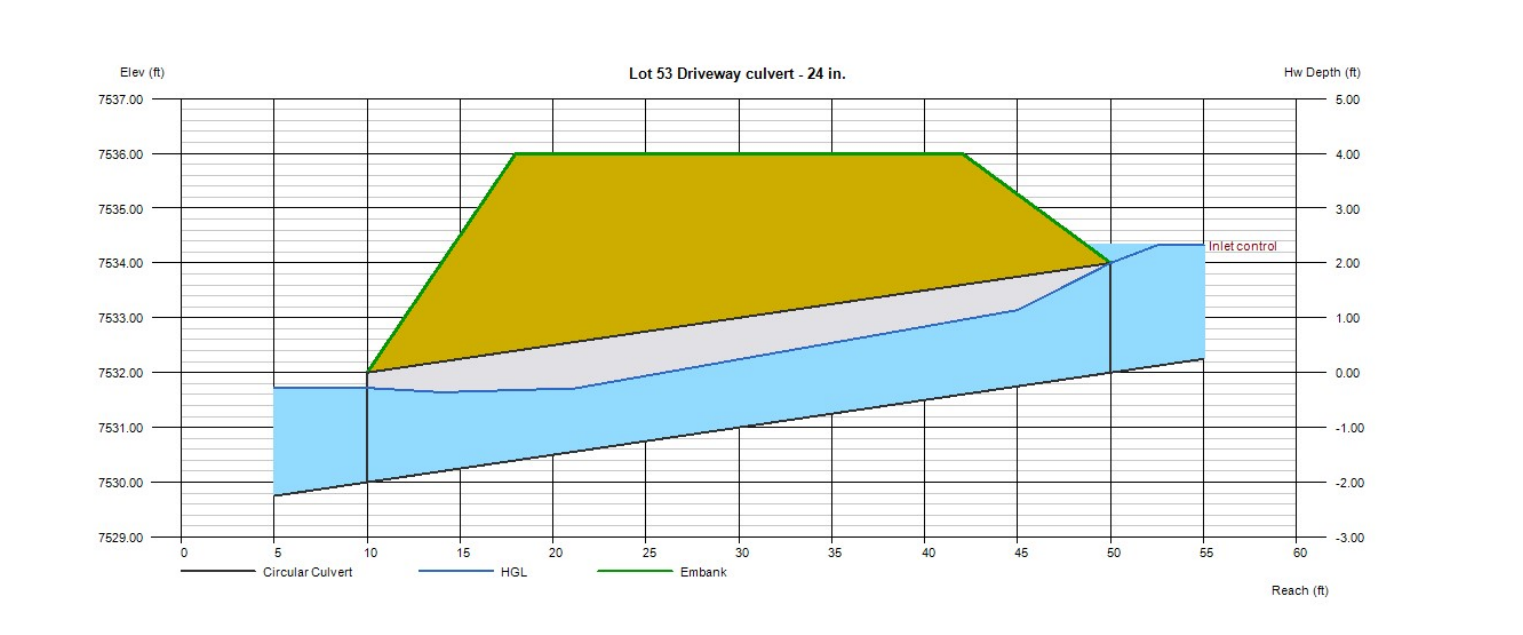
Top Elevation (ft)	=	7536.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	16.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	16.00
Qpipe (cfs)	=	16.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.56
Veloc Up (ft/s)	=	6.60
HGL Dn (ft)	=	7531.72
HGL Up (ft)	=	7533.44
Hw Elev (ft)	=	7534.32
Hw/D (ft)	=	1.16
Flow Regime	=	Inlet Control



Culvert Report

Lot 57 Driveway culvert - 24 in.

Invert Elev Dn (ft)	=	7474.00
Pipe Length (ft)	=	40.00
Slope (%)	=	1.00
Invert Elev Up (ft)	=	7474.40
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

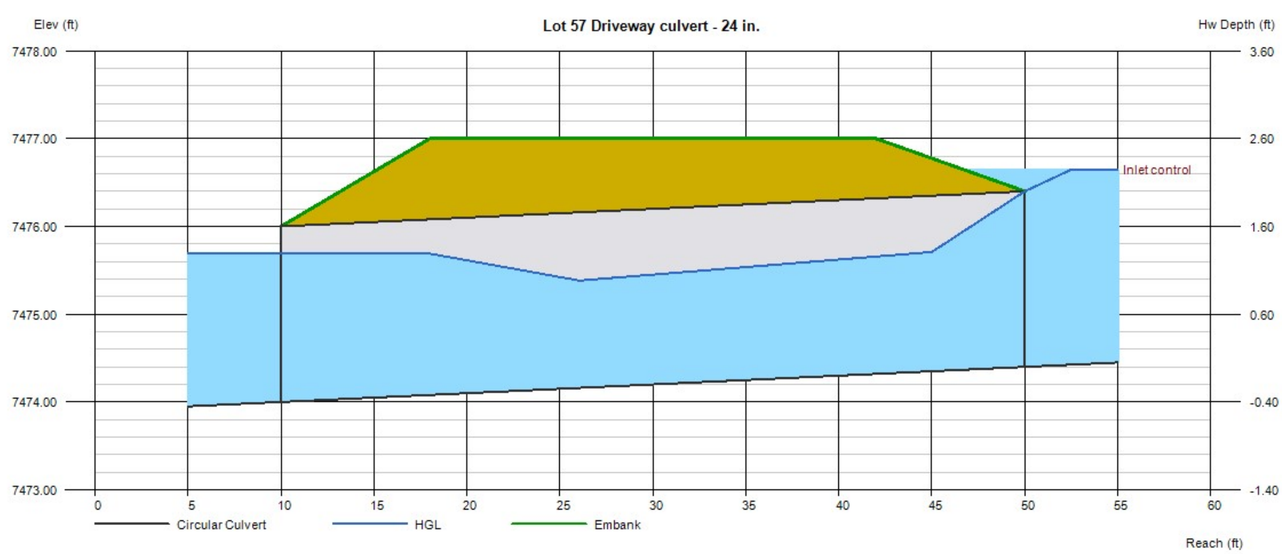
Top Elevation (ft)	=	7477.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	15.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	15.00
Qpipe (cfs)	=	15.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.28
Veloc Up (ft/s)	=	6.41
HGL Dn (ft)	=	7475.70
HGL Up (ft)	=	7475.79
Hw Elev (ft)	=	7476.65
Hw/D (ft)	=	1.12
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Wednesday, Jun 13 2018

Lot 58 Driveway culverts crossing natural ravine - Dual 30 in.

Invert Elev Dn (ft)	=	7471.00
Pipe Length (ft)	=	50.00
Slope (%)	=	4.00
Invert Elev Up (ft)	=	7473.00
Rise (in)	=	30.0
Shape	=	Circular
Span (in)	=	30.0
No. Barrels	=	2
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

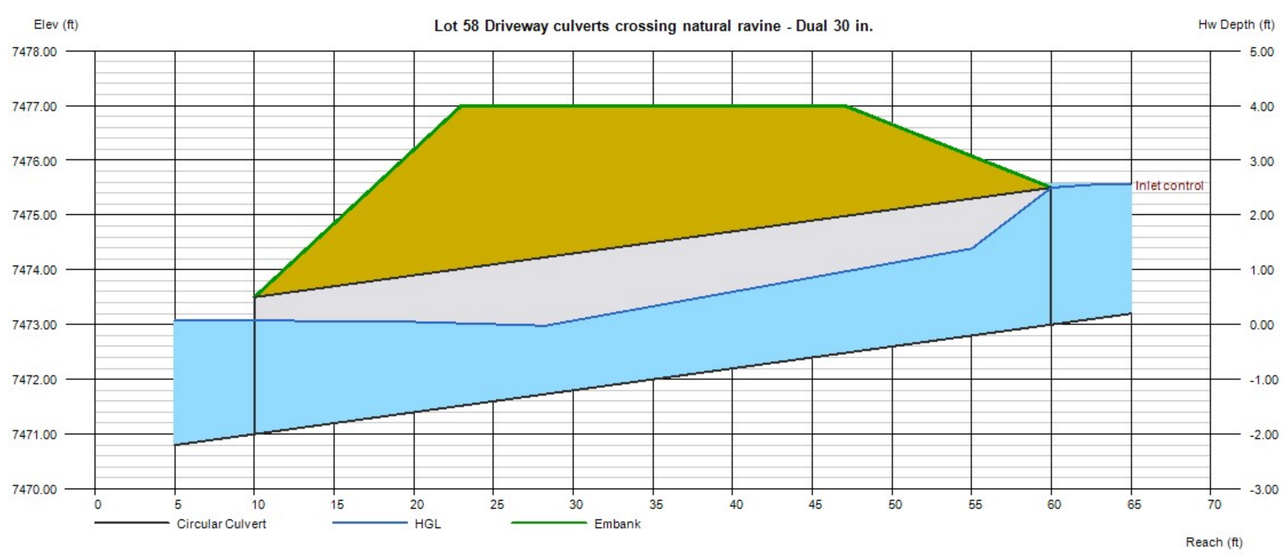
Top Elevation (ft)	=	7477.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	47.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	47.00
Qpipe (cfs)	=	47.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.40
Veloc Up (ft/s)	=	6.84
HGL Dn (ft)	=	7473.07
HGL Up (ft)	=	7474.65
Hw Elev (ft)	=	7475.55
Hw/D (ft)	=	1.02
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Wednesday, Jun 13 2018

Lot 78 Driveway culvert - 24 in.

Invert Elev Dn (ft)	=	7550.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7550.80
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

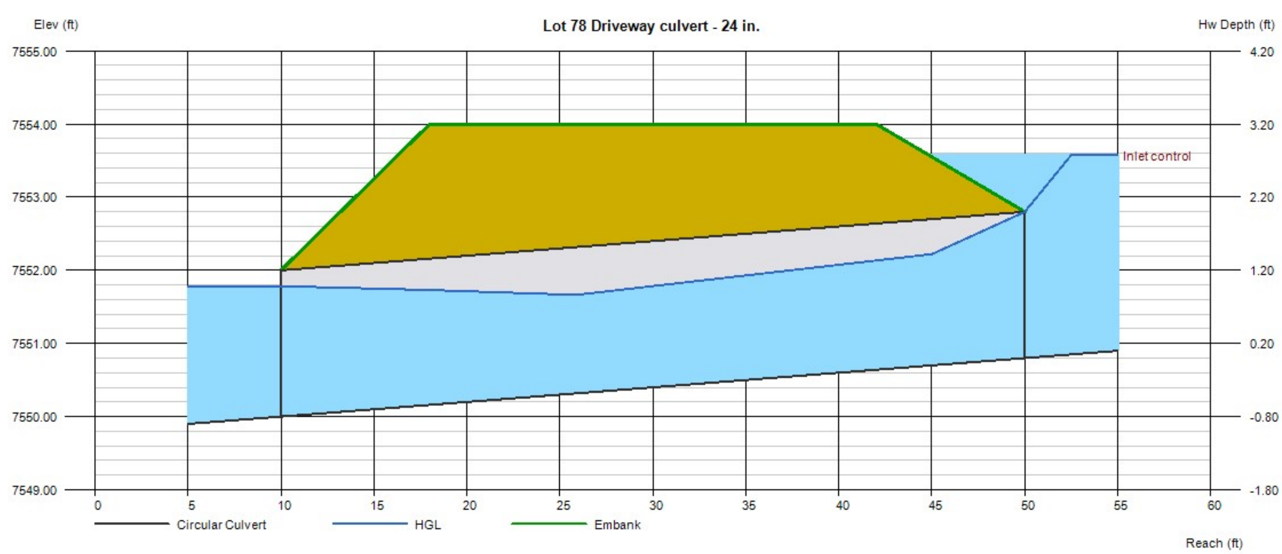
Top Elevation (ft)	=	7554.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	19.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	19.00
Qpipe (cfs)	=	19.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	6.42
Veloc Up (ft/s)	=	7.20
HGL Dn (ft)	=	7551.78
HGL Up (ft)	=	7552.37
Hw Elev (ft)	=	7553.58
Hw/D (ft)	=	1.39
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. — Wednesday, Jun 13 2018

Lot 79 Driveway culvert - 24 in.

Invert Elev Dn (ft)	=	7556.00
Pipe Length (ft)	=	40.00
Slope (%)	=	2.00
Invert Elev Up (ft)	=	7556.80
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.013
Culvert Type	=	Circular Concrete
Culvert Entrance	=	Square edge w/headwall (C)
Coeff. K,M,c,Y,k	=	0.0098, 2, 0.0398, 0.67, 0.5

Embankment

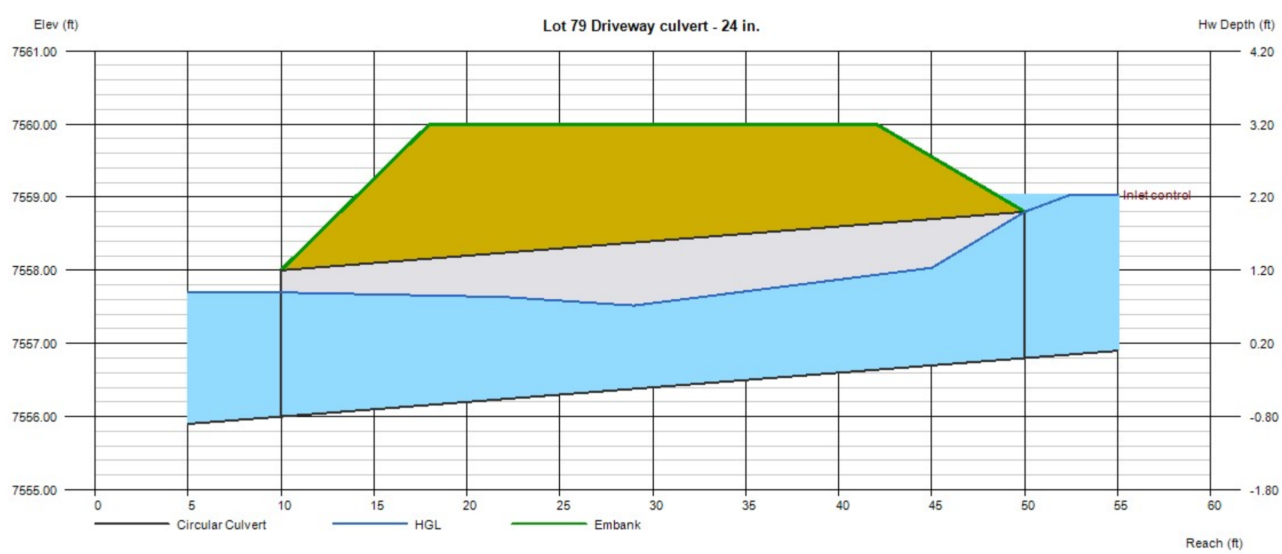
Top Elevation (ft)	=	7560.00
Top Width (ft)	=	24.00
Crest Width (ft)	=	20.00

Calculations

Qmin (cfs)	=	0.00
Qmax (cfs)	=	15.00
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	15.00
Qpipe (cfs)	=	15.00
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.28
Veloc Up (ft/s)	=	6.41
HGL Dn (ft)	=	7557.70
HGL Up (ft)	=	7558.19
Hw Elev (ft)	=	7559.04
Hw/D (ft)	=	1.12
Flow Regime	=	Inlet Control



DETENTION FACILITY CALCULATIONS

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**November 27, 2017**
Project:	**Flying Horse North Filing No. 1**
Location:	**Pond 1**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 20.0 %
B) Tributary Area's Imperviousness Ratio (i = I_a / 100)	i = 0.200
C) Contributing Watershed Area	Area = 21.800 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$	V_{DESIGN}= 0.210 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 0.205 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.434 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 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	No concentrated inflow. Flows will enter as sheet flow
A) Describe means of providing energy dissipation at concentrated inflow locations:	

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**November 27, 2017**
Project:	**Flying Horse North Filing No. 1**
Location:	**Pond 1**

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV) — V_{FMIN} = 0.004 ac-ft

B) Actual Forebay Volume — V_F = 0.005 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 12.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 38.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 0.76 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 = 5.1 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 = 0.0100 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^2 minimum) — A_M = 50 sq ft

C) Outlet Type

Choose One
- ● Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 1.13 inches

E) Total Outlet Area — A_{ot} = 5.16 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton, P.E.**
Company:	**Classic Consulting**
Date:	**November 27, 2017**
Project:	**Flying Horse North Filing No. 1**
Location:	**Pond 1**

8. Initial Surcharge Volume

A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches) — D_{IS} = 6 in

B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV) — V_{IS} = ______ cu ft

C) Initial Surcharge Provided Above Micropool — V_s= 25.0 cu ft

9. Trash Rack

A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$ — A_t = 179 square inches

B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.) — *S.S. Well Screen with 60% Open Area*

Other (Y/N): N

C) Ratio of Total Open Area to Total Area (only for type 'Other') — User Ratio =

D) Total Water Quality Screen Area (based on screen type) — A_{total} = 298 sq. in.

E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E) — H= 2.75 feet

F) Height of Water Quality Screen (H_{TR}) — H_{TR}= 61 inches

G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended) — $W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: November 27, 2017
Project: Flying Horse North Filing No. 1
Location: Pond 1

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Soil Rip-Rap
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One: ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	

Notes:

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator
LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.42	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52	
Max Intensity for Optional User Defined Storm	2.51496		

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: November 30, 2017
Project: Flying Horse North (Trib. Basins to Pond 4)
Location: Black Forest, CO

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	**OS-8**	**OS-9**	**OS-10**	**OS-11**	**BS-13**	**BS-14**	**BS-15**	**BS-16**	**BS-17**					
Receiving Pervious Area Soil Type	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand					
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	14.200	9.800	4.100	28.000	25.600	13.400	5.300	21.600	12.100					
Directly Connected Impervious Area (DCIA, acres)	0.950	0.000	0.180	0.500	2.200	1.100	0.760	1.900	1.600					
Unconnected Impervious Area (UIA, acres)	0.520	0.000	0.200	0.500	1.000	0.500	0.200	1.200	0.400					
Receiving Pervious Area (RPA, acres)	3.000	0.000	1.200	6.300	5.000	3.000	1.000	6.000	2.000					
Separate Pervious Area (SPA, acres)	9.730	9.800	2.520	20.700	17.400	8.800	3.340	12.500	8.100					
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C	C	C					

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	14.200	9.800	4.100	28.000	25.600	13.400	5.300	21.600	12.100					
Directly Connected Impervious Area (DCIA, %)	6.7%	0.0%	4.4%	1.8%	8.6%	8.2%	14.3%	8.8%	13.2%					
Unconnected Impervious Area (UIA, %)	3.7%	0.0%	4.9%	1.8%	3.9%	3.7%	3.8%	5.6%	3.3%					
Receiving Pervious Area (RPA, %)	21.1%	0.0%	29.3%	22.5%	19.5%	22.4%	18.9%	27.8%	16.5%					
Separate Pervious Area (SPA, %)	68.5%	100.0%	61.5%	73.9%	68.0%	65.7%	63.0%	57.9%	66.9%					
A_R (RPA / UIA)	5.769	0.000	6.000	12.600	5.000	6.000	5.000	5.000	5.000					
I_a Check	0.150	1.000	0.140	0.070	0.170	0.140	0.170	0.170	0.170					
f / I for WQCV Event:	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6	4.6					
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5					
f / I for 100-Year Event:	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4					
f / I for Optional User Defined Storm CUHP:	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39	0.39					
IRF for WQCV Event:	0.32	1.00	0.30	0.15	0.37	0.30	0.37	0.37	0.37					
IRF for 5-Year Event:	0.63	1.00	0.59	0.29	0.71	0.59	0.71	0.71	0.71					
IRF for 100-Year Event:	0.65	1.00	0.61	0.30	0.73	0.61	0.73	0.73	0.73					
IRF for Optional User Defined Storm CUHP:	0.65	1.00	0.61	0.30	0.73	0.61	0.73	0.73	0.73					
Total Site Imperviousness: I_{total}	10.4%	0.0%	9.3%	3.6%	12.5%	11.9%	18.1%	14.4%	16.5%					
Effective Imperviousness for WQCV Event:	7.9%	0.0%	5.9%	2.1%	10.0%	9.3%	15.7%	10.8%	14.4%					
Effective Imperviousness for 5-Year Event:	9.0%	0.0%	7.3%	2.3%	11.4%	10.4%	17.0%	12.8%	15.6%					
Effective Imperviousness for 100-Year Event:	9.1%	0.0%	7.3%	2.3%	11.5%	10.5%	17.1%	12.9%	15.7%					
Effective Imperviousness for Optional User Defined Storm CUHP:	9.1%	0.0%	7.3%	2.3%	11.5%	10.5%	17.1%	12.9%	15.7%					

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	21.0%	N/A	33.4%	41.1%	16.8%	18.7%	10.1%	20.5%	9.9%	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	15.3%	N/A	26.4%	79.5%	9.8%	14.7%	6.1%	11.8%	6.0%	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:	7.4%	0.0%	12.1%	13.6%	5.1%	7.6%	3.6%	6.5%	3.4%					

Total Site Imperviousness:	**10.2%**
Total Site Effective Imperviousness for WQCV Event:	**8.0%**
Total Site Effective Imperviousness for 5-Year Event:	**9.0%**
Total Site Effective Imperviousness for 100-Year Event:	**9.1%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**9.1%**

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer: Marc A. Whorton
Company: Classic Consutling
Date: November 27, 2017
Project: Flying Horse North Filing 1 (Pond 4)
Location: Black Forest, CO

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 8.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.080
C) Contributing Watershed Area	Area = 134.100 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)	V_{DESIGN}= 0.617 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= 0.603 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.993 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 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)

Designer:	**Marc A. Whorton**
Company:	**Classic Consutling**
Date:	**November 27, 2017**
Project:	**Flying Horse North Filing 1 (Pond 4)**
Location:	**Black Forest, CO**

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.018 ac-ft

B) Actual Forebay Volume — V_F = 0.019 ac-ft

C) Forebay Depth (D_F = 18 inch maximum) — D_F = 12.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 217.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 4.34 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 = 18.0 in

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ◉ Concrete
- ○ Soft Bottom

F) Slope of Trickle Channel — S = 0.0100 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^2 minimum) — A_M = 160 sq ft

C) Outlet Type

Choose One
- ◉ Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 1.88 inches

E) Total Outlet Area — A_{ot} = 8.58 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton
Company: Classic Consutling
Date: November 27, 2017
Project: Flying Horse North Filing 1 (Pond 4)
Location: Black Forest, CO

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 78.8 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 80.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 276 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 389 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 4 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 76 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton
Company: Classic Consutling
Date: November 27, 2017
Project: Flying Horse North Filing 1 (Pond 4)
Location: Black Forest, CO

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Soil Rip-Rap
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	4.00
11. Vegetation	Choose One ○ Irrigated ● Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer: Marc A. Whorton
Company: Classic Consutling
Date: November 30, 2017
Project: Flying Horse North Filing 1 (Pond 4 - North Forbay Design)
Location: Black Forest, CO

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 8.0 %
B) Tributary Area's Imperviousness Ratio (i = I_a / 100)	i = 0.080
C) Contributing Watershed Area	Area = 107.200 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ◉ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$	V_{DESIGN}= 0.494 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$	$V_{DESIGN\ OTHER}$= 0.482 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ◉ B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.794 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 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)

Designer: Marc A. Whorton
Company: Classic Consutling
Date: November 30, 2017
Project: Flying Horse North Filing 1 (Pond 4 - North Forbay Design)
Location: Black Forest, CO

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.015 ac-ft
B) Actual Forebay Volume	V_F = 0.015 ac-ft
C) Forebay Depth (D_F = 18 inch maximum)	D_F = 12.0 in
D) Forebay Discharge	
i) Undetained 100-year Peak Discharge	Q_{100} = 170.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 3.40 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 = 14.7 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ● Concrete; ○ Soft Bottom
F) Slope of Trickle Channel	S = 0.0100 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^2 minimum)	A_M = 160 sq ft
C) Outlet Type	Choose One: ● Orifice Plate; ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.88 inches
E) Total Outlet Area	A_{ot} = 8.58 square inches

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer:	**Marc A. Whorton**
Company:	**Classic Consutling**
Date:	**November 30, 2017**
Project:	**Flying Horse North Filing 1 (Pond 4 - South Forbay Design)**
Location:	**Black Forest, CO**

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 8.0 %
B) Tributary Area's Imperviousness Ratio (i = I_a / 100)	i = 0.080
C) Contributing Watershed Area	Area = 26.900 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV) ● Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)	V_{DESIGN}= 0.124 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= 0.121 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A ● B ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 0.199 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 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)

Designer:	**Marc A. Whorton**
Company:	**Classic Consutling**
Date:	**November 30, 2017**
Project:	**Flying Horse North Filing 1 (Pond 4 - South Forbay Design)**
Location:	**Black Forest, CO**

5. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 2% of the WQCV)	V_{FMIN} = 0.002 ac-ft
B) Actual Forebay Volume	V_F = 0.002 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} = 56.00 cfs
ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)	Q_F = 1.12 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 = 9.0 in
6. Trickle Channel	
A) Type of Trickle Channel	Choose One: ● Concrete; ○ Soft Bottom
F) Slope of Trickle Channel	S = 0.0100 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^2 minimum)	A_M = 160 sq ft
C) Outlet Type	Choose One: ● Orifice Plate; ○ Other (Describe):
D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention)	$D_{orifice}$ = 1.88 inches
E) Total Outlet Area	A_{ot} = 8.58 square inches

Worksheet Protected

Site-Level Low Impact Development (LID) Design Effective Impervious Calculator

LID Credit by Impervious Reduction Factor (IRF) Method

UD-BMP (Version 3.06, November 2016)

User Input

Calculated cells

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: November 30, 2017
Project: Flying Horse North (Trib. Basins to Pond 8)
Location: Black Forest, CO

***Design Storm: 1-Hour Rain Depth	WQCV Event	0.42	inches
***Minor Storm: 1-Hour Rain Depth	5-Year Event	1.50	inches
***Major Storm: 1-Hour Rain Depth	100-Year Event	2.52	inches
Optional User Defined Storm	CUHP		
(CUHP) NOAA 1 Hour Rainfall Depth and Frequency for User Defined Storm	100-Year Event	2.52	
Max Intensity for Optional User Defined Storm	2.51496		

SITE INFORMATION (USER-INPUT)

Sub-basin Identifier	BS-18	BS-19	BS-20	BS-21	BS-22	BS-23	BS-23A							
Receiving Pervious Area Soil Type	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand	Loamy Sand							
Total Area (ac., Sum of DCIA, UIA, RPA, & SPA)	33.800	6.300	73.900	69.500	18.100	37.100	16.300							
Directly Connected Impervious Area (DCIA, acres)	1.500	1.000	4.500	4.200	1.500	3.200	2.900							
Unconnected Impervious Area (UIA, acres)	1.200	0.300	3.400	3.500	1.700	2.300	1.800							
Receiving Pervious Area (RPA, acres)	5.200	0.700	11.500	10.100	4.000	5.500	2.500							
Separate Pervious Area (SPA, acres)	25.900	4.300	54.500	51.700	10.900	26.100	9.100							
RPA Treatment Type: Conveyance (C), Volume (V), or Permeable Pavement (PP)	C	C	C	C	C	C	C							

CALCULATED RESULTS (OUTPUT)

Total Calculated Area (ac, check against input)	33.800	6.300	73.900	69.500	18.100	37.100	16.300							
Directly Connected Impervious Area (DCIA, %)	4.4%	15.9%	6.1%	6.0%	8.3%	8.6%	17.8%							
Unconnected Impervious Area (UIA, %)	3.6%	4.8%	4.6%	5.0%	9.4%	6.2%	11.0%							
Receiving Pervious Area (RPA, %)	15.4%	11.1%	15.6%	14.5%	22.1%	14.8%	15.3%							
Separate Pervious Area (SPA, %)	76.6%	68.3%	73.7%	74.4%	60.2%	70.4%	55.8%							
A_R (RPA / UIA)	4.333	2.333	3.382	2.886	2.353	2.391	1.389							
I_a Check	0.190	0.300	0.230	0.260	0.300	0.290	0.420							
f / I for WQCV Event:	4.6	4.6	4.6	4.6	4.6	4.6	4.6							
f / I for 5-Year Event:	0.5	0.5	0.5	0.5	0.5	0.5	0.5							
f / I for 100-Year Event:	0.4	0.4	0.4	0.4	0.4	0.4	0.4							
f / I for Optional User Defined Storm CUHP:	0.39	0.39	0.39	0.39	0.39	0.39	0.39							
IRF for WQCV Event:	0.41	0.49	0.45	0.47	0.49	0.49	0.56							
IRF for 5-Year Event:	0.80	0.86	0.84	0.85	0.86	0.85	0.88							
IRF for 100-Year Event:	0.82	0.88	0.87	0.88	0.88	0.88	0.90							
IRF for Optional User Defined Storm CUHP:	0.82	0.88	0.87	0.88	0.88	0.88	0.90							
Total Site Imperviousness: I_{total}	8.0%	20.6%	10.7%	11.1%	17.7%	14.8%	28.8%							
Effective Imperviousness for WQCV Event:	5.9%	18.2%	8.2%	8.4%	12.9%	11.6%	24.0%							
Effective Imperviousness for 5-Year Event:	7.3%	19.9%	10.0%	10.3%	16.3%	13.9%	27.5%							
Effective Imperviousness for 100-Year Event:	7.4%	20.1%	10.1%	10.4%	16.6%	14.1%	27.7%							
Effective Imperviousness for Optional User Defined Storm CUHP:	7.4%	20.1%	10.1%	10.4%	16.6%	14.1%	27.7%							

LID / EFFECTIVE IMPERVIOUSNESS CREDITS

WQCV Event CREDIT: Reduce Detention By:	23.8%	8.6%	20.6%	21.0%	21.7%	17.7%	11.3%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
This line only for 10-Year Event	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
100-Year Event CREDIT**: Reduce Detention By:	10.5%	3.0%	6.8%	6.9%	7.0%	5.7%	4.0%	N/A	N/A	N/A	N/A	N/A	N/A	N/A
User Defined CUHP CREDIT: Reduce Detention By:	4.4%	1.8%	3.3%	3.4%	4.1%	3.2%	2.7%							

Total Site Imperviousness:	**12.9%**
Total Site Effective Imperviousness for WQCV Event:	**10.0%**
Total Site Effective Imperviousness for 5-Year Event:	**12.1%**
Total Site Effective Imperviousness for 100-Year Event:	**12.2%**
Total Site Effective Imperviousness for Optional User Defined Storm CUHP:	**12.2%**

Notes:

* Use Green-Ampt average infiltration rate values from Table 3-3.

** Flood control detention volume credits based on empirical equations from Storage Chapter of USDCM.

*** Method assumes that 1-hour rainfall depth is equivalent to 1-hour intensity for calculation purposed

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton
Company: Classic Consutling
Date: November 30, 2017
Project: Flying Horse North Filing 1 (Pond 8) (Ultimate Build-out)
Location: Black Forest, CO

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 10.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.100
C) Contributing Watershed Area	Area = 255.000 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = 0.42 in
E) Design Concept (Select EURV when also designing for flood control)	Choose One: ○ Water Quality Capture Volume (WQCV); ● Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)	V_{DESIGN}= 1.424 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6*(V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= 1.391 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One: ○ A; ● B; ○ C / D
J) Excess Urban Runoff Volume (EURV) Design Volume For HSG A: $EURV_A = 1.68 * i^{1.28}$ For HSG B: $EURV_B = 1.36 * i^{1.08}$ For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$	EURV = 2.404 ac-f t
2. Basin Shape: Length to Width Ratio (A basin length to width ratio of at least 2:1 will improve TSS reduction.)	L : W = 2.0 : 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)

Designer:	**Marc A. Whorton**
Company:	**Classic Consutling**
Date:	**November 30, 2017**
Project:	**Flying Horse North Filing 1 (Pond 8) (Ultimate Build-out)**
Location:	**Black Forest, CO**

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.042 ac-ft

B) Actual Forebay Volume — V_F = 0.042 ac-ft

C) Forebay Depth (D_F = 30 inch maximum) — D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 390.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 7.80 cfs

E) Forebay Discharge Design

Choose One
- ○ Berm With Pipe
- ● Wall with Rect. Notch
- ○ Wall with V-Notch Weir

F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = ______ in

G) Rectangular Notch Width — Calculated W_N = 18.9 in

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ● Concrete
- ○ Soft Bottom

F) Slope of Trickle Channel — S = 0.0100 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^2 minimum) — A_M = 384 sq ft

C) Outlet Type

Choose One
- ● Orifice Plate
- ○ Other (Describe):

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 2.61 inches

E) Total Outlet Area — A_{ot} = 16.08 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer:	**Marc A. Whorton**
Company:	**Classic Consutling**
Date:	**November 30, 2017**
Project:	**Flying Horse North Filing 1 (Pond 8) (Ultimate Build-out)**
Location:	**Black Forest, CO**

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 181.8 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 192.0 cu ft

9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 483 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*Aluminum Amico-Klemp SR Series with Cross Rods 2" O.C.*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 680 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 5.25 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 91 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: Marc A. Whorton
Company: Classic Consutling
Date: November 30, 2017
Project: Flying Horse North Filing 1 (Pond 8) (Ultimate Build-out)
Location: Black Forest, CO

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping: Soil Rip-Rap

B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred): 4.00

11. Vegetation

Choose One
- ○ Irrigated
- ● Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

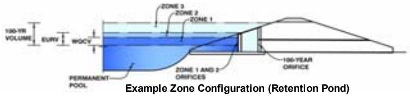
Notes:

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Flying Horse North Filing No. 1

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

Depth Increment = ft

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	21.80	acres		
Watershed Length =	1,500	ft		
Watershed Slope =	0.010	ft/ft		
Watershed Imperviousness =	20.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.210	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.433	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.319	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.469	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	0.809	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.596	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.099	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.758	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.39 in.) =	4.375	acre-feet	3.39	inches
Approximate 2-yr Detention Volume =	0.297	acre-feet		
Approximate 5-yr Detention Volume =	0.440	acre-feet		
Approximate 10-yr Detention Volume =	0.711	acre-feet		
Approximate 25-yr Detention Volume =	0.880	acre-feet		
Approximate 50-yr Detention Volume =	0.930	acre-feet		
Approximate 100-yr Detention Volume =	1.143	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.210	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.223	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.710	acre-feet
Total Detention Basin Volume =	1.143	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	168	0.004		
7392	--	2.00	--	--	--	11,048	0.254	11,106	0.255
7394	--	4.00	--	--	--	14,600	0.335	36,864	0.846
7396	--	6.00	--	--	--	18,643	0.428	70,107	1.609
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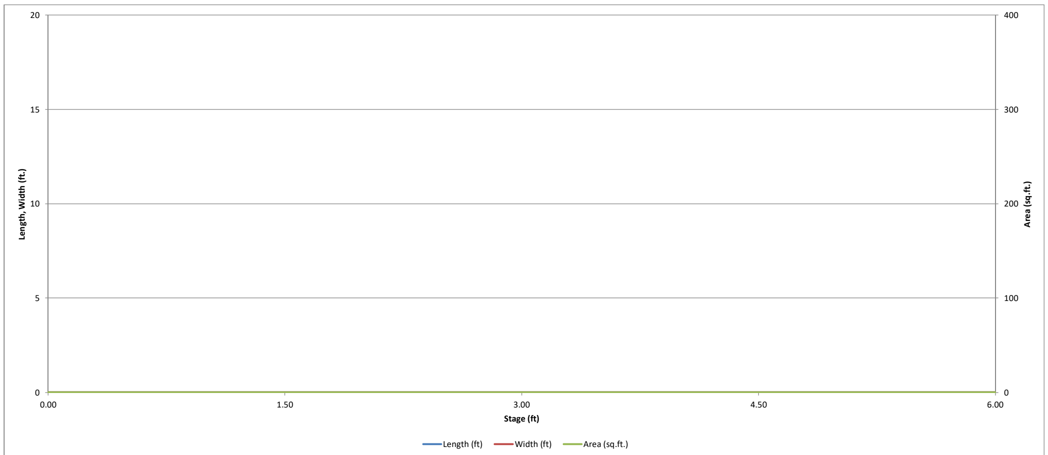
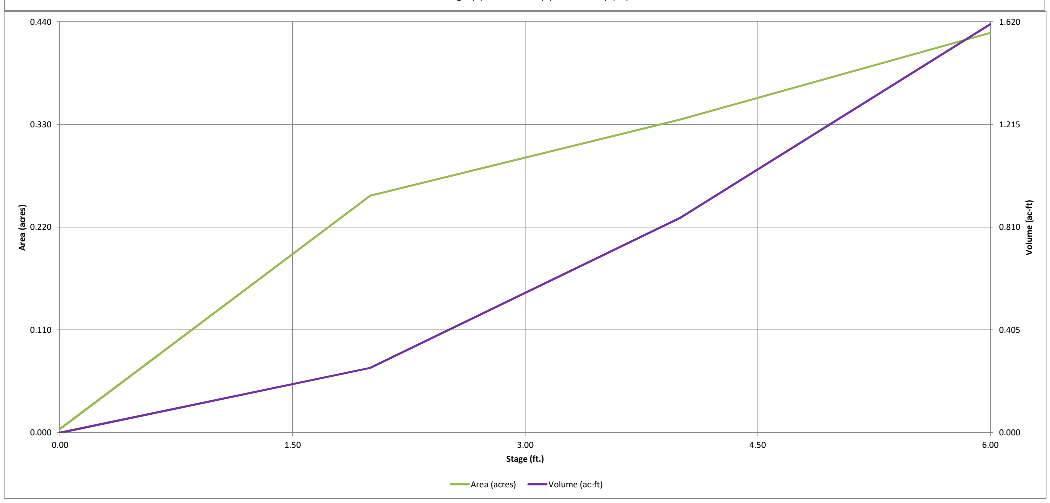
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



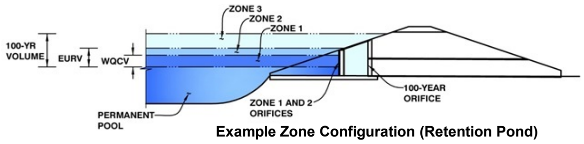


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Flying Horse North Filing No. 1

Basin ID: Pond 1



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.81	0.210	Orifice Plate
Zone 2 (EURV)	2.66	0.223	Orifice Plate
Zone 3 (100-year)	4.84	0.710	Weir&Pipe (Restrict)
		1.143	Total

0

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.75	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	8.25	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.70	1.40	2.10				
Orifice Area (sq. inches)	0.99	1.28	1.28	1.28				

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.75	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	4.00	N/A	feet
Overflow Weir Slope =	3.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	4.08	N/A	feet
Over Flow Weir Slope Length =	4.22	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.05	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	12.65	N/A	ft^2
Overflow Grate Open Area w/ Debris =	6.32	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	24.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	12.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	1.57	N/A	ft^2
Outlet Orifice Centroid =	0.58	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	25.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

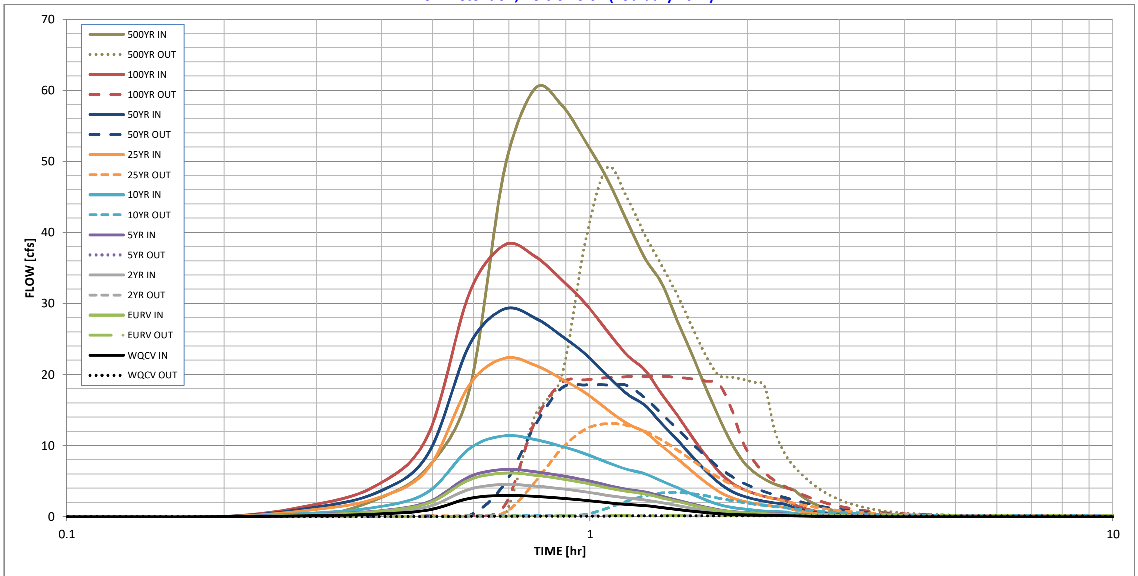
Spillway Design Flow Depth=	0.69	feet
Stage at Top of Freeboard =	6.69	feet
Basin Area at Top of Freeboard =	0.43	acres

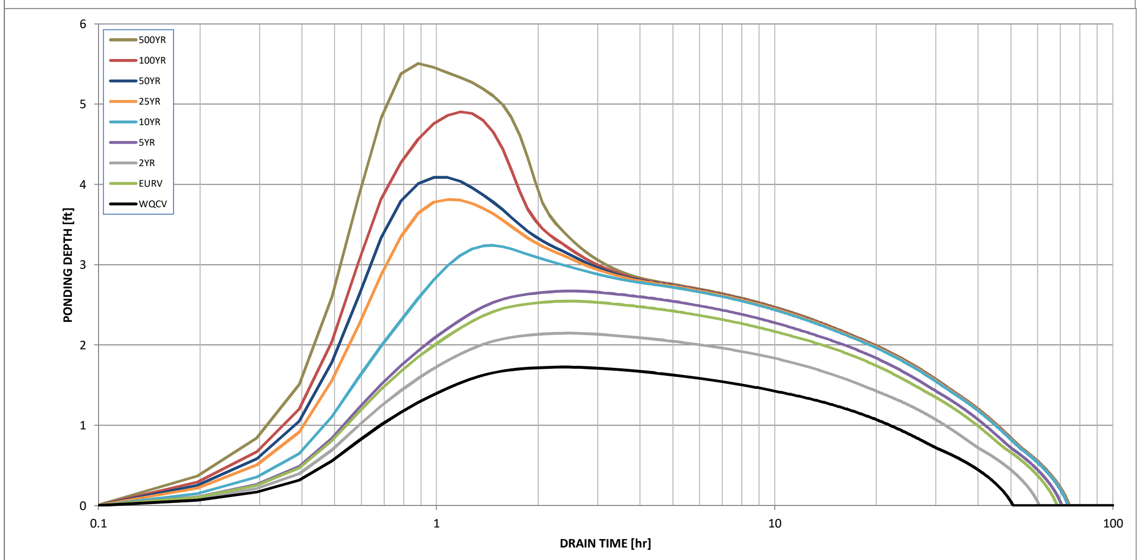
Routed Hydrograph Results

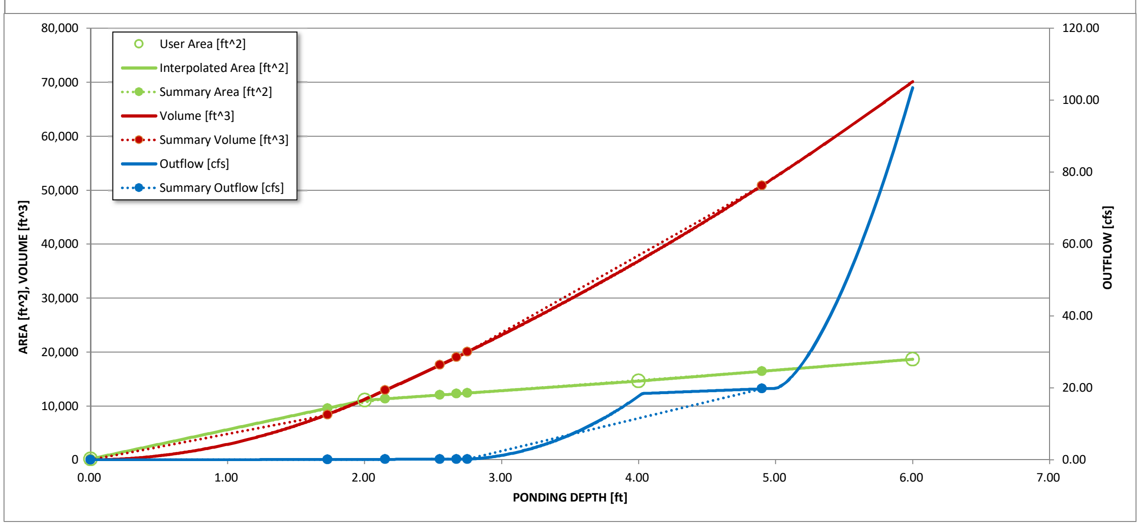
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.39
Calculated Runoff Volume (acre-ft) =	0.210	0.433	0.319	0.469	0.809	1.596	2.099	2.758	4.375
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.210	0.432	0.319	0.469	0.809	1.596	2.099	2.757	4.375
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.16	0.55	0.77	1.04	1.66
Predevelopment Peak Q (cfs) =	0.0	0.0	0.2	0.4	3.5	12.0	16.7	22.6	36.2
Peak Inflow Q (cfs) =	3.0	6.1	4.5	6.6	11.4	22.3	29.2	38.2	60.2
Peak Outflow Q (cfs) =	0.1	0.2	0.1	0.2	3.4	13.1	18.5	19.8	49.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.5	1.0	1.1	1.1	0.9	1.4
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	1.0	1.4	1.5	1.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	45	58	53	60	58	50	46	42	34
Time to Drain 99% of Inflow Volume (hours) =	**48**	64	57	66	67	62	60	57	51
Maximum Ponding Depth (ft) =	1.73	2.55	2.15	2.67	3.24	3.81	4.09	4.90	5.51
Area at Maximum Ponding Depth (acres) =	0.22	0.28	0.26	0.28	0.30	0.33	0.34	0.38	0.40
Maximum Volume Stored (acre-ft) =	0.191	0.400	0.293	0.437	0.603	0.783	0.873	1.167	1.401

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	Hydrograph Constant
5.88 min	0.850

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:11:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:17:38	0.14	0.27	0.20	0.30	0.50	0.96	1.25	1.63	2.49
0:23:31	0.36	0.74	0.55	0.80	1.36	2.63	3.43	4.47	6.93
0:29:24	0.93	1.89	1.40	2.05	3.48	6.75	8.81	11.46	17.79
0:35:17	2.57	5.19	3.86	5.62	9.57	18.53	24.17	31.46	48.76
0:41:10	3.01	6.13	4.54	6.65	11.39	22.29	29.23	38.24	60.21
0:47:02	2.86	5.85	4.32	6.34	10.88	21.33	27.99	36.67	57.98
0:52:55	2.60	5.32	3.93	5.77	9.90	19.42	25.48	33.37	52.82
0:58:48	2.31	4.74	3.50	5.14	8.85	17.42	22.88	30.01	47.59
1:04:41	1.98	4.08	3.01	4.43	7.65	15.12	19.90	26.16	41.65
1:10:34	1.73	3.56	2.62	3.86	6.67	13.14	17.30	22.78	36.37
1:16:26	1.56	3.22	2.37	3.50	6.04	11.92	15.68	20.62	32.82
1:22:19	1.28	2.65	1.95	2.88	5.00	9.92	13.08	17.23	27.52
1:28:12	1.03	2.16	1.58	2.34	4.09	8.16	10.79	14.24	22.81
1:34:05	0.78	1.65	1.20	1.80	3.16	6.38	8.47	11.22	18.09
1:39:58	0.57	1.22	0.88	1.33	2.36	4.84	6.46	8.60	13.98
1:45:50	0.42	0.89	0.65	0.97	1.71	3.54	4.76	6.37	10.45
1:51:43	0.33	0.69	0.50	0.75	1.32	2.70	3.61	4.81	7.83
1:57:36	0.27	0.57	0.41	0.62	1.08	2.20	2.93	3.89	6.29
2:03:29	0.23	0.48	0.35	0.53	0.92	1.86	2.47	3.28	5.29
2:09:22	0.20	0.42	0.31	0.46	0.81	1.63	2.16	2.86	4.61
2:15:14	0.18	0.38	0.28	0.42	0.73	1.46	1.94	2.56	4.12
2:21:07	0.17	0.35	0.26	0.39	0.67	1.34	1.78	2.35	3.77
2:27:00	0.12	0.26	0.19	0.28	0.49	0.99	1.31	1.74	2.81
2:32:53	0.09	0.19	0.14	0.21	0.36	0.72	0.96	1.26	2.04
2:38:46	0.07	0.14	0.10	0.15	0.26	0.53	0.70	0.93	1.51
2:44:38	0.05	0.10	0.07	0.11	0.19	0.39	0.52	0.69	1.12
2:50:31	0.03	0.07	0.05	0.08	0.14	0.28	0.38	0.50	0.82
2:56:24	0.02	0.05	0.04	0.06	0.10	0.20	0.27	0.36	0.59
3:02:17	0.02	0.04	0.03	0.04	0.07	0.15	0.20	0.26	0.43
3:08:10	0.01	0.02	0.02	0.03	0.05	0.10	0.13	0.18	0.30
3:14:02	0.01	0.01	0.01	0.02	0.03	0.06	0.08	0.12	0.19
3:19:55	0.00	0.01	0.00	0.01	0.01	0.03	0.05	0.06	0.11
3:25:48	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.03	0.05
3:31:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
3:37:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:43:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:49:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:55:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:01:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:06:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:12:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:18:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:24:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:30:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:36:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:42:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:48:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:54:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:59:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:05:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:11:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:17:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:23:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:29:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:35:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:41:02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:46:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:52:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:58:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:04:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:10:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:16:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:22:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:28:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:33:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:39:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:45:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:51:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:57:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:03:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
TOP OF MICROPOOL	0.00	168	0.004	0	0.000	0.00
WQCV	1.73	9,525	0.219	8,336	0.191	0.11
2-YR. WSE	2.15	11,314	0.260	12,893	0.296	0.15
EURV	2.55	12,025	0.276	17,561	0.403	0.19
5-YR. WSE	2.67	12,238	0.281	19,017	0.437	0.19
TOP OF BOX	2.75	12,380	0.284	20,001	0.459	0.20
100 YR. WSE	4.90	16,419	0.377	50,823	1.167	19.76

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

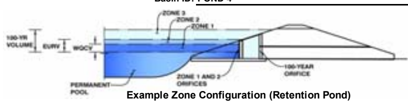
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FLYING HORSE NORTH FILING 1

Basin ID: POND 4



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	134.10	acres		
Watershed Length =	3,900	ft		
Watershed Slope =	0.021	ft/ft		
Watershed Imperviousness =	8.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.617	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	0.990	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.666	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.055	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	2.694	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	7.789	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	10.959	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	15.099	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	28.334	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	0.618	acre-feet		
Approximate 5-yr Detention Volume =	0.988	acre-feet		
Approximate 10-yr Detention Volume =	2.274	acre-feet		
Approximate 25-yr Detention Volume =	3.285	acre-feet		
Approximate 50-yr Detention Volume =	3.412	acre-feet		
Approximate 100-yr Detention Volume =	4.464	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.617	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.373	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.474	acre-feet
Total Detention Basin Volume =	4.464	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	160	0.004		
7422	--	0.50	--	--	--	160	0.004	78	0.002
7424	--	2.50	--	--	--	10,810	0.248	11,050	0.254
7426	--	4.50	--	--	--	42,734	0.981	64,594	1.483
7428	--	6.50	--	--	--	53,403	1.226	160,731	3.690
7430	--	8.50	--	--	--	62,379	1.432	276,513	6.348
7432	--	10.50	--	--	--	71,913	1.651	410,805	9.431
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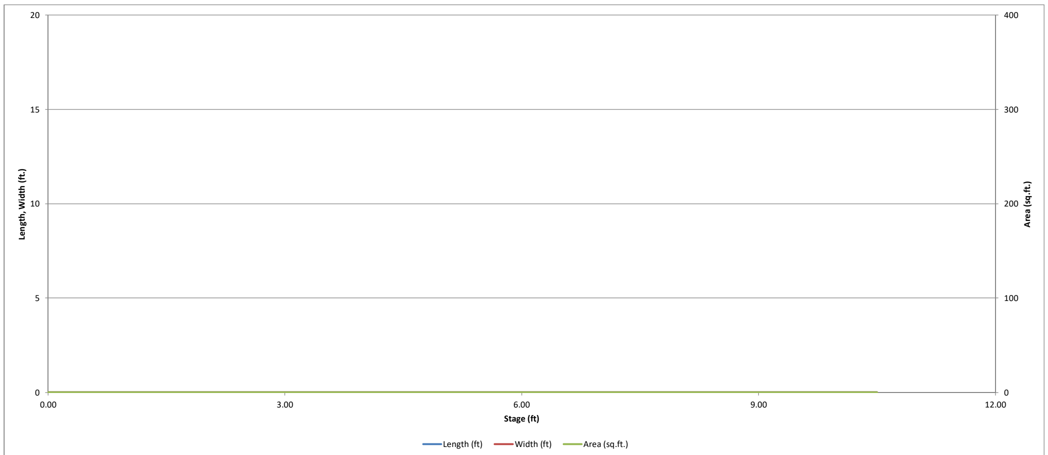
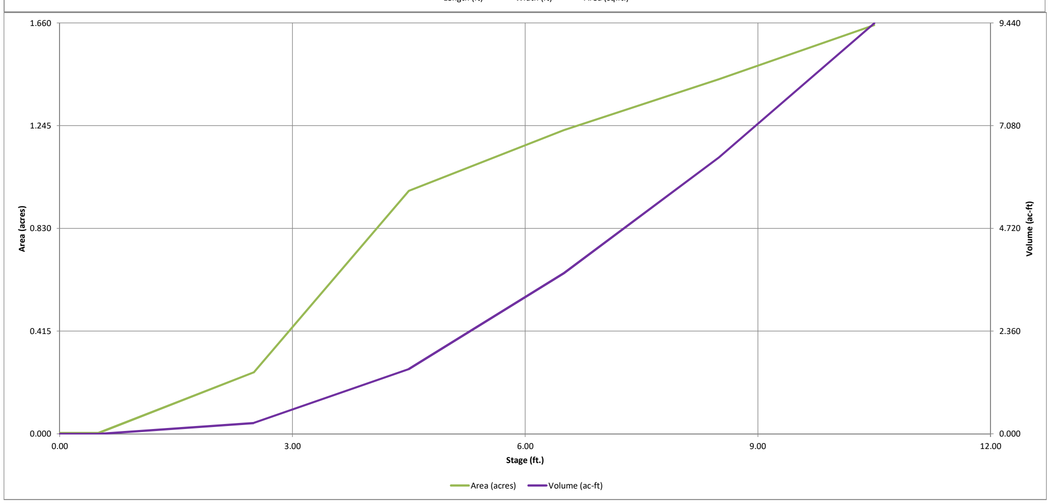
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

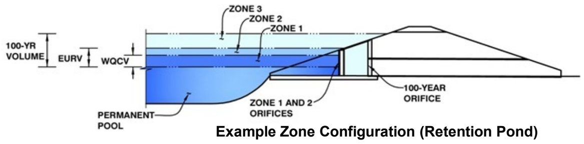




Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FLYING HORSE NORTH FILING 1
Basin ID: POND 4



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.39	0.617	Orifice Plate
Zone 2 (EURV)	3.94	0.373	Orifice Plate
Zone 3 (100-year)	7.12	3.474	Weir&Pipe (Restrict)
		4.464	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	4.00	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.00	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00	3.00				
Orifice Area (sq. inches)	1.39	1.83	1.83	1.83				

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.00	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	10.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.00	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.46	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	30.92	N/A	ft^2
Overflow Grate Open Area w/ Debris =	15.46	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	2.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	48.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	48.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	12.57	N/A	ft^2
Outlet Orifice Centroid =	2.00	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	3.14	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	40.00	feet
Spillway End Slopes =	6.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

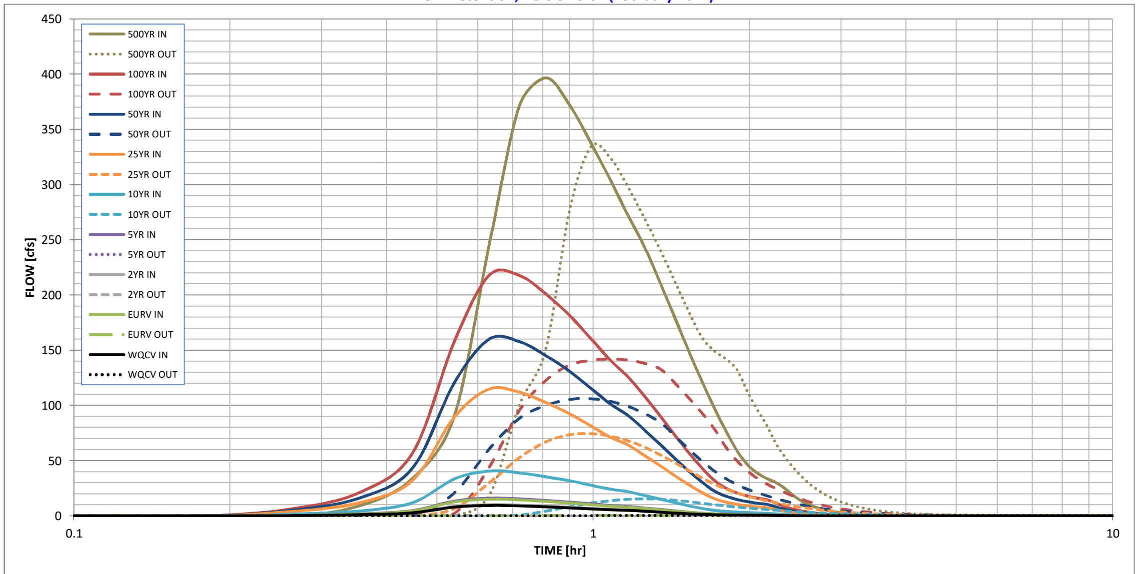
Spillway Design Flow Depth=	1.34	feet
Stage at Top of Freeboard =	10.34	feet
Basin Area at Top of Freeboard =	1.63	acres

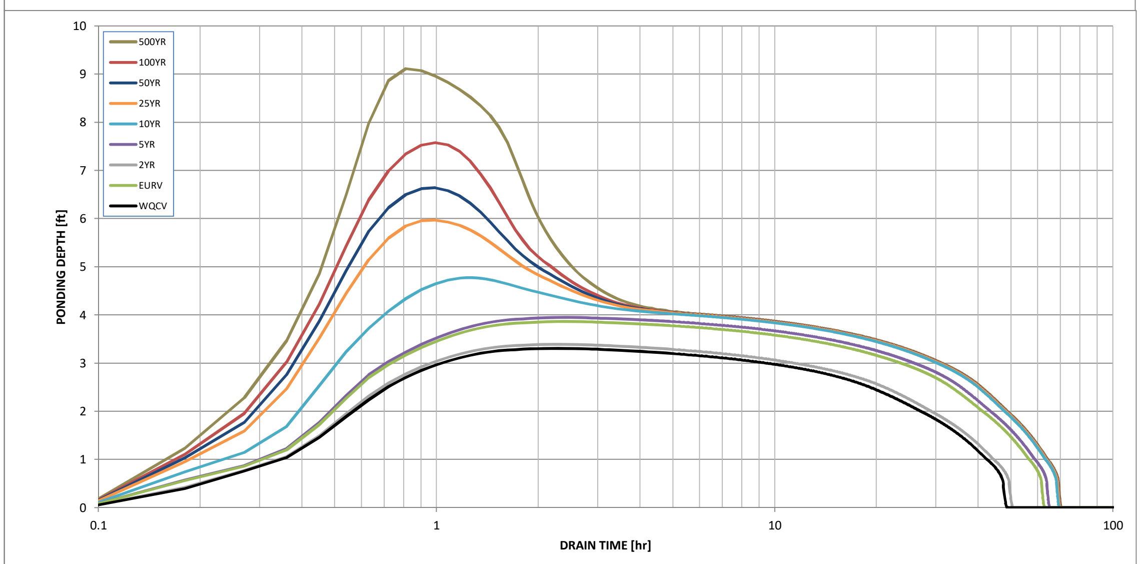
Routed Hydrograph Results

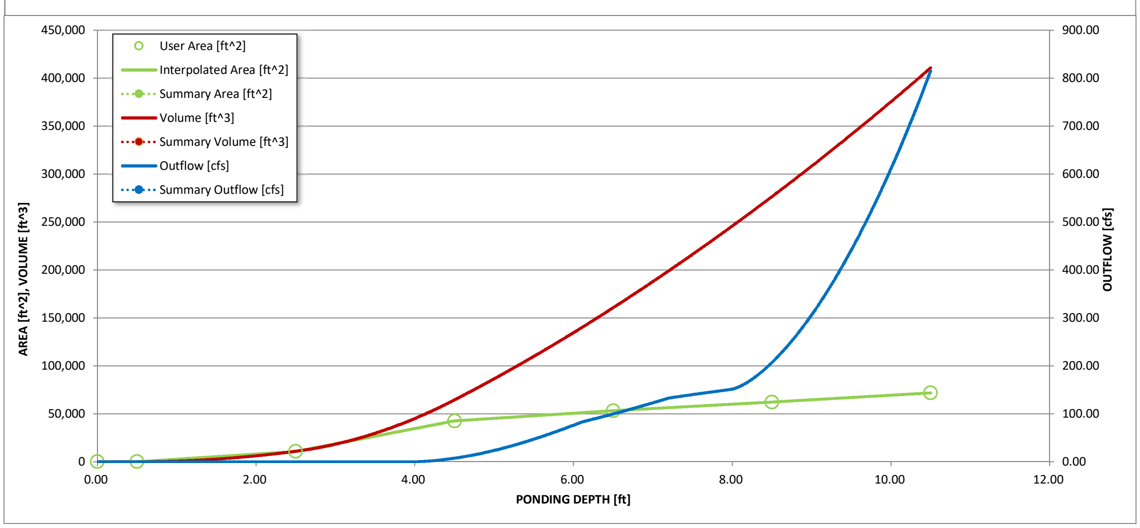
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.617	0.990	0.666	1.055	2.694	7.789	10.959	15.099	28.334
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.617	0.989	0.665	1.054	2.692	7.773	10.944	15.081	28.305
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.18	0.60	0.84	1.13	2.05
Predevelopment Peak Q (cfs) =	0.0	0.0	1.5	2.5	24.1	81.1	112.3	151.7	275.3
Peak Inflow Q (cfs) =	9.5	15.1	10.2	16.1	40.7	114.9	160.1	217.9	396.7
Peak Outflow Q (cfs) =	0.3	0.3	0.3	0.3	15.5	74.5	106.2	142.1	334.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.6	0.9	0.9	0.9	1.2
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.5	2.4	3.4	4.6	5.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	43	55	44	57	55	42	36	30	13
Time to Drain 99% of Inflow Volume (hours) =	**46**	59	48	61	62	55	52	48	39
Maximum Ponding Depth (ft) =	3.31	3.87	3.39	3.95	4.77	5.97	6.64	7.58	9.12
Area at Maximum Ponding Depth (acres) =	0.54	0.75	0.57	0.78	1.01	1.16	1.24	1.34	1.50
Maximum Volume Stored (acre-ft) =	0.569	0.930	0.614	0.991	1.752	3.046	3.850	5.061	7.242

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	Hydrograph Constant
5.40 min	0.925

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:10:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:16:12	0.42	0.66	0.45	0.71	1.73	4.42	5.77	7.29	10.17
0:21:36	1.13	1.80	1.22	1.91	4.75	12.73	17.17	22.53	34.50
0:27:00	2.91	4.61	3.13	4.91	12.20	32.70	44.13	57.96	90.44
0:32:24	8.00	12.68	8.61	13.48	33.46	89.47	120.54	157.99	244.93
0:37:48	9.48	15.14	10.22	16.11	40.66	114.89	160.07	217.88	370.89
0:43:12	9.05	14.46	9.76	15.40	38.98	112.05	157.87	217.76	396.70
0:48:36	8.24	13.17	8.88	14.02	35.48	102.62	145.16	201.10	372.27
0:54:00	7.36	11.79	7.93	12.55	31.90	92.56	131.02	181.62	337.53
0:59:24	6.35	10.20	6.85	10.87	27.81	81.35	115.46	160.46	303.55
1:04:48	5.53	8.88	5.97	9.46	24.21	71.19	101.13	140.64	270.81
1:10:12	5.01	8.05	5.41	8.57	21.92	63.93	90.52	125.45	241.80
1:15:36	4.13	6.67	4.46	7.11	18.31	54.03	76.96	107.31	209.41
1:21:00	3.38	5.47	3.65	5.83	15.13	44.91	64.06	89.43	177.93
1:26:24	2.60	4.24	2.81	4.53	11.91	35.94	51.53	72.33	148.32
1:31:48	1.93	3.18	2.09	3.40	9.13	27.99	40.28	56.74	121.33
1:37:12	1.40	2.30	1.52	2.47	6.76	21.12	30.55	43.29	97.87
1:42:36	1.09	1.77	1.17	1.90	5.11	15.68	22.55	32.04	76.98
1:48:00	0.89	1.46	0.97	1.56	4.13	12.48	17.85	25.15	59.05
1:53:24	0.76	1.23	0.82	1.32	3.49	10.47	14.94	20.95	46.42
1:58:48	0.67	1.08	0.72	1.15	3.04	9.07	12.91	18.05	38.79
2:04:12	0.60	0.97	0.65	1.04	2.72	8.09	11.49	16.03	33.72
2:09:36	0.55	0.90	0.60	0.96	2.50	7.39	10.48	14.59	30.13
2:15:00	0.41	0.66	0.44	0.70	1.85	5.62	8.09	11.44	24.60
2:20:24	0.30	0.48	0.32	0.51	1.34	4.05	5.83	8.25	18.28
2:25:48	0.22	0.35	0.24	0.38	0.99	3.01	4.33	6.11	13.29
2:31:12	0.16	0.26	0.17	0.28	0.74	2.23	3.21	4.54	9.86
2:36:36	0.11	0.19	0.12	0.20	0.54	1.65	2.38	3.36	7.46
2:42:00	0.08	0.13	0.09	0.14	0.38	1.19	1.72	2.44	5.57
2:47:24	0.06	0.10	0.06	0.10	0.28	0.86	1.24	1.76	4.14
2:52:48	0.04	0.06	0.04	0.07	0.19	0.61	0.89	1.27	3.08
2:58:12	0.02	0.04	0.02	0.04	0.12	0.40	0.59	0.85	2.26
3:03:36	0.01	0.02	0.01	0.02	0.07	0.24	0.35	0.52	1.57
3:09:00	0.00	0.01	0.00	0.01	0.03	0.11	0.18	0.27	1.00
3:14:24	0.00	0.00	0.00	0.00	0.01	0.04	0.06	0.10	0.56
3:19:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.24
3:25:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06
3:30:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:36:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:41:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:46:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:52:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:57:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:03:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:08:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:13:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:19:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:24:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:35:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:40:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:46:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:51:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:57:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:02:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:07:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:13:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:18:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:24:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:29:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:34:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:40:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:51:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:56:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:01:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:07:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:12:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:18:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:23:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:28:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

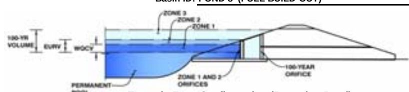
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FLYING HORSE NORTH FILING 1

Basin ID: POND 8 (FULL BUILD-OUT)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	255.00	acres		
Watershed Length =	5,500	ft		
Watershed Slope =	0.017	ft/ft		
Watershed Imperviousness =	10.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	1.424	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	2.397	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	1.648	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	2.564	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	5.846	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	15.453	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	21.458	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	29.303	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	54.585	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	1.530	acre-feet		
Approximate 5-yr Detention Volume =	2.400	acre-feet		
Approximate 10-yr Detention Volume =	4.982	acre-feet		
Approximate 25-yr Detention Volume =	6.957	acre-feet		
Approximate 50-yr Detention Volume =	7.278	acre-feet		
Approximate 100-yr Detention Volume =	9.408	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	1.424	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.973	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	7.011	acre-feet
Total Detention Basin Volume =	9.408	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	384	0.009		
7370	--	0.50	--	--	--	384	0.009	188	0.004
7372	--	2.50	--	--	--	18,082	0.415	18,658	0.428
7374	--	4.50	--	--	--	40,004	0.918	76,744	1.762
7376	--	6.50	--	--	--	61,465	1.411	178,213	4.091
7378	--	8.50	--	--	--	69,433	1.594	309,111	7.096
7380	--	10.50	--	--	--	77,895	1.788	456,439	10.478
7382	--	12.50	--	--	--	88,522	2.032	622,856	14.299
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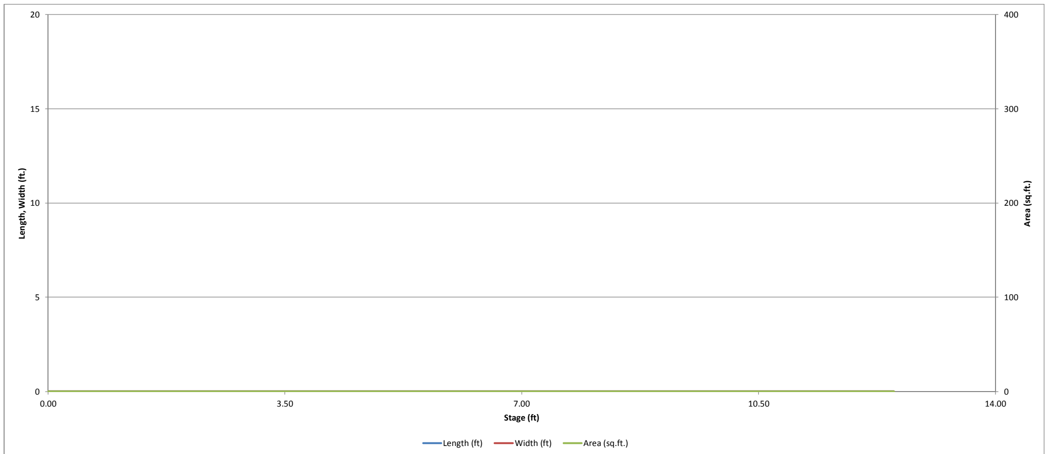
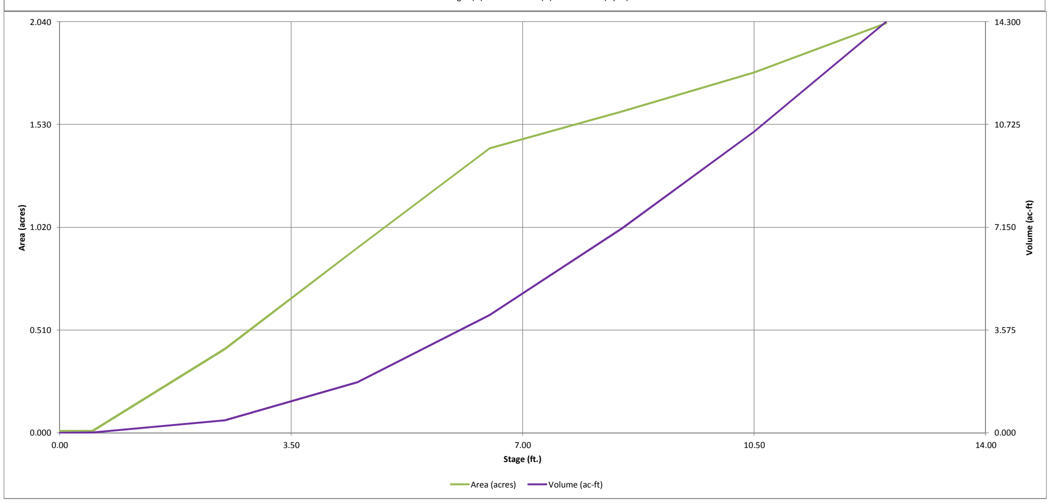
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

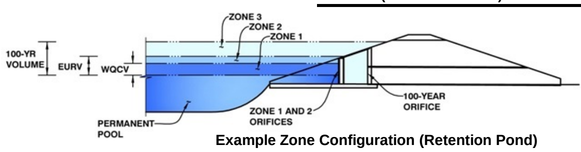




Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FLYING HORSE NORTH FILING 1
Basin ID: POND 8 (FULL BUILD-OUT)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	4.12	1.424	Orifice Plate
Zone 2 (EURV)	5.14	0.973	Orifice Plate
Zone 3 (100-year)	9.90	7.011	Weir&Pipe (Restrict)
		9.408	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	21.00	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.80	3.60					
Orifice Area (sq. inches)	5.35	5.35	5.35					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	16.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00		feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.25	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.66	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	49.48	N/A	ft^2
Overflow Grate Open Area w/ Debris =	24.74	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	60.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	54.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	18.61	N/A	ft^2
Outlet Orifice Centroid =	2.38	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.50	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	10.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	75.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

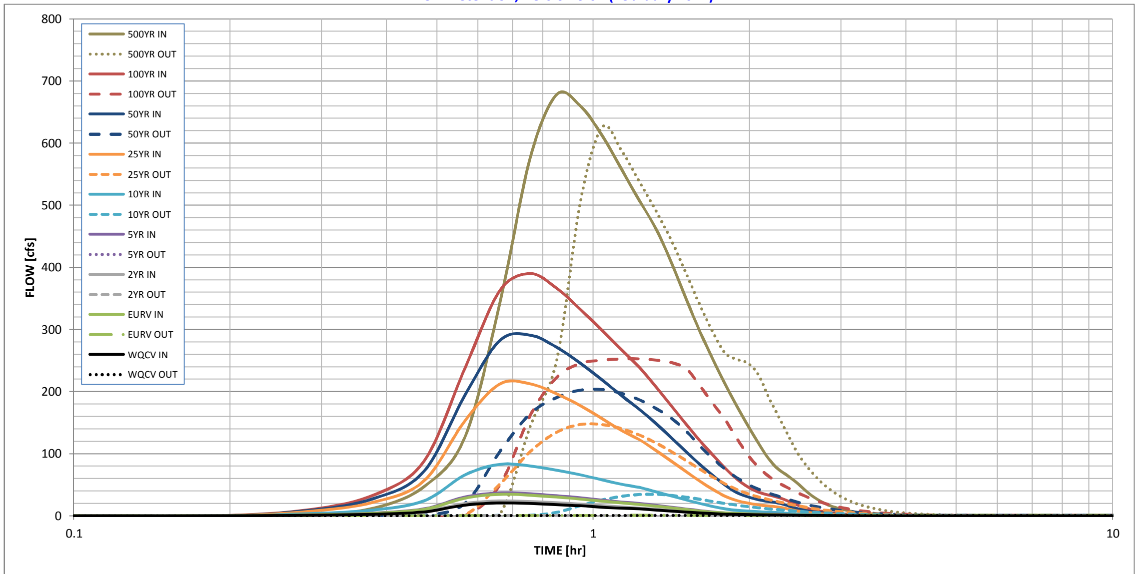
Spillway Design Flow Depth=	1.38	feet
Stage at Top of Freeboard =	12.38	feet
Basin Area at Top of Freeboard =	2.02	acres

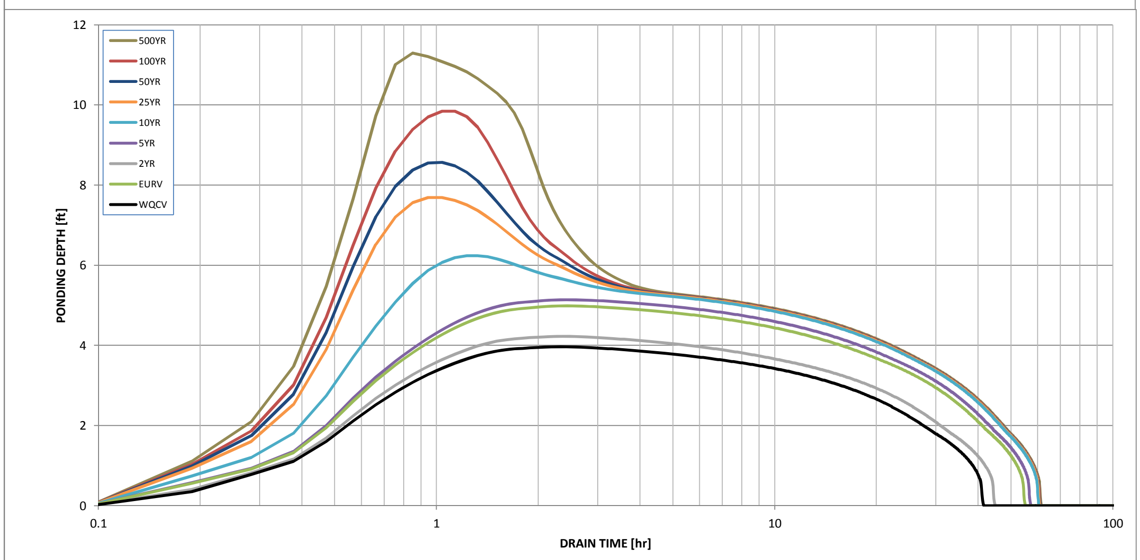
Routed Hydrograph Results

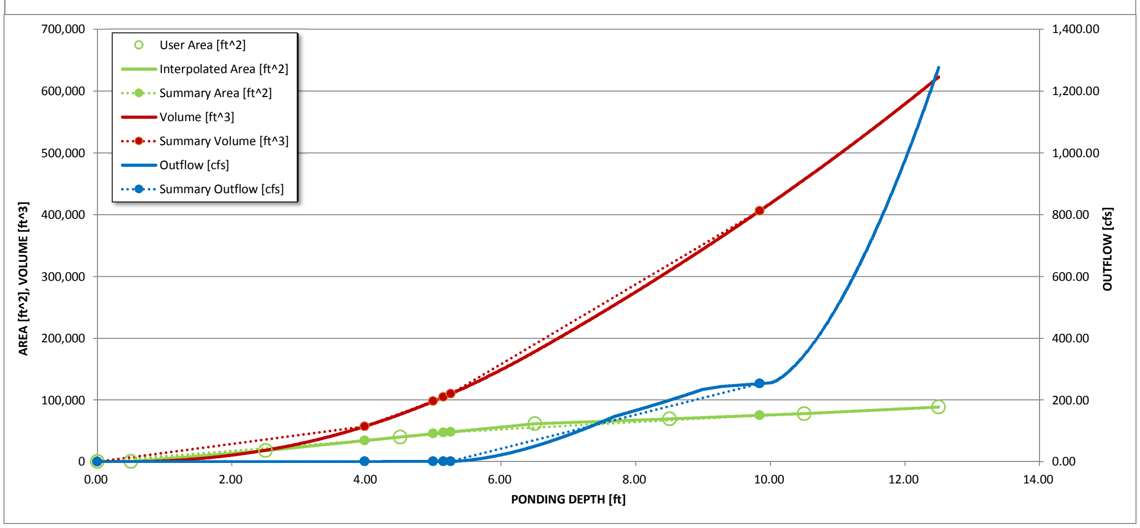
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	1.424	2.397	1.648	2.564	5.846	15.453	21.458	29.303	54.585
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	1.423	2.395	1.646	2.562	5.839	15.442	21.440	29.281	54.548
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.57	0.79	1.07	1.95
Predevelopment Peak Q (cfs) =	0.0	0.0	2.6	4.5	42.9	145.9	202.2	273.7	497.4
Peak Inflow Q (cfs) =	20.6	34.5	23.8	36.9	82.8	212.4	290.8	390.0	677.9
Peak Outflow Q (cfs) =	0.7	0.9	0.8	1.0	34.7	147.2	203.6	252.9	625.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.2	0.8	1.0	1.0	0.9	1.3
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.7	2.9	4.1	5.1	5.5
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	50	41	52	50	40	36	31	18
Time to Drain 99% of Inflow Volume (hours) =	40	53	43	55	56	51	48	46	39
Maximum Ponding Depth (ft) =	3.97	4.99	4.22	5.14	6.24	7.69	8.57	9.84	11.30
Area at Maximum Ponding Depth (acres) =	0.78	1.04	0.85	1.07	1.35	1.52	1.60	1.72	1.88
Maximum Volume Stored (acre-ft) =	1.303	2.231	1.515	2.389	3.733	5.835	7.192	9.319	11.929

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	5.67 min
Hydrograph Constant	0.881

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:05:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:11:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:17:01	0.90	1.47	1.03	1.57	3.32	7.06	8.52	9.82	12.32
0:22:41	2.44	4.04	2.81	4.31	9.37	21.88	27.67	33.54	46.83
0:28:21	6.26	10.37	7.21	11.07	24.07	56.31	71.67	88.06	127.54
0:34:01	17.19	28.47	19.80	30.39	65.93	153.46	194.79	238.36	343.20
0:39:41	20.64	34.51	23.84	36.89	82.80	212.27	282.31	362.92	575.41
0:45:22	19.75	33.07	22.82	35.36	80.17	212.38	290.77	389.96	677.94
0:51:02	17.98	30.10	20.77	32.18	73.22	196.20	271.27	366.28	659.59
0:56:42	16.12	27.05	18.63	28.93	66.00	177.21	245.63	332.17	612.74
1:02:22	13.98	23.55	16.18	25.20	57.88	156.59	218.92	299.06	557.82
1:08:02	12.15	20.49	14.05	21.94	50.60	137.25	193.21	267.13	506.91
1:13:43	11.02	18.56	12.75	19.86	45.56	122.39	171.19	238.73	460.88
1:19:23	9.16	15.49	10.61	16.59	38.34	104.74	148.01	206.78	406.08
1:25:03	7.54	12.79	8.74	13.70	31.83	87.30	124.78	175.85	347.82
1:30:43	5.88	10.06	6.83	10.78	25.35	70.63	102.70	146.80	295.93
1:36:23	4.45	7.69	5.19	8.26	19.67	55.42	82.28	120.36	251.22
1:42:04	3.25	5.68	3.80	6.11	14.78	42.31	64.67	97.36	211.51
1:47:44	2.48	4.30	2.89	4.62	11.02	31.33	49.21	76.89	177.08
1:53:24	2.03	3.49	2.36	3.74	8.82	24.57	37.34	59.19	145.61
1:59:04	1.71	2.94	1.99	3.15	7.41	20.46	30.48	46.30	117.11
2:04:44	1.50	2.57	1.74	2.75	6.43	17.62	25.97	38.58	92.60
2:10:25	1.35	2.30	1.57	2.47	5.74	15.65	22.87	33.48	75.52
2:16:05	1.24	2.11	1.44	2.26	5.25	14.24	20.63	29.88	64.95
2:21:45	0.91	1.56	1.06	1.67	3.95	11.18	16.56	24.44	54.24
2:27:25	0.67	1.14	0.77	1.22	2.86	8.06	12.07	18.21	42.19
2:33:05	0.49	0.84	0.57	0.90	2.12	5.97	8.83	13.23	31.42
2:38:46	0.36	0.62	0.42	0.67	1.57	4.43	6.59	9.80	23.43
2:44:26	0.26	0.45	0.30	0.48	1.16	3.28	4.92	7.43	17.42
2:50:06	0.19	0.32	0.22	0.35	0.83	2.39	3.63	5.56	13.19
2:55:46	0.13	0.23	0.16	0.25	0.60	1.72	2.65	4.13	10.01
3:01:26	0.09	0.16	0.11	0.17	0.43	1.24	1.96	3.08	7.60
3:07:07	0.06	0.10	0.07	0.11	0.28	0.83	1.38	2.27	5.82
3:12:47	0.03	0.06	0.04	0.06	0.16	0.51	0.90	1.58	4.44
3:18:27	0.01	0.02	0.01	0.03	0.08	0.26	0.52	1.02	3.25
3:24:07	0.00	0.01	0.00	0.01	0.02	0.10	0.25	0.58	2.24
3:29:47	0.00	0.00	0.00	0.00	0.00	0.01	0.07	0.26	1.42
3:35:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.78
3:41:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34
3:46:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07
3:52:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:58:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:03:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:09:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:15:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:20:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:26:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:32:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:37:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:43:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:49:10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:54:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:06:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:11:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:17:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:23:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:28:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:34:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:40:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:45:52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:51:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:57:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:02:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:08:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:14:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:19:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:25:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:31:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:36:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:42:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:48:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
TOP OF MICROPOOL	0.00	384	0.009	0	0.000	0.00
WQCV	3.97	34,195	0.785	57,081	1.310	0.73
EURV	4.99	45,262	1.039	97,634	2.241	0.93
5 YR. WSE	5.14	46,872	1.076	104,544	2.400	0.95
TOP OF BOX	5.25	48,052	1.103	109,765	2.520	0.97
100 YR. WSE	9.84	75,103	1.724	405,950	9.319	252.87

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

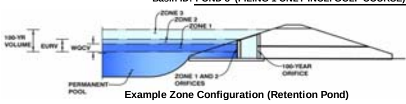
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: FLYING HORSE NORTH FILING 1

Basin ID: POND 8 (FILING 1 ONLY INCL. GOLF COURSE)



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	255.00	acres		
Watershed Length =	6,000	ft		
Watershed Slope =	0.006	ft/ft		
Watershed Imperviousness =	5.00%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.768	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.134	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.728	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.198	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	4.039	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	13.847	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	19.909	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	27.825	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.85 in.) =	52.818	acre-feet	3.85	inches
Approximate 2-yr Detention Volume =	0.673	acre-feet		
Approximate 5-yr Detention Volume =	1.120	acre-feet		
Approximate 10-yr Detention Volume =	3.339	acre-feet		
Approximate 25-yr Detention Volume =	5.092	acre-feet		
Approximate 50-yr Detention Volume =	5.177	acre-feet		
Approximate 100-yr Detention Volume =	6.915	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.768	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.366	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	5.782	acre-feet
Total Detention Basin Volume =	6.915	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	384	0.009		
7370	--	0.50	--	--	--	384	0.009	188	0.004
7372	--	2.50	--	--	--	18,082	0.415	18,658	0.428
7374	--	4.50	--	--	--	40,004	0.918	76,744	1.762
7376	--	6.50	--	--	--	61,465	1.411	178,213	4.091
7378	--	8.50	--	--	--	69,433	1.594	309,111	7.096
7380	--	10.50	--	--	--	77,895	1.788	456,439	10.478
7382	--	12.50	--	--	--	88,522	2.032	622,856	14.299
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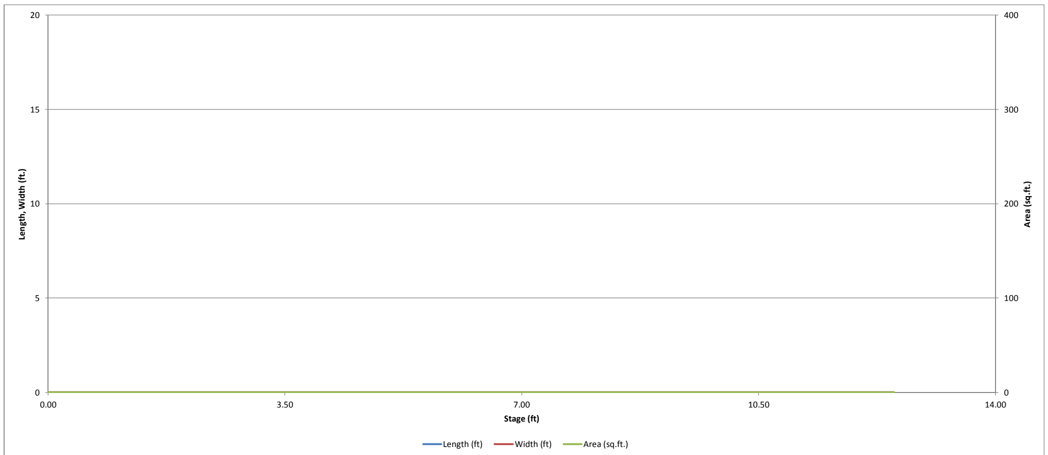
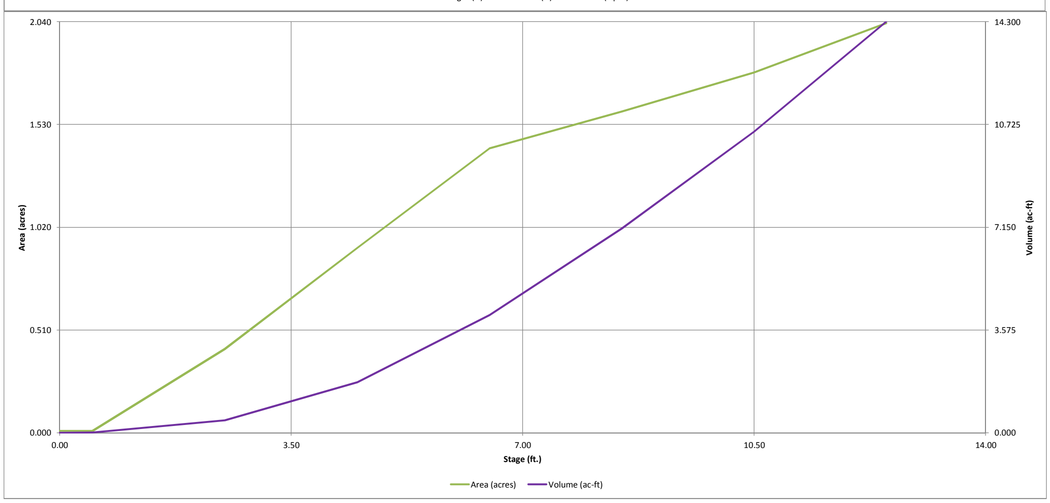
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



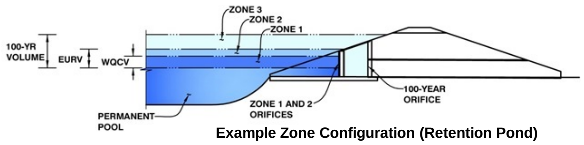


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: FLYING HORSE NORTH FILING 1

Basin ID: POND 8 (FILING 1 ONLY INCL. GOLF COURSE)



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.18	0.768	Orifice Plate
Zone 2 (EURV)	3.74	0.366	Orifice Plate
Zone 3 (100-year)	8.39	5.782	Weir&Pipe (Restrict)
		6.915	Total

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	21.00	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.80	3.60					
Orifice Area (sq. inches)	3.75	3.75	3.75					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	16.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00		feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.25	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	2.94	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	49.48	N/A	ft^2
Overflow Grate Open Area w/ Debris =	24.74	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	60.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	48.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	16.84	N/A	ft^2
Outlet Orifice Centroid =	2.18	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.21	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	10.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	75.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

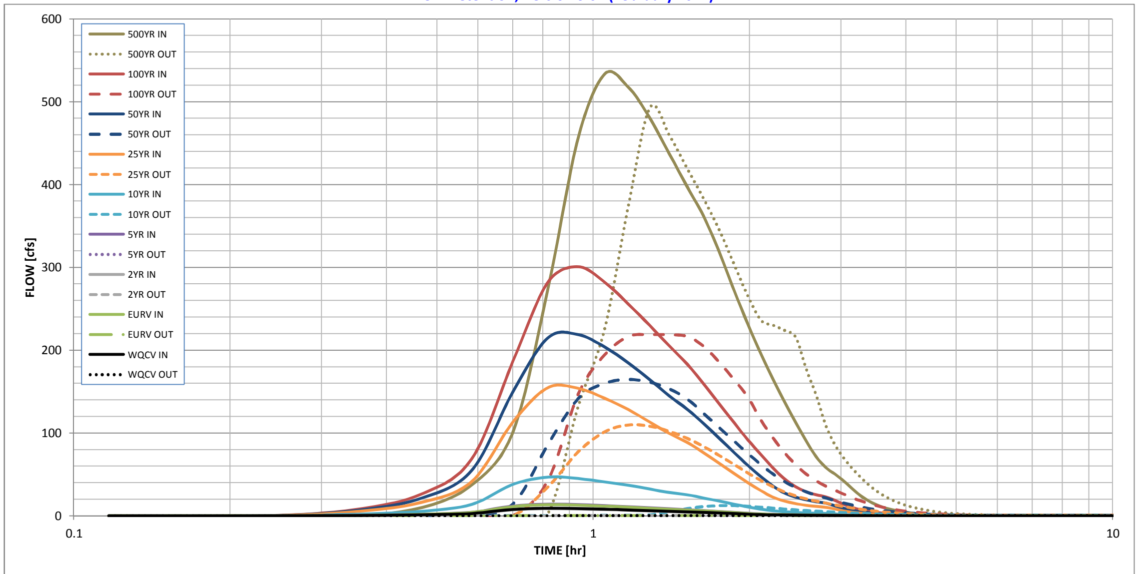
Spillway Design Flow Depth=	1.38	feet
Stage at Top of Freeboard =	12.38	feet
Basin Area at Top of Freeboard =	2.02	acres

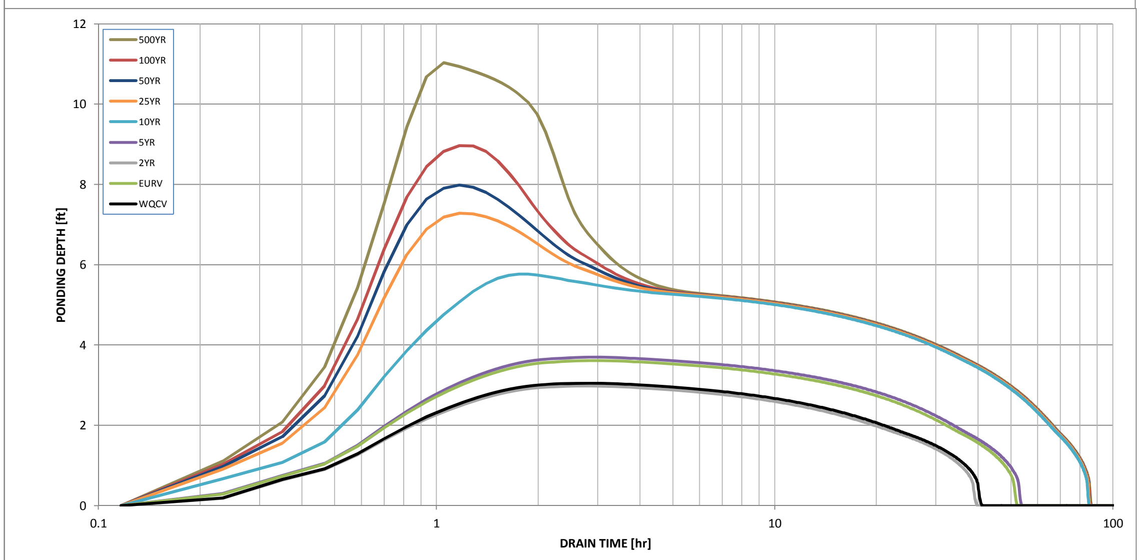
Routed Hydrograph Results

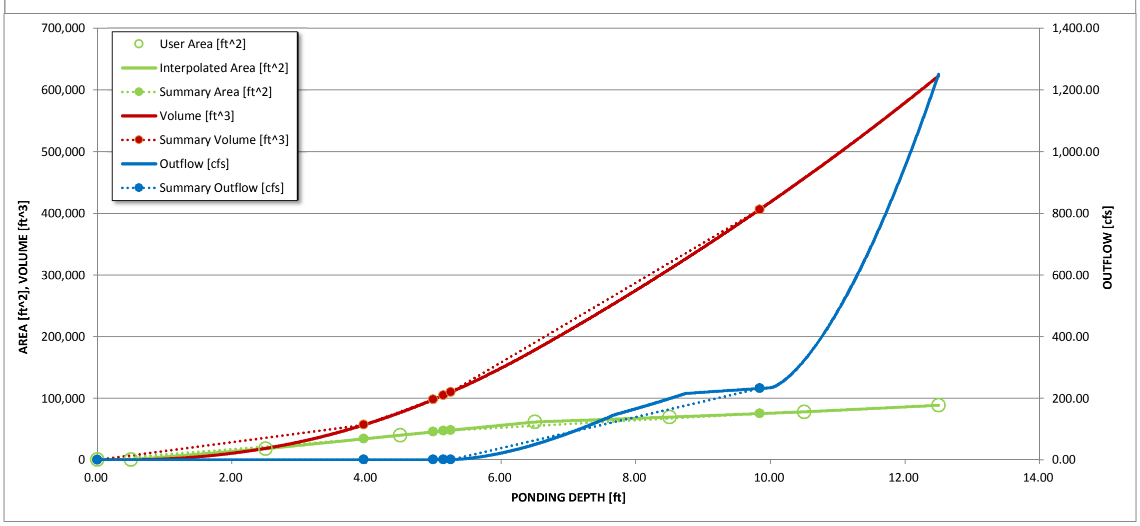
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.85
Calculated Runoff Volume (acre-ft) =	0.768	1.134	0.728	1.198	4.039	13.847	19.909	27.825	52.818
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.768	1.133	0.728	1.197	4.038	13.842	19.906	27.823	52.817
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.14	0.49	0.68	0.93	1.69
Predevelopment Peak Q (cfs) =	0.0	0.0	2.2	3.9	35.8	125.2	173.8	236.6	431.3
Peak Inflow Q (cfs) =	9.1	13.3	8.6	14.1	46.7	154.6	218.8	300.7	533.2
Peak Outflow Q (cfs) =	0.4	0.4	0.4	0.5	12.4	109.9	164.8	218.9	492.9
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.1	0.3	0.9	0.9	0.9	1.1
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	2.2	3.3	4.4	5.0
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	48	37	49	74	58	52	44	25
Time to Drain 99% of Inflow Volume (hours) =	40	50	38	52	80	73	69	65	55
Maximum Ponding Depth (ft) =	3.05	3.61	2.98	3.70	5.77	7.28	7.98	8.97	11.03
Area at Maximum Ponding Depth (acres) =	0.55	0.69	0.53	0.71	1.23	1.48	1.55	1.64	1.85
Maximum Volume Stored (acre-ft) =	0.689	1.044	0.651	1.100	3.114	5.220	6.280	7.840	11.425

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs UD-Detention, Version 3.07 (February 2017)

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval
7.01 min

Hydrograph Constant
0.713

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:07:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:14:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:21:02	0.40	0.58	0.38	0.61	1.94	5.29	6.64	7.78	9.87
0:28:02	1.08	1.58	1.03	1.67	5.39	16.16	21.33	26.31	37.31
0:35:03	2.78	4.06	2.63	4.28	13.84	41.55	55.07	68.92	101.34
0:42:04	7.63	11.14	7.24	11.76	37.95	113.33	149.82	186.68	272.77
0:49:04	9.07	13.34	8.61	14.08	46.69	154.61	214.68	281.86	455.14
0:56:05	8.66	12.75	8.22	13.46	44.90	153.93	218.83	300.74	533.24
1:03:05	7.89	11.61	7.48	12.25	40.89	141.97	203.92	282.08	517.64
1:10:06	7.05	10.39	6.69	10.98	36.83	128.20	184.68	255.72	480.21
1:17:07	6.09	9.00	5.78	9.51	32.21	113.19	164.23	229.85	436.94
1:24:07	5.31	7.83	5.03	8.27	28.12	99.19	144.66	204.92	396.74
1:31:08	4.81	7.10	4.56	7.50	25.39	88.56	128.40	182.88	360.38
1:38:08	3.98	5.89	3.77	6.23	21.27	75.63	110.72	158.37	317.03
1:45:09	3.25	4.84	3.08	5.11	17.62	63.01	93.00	134.50	271.55
1:52:10	2.51	3.76	2.38	3.98	13.96	50.88	76.23	112.03	230.93
1:59:10	1.88	2.83	1.77	3.00	10.78	39.88	60.70	91.53	195.76
2:06:11	1.36	2.05	1.28	2.18	8.04	30.37	47.33	73.71	164.57
2:13:11	1.05	1.58	0.99	1.67	6.04	22.45	35.75	57.86	137.44
2:20:12	0.86	1.29	0.82	1.37	4.86	17.67	27.36	44.29	112.68
2:27:13	0.73	1.09	0.69	1.16	4.09	14.74	22.45	34.91	90.29
2:34:13	0.64	0.96	0.61	1.02	3.56	12.71	19.19	29.22	71.20
2:41:14	0.58	0.86	0.55	0.91	3.18	11.29	16.93	25.42	58.37
2:48:14	0.53	0.79	0.50	0.84	2.91	10.28	15.31	22.73	50.37
2:55:15	0.39	0.58	0.37	0.62	2.17	8.03	12.22	18.54	42.05
3:02:16	0.29	0.43	0.27	0.45	1.57	5.79	8.87	13.76	32.64
3:09:16	0.21	0.31	0.20	0.33	1.16	4.29	6.53	10.00	24.27
3:16:17	0.15	0.23	0.15	0.25	0.86	3.18	4.86	7.43	18.07
3:23:17	0.11	0.17	0.11	0.18	0.63	2.36	3.62	5.61	13.43
3:30:18	0.08	0.12	0.07	0.13	0.45	1.71	2.66	4.19	10.19
3:37:19	0.06	0.09	0.05	0.09	0.33	1.24	1.93	3.11	7.72
3:44:19	0.04	0.06	0.04	0.06	0.23	0.89	1.42	2.32	5.86
3:51:20	0.02	0.03	0.02	0.04	0.15	0.59	0.99	1.69	4.49
3:58:20	0.01	0.02	0.01	0.02	0.08	0.36	0.64	1.17	3.41
4:05:21	0.00	0.01	0.00	0.01	0.04	0.18	0.36	0.74	2.48
4:12:22	0.00	0.00	0.00	0.00	0.01	0.06	0.16	0.41	1.70
4:19:22	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.18	1.06
4:26:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.58
4:33:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24
4:40:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
4:47:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:54:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:01:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:08:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:15:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:22:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:29:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:36:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:43:29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:50:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:57:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:04:31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:11:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:18:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:25:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:32:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:39:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:46:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:53:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:00:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:07:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:14:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:21:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:28:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:35:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:42:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:49:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:56:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:03:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:10:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:17:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8:24:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
TOP OF MICROPOOL	0.00	384	0.009	0	0.000	0.00
WQCV	3.96	34,085	0.782	56,740	1.303	0.51
EURV	4.99	45,262	1.039	97,634	2.241	0.65
5 YR. WSE	5.14	46,872	1.076	104,544	2.400	0.67
TOP OF BOX	5.25	48,052	1.103	109,765	2.520	0.68
100 YR. WSE	9.84	75,103	1.724	405,950	9.319	231.57

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

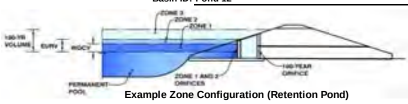
Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: Flying Horse North Filing No. 1

Basin ID: Pond 12



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**	
Watershed Area =	57.60	acres
Watershed Length =	3,000	ft
Watershed Slope =	0.014	ft/ft
Watershed Imperviousness =	12.00%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	100.0%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Desired WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	
Water Quality Capture Volume (WQCV) =	0.375	acre-feet
Excess Urban Runoff Volume (EURV) =	0.659	acre-feet

Optional User Override 1-hr Precipitation

2-yr Runoff Volume (P1 = 1.19 in.) =	0.461	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	0.708	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.484	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	3.636	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	4.987	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	6.752	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.39 in.) =	10.997	acre-feet	3.39	inches
Approximate 2-yr Detention Volume =	0.429	acre-feet		
Approximate 5-yr Detention Volume =	0.663	acre-feet		
Approximate 10-yr Detention Volume =	1.275	acre-feet		
Approximate 25-yr Detention Volume =	1.727	acre-feet		
Approximate 50-yr Detention Volume =	1.814	acre-feet		
Approximate 100-yr Detention Volume =	2.319	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.375	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.285	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.660	acre-feet
Total Detention Basin Volume =	2.319	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002		
7546	--	1.50	--	--	--	20,138	0.462	14,977	0.344
7548	--	3.50	--	--	--	26,118	0.600	61,434	1.410
7550	--	5.50	--	--	--	32,634	0.749	120,186	2.759
7552	--	7.50	--	--	--	39,405	0.905	192,225	4.413
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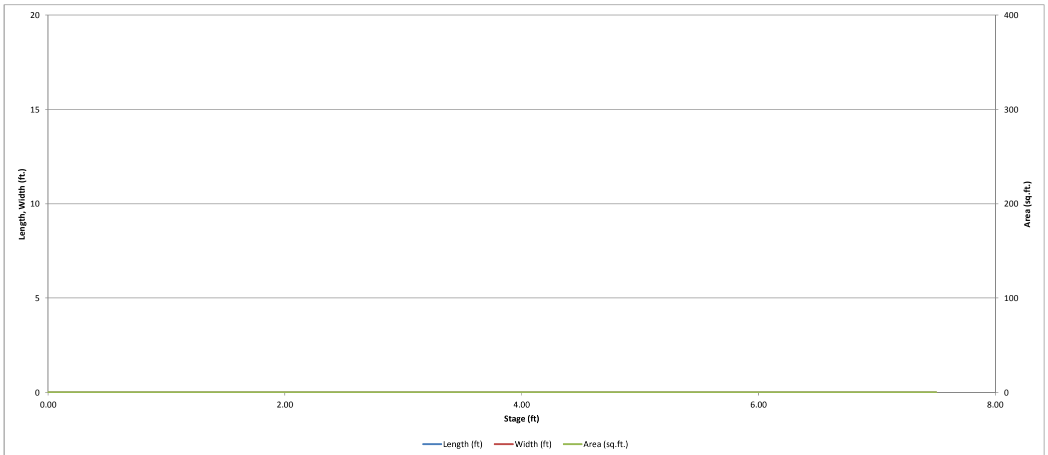
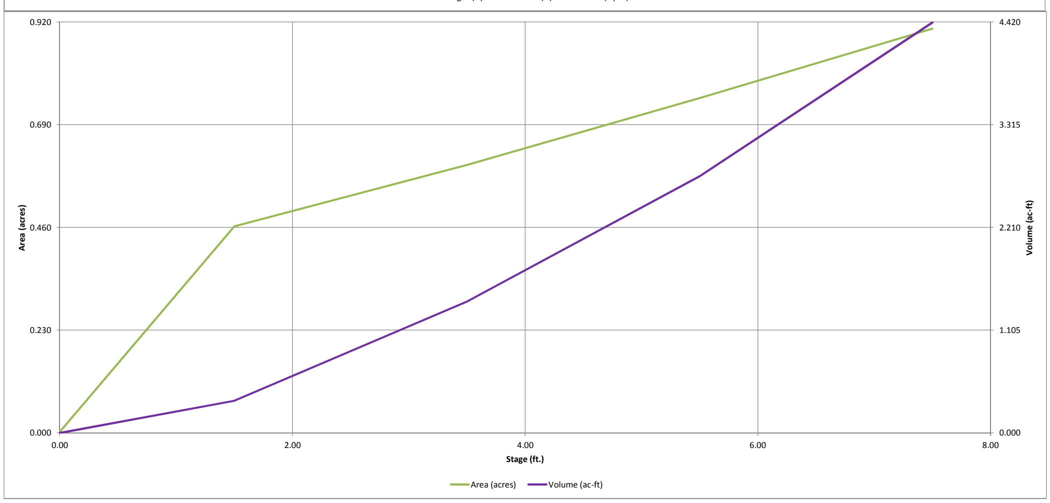
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



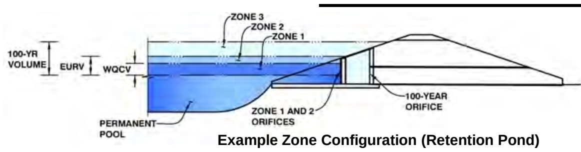


Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: Flying Horse North Filing No. 1

Basin ID: Pond 12



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.56	0.375	Orifice Plate
Zone 2 (EURV)	2.15	0.285	Orifice Plate
Zone 3 (100-year)	4.90	1.660	Weir&Pipe (Restrict)
		2.319	Total

0

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)
Underdrain Orifice Diameter =	N/A	inches

Calculated Parameters for Underdrain

Underdrain Orifice Area =	N/A	ft^2
Underdrain Orifice Centroid =	N/A	feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	2.25	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	9.00	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

WQ Orifice Area per Row =	N/A	ft^2
Elliptical Half-Width =	N/A	feet
Elliptical Slot Centroid =	N/A	feet
Elliptical Slot Area =	N/A	ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.80	1.60					
Orifice Area (sq. inches)	2.41	2.79	2.79					

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Not Selected	Not Selected	
Invert of Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	N/A	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	N/A	N/A	inches

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =	N/A	N/A	ft^2
Vertical Orifice Centroid =	N/A	N/A	feet

User Input: Overflow Weir (Dropbox) and Grate (Flat or Sloped)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.25	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Slope =	4.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	4.00	N/A	feet
Overflow Grate Open Area % =	75%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.25	N/A	feet
Over Flow Weir Slope Length =	4.12	N/A	feet
Grate Open Area / 100-yr Orifice Area =	4.41	N/A	should be $\geq$ 4
Overflow Grate Open Area w/o Debris =	18.55	N/A	ft^2
Overflow Grate Open Area w/ Debris =	9.28	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.50	N/A	ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	30.00	N/A	inches
Restrictor Plate Height Above Pipe Invert =	24.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Restrictor	Not Selected	
Outlet Orifice Area =	4.21	N/A	ft^2
Outlet Orifice Centroid =	1.09	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	2.21	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	5.50	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	20.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

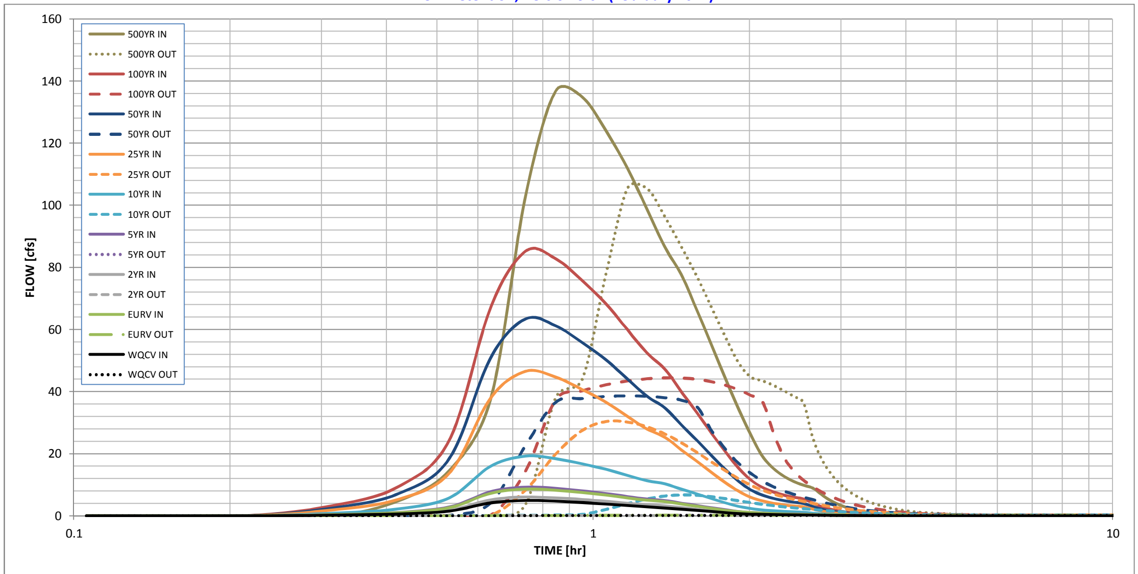
Spillway Design Flow Depth=	1.13	feet
Stage at Top of Freeboard =	7.63	feet
Basin Area at Top of Freeboard =	0.90	acres

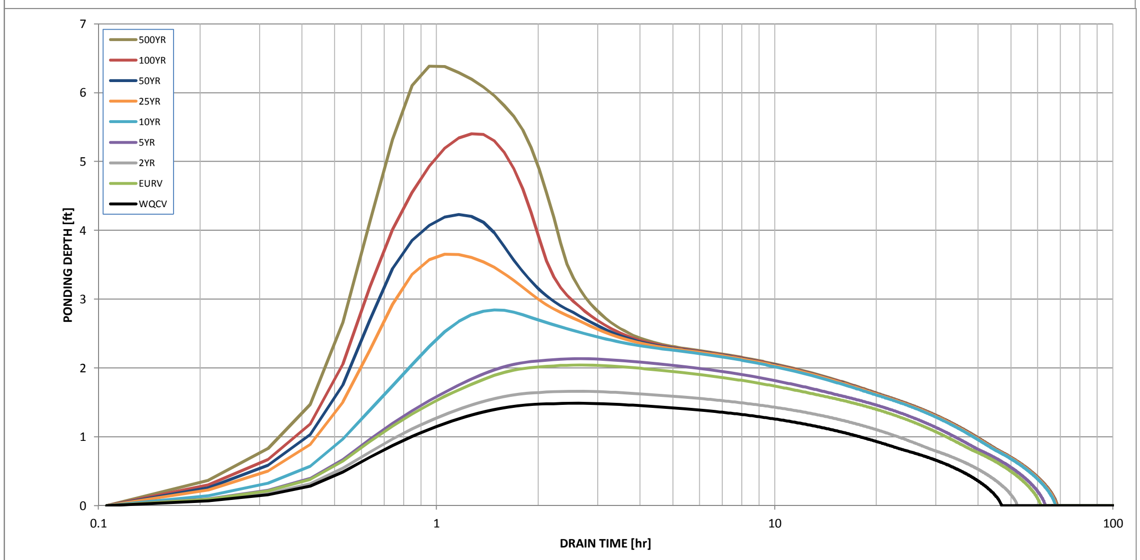
Routed Hydrograph Results

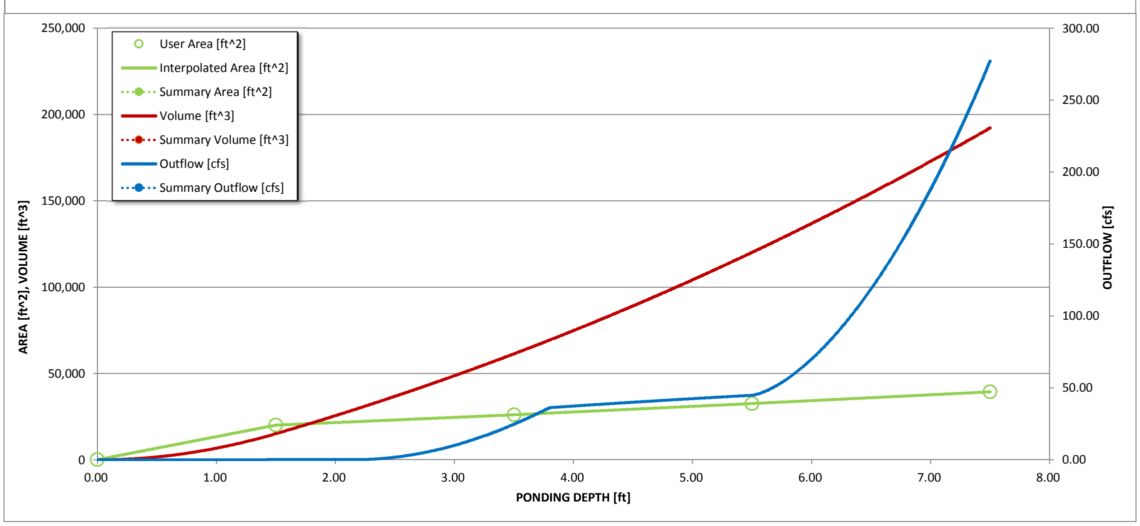
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.39
Calculated Runoff Volume (acre-ft) =	0.375	0.659	0.461	0.708	1.484	3.636	4.987	6.752	10.997
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.374	0.659	0.461	0.707	1.483	3.636	4.986	6.752	10.992
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.14	0.50	0.70	0.95	1.52
Predevelopment Peak Q (cfs) =	0.0	0.0	0.5	0.9	8.3	28.9	40.1	54.6	87.5
Peak Inflow Q (cfs) =	4.9	8.6	6.1	9.2	19.2	46.5	63.4	85.2	136.7
Peak Outflow Q (cfs) =	0.2	0.3	0.2	0.3	6.8	30.4	38.7	44.5	105.6
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.3	0.8	1.1	1.0	0.8	1.2
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.3	1.6	2.1	2.4	2.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	43	55	47	56	56	44	40	35	26
Time to Drain 99% of Inflow Volume (hours) =	**45**	58	50	60	62	58	55	52	45
Maximum Ponding Depth (ft) =	1.49	2.04	1.66	2.13	2.84	3.65	4.23	5.40	6.38
Area at Maximum Ponding Depth (acres) =	0.46	0.50	0.47	0.51	0.55	0.61	0.65	0.74	0.82
Maximum Volume Stored (acre-ft) =	0.339	0.608	0.423	0.653	1.030	1.501	1.861	2.685	3.448

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







S-A-V-D Chart Axis Override	X-axis	Left Y-Axis	Right Y-Axis
minimum bound			
maximum bound			

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

Storm Inflow Hydrographs **UD-Detention, Version 3.07 (February 2017)**

The user can override the calculated inflow hydrographs from this workbook with inflow hydrographs developed in a separate program.

Time Interval	
6.35 min	
Hydrograph Constant	0.787

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:06:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:12:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:19:03	0.22	0.38	0.27	0.41	0.83	1.95	2.59	3.35	4.93
0:25:24	0.59	1.03	0.73	1.10	2.27	5.39	7.24	9.55	14.66
0:31:45	1.52	2.64	1.86	2.83	5.82	13.84	18.60	24.51	37.68
0:38:06	4.18	7.25	5.12	7.77	15.98	37.96	50.96	67.11	102.91
0:44:27	4.93	8.61	6.05	9.24	19.20	46.50	63.37	85.18	136.71
0:50:48	4.69	8.22	5.77	8.82	18.37	44.66	61.16	82.76	134.85
0:57:09	4.27	7.48	5.25	8.03	16.72	40.65	55.78	75.69	123.99
1:03:30	3.80	6.68	4.68	7.17	14.99	36.60	50.26	68.25	111.92
1:09:51	3.27	5.77	4.03	6.20	13.01	31.99	44.03	59.91	98.63
1:16:12	2.86	5.03	3.52	5.40	11.31	27.91	38.47	52.41	86.39
1:22:33	2.59	4.56	3.19	4.89	10.25	25.22	34.68	47.13	77.33
1:28:54	2.12	3.76	2.62	4.04	8.53	21.11	29.12	39.74	65.74
1:35:15	1.72	3.07	2.13	3.30	7.02	17.48	24.16	33.01	54.72
1:41:36	1.32	2.37	1.63	2.55	5.48	13.82	19.19	26.36	44.03
1:47:57	0.97	1.76	1.21	1.90	4.15	10.65	14.86	20.49	34.41
1:54:18	0.71	1.28	0.88	1.37	3.03	7.94	11.14	15.43	26.10
2:00:39	0.55	0.99	0.68	1.06	2.31	5.96	8.33	11.48	19.26
2:07:00	0.45	0.81	0.56	0.87	1.89	4.81	6.68	9.16	15.25
2:13:21	0.39	0.69	0.48	0.74	1.60	4.05	5.61	7.69	12.76
2:19:42	0.34	0.61	0.42	0.65	1.40	3.52	4.88	6.67	11.03
2:26:03	0.31	0.55	0.38	0.59	1.26	3.15	4.36	5.95	9.82
2:32:24	0.28	0.50	0.35	0.54	1.15	2.89	3.99	5.44	8.95
2:38:45	0.21	0.37	0.26	0.40	0.85	2.15	2.99	4.12	6.91
2:45:06	0.15	0.27	0.19	0.29	0.62	1.56	2.16	2.97	4.98
2:51:27	0.11	0.20	0.14	0.21	0.46	1.15	1.60	2.20	3.70
2:57:48	0.08	0.15	0.10	0.16	0.34	0.86	1.19	1.64	2.74
3:04:09	0.06	0.10	0.07	0.11	0.24	0.63	0.87	1.21	2.03
3:10:30	0.04	0.07	0.05	0.08	0.17	0.45	0.63	0.87	1.47
3:16:51	0.03	0.05	0.04	0.06	0.13	0.33	0.46	0.63	1.06
3:23:12	0.02	0.03	0.02	0.04	0.09	0.23	0.32	0.44	0.76
3:29:33	0.01	0.02	0.01	0.02	0.05	0.15	0.21	0.29	0.50
3:35:54	0.01	0.01	0.01	0.01	0.03	0.08	0.12	0.17	0.30
3:42:15	0.00	0.00	0.00	0.00	0.01	0.04	0.06	0.08	0.15
3:48:36	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.05
3:54:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:01:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:07:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:14:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:20:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:26:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:33:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:39:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:45:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:52:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:58:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:04:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:11:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:17:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:23:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:30:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:36:33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:42:54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:49:15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:55:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:01:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:08:18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:14:39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:21:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:27:21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:33:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:40:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:46:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:52:45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:59:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:05:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:11:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:18:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:24:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:30:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:37:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.

The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]

For best results, include the stages of all grade slope changes (e.g. ISV and Floor) from the S-A-V table on Sheet 'Basin'.

Also include the inverts of all outlets (e.g. vertical orifice, overflow grate, and spillway, where applicable).

Project Summary

Title	Flying Horse North Filing No.1
Engineer	MAW
Company	CCES
Date	4/4/2018

Notes	2 Year

Table of Contents

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Area to HFR Pond 16	Post-Development 2 YR	2	4.331	12.250	20.25
Area to Pond 1	Post-Development 2 YR	2	0.379	12.100	3.10
BS-10	Post-Development 2 YR	2	0.416	12.050	5.95
BS-11	Post-Development 2 YR	2	0.083	12.000	1.45
BS-12	Post-Development 2 YR	2	0.104	12.100	0.78
BS-13	Post-Development 2 YR	2	0.511	12.100	4.88
BS-14	Post-Development 2 YR	2	0.263	12.100	2.48
BS-15	Post-Development 2 YR	2	0.127	12.050	1.58
BS-16	Post-Development 2 YR	2	0.445	12.150	3.42
BS-17	Post-Development 2 YR	2	0.278	12.100	3.02
BS-18	Post-Development 2 YR	2	0.499	12.100	3.50
BS-19	Post-Development 2 YR	2	0.161	12.050	2.08
BS-1A	Post-Development 2 YR	2	0.047	12.100	0.36
BS-1B	Post-Development 2 YR	2	0.093	12.100	0.43
BS-2	Post-Development 2 YR	2	0.176	12.000	2.90
BS-20	Post-Development 2 YR	2	1.164	12.150	7.43
BS-21	Post-Development 2 YR	2	1.202	12.200	7.78
BS-22	Post-Development 2 YR	2	0.372	12.100	3.72
BS-23	Post-Development 2 YR	2	0.657	12.150	4.49
BS-23A	Post-Development 2 YR	2	0.463	12.050	5.48
BS-24	Post-Development 2 YR	2	0.114	12.100	0.59
BS-25	Post-Development 2 YR	2	0.115	12.150	0.36
BS-26	Post-Development 2 YR	2	0.016	14.250	0.04
BS-27	Post-Development 2 YR	2	0.315	12.100	2.10

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
BS-28	Post-Development 2 YR	2	0.462	12.200	2.21
BS-29	Post-Development 2 YR	2	0.329	12.200	1.43
BS-2A	Post-Development 2 YR	2	0.074	12.000	1.22
BS-2B	Post-Development 2 YR	2	0.083	12.000	1.40
BS-3	Post-Development 2 YR	2	0.084	12.100	0.60
BS-30	Post-Development 2 YR	2	0.091	12.100	0.65
BS-31	Post-Development 2 YR	2	0.082	12.150	0.31
BS-32	Post-Development 2 YR	2	0.061	12.100	0.25
BS-33	Post-Development 2 YR	2	0.116	12.100	0.81
BS-4	Post-Development 2 YR	2	0.222	12.100	1.86
BS-5	Post-Development 2 YR	2	0.152	12.100	1.13
BS-6	Post-Development 2 YR	2	0.111	12.000	1.93
BS-7	Post-Development 2 YR	2	0.268	12.000	4.43
BS-8	Post-Development 2 YR	2	0.093	12.000	1.55
BS-9	Post-Development 2 YR	2	0.139	12.000	2.29
CC-10	Post-Development 2 YR	2	0.839	12.350	2.56
CC-11	Post-Development 2 YR	2	0.197	12.100	0.90
CC-12	Post-Development 2 YR	2	0.165	12.150	0.98
CC-13A	Post-Development 2 YR	2	0.261	12.200	1.39
CC-13B	Post-Development 2 YR	2	0.344	12.200	1.84
CC-13C	Post-Development 2 YR	2	0.134	12.100	0.89
CC-13D	Post-Development 2 YR	2	0.254	12.150	1.54
CC-14	Post-Development 2 YR	2	0.062	12.100	0.43
CC-15	Post-Development 2 YR	2	0.173	12.100	1.08

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
CC-16	Post-Development 2 YR	2	0.220	12.150	1.19
CC-17	Post-Development 2 YR	2	0.337	12.200	1.66
CC-18	Post-Development 2 YR	2	0.100	12.150	0.67
CC-19	Post-Development 2 YR	2	0.050	12.150	0.30
CC-1A	Post-Development 2 YR	2	0.133	12.100	0.84
CC-1B	Post-Development 2 YR	2	0.166	12.150	0.98
CC-20	Post-Development 2 YR	2	0.532	12.150	3.23
CC-21	Post-Development 2 YR	2	0.048	12.300	0.12
CC-22	Post-Development 2 YR	2	0.187	12.150	1.13
CC-23	Post-Development 2 YR	2	0.074	12.200	0.37
CC-24	Post-Development 2 YR	2	0.536	12.150	3.25
CC-25	Post-Development 2 YR	2	0.047	12.100	0.30
CC-26	Post-Development 2 YR	2	0.226	12.150	1.35
CC-27	Post-Development 2 YR	2	0.237	12.200	1.15
CC-28	Post-Development 2 YR	2	1.917	12.500	6.47
CC-2A	Post-Development 2 YR	2	0.149	12.100	0.99
CC-2B	Post-Development 2 YR	2	0.282	12.100	1.87
CC-2C	Post-Development 2 YR	2	0.087	12.100	0.65
CC-3	Post-Development 2 YR	2	0.551	12.350	1.80
CC-4A	Post-Development 2 YR	2	2.341	12.200	15.39
CC-4B	Post-Development 2 YR	2	0.316	12.100	3.95
CC-4C (Pre-Development)	Post-Development 2 YR	2	0.057	12.100	0.15
CC-5	Post-Development 2 YR	2	0.303	12.150	1.81
CC-6	Post-Development 2 YR	2	0.376	12.150	2.28

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
CC-7	Post-Development 2 YR	2	0.249	12.150	1.38
CC-8	Post-Development 2 YR	2	0.104	12.150	0.63
CC-9	Post-Development 2 YR	2	0.076	12.100	0.55
EX-24	Post-Development 2 YR	2	0.086	14.250	0.21
EX-DP-3 (Pre-Dev.)	Post-Development 2 YR	2	0.235	14.300	0.54
OS-10	Post-Development 2 YR	2	0.072	12.050	0.73
OS-11	Post-Development 2 YR	2	0.420	12.200	2.36
OS-12	Post-Development 2 YR	2	0.678	12.300	2.17
OS-13	Post-Development 2 YR	2	0.384	12.250	1.37
OS-14	Post-Development 2 YR	2	0.238	12.250	0.68
OS-15	Post-Development 2 YR	2	0.829	12.250	3.30
OS-16	Post-Development 2 YR	2	0.061	12.100	0.38
OS-17	Post-Development 2 YR	2	0.214	12.100	1.56
OS-18	Post-Development 2 YR	2	0.176	12.100	1.26
OS-1A	Post-Development 2 YR	2	0.060	12.100	0.43
OS-1B	Post-Development 2 YR	2	0.076	12.100	0.52
OS-2	Post-Development 2 YR	2	0.022	12.300	0.05
OS-3	Post-Development 2 YR	2	0.138	12.100	1.01
OS-4	Post-Development 2 YR	2	0.445	12.100	2.84
OS-5	Post-Development 2 YR	2	0.400	12.250	1.87
OS-6	Post-Development 2 YR	2	0.125	12.100	0.86
OS-7	Post-Development 2 YR	2	0.068	12.100	0.51
OS-8	Post-Development 2 YR	2	0.264	12.100	2.12
OS-9	Post-Development 2 YR	2	0.064	14.350	0.13

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-1	Post-Development 2 YR	2	0.143	12.050	1.61
DP-10	Post-Development 2 YR	2	1.530	12.100	11.95
DP-11	Post-Development 2 YR	2	0.445	12.150	3.42
DP-12	Post-Development 2 YR	2	0.572	12.150	4.24
DP-13	Post-Development 2 YR	2	1.520	14.500	3.35
DP-16	Post-Development 2 YR	2	4.050	12.200	24.96
DP-17	Post-Development 2 YR	2	2.080	16.550	3.36
DP-18	Post-Development 2 YR	2	1.058	12.150	5.03
DP-19	Post-Development 2 YR	2	1.520	12.100	3.82
DP-2	Post-Development 2 YR	2	0.365	12.100	3.23
DP-20	Post-Development 2 YR	2	0.810	12.300	2.70
DP-21	Post-Development 2 YR	2	0.532	12.150	2.10
DP-22	Post-Development 2 YR	2	0.814	12.150	3.73
DP-23	Post-Development 2 YR	2	0.789	12.350	2.47
DP-24	Post-Development 2 YR	2	0.360	12.150	1.94
DP-25	Post-Development 2 YR	2	0.313	23.950	0.35
DP-26	Post-Development 2 YR	2	0.943	12.300	2.98
DP-27	Post-Development 2 YR	2	0.705	12.150	4.29
DP-28	Post-Development 2 YR	2	1.090	12.250	4.59
DP-29	Post-Development 2 YR	2	1.552	12.350	5.78
DP-3	Post-Development 2 YR	2	0.572	12.150	1.43
DP-30	Post-Development 2 YR	2	0.100	12.150	0.67
DP-31	Post-Development 2 YR	2	0.150	12.150	0.94
DP-32	Post-Development 2 YR	2	0.398	12.200	1.99

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-33	Post-Development 2 YR	2	0.610	12.150	3.60
DP-34	Post-Development 2 YR	2	2.819	13.250	5.98
DP-4	Post-Development 2 YR	2	0.176	12.000	2.90
DP-5	Post-Development 2 YR	2	0.150	12.050	1.54
DP-6	Post-Development 2 YR	2	0.106	12.100	0.64
DP-7	Post-Development 2 YR	2	0.290	12.100	2.14
DP-8	Post-Development 2 YR	2	5.527	12.350	20.94
DP-9	Post-Development 2 YR	2	0.172	12.100	1.29
J-75	Post-Development 2 YR	2	2.535	12.450	8.58
O-100	Post-Development 2 YR	2	0.197	12.100	0.90
O-101	Post-Development 2 YR	2	0.254	12.150	1.54
O-102	Post-Development 2 YR	2	0.062	12.100	0.43
O-108	Post-Development 2 YR	2	0.235	12.150	1.24
O-110	Post-Development 2 YR	2	0.047	12.100	0.30
O-122	Post-Development 2 YR	2	0.047	12.100	0.36
O-125	Post-Development 2 YR	2	0.165	12.150	0.98
O-126	Post-Development 2 YR	2	2.733	12.200	18.53
O-127	Post-Development 2 YR	2	0.426	12.000	7.22
O-129	Post-Development 2 YR	2	0.400	12.250	1.87
O-137	Post-Development 2 YR	2	0.086	14.250	0.21
O-138	Post-Development 2 YR	2	0.235	14.300	0.54
O-73	Post-Development 2 YR	2	0.114	12.100	0.59
O-74	Post-Development 2 YR	2	0.115	12.150	0.36
O-75	Post-Development 2 YR	2	0.016	14.250	0.04

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
O-80	Post-Development 2 YR	2	0.082	12.150	0.31
O-81	Post-Development 2 YR	2	0.061	12.100	0.25
O-82	Post-Development 2 YR	2	0.116	12.100	0.81
O-86	Post-Development 2 YR	2	0.166	12.150	0.98
O-96	Post-Development 2 YR	2	0.087	12.100	0.65
O-98	Post-Development 2 YR	2	0.249	12.150	1.38

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Exist. HFR Pond 16 (IN)	Post-Development 2 YR	2	4.331	12.250	20.25	(N/A)	(N/A)
Exist. HFR Pond 16 (OUT)	Post-Development 2 YR	2	4.273	12.400	17.00	7,455.39	0.222
FH North Pond 1 (IN)	Post-Development 2 YR	2	0.379	12.100	3.10	(N/A)	(N/A)
FH North Pond 1 (OUT)	Post-Development 2 YR	2	0.373	13.350	0.62	7,391.48	0.086
FH North Pond 12 (IN)	Post-Development 2 YR	2	0.736	12.150	4.19	(N/A)	(N/A)
FH North Pond 12 (OUT)	Post-Development 2 YR	2	0.313	23.950	0.35	7,546.37	0.421
FH North Pond 4 (IN)	Post-Development 2 YR	2	2.442	12.150	18.30	(N/A)	(N/A)
FH North Pond 4 (OUT)	Post-Development 2 YR	2	1.520	14.500	3.35	7,425.62	1.002
FH North Pond 8 (IN)	Post-Development 2 YR	2	4.509	12.200	27.90	(N/A)	(N/A)

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
FH North Pond 8 (OUT)	Post-Development 2 YR	2	2.080	16.550	3.36	7,374.84	2.484
Golf Course Pond 6 (IN)	Post-Development 2 YR	2	2.366	12.200	15.07	(N/A)	(N/A)
Golf Course Pond 6 (OUT)	Post-Development 2 YR	2	2.363	12.200	14.50	7,436.08	2.505
Golf Course Pond 7 (IN)	Post-Development 2 YR	2	2.896	12.200	17.89	(N/A)	(N/A)
Golf Course Pond 7 (OUT)	Post-Development 2 YR	2	2.896	12.200	17.64	7,424.09	1.477

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	2 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
1.250	0.0	0.0	0.0	0.0	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.1	0.1
5.000	0.1	0.1	0.2	0.2	0.2
6.250	0.2	0.2	0.2	0.2	0.2
7.500	0.2	0.2	0.3	0.3	0.3
8.750	0.3	0.3	0.3	0.3	0.4
10.000	0.4	0.4	0.4	0.5	0.5
11.250	0.5	0.6	0.8	1.4	1.5
12.500	1.5	1.6	1.6	1.7	1.7
13.750	1.7	1.7	1.8	1.8	1.8
15.000	1.8	1.8	1.8	1.9	1.9
16.250	1.9	1.9	1.9	1.9	1.9
17.500	1.9	1.9	1.9	1.9	2.0
18.750	2.0	2.0	2.0	2.0	2.0
20.000	2.0	2.0	2.0	2.0	2.0
21.250	2.0	2.0	2.0	2.1	2.1
22.500	2.1	2.1	2.1	2.1	2.1
23.750	2.1	2.1	(N/A)	(N/A)	(N/A)

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,390.00	0.0000	0.004	0.000	0.000	0.000
7,392.00	0.0000	0.242	0.277	0.185	0.185
7,394.00	0.0000	0.311	0.827	0.552	0.736
7,396.00	0.0000	0.387	1.045	0.697	1.433

Subsection: Elevation-Area Volume Curve | Return Event: 2 years
Label: FH North Pond 12 | Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,544.50	0.0000	0.002	0.000	0.000	0.000
7,546.00	0.0000	0.462	0.494	0.247	0.247
7,548.00	0.0000	0.600	1.588	1.059	1.306
7,550.00	0.0000	0.749	2.019	1.346	2.652
7,552.00	0.0000	0.905	2.477	1.652	4.304

Subsection: Elevation-Area Volume Curve | Return Event: 2 years
Label: FH North Pond 4 | Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,421.50	0.0000	0.004	0.000	0.000	0.000
7,422.00	0.0000	0.004	0.012	0.002	0.002
7,424.00	0.0000	0.248	0.283	0.189	0.191
7,426.00	0.0000	0.981	1.722	1.148	1.339
7,428.00	0.0000	1.226	3.304	2.202	3.542
7,430.00	0.0000	1.432	3.983	2.655	6.197
7,432.00	0.0000	1.651	4.621	3.080	9.277

Subsection: Elevation-Area Volume Curve | Return Event: 2 years
Label: FH North Pond 8 | Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,369.00	0.0000	0.009	0.000	0.000	0.000
7,370.00	0.0000	0.009	0.027	0.009	0.009
7,372.00	0.0000	0.415	0.485	0.323	0.332
7,374.00	0.0000	0.918	1.950	1.300	1.633
7,376.00	0.0000	1.411	3.467	2.311	3.944
7,378.00	0.0000	1.594	4.505	3.003	6.947
7,380.00	0.0000	1.788	5.070	3.380	10.327
7,382.00	0.0000	2.032	5.726	3.817	14.145

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,390.00	0.00	(N/A)	0.00
7,390.50	0.21	(N/A)	0.00
7,391.00	0.42	(N/A)	0.00
7,391.50	0.63	(N/A)	0.00
7,392.00	0.84	(N/A)	0.00
7,392.50	1.05	(N/A)	0.00
7,392.75	1.15	(N/A)	0.00
7,393.00	2.70	(N/A)	0.00
7,393.50	9.09	(N/A)	0.00
7,394.00	18.16	(N/A)	0.00
7,394.50	29.05	(N/A)	0.00
7,395.00	41.22	(N/A)	0.00
7,395.50	47.14	(N/A)	0.00
7,396.00	48.76	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
7,544.50	0.00	(N/A)	0.00	(no Q: Riser - 1,Orifice - 1,Culvert - 1)
7,545.00	0.09	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,545.50	0.19	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,546.00	0.28	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,546.50	0.37	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,546.75	0.42	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,547.00	1.93	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,547.50	8.19	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,548.00	17.12	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,548.50	27.99	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,549.00	33.62	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,549.50	35.86	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,550.00	37.97	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,550.50	39.96	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,551.00	41.87	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,551.50	43.69	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,552.00	45.43	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Subsection: Composite Rating Curve
Label: FH North Pond 4

Return Event: 2 years
Storm Event: TYPE II 24 HOUR

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
7,421.50	0.00	(N/A)	0.00	(no Q: Riser - 1,Orifice - 1,Culvert - 1)
7,422.00	0.09	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,422.50	0.19	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,423.00	0.29	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,423.50	0.38	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,424.00	0.48	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,424.50	0.57	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,425.00	0.67	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,425.50	0.77	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,426.00	11.42	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,426.50	30.84	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,427.00	55.96	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,427.50	85.67	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,428.00	119.35	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,428.50	156.50	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,429.00	196.62	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,429.50	205.78	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,430.00	211.74	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,430.50	217.53	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,431.00	223.18	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,431.50	228.71	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,432.00	234.08	(N/A)	0.00	

Composite Outflow Summary

Contributing Structures
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
7,369.00	0.00	(N/A)	0.00	(no Q: Riser - 1,Orifice - 1,Culvert - 1)
7,369.25	0.00	(N/A)	0.00	(no Q: Riser - 1,Orifice - 1,Culvert - 1)
7,369.50	0.00	(N/A)	0.00	(no Q: Riser - 1,Orifice - 1,Culvert - 1)
7,370.00	0.12	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,370.50	0.23	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,371.00	0.35	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,371.50	0.47	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,372.00	0.58	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,372.50	0.69	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,373.00	0.81	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,373.50	0.92	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,374.00	1.04	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,374.50	1.15	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,374.75	1.21	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,375.00	7.17	(N/A)	0.00	
7,375.50	32.24	(N/A)	0.00	
7,376.00	68.01	(N/A)	0.00	
7,376.50	112.00	(N/A)	0.00	
7,377.00	162.75	(N/A)	0.00	
7,377.50	219.40	(N/A)	0.00	
7,378.00	254.44	(N/A)	0.00	
7,378.50	266.12	(N/A)	0.00	
7,379.00	277.33	(N/A)	0.00	
7,379.50	288.06	(N/A)	0.00	
7,380.00	298.45	(N/A)	0.00	
7,380.50	308.47	(N/A)	0.00	
7,381.00	318.15	(N/A)	0.00	
7,381.50	327.59	(N/A)	0.00	
7,382.00	336.74	(N/A)	0.00	

Composite Outflow Summary

Contributing Structures
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Subsection: Elevation-Volume-Flow Table (Pond) | Return Event: 2 years
Label: FH North Pond 1 | Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,390.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,390.00	0.00	0.000	0.004	0.00	0.00	0.00
7,390.50	0.21	0.007	0.029	0.00	0.21	3.74
7,391.00	0.42	0.033	0.077	0.00	0.42	16.33
7,391.50	0.63	0.088	0.148	0.00	0.63	43.31
7,392.00	0.84	0.185	0.242	0.00	0.84	90.25
7,392.50	1.05	0.310	0.258	0.00	1.05	151.00
7,392.75	1.15	0.375	0.267	0.00	1.15	182.89
7,393.00	2.70	0.443	0.275	0.00	2.70	217.24
7,393.50	9.09	0.585	0.293	0.00	9.09	292.39
7,394.00	18.16	0.736	0.311	0.00	18.16	374.53
7,394.50	29.05	0.896	0.329	0.00	29.05	462.88
7,395.00	41.22	1.066	0.348	0.00	41.22	556.98
7,395.50	47.14	1.244	0.367	0.00	47.14	649.42
7,396.00	48.76	1.433	0.387	0.00	48.76	742.29

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,544.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,544.50	0.00	0.000	0.002	0.00	0.00	0.00
7,545.00	0.09	0.013	0.066	0.00	0.09	6.48
7,545.50	0.19	0.081	0.219	0.00	0.19	39.23
7,546.00	0.28	0.247	0.462	0.00	0.28	119.92
7,546.50	0.37	0.486	0.495	0.00	0.37	235.77
7,546.75	0.42	0.612	0.512	0.00	0.42	296.70
7,547.00	1.93	0.742	0.529	0.00	1.93	361.15
7,547.50	8.19	1.015	0.564	0.00	8.19	499.59
7,548.00	17.12	1.306	0.600	0.00	17.12	649.32
7,548.50	27.99	1.615	0.636	0.00	27.99	809.69
7,549.00	33.62	1.942	0.672	0.00	33.62	973.58
7,549.50	35.86	2.288	0.710	0.00	35.86	1,143.10
7,550.00	37.97	2.652	0.749	0.00	37.97	1,321.75
7,550.50	39.96	3.036	0.787	0.00	39.96	1,509.54
7,551.00	41.87	3.439	0.825	0.00	41.87	1,706.45
7,551.50	43.69	3.862	0.865	0.00	43.69	1,912.72
7,552.00	45.43	4.304	0.905	0.00	45.43	2,128.56

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,421.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,421.50	0.00	0.000	0.004	0.00	0.00	0.00
7,422.00	0.09	0.002	0.004	0.00	0.09	1.06
7,422.50	0.19	0.009	0.030	0.00	0.19	4.74
7,423.00	0.29	0.035	0.079	0.00	0.29	17.47
7,423.50	0.38	0.092	0.152	0.00	0.38	44.96
7,424.00	0.48	0.191	0.248	0.00	0.48	92.92
7,424.50	0.57	0.348	0.386	0.00	0.57	169.09
7,425.00	0.67	0.582	0.554	0.00	0.67	282.28
7,425.50	0.77	0.907	0.752	0.00	0.77	439.80
7,426.00	11.42	1.339	0.981	0.00	11.42	659.57
7,426.50	30.84	1.844	1.040	0.00	30.84	923.46
7,427.00	55.96	2.379	1.100	0.00	55.96	1,207.47
7,427.50	85.67	2.945	1.162	0.00	85.67	1,510.87
7,428.00	119.35	3.542	1.226	0.00	119.35	1,833.49
7,428.50	156.50	4.167	1.276	0.00	156.50	2,173.36
7,429.00	196.62	4.818	1.327	0.00	196.62	2,528.43
7,429.50	205.78	5.494	1.379	0.00	205.78	2,864.99
7,430.00	211.74	6.197	1.432	0.00	211.74	3,211.06
7,430.50	217.53	6.926	1.485	0.00	217.53	3,569.83
7,431.00	223.18	7.682	1.540	0.00	223.18	3,941.46
7,431.50	228.71	8.466	1.595	0.00	228.71	4,326.23
7,432.00	234.08	9.277	1.651	0.00	234.08	4,724.32

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,369.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,369.00	0.00	0.000	0.009	0.00	0.00	0.00
7,369.25	0.00	0.002	0.009	0.00	0.00	1.09
7,369.50	0.00	0.004	0.009	0.00	0.00	2.18
7,370.00	0.12	0.009	0.009	0.00	0.12	4.47
7,370.50	0.23	0.023	0.054	0.00	0.23	11.44
7,371.00	0.35	0.069	0.137	0.00	0.35	33.85
7,371.50	0.47	0.166	0.257	0.00	0.47	80.81
7,372.00	0.58	0.332	0.415	0.00	0.58	161.47
7,372.50	0.69	0.566	0.522	0.00	0.69	274.74
7,373.00	0.81	0.857	0.642	0.00	0.81	415.47
7,373.50	0.92	1.210	0.774	0.00	0.92	586.62
7,374.00	1.04	1.633	0.918	0.00	1.04	791.20
7,374.50	1.15	2.120	1.031	0.00	1.15	1,027.05
7,374.75	1.21	2.385	1.091	0.00	1.21	1,155.47
7,375.00	7.17	2.665	1.151	0.00	7.17	1,297.03
7,375.50	32.24	3.272	1.278	0.00	32.24	1,615.90
7,376.00	68.01	3.944	1.411	0.00	68.01	1,976.89
7,376.50	112.00	4.661	1.456	0.00	112.00	2,367.74
7,377.00	162.75	5.400	1.501	0.00	162.75	2,776.25
7,377.50	219.40	6.162	1.547	0.00	219.40	3,201.72
7,378.00	254.44	6.947	1.594	0.00	254.44	3,616.84
7,378.50	266.12	7.756	1.641	0.00	266.12	4,020.00
7,379.00	277.33	8.589	1.690	0.00	277.33	4,434.25
7,379.50	288.06	9.446	1.738	0.00	288.06	4,859.76
7,380.00	298.45	10.327	1.788	0.00	298.45	5,296.84
7,380.50	308.47	11.236	1.848	0.00	308.47	5,746.74
7,381.00	318.15	12.175	1.908	0.00	318.15	6,210.82
7,381.50	327.59	13.144	1.970	0.00	327.59	6,689.43
7,382.00	336.74	14.145	2.032	0.00	336.74	7,182.75

Index

Project Summary

Title	Flying Horse North Filing No.1
Engineer	MAW
Company	CCES
Date	4/4/2018

Notes	5 Year

Table of Contents

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Area to HFR Pond 16	Post-Development 5 YR	5	9.990	12.200	77.31
Area to Pond 1	Post-Development 5 YR	5	0.813	12.100	9.36
BS-10	Post-Development 5 YR	5	0.610	12.050	8.66
BS-11	Post-Development 5 YR	5	0.122	12.000	2.08
BS-12	Post-Development 5 YR	5	0.240	12.050	3.01
BS-13	Post-Development 5 YR	5	1.054	12.050	12.78
BS-14	Post-Development 5 YR	5	0.545	12.050	6.57
BS-15	Post-Development 5 YR	5	0.250	12.050	3.66
BS-16	Post-Development 5 YR	5	0.912	12.150	9.19
BS-17	Post-Development 5 YR	5	0.553	12.050	7.36
BS-18	Post-Development 5 YR	5	1.121	12.100	12.38
BS-19	Post-Development 5 YR	5	0.312	12.050	4.62
BS-1A	Post-Development 5 YR	5	0.109	12.050	1.39
BS-1B	Post-Development 5 YR	5	0.232	12.050	2.37
BS-2	Post-Development 5 YR	5	0.258	12.000	4.20
BS-20	Post-Development 5 YR	5	2.565	12.150	24.57
BS-21	Post-Development 5 YR	5	2.579	12.150	23.92
BS-22	Post-Development 5 YR	5	0.762	12.050	9.63
BS-23	Post-Development 5 YR	5	1.401	12.150	13.59
BS-23A	Post-Development 5 YR	5	0.874	12.050	11.98
BS-24	Post-Development 5 YR	5	0.285	12.050	3.25
BS-25	Post-Development 5 YR	5	0.301	12.100	2.68
BS-26	Post-Development 5 YR	5	0.048	12.100	0.40
BS-27	Post-Development 5 YR	5	0.727	12.100	7.95

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
BS-28	Post-Development 5 YR	5	1.090	12.150	9.31
BS-29	Post-Development 5 YR	5	0.790	12.150	6.49
BS-2A	Post-Development 5 YR	5	0.109	12.000	1.77
BS-2B	Post-Development 5 YR	5	0.122	12.000	2.02
BS-3	Post-Development 5 YR	5	0.194	12.050	2.25
BS-30	Post-Development 5 YR	5	0.209	12.050	2.43
BS-31	Post-Development 5 YR	5	0.209	12.100	1.94
BS-32	Post-Development 5 YR	5	0.156	12.100	1.55
BS-33	Post-Development 5 YR	5	0.271	12.050	3.18
BS-4	Post-Development 5 YR	5	0.478	12.100	5.54
BS-5	Post-Development 5 YR	5	0.350	12.050	4.38
BS-6	Post-Development 5 YR	5	0.163	12.000	2.76
BS-7	Post-Development 5 YR	5	0.394	12.000	6.40
BS-8	Post-Development 5 YR	5	0.136	12.000	2.24
BS-9	Post-Development 5 YR	5	0.204	12.000	3.31
CC-10	Post-Development 5 YR	5	2.140	12.200	14.13
CC-11	Post-Development 5 YR	5	0.490	12.100	4.95
CC-12	Post-Development 5 YR	5	0.380	12.100	3.88
CC-13A	Post-Development 5 YR	5	0.601	12.150	5.42
CC-13B	Post-Development 5 YR	5	0.794	12.150	7.17
CC-13C	Post-Development 5 YR	5	0.309	12.100	3.38
CC-13D	Post-Development 5 YR	5	0.586	12.100	6.17
CC-14	Post-Development 5 YR	5	0.144	12.100	1.59
CC-15	Post-Development 5 YR	5	0.399	12.100	4.27

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
CC-16	Post-Development 5 YR	5	0.507	12.150	4.64
CC-17	Post-Development 5 YR	5	0.777	12.150	6.47
CC-18	Post-Development 5 YR	5	0.219	12.100	2.15
CC-19	Post-Development 5 YR	5	0.115	12.100	1.21
CC-1A	Post-Development 5 YR	5	0.306	12.100	3.28
CC-1B	Post-Development 5 YR	5	0.386	12.100	4.02
CC-20	Post-Development 5 YR	5	1.225	12.100	12.89
CC-21	Post-Development 5 YR	5	0.133	12.100	1.17
CC-22	Post-Development 5 YR	5	0.430	12.100	4.53
CC-23	Post-Development 5 YR	5	0.173	12.150	1.48
CC-24	Post-Development 5 YR	5	1.235	12.100	12.99
CC-25	Post-Development 5 YR	5	0.109	12.100	1.17
CC-26	Post-Development 5 YR	5	0.521	12.100	5.31
CC-27	Post-Development 5 YR	5	0.558	12.150	4.88
CC-28	Post-Development 5 YR	5	4.534	12.350	24.70
CC-2A	Post-Development 5 YR	5	0.343	12.100	3.76
CC-2B	Post-Development 5 YR	5	0.649	12.100	7.10
CC-2C	Post-Development 5 YR	5	0.200	12.050	2.50
CC-3	Post-Development 5 YR	5	1.375	12.250	8.79
CC-4A	Post-Development 5 YR	5	4.709	12.200	38.97
CC-4B	Post-Development 5 YR	5	0.554	12.100	7.31
CC-4C (Pre-Development)	Post-Development 5 YR	5	0.159	12.050	1.81
CC-5	Post-Development 5 YR	5	0.698	12.100	7.13
CC-6	Post-Development 5 YR	5	0.867	12.100	9.12

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
CC-7	Post-Development 5 YR	5	0.573	12.100	5.35
CC-8	Post-Development 5 YR	5	0.240	12.100	2.53
CC-9	Post-Development 5 YR	5	0.175	12.050	2.08
EX-24	Post-Development 5 YR	5	0.255	12.050	2.17
EX-DP-3 (Pre-Dev.)	Post-Development 5 YR	5	0.693	12.100	4.76
OS-10	Post-Development 5 YR	5	0.154	12.050	2.13
OS-11	Post-Development 5 YR	5	0.938	12.150	8.20
OS-12	Post-Development 5 YR	5	1.720	12.200	11.85
OS-13	Post-Development 5 YR	5	0.961	12.150	7.35
OS-14	Post-Development 5 YR	5	0.624	12.150	4.61
OS-15	Post-Development 5 YR	5	1.997	12.200	14.76
OS-16	Post-Development 5 YR	5	0.140	12.100	1.50
OS-17	Post-Development 5 YR	5	0.493	12.050	5.88
OS-18	Post-Development 5 YR	5	0.406	12.050	4.72
OS-1A	Post-Development 5 YR	5	0.137	12.050	1.60
OS-1B	Post-Development 5 YR	5	0.175	12.100	1.94
OS-2	Post-Development 5 YR	5	0.062	12.100	0.55
OS-3	Post-Development 5 YR	5	0.318	12.050	3.80
OS-4	Post-Development 5 YR	5	1.026	12.100	11.02
OS-5	Post-Development 5 YR	5	0.922	12.200	7.14
OS-6	Post-Development 5 YR	5	0.287	12.100	3.18
OS-7	Post-Development 5 YR	5	0.156	12.050	1.96
OS-8	Post-Development 5 YR	5	0.556	12.100	6.22
OS-9	Post-Development 5 YR	5	0.188	12.200	0.99

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-1	Post-Development 5 YR	5	0.260	12.050	3.37
DP-10	Post-Development 5 YR	5	3.247	12.100	34.85
DP-11	Post-Development 5 YR	5	0.912	12.150	9.19
DP-12	Post-Development 5 YR	5	1.161	12.100	11.23
DP-13	Post-Development 5 YR	5	4.192	12.600	15.02
DP-16	Post-Development 5 YR	5	8.729	12.150	78.46
DP-17	Post-Development 5 YR	5	7.095	12.800	23.12
DP-18	Post-Development 5 YR	5	2.495	12.100	21.62
DP-19	Post-Development 5 YR	5	3.616	12.100	16.76
DP-2	Post-Development 5 YR	5	0.737	12.050	8.76
DP-20	Post-Development 5 YR	5	2.026	12.150	14.26
DP-21	Post-Development 5 YR	5	1.304	12.150	10.47
DP-22	Post-Development 5 YR	5	1.951	12.100	16.60
DP-23	Post-Development 5 YR	5	1.999	12.200	13.04
DP-24	Post-Development 5 YR	5	0.857	12.100	8.41
DP-25	Post-Development 5 YR	5	1.084	14.200	1.85
DP-26	Post-Development 5 YR	5	2.380	12.200	15.93
DP-27	Post-Development 5 YR	5	1.624	12.100	17.16
DP-28	Post-Development 5 YR	5	2.598	12.150	19.79
DP-29	Post-Development 5 YR	5	3.678	12.200	26.59
DP-3	Post-Development 5 YR	5	1.262	12.100	5.77
DP-30	Post-Development 5 YR	5	0.219	12.100	2.15
DP-31	Post-Development 5 YR	5	0.334	12.150	3.22
DP-32	Post-Development 5 YR	5	0.917	12.150	7.77

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-33	Post-Development 5 YR	5	1.407	12.100	14.38
DP-34	Post-Development 5 YR	5	6.776	12.650	23.53
DP-4	Post-Development 5 YR	5	0.258	12.000	4.20
DP-5	Post-Development 5 YR	5	0.283	12.050	3.52
DP-6	Post-Development 5 YR	5	0.256	12.050	2.77
DP-7	Post-Development 5 YR	5	0.668	12.050	8.18
DP-8	Post-Development 5 YR	5	12.227	12.300	70.39
DP-9	Post-Development 5 YR	5	0.397	12.050	4.97
J-75	Post-Development 5 YR	5	5.958	12.300	32.44
O-100	Post-Development 5 YR	5	0.490	12.100	4.95
O-101	Post-Development 5 YR	5	0.586	12.100	6.17
O-102	Post-Development 5 YR	5	0.144	12.100	1.59
O-108	Post-Development 5 YR	5	0.563	12.100	5.70
O-110	Post-Development 5 YR	5	0.109	12.100	1.17
O-122	Post-Development 5 YR	5	0.109	12.050	1.39
O-125	Post-Development 5 YR	5	0.380	12.100	3.88
O-126	Post-Development 5 YR	5	5.438	12.150	44.99
O-127	Post-Development 5 YR	5	0.625	12.000	10.39
O-129	Post-Development 5 YR	5	0.922	12.200	7.14
O-137	Post-Development 5 YR	5	0.255	12.050	2.17
O-138	Post-Development 5 YR	5	0.693	12.100	4.76
O-73	Post-Development 5 YR	5	0.285	12.050	3.25
O-74	Post-Development 5 YR	5	0.301	12.100	2.68
O-75	Post-Development 5 YR	5	0.048	12.100	0.40

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
O-80	Post-Development 5 YR	5	0.209	12.100	1.94
O-81	Post-Development 5 YR	5	0.156	12.100	1.55
O-82	Post-Development 5 YR	5	0.271	12.050	3.18
O-86	Post-Development 5 YR	5	0.386	12.100	4.02
O-96	Post-Development 5 YR	5	0.200	12.050	2.50
O-98	Post-Development 5 YR	5	0.573	12.100	5.35

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Exist. HFR Pond 16 (IN)	Post-Development 5 YR	5	9.990	12.200	77.31	(N/A)	(N/A)
Exist. HFR Pond 16 (OUT)	Post-Development 5 YR	5	9.910	12.350	60.95	7,456.98	0.761
FH North Pond 1 (IN)	Post-Development 5 YR	5	0.813	12.100	9.36	(N/A)	(N/A)
FH North Pond 1 (OUT)	Post-Development 5 YR	5	0.774	13.700	1.01	7,392.43	0.291
FH North Pond 12 (IN)	Post-Development 5 YR	5	1.723	12.100	17.34	(N/A)	(N/A)
FH North Pond 12 (OUT)	Post-Development 5 YR	5	1.084	14.200	1.85	7,546.99	0.735
FH North Pond 4 (IN)	Post-Development 5 YR	5	5.146	12.100	52.30	(N/A)	(N/A)
FH North Pond 4 (OUT)	Post-Development 5 YR	5	4.192	12.600	15.02	7,426.09	1.431
FH North Pond 8 (IN)	Post-Development 5 YR	5	9.596	12.150	84.97	(N/A)	(N/A)

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
FH North Pond 8 (OUT)	Post-Development 5 YR	5	7.095	12.800	23.12	7,375.32	3.044
Golf Course Pond 6 (IN)	Post-Development 5 YR	5	5.144	12.150	48.48	(N/A)	(N/A)
Golf Course Pond 6 (OUT)	Post-Development 5 YR	5	5.138	12.200	46.40	7,436.24	2.611
Golf Course Pond 7 (IN)	Post-Development 5 YR	5	6.211	12.150	55.75	(N/A)	(N/A)
Golf Course Pond 7 (OUT)	Post-Development 5 YR	5	6.211	12.200	54.75	7,424.29	1.551

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	5 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
1.250	0.0	0.0	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.2
6.250	0.2	0.2	0.3	0.3	0.3
7.500	0.3	0.3	0.3	0.3	0.4
8.750	0.4	0.4	0.4	0.4	0.5
10.000	0.5	0.5	0.5	0.6	0.6
11.250	0.7	0.8	1.0	1.8	1.9
12.500	2.0	2.0	2.1	2.1	2.2
13.750	2.2	2.2	2.3	2.3	2.3
15.000	2.3	2.3	2.3	2.4	2.4
16.250	2.4	2.4	2.4	2.4	2.5
17.500	2.5	2.5	2.5	2.5	2.5
18.750	2.5	2.5	2.5	2.6	2.6
20.000	2.6	2.6	2.6	2.6	2.6
21.250	2.6	2.6	2.6	2.6	2.6
22.500	2.7	2.7	2.7	2.7	2.7
23.750	2.7	2.7	(N/A)	(N/A)	(N/A)

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,390.00	0.0000	0.004	0.000	0.000	0.000
7,392.00	0.0000	0.242	0.277	0.185	0.185
7,394.00	0.0000	0.311	0.827	0.552	0.736
7,396.00	0.0000	0.387	1.045	0.697	1.433

Subsection: Elevation-Area Volume Curve | Return Event: 5 years
Label: FH North Pond 12 | Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,544.50	0.0000	0.002	0.000	0.000	0.000
7,546.00	0.0000	0.462	0.494	0.247	0.247
7,548.00	0.0000	0.600	1.588	1.059	1.306
7,550.00	0.0000	0.749	2.019	1.346	2.652
7,552.00	0.0000	0.905	2.477	1.652	4.304

Subsection: Elevation-Area Volume Curve — Return Event: 5 years

Label: FH North Pond 4 — Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,421.50	0.0000	0.004	0.000	0.000	0.000
7,422.00	0.0000	0.004	0.012	0.002	0.002
7,424.00	0.0000	0.248	0.283	0.189	0.191
7,426.00	0.0000	0.981	1.722	1.148	1.339
7,428.00	0.0000	1.226	3.304	2.202	3.542
7,430.00	0.0000	1.432	3.983	2.655	6.197
7,432.00	0.0000	1.651	4.621	3.080	9.277

Subsection: Elevation-Area Volume Curve | Return Event: 5 years
Label: FH North Pond 8 | Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,369.00	0.0000	0.009	0.000	0.000	0.000
7,370.00	0.0000	0.009	0.027	0.009	0.009
7,372.00	0.0000	0.415	0.485	0.323	0.332
7,374.00	0.0000	0.918	1.950	1.300	1.633
7,376.00	0.0000	1.411	3.467	2.311	3.944
7,378.00	0.0000	1.594	4.505	3.003	6.947
7,380.00	0.0000	1.788	5.070	3.380	10.327
7,382.00	0.0000	2.032	5.726	3.817	14.145

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,390.00	0.00	(N/A)	0.00
7,390.50	0.21	(N/A)	0.00
7,391.00	0.42	(N/A)	0.00
7,391.50	0.63	(N/A)	0.00
7,392.00	0.84	(N/A)	0.00
7,392.50	1.05	(N/A)	0.00
7,392.75	1.15	(N/A)	0.00
7,393.00	2.70	(N/A)	0.00
7,393.50	9.09	(N/A)	0.00
7,394.00	18.16	(N/A)	0.00
7,394.50	29.05	(N/A)	0.00
7,395.00	41.22	(N/A)	0.00
7,395.50	47.14	(N/A)	0.00
7,396.00	48.76	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Subsection: Composite Rating Curve
Label: FH North Pond 12

Return Event: 5 years
Storm Event: TYPE II 24 HOUR

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
7,544.50	0.00	(N/A)	0.00	(no Q: Riser - 1,Orifice - 1,Culvert - 1)
7,545.00	0.09	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,545.50	0.19	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,546.00	0.28	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,546.50	0.37	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,546.75	0.42	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,547.00	1.93	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,547.50	8.19	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,548.00	17.12	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,548.50	27.99	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,549.00	33.62	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,549.50	35.86	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,550.00	37.97	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,550.50	39.96	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,551.00	41.87	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,551.50	43.69	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,552.00	45.43	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,421.50	0.00	(N/A)	0.00
7,422.00	0.09	(N/A)	0.00
7,422.50	0.19	(N/A)	0.00
7,423.00	0.29	(N/A)	0.00
7,423.50	0.38	(N/A)	0.00
7,424.00	0.48	(N/A)	0.00
7,424.50	0.57	(N/A)	0.00
7,425.00	0.67	(N/A)	0.00
7,425.50	0.77	(N/A)	0.00
7,426.00	11.42	(N/A)	0.00
7,426.50	30.84	(N/A)	0.00
7,427.00	55.96	(N/A)	0.00
7,427.50	85.67	(N/A)	0.00
7,428.00	119.35	(N/A)	0.00
7,428.50	156.50	(N/A)	0.00
7,429.00	196.62	(N/A)	0.00
7,429.50	205.78	(N/A)	0.00
7,430.00	211.74	(N/A)	0.00
7,430.50	217.53	(N/A)	0.00
7,431.00	223.18	(N/A)	0.00
7,431.50	228.71	(N/A)	0.00
7,432.00	234.08	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Composite Outflow Summary

Contributing Structures
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,369.00	0.00	(N/A)	0.00
7,369.25	0.00	(N/A)	0.00
7,369.50	0.00	(N/A)	0.00
7,370.00	0.12	(N/A)	0.00
7,370.50	0.23	(N/A)	0.00
7,371.00	0.35	(N/A)	0.00
7,371.50	0.47	(N/A)	0.00
7,372.00	0.58	(N/A)	0.00
7,372.50	0.69	(N/A)	0.00
7,373.00	0.81	(N/A)	0.00
7,373.50	0.92	(N/A)	0.00
7,374.00	1.04	(N/A)	0.00
7,374.50	1.15	(N/A)	0.00
7,374.75	1.21	(N/A)	0.00
7,375.00	7.17	(N/A)	0.00
7,375.50	32.24	(N/A)	0.00
7,376.00	68.01	(N/A)	0.00
7,376.50	112.00	(N/A)	0.00
7,377.00	162.75	(N/A)	0.00
7,377.50	219.40	(N/A)	0.00
7,378.00	254.44	(N/A)	0.00
7,378.50	266.12	(N/A)	0.00
7,379.00	277.33	(N/A)	0.00
7,379.50	288.06	(N/A)	0.00
7,380.00	298.45	(N/A)	0.00
7,380.50	308.47	(N/A)	0.00
7,381.00	318.15	(N/A)	0.00
7,381.50	327.59	(N/A)	0.00
7,382.00	336.74	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)

Composite Outflow Summary

Contributing Structures
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,390.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,390.00	0.00	0.000	0.004	0.00	0.00	0.00
7,390.50	0.21	0.007	0.029	0.00	0.21	3.74
7,391.00	0.42	0.033	0.077	0.00	0.42	16.33
7,391.50	0.63	0.088	0.148	0.00	0.63	43.31
7,392.00	0.84	0.185	0.242	0.00	0.84	90.25
7,392.50	1.05	0.310	0.258	0.00	1.05	151.00
7,392.75	1.15	0.375	0.267	0.00	1.15	182.89
7,393.00	2.70	0.443	0.275	0.00	2.70	217.24
7,393.50	9.09	0.585	0.293	0.00	9.09	292.39
7,394.00	18.16	0.736	0.311	0.00	18.16	374.53
7,394.50	29.05	0.896	0.329	0.00	29.05	462.88
7,395.00	41.22	1.066	0.348	0.00	41.22	556.98
7,395.50	47.14	1.244	0.367	0.00	47.14	649.42
7,396.00	48.76	1.433	0.387	0.00	48.76	742.29

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,544.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,544.50	0.00	0.000	0.002	0.00	0.00	0.00
7,545.00	0.09	0.013	0.066	0.00	0.09	6.48
7,545.50	0.19	0.081	0.219	0.00	0.19	39.23
7,546.00	0.28	0.247	0.462	0.00	0.28	119.92
7,546.50	0.37	0.486	0.495	0.00	0.37	235.77
7,546.75	0.42	0.612	0.512	0.00	0.42	296.70
7,547.00	1.93	0.742	0.529	0.00	1.93	361.15
7,547.50	8.19	1.015	0.564	0.00	8.19	499.59
7,548.00	17.12	1.306	0.600	0.00	17.12	649.32
7,548.50	27.99	1.615	0.636	0.00	27.99	809.69
7,549.00	33.62	1.942	0.672	0.00	33.62	973.58
7,549.50	35.86	2.288	0.710	0.00	35.86	1,143.10
7,550.00	37.97	2.652	0.749	0.00	37.97	1,321.75
7,550.50	39.96	3.036	0.787	0.00	39.96	1,509.54
7,551.00	41.87	3.439	0.825	0.00	41.87	1,706.45
7,551.50	43.69	3.862	0.865	0.00	43.69	1,912.72
7,552.00	45.43	4.304	0.905	0.00	45.43	2,128.56

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,421.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,421.50	0.00	0.000	0.004	0.00	0.00	0.00
7,422.00	0.09	0.002	0.004	0.00	0.09	1.06
7,422.50	0.19	0.009	0.030	0.00	0.19	4.74
7,423.00	0.29	0.035	0.079	0.00	0.29	17.47
7,423.50	0.38	0.092	0.152	0.00	0.38	44.96
7,424.00	0.48	0.191	0.248	0.00	0.48	92.92
7,424.50	0.57	0.348	0.386	0.00	0.57	169.09
7,425.00	0.67	0.582	0.554	0.00	0.67	282.28
7,425.50	0.77	0.907	0.752	0.00	0.77	439.80
7,426.00	11.42	1.339	0.981	0.00	11.42	659.57
7,426.50	30.84	1.844	1.040	0.00	30.84	923.46
7,427.00	55.96	2.379	1.100	0.00	55.96	1,207.47
7,427.50	85.67	2.945	1.162	0.00	85.67	1,510.87
7,428.00	119.35	3.542	1.226	0.00	119.35	1,833.49
7,428.50	156.50	4.167	1.276	0.00	156.50	2,173.36
7,429.00	196.62	4.818	1.327	0.00	196.62	2,528.43
7,429.50	205.78	5.494	1.379	0.00	205.78	2,864.99
7,430.00	211.74	6.197	1.432	0.00	211.74	3,211.06
7,430.50	217.53	6.926	1.485	0.00	217.53	3,569.83
7,431.00	223.18	7.682	1.540	0.00	223.18	3,941.46
7,431.50	228.71	8.466	1.595	0.00	228.71	4,326.23
7,432.00	234.08	9.277	1.651	0.00	234.08	4,724.32

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,369.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,369.00	0.00	0.000	0.009	0.00	0.00	0.00
7,369.25	0.00	0.002	0.009	0.00	0.00	1.09
7,369.50	0.00	0.004	0.009	0.00	0.00	2.18
7,370.00	0.12	0.009	0.009	0.00	0.12	4.47
7,370.50	0.23	0.023	0.054	0.00	0.23	11.44
7,371.00	0.35	0.069	0.137	0.00	0.35	33.85
7,371.50	0.47	0.166	0.257	0.00	0.47	80.81
7,372.00	0.58	0.332	0.415	0.00	0.58	161.47
7,372.50	0.69	0.566	0.522	0.00	0.69	274.74
7,373.00	0.81	0.857	0.642	0.00	0.81	415.47
7,373.50	0.92	1.210	0.774	0.00	0.92	586.62
7,374.00	1.04	1.633	0.918	0.00	1.04	791.20
7,374.50	1.15	2.120	1.031	0.00	1.15	1,027.05
7,374.75	1.21	2.385	1.091	0.00	1.21	1,155.47
7,375.00	7.17	2.665	1.151	0.00	7.17	1,297.03
7,375.50	32.24	3.272	1.278	0.00	32.24	1,615.90
7,376.00	68.01	3.944	1.411	0.00	68.01	1,976.89
7,376.50	112.00	4.661	1.456	0.00	112.00	2,367.74
7,377.00	162.75	5.400	1.501	0.00	162.75	2,776.25
7,377.50	219.40	6.162	1.547	0.00	219.40	3,201.72
7,378.00	254.44	6.947	1.594	0.00	254.44	3,616.84
7,378.50	266.12	7.756	1.641	0.00	266.12	4,020.00
7,379.00	277.33	8.589	1.690	0.00	277.33	4,434.25
7,379.50	288.06	9.446	1.738	0.00	288.06	4,859.76
7,380.00	298.45	10.327	1.788	0.00	298.45	5,296.84
7,380.50	308.47	11.236	1.848	0.00	308.47	5,746.74
7,381.00	318.15	12.175	1.908	0.00	318.15	6,210.82
7,381.50	327.59	13.144	1.970	0.00	327.59	6,689.43
7,382.00	336.74	14.145	2.032	0.00	336.74	7,182.75

Index

Project Summary

Title	Flying Horse North Filing No.1
Engineer	MAW
Company	CCES
Date	4/4/2018

Notes	100 Year

Table of Contents

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
Area to HFR Pond 16	Post-Development 100 YR	100	37.106	12.150	400.62
Area to Pond 1	Post-Development 100 YR	100	2.793	12.050	38.16
BS-10	Post-Development 100 YR	100	1.269	12.050	17.46
BS-11	Post-Development 100 YR	100	0.254	12.000	4.09
BS-12	Post-Development 100 YR	100	0.892	12.050	13.83
BS-13	Post-Development 100 YR	100	3.477	12.050	49.97
BS-14	Post-Development 100 YR	100	1.807	12.050	25.95
BS-15	Post-Development 100 YR	100	0.781	12.050	12.22
BS-16	Post-Development 100 YR	100	2.975	12.100	35.70
BS-17	Post-Development 100 YR	100	1.747	12.050	25.96
BS-18	Post-Development 100 YR	100	4.050	12.050	56.04
BS-19	Post-Development 100 YR	100	0.955	12.050	14.95
BS-1A	Post-Development 100 YR	100	0.405	12.050	6.29
BS-1B	Post-Development 100 YR	100	0.933	12.050	13.83
BS-2	Post-Development 100 YR	100	0.536	12.000	8.36
BS-20	Post-Development 100 YR	100	9.086	12.100	112.39
BS-21	Post-Development 100 YR	100	8.877	12.100	103.01
BS-22	Post-Development 100 YR	100	2.489	12.050	36.51
BS-23	Post-Development 100 YR	100	4.789	12.100	58.24
BS-23A	Post-Development 100 YR	100	2.590	12.050	38.30
BS-24	Post-Development 100 YR	100	1.143	12.050	17.59
BS-25	Post-Development 100 YR	100	1.263	12.050	17.27
BS-26	Post-Development 100 YR	100	0.223	12.050	3.35
BS-27	Post-Development 100 YR	100	2.696	12.050	38.80

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
BS-28	Post-Development 100 YR	100	4.139	12.100	49.40
BS-29	Post-Development 100 YR	100	3.050	12.100	35.94
BS-2A	Post-Development 100 YR	100	0.226	12.000	3.52
BS-2B	Post-Development 100 YR	100	0.254	12.000	4.00
BS-3	Post-Development 100 YR	100	0.718	12.050	10.78
BS-30	Post-Development 100 YR	100	0.776	12.050	11.65
BS-31	Post-Development 100 YR	100	0.858	12.050	11.80
BS-32	Post-Development 100 YR	100	0.637	12.050	9.41
BS-33	Post-Development 100 YR	100	1.016	12.050	15.33
BS-4	Post-Development 100 YR	100	1.652	12.050	23.58
BS-5	Post-Development 100 YR	100	1.298	12.050	20.12
BS-6	Post-Development 100 YR	100	0.339	12.000	5.44
BS-7	Post-Development 100 YR	100	0.818	12.000	12.76
BS-8	Post-Development 100 YR	100	0.282	12.000	4.45
BS-9	Post-Development 100 YR	100	0.423	12.000	6.60
CC-10	Post-Development 100 YR	100	8.756	12.150	91.86
CC-11	Post-Development 100 YR	100	1.960	12.050	28.14
CC-12	Post-Development 100 YR	100	1.411	12.100	18.67
CC-13A	Post-Development 100 YR	100	2.230	12.100	27.30
CC-13B	Post-Development 100 YR	100	2.947	12.100	36.07
CC-13C	Post-Development 100 YR	100	1.146	12.050	16.49
CC-13D	Post-Development 100 YR	100	2.175	12.050	29.20
CC-14	Post-Development 100 YR	100	0.532	12.050	7.76
CC-15	Post-Development 100 YR	100	1.481	12.050	20.37

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
CC-16	Post-Development 100 YR	100	1.884	12.100	23.58
CC-17	Post-Development 100 YR	100	2.885	12.100	32.77
CC-18	Post-Development 100 YR	100	0.769	12.100	9.73
CC-19	Post-Development 100 YR	100	0.428	12.050	5.75
CC-1A	Post-Development 100 YR	100	1.134	12.050	15.97
CC-1B	Post-Development 100 YR	100	1.444	12.050	19.35
CC-20	Post-Development 100 YR	100	4.547	12.050	61.04
CC-21	Post-Development 100 YR	100	0.585	12.050	8.51
CC-22	Post-Development 100 YR	100	1.597	12.050	21.44
CC-23	Post-Development 100 YR	100	0.650	12.100	7.71
CC-24	Post-Development 100 YR	100	4.581	12.050	61.51
CC-25	Post-Development 100 YR	100	0.405	12.050	5.70
CC-26	Post-Development 100 YR	100	1.932	12.100	25.56
CC-27	Post-Development 100 YR	100	2.121	12.100	25.82
CC-28	Post-Development 100 YR	100	17.270	12.300	136.30
CC-2A	Post-Development 100 YR	100	1.273	12.050	18.32
CC-2B	Post-Development 100 YR	100	2.407	12.050	34.64
CC-2C	Post-Development 100 YR	100	0.742	12.050	11.50
CC-3	Post-Development 100 YR	100	5.511	12.150	54.50
CC-4A	Post-Development 100 YR	100	15.367	12.150	155.93
CC-4B	Post-Development 100 YR	100	1.493	12.050	20.60
CC-4C (Pre-Development)	Post-Development 100 YR	100	0.699	12.000	11.16
CC-5	Post-Development 100 YR	100	2.591	12.100	34.28
CC-6	Post-Development 100 YR	100	3.216	12.050	43.18

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
CC-7	Post-Development 100 YR	100	2.127	12.100	27.04
CC-8	Post-Development 100 YR	100	0.891	12.050	11.96
CC-9	Post-Development 100 YR	100	0.648	12.050	9.80
EX-24	Post-Development 100 YR	100	1.178	12.050	17.75
EX-DP-3 (Pre-Dev.)	Post-Development 100 YR	100	3.210	12.100	41.28
OS-10	Post-Development 100 YR	100	0.528	12.050	8.23
OS-11	Post-Development 100 YR	100	3.372	12.100	38.66
OS-12	Post-Development 100 YR	100	7.008	12.150	75.81
OS-13	Post-Development 100 YR	100	3.863	12.100	44.96
OS-14	Post-Development 100 YR	100	2.622	12.100	31.03
OS-15	Post-Development 100 YR	100	7.742	12.150	84.16
OS-16	Post-Development 100 YR	100	0.521	12.050	7.16
OS-17	Post-Development 100 YR	100	1.829	12.050	27.65
OS-18	Post-Development 100 YR	100	1.506	12.050	22.60
OS-1A	Post-Development 100 YR	100	0.510	12.050	7.65
OS-1B	Post-Development 100 YR	100	0.648	12.050	9.44
OS-2	Post-Development 100 YR	100	0.274	12.050	3.98
OS-3	Post-Development 100 YR	100	1.181	12.050	17.85
OS-4	Post-Development 100 YR	100	3.807	12.050	53.61
OS-5	Post-Development 100 YR	100	3.426	12.150	36.99
OS-6	Post-Development 100 YR	100	1.065	12.050	15.51
OS-7	Post-Development 100 YR	100	0.579	12.050	8.98
OS-8	Post-Development 100 YR	100	1.872	12.100	24.73
OS-9	Post-Development 100 YR	100	0.871	12.150	9.05

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-1	Post-Development 100 YR	100	0.764	12.050	11.13
DP-10	Post-Development 100 YR	100	11.054	12.050	143.30
DP-11	Post-Development 100 YR	100	2.975	12.100	35.70
DP-12	Post-Development 100 YR	100	3.754	12.100	44.11
DP-13	Post-Development 100 YR	100	16.350	12.250	139.15
DP-16	Post-Development 100 YR	100	30.220	12.100	361.52
DP-17	Post-Development 100 YR	100	30.083	12.300	255.78
DP-18	Post-Development 100 YR	100	9.471	12.100	115.49
DP-19	Post-Development 100 YR	100	13.817	12.100	125.58
DP-2	Post-Development 100 YR	100	2.416	12.050	34.63
DP-20	Post-Development 100 YR	100	8.142	12.100	88.44
DP-21	Post-Development 100 YR	100	5.136	12.100	61.96
DP-22	Post-Development 100 YR	100	7.540	12.100	92.42
DP-23	Post-Development 100 YR	100	8.133	12.150	84.40
DP-24	Post-Development 100 YR	100	3.290	12.050	44.82
DP-25	Post-Development 100 YR	100	5.764	12.300	32.88
DP-26	Post-Development 100 YR	100	9.647	12.150	101.89
DP-27	Post-Development 100 YR	100	6.028	12.050	81.42
DP-28	Post-Development 100 YR	100	9.972	12.150	110.17
DP-29	Post-Development 100 YR	100	14.023	12.150	154.97
DP-3	Post-Development 100 YR	100	4.441	12.100	38.98
DP-30	Post-Development 100 YR	100	0.769	12.100	9.73
DP-31	Post-Development 100 YR	100	1.197	12.100	15.22
DP-32	Post-Development 100 YR	100	3.406	12.100	39.76

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-33	Post-Development 100 YR	100	5.231	12.100	69.08
DP-34	Post-Development 100 YR	100	26.136	12.400	167.92
DP-4	Post-Development 100 YR	100	0.536	12.000	8.36
DP-5	Post-Development 100 YR	100	0.874	12.050	12.59
DP-6	Post-Development 100 YR	100	0.992	12.050	14.76
DP-7	Post-Development 100 YR	100	2.479	12.050	37.97
DP-8	Post-Development 100 YR	100	43.909	12.350	284.14
DP-9	Post-Development 100 YR	100	1.472	12.050	22.81
J-75	Post-Development 100 YR	100	22.558	12.250	180.87
O-100	Post-Development 100 YR	100	1.960	12.050	28.14
O-101	Post-Development 100 YR	100	2.175	12.050	29.20
O-102	Post-Development 100 YR	100	0.532	12.050	7.76
O-108	Post-Development 100 YR	100	2.182	12.050	29.95
O-110	Post-Development 100 YR	100	0.405	12.050	5.70
O-122	Post-Development 100 YR	100	0.405	12.050	6.29
O-125	Post-Development 100 YR	100	1.411	12.100	18.67
O-126	Post-Development 100 YR	100	17.508	12.150	178.97
O-127	Post-Development 100 YR	100	1.298	12.000	20.57
O-129	Post-Development 100 YR	100	3.426	12.150	36.99
O-137	Post-Development 100 YR	100	1.178	12.050	17.75
O-138	Post-Development 100 YR	100	3.210	12.100	41.28
O-73	Post-Development 100 YR	100	1.143	12.050	17.59
O-74	Post-Development 100 YR	100	1.263	12.050	17.27
O-75	Post-Development 100 YR	100	0.223	12.050	3.35

Subsection: Master Network Summary

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
O-80	Post-Development 100 YR	100	0.858	12.050	11.80
O-81	Post-Development 100 YR	100	0.637	12.050	9.41
O-82	Post-Development 100 YR	100	1.016	12.050	15.33
O-86	Post-Development 100 YR	100	1.444	12.050	19.35
O-96	Post-Development 100 YR	100	0.742	12.050	11.50
O-98	Post-Development 100 YR	100	2.127	12.100	27.04

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Exist. HFR Pond 16 (IN)	Post-Development 100 YR	100	37.106	12.150	400.62	(N/A)	(N/A)
Exist. HFR Pond 16 (OUT)	Post-Development 100 YR	100	36.950	12.350	258.25	7,462.42	6.804
FH North Pond 1 (IN)	Post-Development 100 YR	100	2.793	12.050	38.16	(N/A)	(N/A)
FH North Pond 1 (OUT)	Post-Development 100 YR	100	2.517	12.250	20.41	7,394.10	0.769
FH North Pond 12 (IN)	Post-Development 100 YR	100	6.505	12.100	86.17	(N/A)	(N/A)
FH North Pond 12 (OUT)	Post-Development 100 YR	100	5.764	12.300	32.88	7,548.93	1.898
FH North Pond 4 (IN)	Post-Development 100 YR	100	17.420	12.100	217.23	(N/A)	(N/A)
FH North Pond 4 (OUT)	Post-Development 100 YR	100	16.350	12.250	139.15	7,428.27	3.872
FH North Pond 8 (IN)	Post-Development 100 YR	100	32.794	12.150	383.43	(N/A)	(N/A)

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
FH North Pond 8 (OUT)	Post-Development 100 YR	100	30.083	12.300	255.78	7,378.06	7.039
Golf Course Pond 6 (IN)	Post-Development 100 YR	100	17.962	12.100	215.40	(N/A)	(N/A)
Golf Course Pond 6 (OUT)	Post-Development 100 YR	100	17.947	12.150	212.28	7,436.83	3.002
Golf Course Pond 7 (IN)	Post-Development 100 YR	100	21.391	12.100	253.17	(N/A)	(N/A)
Golf Course Pond 7 (OUT)	Post-Development 100 YR	100	21.391	12.150	250.27	7,424.94	1.819

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.1
1.250	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.2	0.2	0.2
3.750	0.2	0.2	0.2	0.3	0.3
5.000	0.3	0.3	0.3	0.3	0.4
6.250	0.4	0.4	0.4	0.5	0.5
7.500	0.5	0.5	0.6	0.6	0.6
8.750	0.6	0.7	0.7	0.7	0.8
10.000	0.8	0.9	0.9	1.0	1.1
11.250	1.2	1.3	1.8	3.0	3.3
12.500	3.4	3.5	3.6	3.6	3.7
13.750	3.7	3.8	3.8	3.9	3.9
15.000	3.9	4.0	4.0	4.0	4.1
16.250	4.1	4.1	4.1	4.2	4.2
17.500	4.2	4.2	4.2	4.3	4.3
18.750	4.3	4.3	4.3	4.4	4.4
20.000	4.4	4.4	4.4	4.4	4.4
21.250	4.5	4.5	4.5	4.5	4.5
22.500	4.5	4.5	4.5	4.6	4.6
23.750	4.6	4.6	(N/A)	(N/A)	(N/A)

Subsection: Elevation-Area Volume Curve | Return Event: 100 years
Label: FH North Pond 1 | Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,390.00	0.0000	0.004	0.000	0.000	0.000
7,392.00	0.0000	0.242	0.277	0.185	0.185
7,394.00	0.0000	0.311	0.827	0.552	0.736
7,396.00	0.0000	0.387	1.045	0.697	1.433

Subsection: Elevation-Area Volume Curve

Return Event: 100 years

Label: FH North Pond 12

Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,544.50	0.0000	0.002	0.000	0.000	0.000
7,546.00	0.0000	0.462	0.494	0.247	0.247
7,548.00	0.0000	0.600	1.588	1.059	1.306
7,550.00	0.0000	0.749	2.019	1.346	2.652
7,552.00	0.0000	0.905	2.477	1.652	4.304

Subsection: Elevation-Area Volume Curve | Return Event: 100 years
Label: FH North Pond 4 | Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,421.50	0.0000	0.004	0.000	0.000	0.000
7,422.00	0.0000	0.004	0.012	0.002	0.002
7,424.00	0.0000	0.248	0.283	0.189	0.191
7,426.00	0.0000	0.981	1.722	1.148	1.339
7,428.00	0.0000	1.226	3.304	2.202	3.542
7,430.00	0.0000	1.432	3.983	2.655	6.197
7,432.00	0.0000	1.651	4.621	3.080	9.277

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,369.00	0.0000	0.009	0.000	0.000	0.000
7,370.00	0.0000	0.009	0.027	0.009	0.009
7,372.00	0.0000	0.415	0.485	0.323	0.332
7,374.00	0.0000	0.918	1.950	1.300	1.633
7,376.00	0.0000	1.411	3.467	2.311	3.944
7,378.00	0.0000	1.594	4.505	3.003	6.947
7,380.00	0.0000	1.788	5.070	3.380	10.327
7,382.00	0.0000	2.032	5.726	3.817	14.145

Subsection: Composite Rating Curve | Return Event: 100 years
Label: FH North Pond 1 | Storm Event: TYPE II 24 HOUR

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,390.00	0.00	(N/A)	0.00
7,390.50	0.21	(N/A)	0.00
7,391.00	0.42	(N/A)	0.00
7,391.50	0.63	(N/A)	0.00
7,392.00	0.84	(N/A)	0.00
7,392.50	1.05	(N/A)	0.00
7,392.75	1.15	(N/A)	0.00
7,393.00	2.70	(N/A)	0.00
7,393.50	9.09	(N/A)	0.00
7,394.00	18.16	(N/A)	0.00
7,394.50	29.05	(N/A)	0.00
7,395.00	41.22	(N/A)	0.00
7,395.50	47.14	(N/A)	0.00
7,396.00	48.76	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,544.50	0.00	(N/A)	0.00
7,545.00	0.09	(N/A)	0.00
7,545.50	0.19	(N/A)	0.00
7,546.00	0.28	(N/A)	0.00
7,546.50	0.37	(N/A)	0.00
7,546.75	0.42	(N/A)	0.00
7,547.00	1.93	(N/A)	0.00
7,547.50	8.19	(N/A)	0.00
7,548.00	17.12	(N/A)	0.00
7,548.50	27.99	(N/A)	0.00
7,549.00	33.62	(N/A)	0.00
7,549.50	35.86	(N/A)	0.00
7,550.00	37.97	(N/A)	0.00
7,550.50	39.96	(N/A)	0.00
7,551.00	41.87	(N/A)	0.00
7,551.50	43.69	(N/A)	0.00
7,552.00	45.43	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)	Contributing Structures
7,421.50	0.00	(N/A)	0.00	(no Q: Riser - 1,Orifice - 1,Culvert - 1)
7,422.00	0.09	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,422.50	0.19	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,423.00	0.29	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,423.50	0.38	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,424.00	0.48	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,424.50	0.57	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,425.00	0.67	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,425.50	0.77	(N/A)	0.00	Orifice - 1,Culvert - 1 (no Q: Riser - 1)
7,426.00	11.42	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,426.50	30.84	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,427.00	55.96	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,427.50	85.67	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,428.00	119.35	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,428.50	156.50	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,429.00	196.62	(N/A)	0.00	Riser - 1,Orifice - 1,Culvert - 1
7,429.50	205.78	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,430.00	211.74	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,430.50	217.53	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,431.00	223.18	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,431.50	228.71	(N/A)	0.00	Riser - 1,Culvert - 1 (no Q: Orifice - 1)
7,432.00	234.08	(N/A)	0.00	

Composite Outflow Summary

Contributing Structures
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft³/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,369.00	0.00	(N/A)	0.00
7,369.25	0.00	(N/A)	0.00
7,369.50	0.00	(N/A)	0.00
7,370.00	0.12	(N/A)	0.00
7,370.50	0.23	(N/A)	0.00
7,371.00	0.35	(N/A)	0.00
7,371.50	0.47	(N/A)	0.00
7,372.00	0.58	(N/A)	0.00
7,372.50	0.69	(N/A)	0.00
7,373.00	0.81	(N/A)	0.00
7,373.50	0.92	(N/A)	0.00
7,374.00	1.04	(N/A)	0.00
7,374.50	1.15	(N/A)	0.00
7,374.75	1.21	(N/A)	0.00
7,375.00	7.17	(N/A)	0.00
7,375.50	32.24	(N/A)	0.00
7,376.00	68.01	(N/A)	0.00
7,376.50	112.00	(N/A)	0.00
7,377.00	162.75	(N/A)	0.00
7,377.50	219.40	(N/A)	0.00
7,378.00	254.44	(N/A)	0.00
7,378.50	266.12	(N/A)	0.00
7,379.00	277.33	(N/A)	0.00
7,379.50	288.06	(N/A)	0.00
7,380.00	298.45	(N/A)	0.00
7,380.50	308.47	(N/A)	0.00
7,381.00	318.15	(N/A)	0.00
7,381.50	327.59	(N/A)	0.00
7,382.00	336.74	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)

Composite Outflow Summary

Contributing Structures
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,390.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,390.00	0.00	0.000	0.004	0.00	0.00	0.00
7,390.50	0.21	0.007	0.029	0.00	0.21	3.74
7,391.00	0.42	0.033	0.077	0.00	0.42	16.33
7,391.50	0.63	0.088	0.148	0.00	0.63	43.31
7,392.00	0.84	0.185	0.242	0.00	0.84	90.25
7,392.50	1.05	0.310	0.258	0.00	1.05	151.00
7,392.75	1.15	0.375	0.267	0.00	1.15	182.89
7,393.00	2.70	0.443	0.275	0.00	2.70	217.24
7,393.50	9.09	0.585	0.293	0.00	9.09	292.39
7,394.00	18.16	0.736	0.311	0.00	18.16	374.53
7,394.50	29.05	0.896	0.329	0.00	29.05	462.88
7,395.00	41.22	1.066	0.348	0.00	41.22	556.98
7,395.50	47.14	1.244	0.367	0.00	47.14	649.42
7,396.00	48.76	1.433	0.387	0.00	48.76	742.29

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,544.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,544.50	0.00	0.000	0.002	0.00	0.00	0.00
7,545.00	0.09	0.013	0.066	0.00	0.09	6.48
7,545.50	0.19	0.081	0.219	0.00	0.19	39.23
7,546.00	0.28	0.247	0.462	0.00	0.28	119.92
7,546.50	0.37	0.486	0.495	0.00	0.37	235.77
7,546.75	0.42	0.612	0.512	0.00	0.42	296.70
7,547.00	1.93	0.742	0.529	0.00	1.93	361.15
7,547.50	8.19	1.015	0.564	0.00	8.19	499.59
7,548.00	17.12	1.306	0.600	0.00	17.12	649.32
7,548.50	27.99	1.615	0.636	0.00	27.99	809.69
7,549.00	33.62	1.942	0.672	0.00	33.62	973.58
7,549.50	35.86	2.288	0.710	0.00	35.86	1,143.10
7,550.00	37.97	2.652	0.749	0.00	37.97	1,321.75
7,550.50	39.96	3.036	0.787	0.00	39.96	1,509.54
7,551.00	41.87	3.439	0.825	0.00	41.87	1,706.45
7,551.50	43.69	3.862	0.865	0.00	43.69	1,912.72
7,552.00	45.43	4.304	0.905	0.00	45.43	2,128.56

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,421.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,421.50	0.00	0.000	0.004	0.00	0.00	0.00
7,422.00	0.09	0.002	0.004	0.00	0.09	1.06
7,422.50	0.19	0.009	0.030	0.00	0.19	4.74
7,423.00	0.29	0.035	0.079	0.00	0.29	17.47
7,423.50	0.38	0.092	0.152	0.00	0.38	44.96
7,424.00	0.48	0.191	0.248	0.00	0.48	92.92
7,424.50	0.57	0.348	0.386	0.00	0.57	169.09
7,425.00	0.67	0.582	0.554	0.00	0.67	282.28
7,425.50	0.77	0.907	0.752	0.00	0.77	439.80
7,426.00	11.42	1.339	0.981	0.00	11.42	659.57
7,426.50	30.84	1.844	1.040	0.00	30.84	923.46
7,427.00	55.96	2.379	1.100	0.00	55.96	1,207.47
7,427.50	85.67	2.945	1.162	0.00	85.67	1,510.87
7,428.00	119.35	3.542	1.226	0.00	119.35	1,833.49
7,428.50	156.50	4.167	1.276	0.00	156.50	2,173.36
7,429.00	196.62	4.818	1.327	0.00	196.62	2,528.43
7,429.50	205.78	5.494	1.379	0.00	205.78	2,864.99
7,430.00	211.74	6.197	1.432	0.00	211.74	3,211.06
7,430.50	217.53	6.926	1.485	0.00	217.53	3,569.83
7,431.00	223.18	7.682	1.540	0.00	223.18	3,941.46
7,431.50	228.71	8.466	1.595	0.00	228.71	4,326.23
7,432.00	234.08	9.277	1.651	0.00	234.08	4,724.32

Subsection: Elevation-Volume-Flow Table (Pond)
Label: FH North Pond 8

Return Event: 100 years
Storm Event: TYPE II 24 HOUR

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,369.00 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,369.00	0.00	0.000	0.009	0.00	0.00	0.00
7,369.25	0.00	0.002	0.009	0.00	0.00	1.09
7,369.50	0.00	0.004	0.009	0.00	0.00	2.18
7,370.00	0.12	0.009	0.009	0.00	0.12	4.47
7,370.50	0.23	0.023	0.054	0.00	0.23	11.44
7,371.00	0.35	0.069	0.137	0.00	0.35	33.85
7,371.50	0.47	0.166	0.257	0.00	0.47	80.81
7,372.00	0.58	0.332	0.415	0.00	0.58	161.47
7,372.50	0.69	0.566	0.522	0.00	0.69	274.74
7,373.00	0.81	0.857	0.642	0.00	0.81	415.47
7,373.50	0.92	1.210	0.774	0.00	0.92	586.62
7,374.00	1.04	1.633	0.918	0.00	1.04	791.20
7,374.50	1.15	2.120	1.031	0.00	1.15	1,027.05
7,374.75	1.21	2.385	1.091	0.00	1.21	1,155.47
7,375.00	7.17	2.665	1.151	0.00	7.17	1,297.03
7,375.50	32.24	3.272	1.278	0.00	32.24	1,615.90
7,376.00	68.01	3.944	1.411	0.00	68.01	1,976.89
7,376.50	112.00	4.661	1.456	0.00	112.00	2,367.74
7,377.00	162.75	5.400	1.501	0.00	162.75	2,776.25
7,377.50	219.40	6.162	1.547	0.00	219.40	3,201.72
7,378.00	254.44	6.947	1.594	0.00	254.44	3,616.84
7,378.50	266.12	7.756	1.641	0.00	266.12	4,020.00
7,379.00	277.33	8.589	1.690	0.00	277.33	4,434.25
7,379.50	288.06	9.446	1.738	0.00	288.06	4,859.76
7,380.00	298.45	10.327	1.788	0.00	298.45	5,296.84
7,380.50	308.47	11.236	1.848	0.00	308.47	5,746.74
7,381.00	318.15	12.175	1.908	0.00	318.15	6,210.82
7,381.50	327.59	13.144	1.970	0.00	327.59	6,689.43
7,382.00	336.74	14.145	2.032	0.00	336.74	7,182.75

Index

Project Summary

Title	Flying Horse North Filing No.1
Engineer	MAW
Company	CCES
Date	11/20/2017

Notes	2 Year (Filing 1 Only)

Table of Contents

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
BS-18	Post-Development 2 YR (Filing 1 Only)	2	0.494	12.100	3.42
BS-19	Post-Development 2 YR (Filing 1 Only)	2	0.161	12.050	2.08
BS-20	Post-Development 2 YR (Filing 1 Only)	2	0.532	14.350	1.14
BS-21	Post-Development 2 YR (Filing 1 Only)	2	0.840	12.300	3.20
BS-22	Post-Development 2 YR (Filing 1 Only)	2	0.207	12.100	1.05
BS-23	Post-Development 2 YR (Filing 1 Only)	2	0.626	12.200	4.08
BS-23A	Post-Development 2 YR (Filing 1 Only)	2	0.174	12.250	0.64

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-16	Post-Development 2 YR (Filing 1 Only)	2	2.856	12.150	11.61
DP-17	Post-Development 2 YR (Filing 1 Only)	2	0.989	24.000	1.13

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
FH North Pond 8 (IN)	Post-Development 2 YR (Filing 1 Only)	2	3.026	12.200	12.12	(N/A)	(N/A)
FH North Pond 8 (OUT)	Post-Development 2 YR (Filing 1 Only)	2	0.989	24.000	1.13	7,374.42	2.034
Golf Course Pond 6 (IN)	Post-Development 2 YR (Filing 1 Only)	2	1.372	12.350	4.24	(N/A)	(N/A)
Golf Course Pond 6 (OUT)	Post-Development 2 YR (Filing 1 Only)	2	1.370	12.400	4.18	7,436.02	2.471

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Golf Course Pond 7 (IN)	Post-Development 2 YR (Filing 1 Only)	2	1.738	12.350	5.39	(N/A)	(N/A)
Golf Course Pond 7 (OUT)	Post-Development 2 YR (Filing 1 Only)	2	1.738	12.350	5.35	7,424.03	1.453

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	2 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
1.250	0.0	0.0	0.0	0.0	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.1	0.1
5.000	0.1	0.1	0.2	0.2	0.2
6.250	0.2	0.2	0.2	0.2	0.2
7.500	0.2	0.2	0.3	0.3	0.3
8.750	0.3	0.3	0.3	0.3	0.4
10.000	0.4	0.4	0.4	0.5	0.5
11.250	0.5	0.6	0.8	1.4	1.5
12.500	1.5	1.6	1.6	1.7	1.7
13.750	1.7	1.7	1.8	1.8	1.8
15.000	1.8	1.8	1.8	1.9	1.9
16.250	1.9	1.9	1.9	1.9	1.9
17.500	1.9	1.9	1.9	1.9	2.0
18.750	2.0	2.0	2.0	2.0	2.0
20.000	2.0	2.0	2.0	2.0	2.0
21.250	2.0	2.0	2.0	2.1	2.1
22.500	2.1	2.1	2.1	2.1	2.1
23.750	2.1	2.1	(N/A)	(N/A)	(N/A)

Subsection: Elevation-Area Volume Curve | Return Event: 2 years
Label: FH North Pond 8 | Storm Event: TYPE II 24 HOUR

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,369.50	0.000	0.009	0.000	0.000	0.000
7,370.00	0.000	0.009	0.027	0.004	0.004
7,372.00	0.000	0.415	0.485	0.323	0.328
7,374.00	0.000	0.918	1.950	1.300	1.628
7,376.00	0.000	1.411	3.467	2.311	3.939
7,378.00	0.000	1.594	4.505	3.003	6.943
7,380.00	0.000	1.788	5.070	3.380	10.323
7,382.00	0.000	2.032	5.726	3.817	14.140

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,369.50	0.00	(N/A)	0.00
7,370.00	0.12	(N/A)	0.00
7,370.50	0.23	(N/A)	0.00
7,371.00	0.35	(N/A)	0.00
7,371.50	0.47	(N/A)	0.00
7,372.00	0.58	(N/A)	0.00
7,372.50	0.69	(N/A)	0.00
7,373.00	0.81	(N/A)	0.00
7,373.50	0.92	(N/A)	0.00
7,374.00	1.04	(N/A)	0.00
7,374.50	1.15	(N/A)	0.00
7,374.75	1.21	(N/A)	0.00
7,375.00	7.17	(N/A)	0.00
7,375.50	32.24	(N/A)	0.00
7,376.00	68.01	(N/A)	0.00
7,376.50	112.00	(N/A)	0.00
7,377.00	162.75	(N/A)	0.00
7,377.50	219.40	(N/A)	0.00
7,378.00	254.44	(N/A)	0.00
7,378.50	266.12	(N/A)	0.00
7,379.00	277.33	(N/A)	0.00
7,379.50	288.06	(N/A)	0.00
7,380.00	298.45	(N/A)	0.00
7,380.50	308.47	(N/A)	0.00
7,381.00	318.15	(N/A)	0.00
7,381.50	327.59	(N/A)	0.00
7,382.00	336.74	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1

Composite Outflow Summary

Contributing Structures
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,369.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,369.50	0.00	0.000	0.009	0.00	0.00	0.00
7,370.00	0.12	0.004	0.009	0.00	0.12	2.30
7,370.50	0.23	0.019	0.054	0.00	0.23	9.26
7,371.00	0.35	0.065	0.137	0.00	0.35	31.67
7,371.50	0.47	0.162	0.257	0.00	0.47	78.63
7,372.00	0.58	0.328	0.415	0.00	0.58	159.29
7,372.50	0.69	0.562	0.522	0.00	0.69	272.56
7,373.00	0.81	0.852	0.642	0.00	0.81	413.29
7,373.50	0.92	1.206	0.774	0.00	0.92	584.45
7,374.00	1.04	1.628	0.918	0.00	1.04	789.02
7,374.50	1.15	2.115	1.031	0.00	1.15	1,024.87
7,374.75	1.21	2.380	1.091	0.00	1.21	1,153.29
7,375.00	7.17	2.661	1.151	0.00	7.17	1,294.86
7,375.50	32.24	3.268	1.278	0.00	32.24	1,613.72
7,376.00	68.01	3.939	1.411	0.00	68.01	1,974.71
7,376.50	112.00	4.656	1.456	0.00	112.00	2,365.56
7,377.00	162.75	5.395	1.501	0.00	162.75	2,774.07
7,377.50	219.40	6.157	1.547	0.00	219.40	3,199.55
7,378.00	254.44	6.943	1.594	0.00	254.44	3,614.66
7,378.50	266.12	7.751	1.641	0.00	266.12	4,017.82
7,379.00	277.33	8.584	1.690	0.00	277.33	4,432.07
7,379.50	288.06	9.441	1.738	0.00	288.06	4,857.58
7,380.00	298.45	10.323	1.788	0.00	298.45	5,294.67
7,380.50	308.47	11.232	1.848	0.00	308.47	5,744.56
7,381.00	318.15	12.170	1.908	0.00	318.15	6,208.65
7,381.50	327.59	13.140	1.970	0.00	327.59	6,687.26
7,382.00	336.74	14.140	2.032	0.00	336.74	7,180.58

Index

Project Summary

Title	Flying Horse North Filing No.1
Engineer	MAW
Company	CCES
Date	11/20/2017

Notes	5 Year (Filing 1 Only)

Table of Contents

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
BS-18	Post-Development 5 YR (Filing 1 Only)	5	1.112	12.100	12.24
BS-19	Post-Development 5 YR (Filing 1 Only)	5	0.312	12.050	4.62
BS-20	Post-Development 5 YR (Filing 1 Only)	5	1.513	12.150	9.35
BS-21	Post-Development 5 YR (Filing 1 Only)	5	2.002	12.250	13.46
BS-22	Post-Development 5 YR (Filing 1 Only)	5	0.502	12.100	5.15
BS-23	Post-Development 5 YR (Filing 1 Only)	5	1.353	12.150	12.91
BS-23A	Post-Development 5 YR (Filing 1 Only)	5	0.432	12.150	3.28

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-16	Post-Development 5 YR (Filing 1 Only)	5	6.787	12.150	47.28
DP-17	Post-Development 5 YR (Filing 1 Only)	5	4.742	13.600	10.89

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
FH North Pond 8 (IN)	Post-Development 5 YR (Filing 1 Only)	5	7.213	12.200	49.73	(N/A)	(N/A)
FH North Pond 8 (OUT)	Post-Development 5 YR (Filing 1 Only)	5	4.742	13.600	10.89	7,375.07	2.747
Golf Course Pond 6 (IN)	Post-Development 5 YR (Filing 1 Only)	5	3.515	12.200	22.52	(N/A)	(N/A)
Golf Course Pond 6 (OUT)	Post-Development 5 YR (Filing 1 Only)	5	3.510	12.250	21.92	7,436.11	2.529

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Golf Course Pond 7 (IN)	Post-Development 5 YR (Filing 1 Only)	5	4.324	12.200	26.09	(N/A)	(N/A)
Golf Course Pond 7 (OUT)	Post-Development 5 YR (Filing 1 Only)	5	4.325	12.250	26.02	7,424.14	1.493

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	5 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.0
1.250	0.0	0.0	0.1	0.1	0.1
2.500	0.1	0.1	0.1	0.1	0.1
3.750	0.1	0.1	0.1	0.2	0.2
5.000	0.2	0.2	0.2	0.2	0.2
6.250	0.2	0.2	0.3	0.3	0.3
7.500	0.3	0.3	0.3	0.3	0.4
8.750	0.4	0.4	0.4	0.4	0.5
10.000	0.5	0.5	0.5	0.6	0.6
11.250	0.7	0.8	1.0	1.8	1.9
12.500	2.0	2.0	2.1	2.1	2.2
13.750	2.2	2.2	2.3	2.3	2.3
15.000	2.3	2.3	2.3	2.4	2.4
16.250	2.4	2.4	2.4	2.4	2.5
17.500	2.5	2.5	2.5	2.5	2.5
18.750	2.5	2.5	2.5	2.6	2.6
20.000	2.6	2.6	2.6	2.6	2.6
21.250	2.6	2.6	2.6	2.6	2.6
22.500	2.7	2.7	2.7	2.7	2.7
23.750	2.7	2.7	(N/A)	(N/A)	(N/A)

Elevation (ft)	Planimeter (ft²)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,369.50	0.000	0.009	0.000	0.000	0.000
7,370.00	0.000	0.009	0.027	0.004	0.004
7,372.00	0.000	0.415	0.485	0.323	0.328
7,374.00	0.000	0.918	1.950	1.300	1.628
7,376.00	0.000	1.411	3.467	2.311	3.939
7,378.00	0.000	1.594	4.505	3.003	6.943
7,380.00	0.000	1.788	5.070	3.380	10.323
7,382.00	0.000	2.032	5.726	3.817	14.140

Subsection: Composite Rating Curve | Return Event: 5 years
Label: FH North Pond 8 | Storm Event: TYPE II 24 HOUR

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,369.50	0.00	(N/A)	0.00
7,370.00	0.12	(N/A)	0.00
7,370.50	0.23	(N/A)	0.00
7,371.00	0.35	(N/A)	0.00
7,371.50	0.47	(N/A)	0.00
7,372.00	0.58	(N/A)	0.00
7,372.50	0.69	(N/A)	0.00
7,373.00	0.81	(N/A)	0.00
7,373.50	0.92	(N/A)	0.00
7,374.00	1.04	(N/A)	0.00
7,374.50	1.15	(N/A)	0.00
7,374.75	1.21	(N/A)	0.00
7,375.00	7.17	(N/A)	0.00
7,375.50	32.24	(N/A)	0.00
7,376.00	68.01	(N/A)	0.00
7,376.50	112.00	(N/A)	0.00
7,377.00	162.75	(N/A)	0.00
7,377.50	219.40	(N/A)	0.00
7,378.00	254.44	(N/A)	0.00
7,378.50	266.12	(N/A)	0.00
7,379.00	277.33	(N/A)	0.00
7,379.50	288.06	(N/A)	0.00
7,380.00	298.45	(N/A)	0.00
7,380.50	308.47	(N/A)	0.00
7,381.00	318.15	(N/A)	0.00
7,381.50	327.59	(N/A)	0.00
7,382.00	336.74	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1

Composite Outflow Summary

Contributing Structures
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,369.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,369.50	0.00	0.000	0.009	0.00	0.00	0.00
7,370.00	0.12	0.004	0.009	0.00	0.12	2.30
7,370.50	0.23	0.019	0.054	0.00	0.23	9.26
7,371.00	0.35	0.065	0.137	0.00	0.35	31.67
7,371.50	0.47	0.162	0.257	0.00	0.47	78.63
7,372.00	0.58	0.328	0.415	0.00	0.58	159.29
7,372.50	0.69	0.562	0.522	0.00	0.69	272.56
7,373.00	0.81	0.852	0.642	0.00	0.81	413.29
7,373.50	0.92	1.206	0.774	0.00	0.92	584.45
7,374.00	1.04	1.628	0.918	0.00	1.04	789.02
7,374.50	1.15	2.115	1.031	0.00	1.15	1,024.87
7,374.75	1.21	2.380	1.091	0.00	1.21	1,153.29
7,375.00	7.17	2.661	1.151	0.00	7.17	1,294.86
7,375.50	32.24	3.268	1.278	0.00	32.24	1,613.72
7,376.00	68.01	3.939	1.411	0.00	68.01	1,974.71
7,376.50	112.00	4.656	1.456	0.00	112.00	2,365.56
7,377.00	162.75	5.395	1.501	0.00	162.75	2,774.07
7,377.50	219.40	6.157	1.547	0.00	219.40	3,199.55
7,378.00	254.44	6.943	1.594	0.00	254.44	3,614.66
7,378.50	266.12	7.751	1.641	0.00	266.12	4,017.82
7,379.00	277.33	8.584	1.690	0.00	277.33	4,432.07
7,379.50	288.06	9.441	1.738	0.00	288.06	4,857.58
7,380.00	298.45	10.323	1.788	0.00	298.45	5,294.67
7,380.50	308.47	11.232	1.848	0.00	308.47	5,744.56
7,381.00	318.15	12.170	1.908	0.00	318.15	6,208.65
7,381.50	327.59	13.140	1.970	0.00	327.59	6,687.26
7,382.00	336.74	14.140	2.032	0.00	336.74	7,180.58

Index

Project Summary

Title	Flying Horse North Filing No.1
Engineer	MAW
Company	CCES
Date	11/20/2017

Notes	100 Year (Filing 1 Only)

Table of Contents

Subsection: Master Network Summary

Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
BS-18	Post-Development 100 YR (Filing 1 Only)	100	4.033	12.050	55.75
BS-19	Post-Development 100 YR (Filing 1 Only)	100	0.955	12.050	14.95
BS-20	Post-Development 100 YR (Filing 1 Only)	100	6.797	12.100	76.94
BS-21	Post-Development 100 YR (Filing 1 Only)	100	7.687	12.200	75.52
BS-22	Post-Development 100 YR (Filing 1 Only)	100	1.962	12.050	27.95
BS-23	Post-Development 100 YR (Filing 1 Only)	100	4.695	12.100	56.90
BS-23A	Post-Development 100 YR (Filing 1 Only)	100	1.722	12.100	19.56

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)
DP-16	Post-Development 100 YR (Filing 1 Only)	100	26.105	12.100	278.35
DP-17	Post-Development 100 YR (Filing 1 Only)	100	25.124	12.350	197.59

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
FH North Pond 8 (IN)	Post-Development 100 YR (Filing 1 Only)	100	27.812	12.150	297.19	(N/A)	(N/A)
FH North Pond 8 (OUT)	Post-Development 100 YR (Filing 1 Only)	100	25.124	12.350	197.59	7,377.31	5.861

Subsection: Master Network Summary

Pond Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft³/s)	Maximum Water Surface Elevation (ft)	Maximum Pond Storage (ac-ft)
Golf Course Pond 6 (IN)	Post-Development 100 YR (Filing 1 Only)	100	14.484	12.150	149.77	(N/A)	(N/A)
Golf Course Pond 6 (OUT)	Post-Development 100 YR (Filing 1 Only)	100	14.470	12.150	147.51	7,436.65	2.876
Golf Course Pond 7 (IN)	Post-Development 100 YR (Filing 1 Only)	100	17.387	12.150	176.39	(N/A)	(N/A)
Golf Course Pond 7 (OUT)	Post-Development 100 YR (Filing 1 Only)	100	17.388	12.150	177.48	7,424.73	1.731

Time-Depth Curve: TYPE II 24 HOUR	
Label	TYPE II 24 HOUR
Start Time	0.000 hours
Increment	0.250 hours
End Time	24.000 hours
Return Event	100 years

CUMULATIVE RAINFALL (in)
Output Time Increment = 0.250 hours
Time on left represents time for first value in each row.

Time (hours)	Depth (in)	Depth (in)	Depth (in)	Depth (in)	Depth (in)
0.000	0.0	0.0	0.0	0.0	0.1
1.250	0.1	0.1	0.1	0.1	0.1
2.500	0.1	0.1	0.2	0.2	0.2
3.750	0.2	0.2	0.2	0.3	0.3
5.000	0.3	0.3	0.3	0.3	0.4
6.250	0.4	0.4	0.4	0.5	0.5
7.500	0.5	0.5	0.6	0.6	0.6
8.750	0.6	0.7	0.7	0.7	0.8
10.000	0.8	0.9	0.9	1.0	1.1
11.250	1.2	1.3	1.8	3.0	3.3
12.500	3.4	3.5	3.6	3.6	3.7
13.750	3.7	3.8	3.8	3.9	3.9
15.000	3.9	4.0	4.0	4.0	4.1
16.250	4.1	4.1	4.1	4.2	4.2
17.500	4.2	4.2	4.2	4.3	4.3
18.750	4.3	4.3	4.3	4.4	4.4
20.000	4.4	4.4	4.4	4.4	4.4
21.250	4.5	4.5	4.5	4.5	4.5
22.500	4.5	4.5	4.5	4.6	4.6
23.750	4.6	4.6	(N/A)	(N/A)	(N/A)

Elevation (ft)	Planimeter (ft^2)	Area (acres)	A1+A2+sqr (A1*A2) (acres)	Volume (ac-ft)	Volume (Total) (ac-ft)
7,369.50	0.000	0.009	0.000	0.000	0.000
7,370.00	0.000	0.009	0.027	0.004	0.004
7,372.00	0.000	0.415	0.485	0.323	0.328
7,374.00	0.000	0.918	1.950	1.300	1.628
7,376.00	0.000	1.411	3.467	2.311	3.939
7,378.00	0.000	1.594	4.505	3.003	6.943
7,380.00	0.000	1.788	5.070	3.380	10.323
7,382.00	0.000	2.032	5.726	3.817	14.140

Subsection: Composite Rating Curve
Label: FH North Pond 8

Return Event: 100 years
Storm Event: TYPE II 24 HOUR

Composite Outflow Summary

Water Surface Elevation (ft)	Flow (ft^3/s)	Tailwater Elevation (ft)	Convergence Error (ft)
7,369.50	0.00	(N/A)	0.00
7,370.00	0.12	(N/A)	0.00
7,370.50	0.23	(N/A)	0.00
7,371.00	0.35	(N/A)	0.00
7,371.50	0.47	(N/A)	0.00
7,372.00	0.58	(N/A)	0.00
7,372.50	0.69	(N/A)	0.00
7,373.00	0.81	(N/A)	0.00
7,373.50	0.92	(N/A)	0.00
7,374.00	1.04	(N/A)	0.00
7,374.50	1.15	(N/A)	0.00
7,374.75	1.21	(N/A)	0.00
7,375.00	7.17	(N/A)	0.00
7,375.50	32.24	(N/A)	0.00
7,376.00	68.01	(N/A)	0.00
7,376.50	112.00	(N/A)	0.00
7,377.00	162.75	(N/A)	0.00
7,377.50	219.40	(N/A)	0.00
7,378.00	254.44	(N/A)	0.00
7,378.50	266.12	(N/A)	0.00
7,379.00	277.33	(N/A)	0.00
7,379.50	288.06	(N/A)	0.00
7,380.00	298.45	(N/A)	0.00
7,380.50	308.47	(N/A)	0.00
7,381.00	318.15	(N/A)	0.00
7,381.50	327.59	(N/A)	0.00
7,382.00	336.74	(N/A)	0.00

Contributing Structures
(no Q: Riser - 1,Orifice - 1,Culvert - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Orifice - 1,Culvert - 1 (no Q: Riser - 1)
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1

Composite Outflow Summary

Contributing Structures
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Orifice - 1,Culvert - 1
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)
Riser - 1,Culvert - 1 (no Q: Orifice - 1)

Subsection: Elevation-Volume-Flow Table (Pond)
Label: FH North Pond 8

Return Event: 100 years
Storm Event: TYPE II 24 HOUR

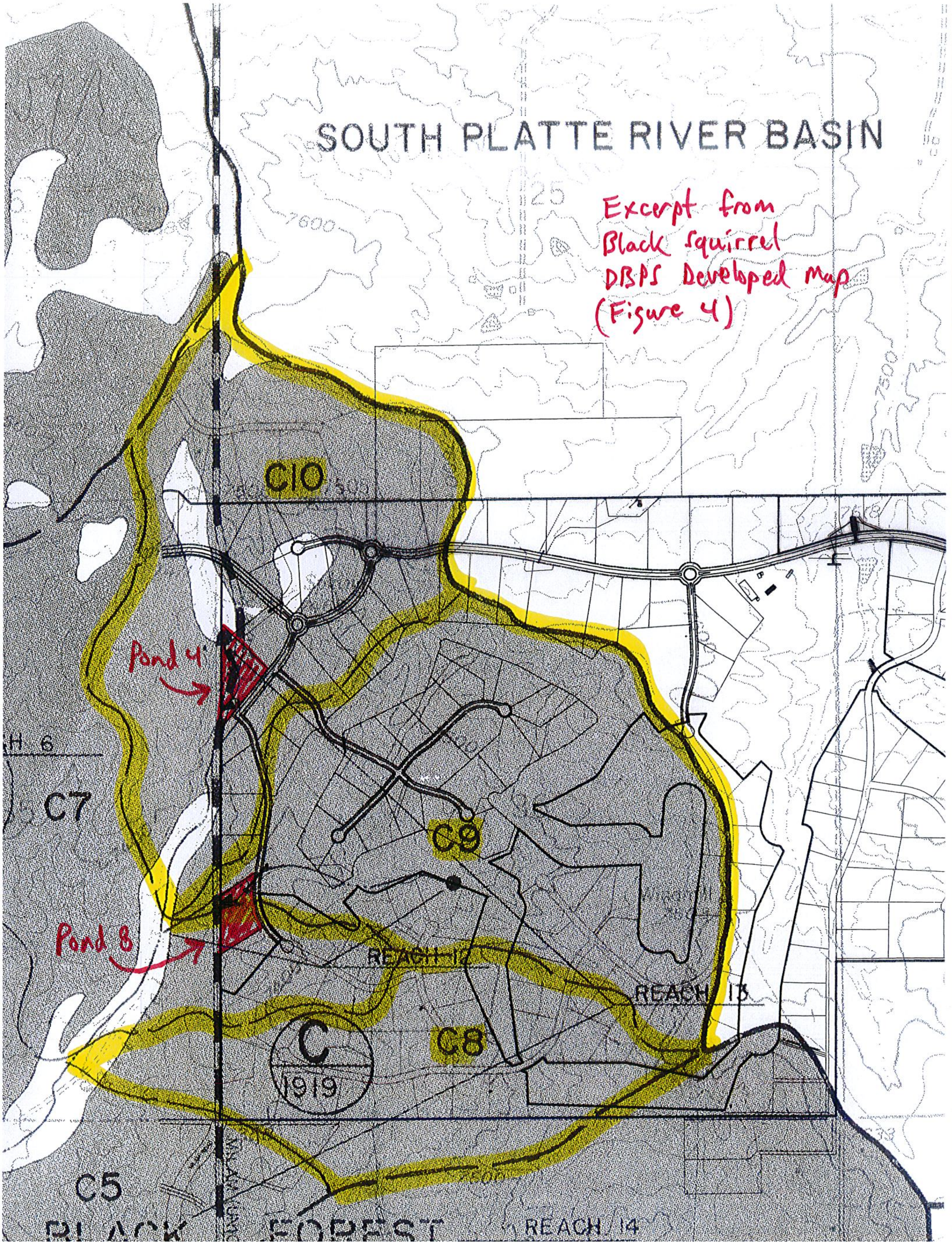
Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	7,369.50 ft
Volume (Initial)	0.000 ac-ft
Flow (Initial Outlet)	0.00 ft³/s
Flow (Initial Infiltration)	0.00 ft³/s
Flow (Initial, Total)	0.00 ft³/s
Time Increment	0.050 hours

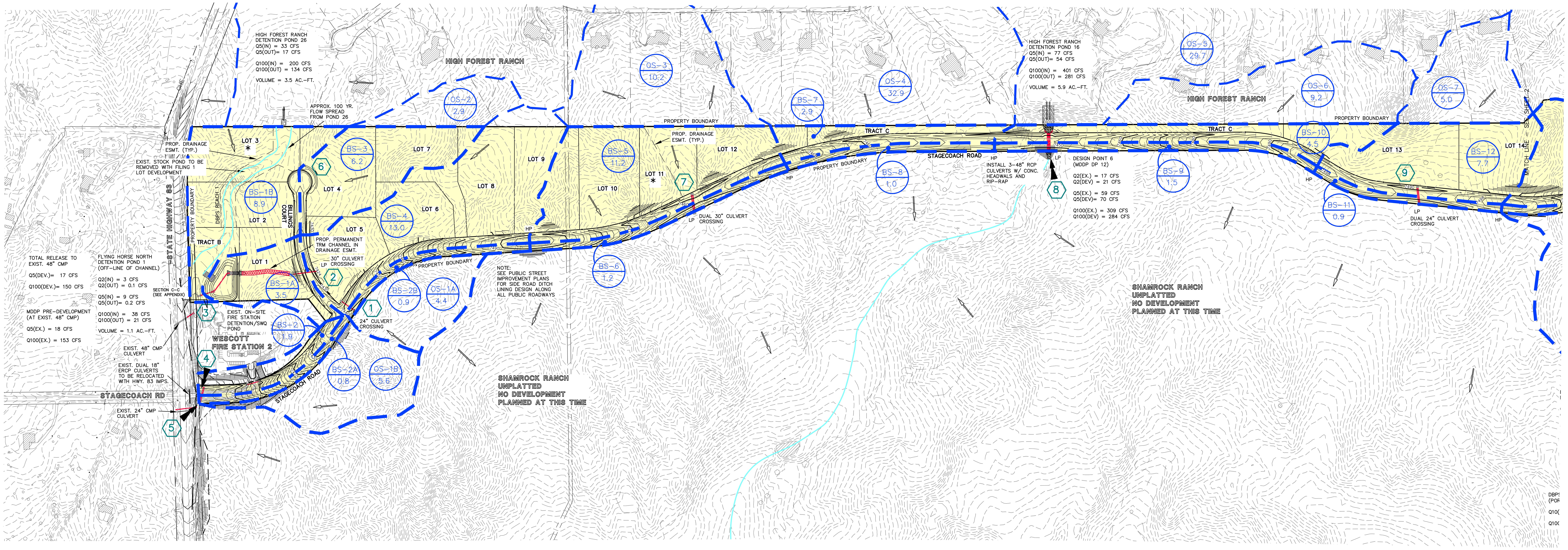
Elevation (ft)	Outflow (ft³/s)	Storage (ac-ft)	Area (acres)	Infiltration (ft³/s)	Flow (Total) (ft³/s)	2S/t + O (ft³/s)
7,369.50	0.00	0.000	0.009	0.00	0.00	0.00
7,370.00	0.12	0.004	0.009	0.00	0.12	2.30
7,370.50	0.23	0.019	0.054	0.00	0.23	9.26
7,371.00	0.35	0.065	0.137	0.00	0.35	31.67
7,371.50	0.47	0.162	0.257	0.00	0.47	78.63
7,372.00	0.58	0.328	0.415	0.00	0.58	159.29
7,372.50	0.69	0.562	0.522	0.00	0.69	272.56
7,373.00	0.81	0.852	0.642	0.00	0.81	413.29
7,373.50	0.92	1.206	0.774	0.00	0.92	584.45
7,374.00	1.04	1.628	0.918	0.00	1.04	789.02
7,374.50	1.15	2.115	1.031	0.00	1.15	1,024.87
7,374.75	1.21	2.380	1.091	0.00	1.21	1,153.29
7,375.00	7.17	2.661	1.151	0.00	7.17	1,294.86
7,375.50	32.24	3.268	1.278	0.00	32.24	1,613.72
7,376.00	68.01	3.939	1.411	0.00	68.01	1,974.71
7,376.50	112.00	4.656	1.456	0.00	112.00	2,365.56
7,377.00	162.75	5.395	1.501	0.00	162.75	2,774.07
7,377.50	219.40	6.157	1.547	0.00	219.40	3,199.55
7,378.00	254.44	6.943	1.594	0.00	254.44	3,614.66
7,378.50	266.12	7.751	1.641	0.00	266.12	4,017.82
7,379.00	277.33	8.584	1.690	0.00	277.33	4,432.07
7,379.50	288.06	9.441	1.738	0.00	288.06	4,857.58
7,380.00	298.45	10.323	1.788	0.00	298.45	5,294.67
7,380.50	308.47	11.232	1.848	0.00	308.47	5,744.56
7,381.00	318.15	12.170	1.908	0.00	318.15	6,208.65
7,381.50	327.59	13.140	1.970	0.00	327.59	6,687.26
7,382.00	336.74	14.140	2.032	0.00	336.74	7,180.58

Index

DRAINAGE MAPS



SOUTH PLATTE RIVER BASIN
Excerpt from Black Squirrel DBPS Developed Map (Figure 4)
7600
C10
Pond 4
Pond 8
C7
C9
C8
REACH 12
REACH 13
C
1919
C5
REACH 14



BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-1A	4.40	61.0	0.20	0.4	1.6	7.7
OS-1B	5.60	61.0	0.21	0.5	1.9	9.4
EX-DP-3 (Pre-Dev.)	36.00	60.0	0.25	0.5	4.8	41.3
OS-2	2.90	61.0	0.20	0.1	0.6	4.0
OS-3	10.20	65.0	0.19	1.0	3.8	17.9
OS-4	32.90	65.0	0.23	2.8	11.2	53.6
OS-5	29.70	65.0	0.39	1.9	7.1	37.0
OS-6	9.20	65.0	0.21	0.9	3.2	15.5
OS-7	5.00	65.0	0.18	0.5	2.0	9.0
BS-1A	3.50	65.0	0.17	0.4	1.4	6.3
BS-1B	8.90	65.0	0.20	0.4	2.4	13.8
BS-2	1.90	89.0	0.35	2.9	4.2	8.4
BS-2A	0.80	89.0	0.13	1.2	1.8	3.5
BS-2B	0.90	89.0	0.12	1.4	2.0	4.0
BS-3	6.20	65.0	0.20	0.6	2.3	10.8
BS-4	13.00	67.0	0.23	1.9	5.5	23.6
BS-5	11.20	65.0	0.18	1.1	4.4	20.1
BS-6	1.20	89.0	0.09	1.9	2.8	5.4
BS-7	2.90	65.0	0.13	4.4	6.4	12.8
BS-8	1.00	89.0	0.12	1.6	2.2	4.5
BS-9	1.50	89.0	0.13	2.3	3.3	6.6
BS-10	4.50	65.0	0.24	6.0	8.7	17.5
BS-11	0.90	89.0	0.08	1.5	2.1	4.1
BS-12	7.70	65.0	0.19	0.8	3.0	13.8

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-1 DEV	OS-1A, BS-2B	1.6	3.4	11
DP-2 DEV	DP-1, BS-4	3.2	8.8	35
TOTAL INFLOW TO POND 1 (UD Detention hydrograph)	**DP-1, DP-2, BS-1A**	**4**	**7**	**38**
DP-3 DEV (Pond Pack routing)	**OS-2, BS-3, BS-1B, Release from FHN Pond 1**	**1**	**6**	**39**
DP-4 DEV	BS-2	2.9	4.2	8
DP-5 DEV	OS-1B, BS-2A	1.5	3.5	13
DP-6 DEV	OS-2, BS-3	0.6	2.8	15
DP-7 DEV	OS-3, BS-5	2.1	8.2	38
DP-8 DEV	OS-4, OS-5, OS-6, BS-7, BS-10, Release from Exist. HFR Pond 16	20.9	70.4	284
DP-9 DEV	OS-7, BS-12	1.3	5.0	23

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY BLACK SQUIRREL	
DESIGN POINT	3
LOTS WITH NON-STANDARD CULVERT SIZE	*
BASIN IDENTIFIER	BB
AREA IN ACRES	10.0
EXISTING DIRECTION OF FLOW	
PROPOSED DIRECTION OF FLOW	
STORM SEWER	
FILING NO. 1 PLAT AREA	

N

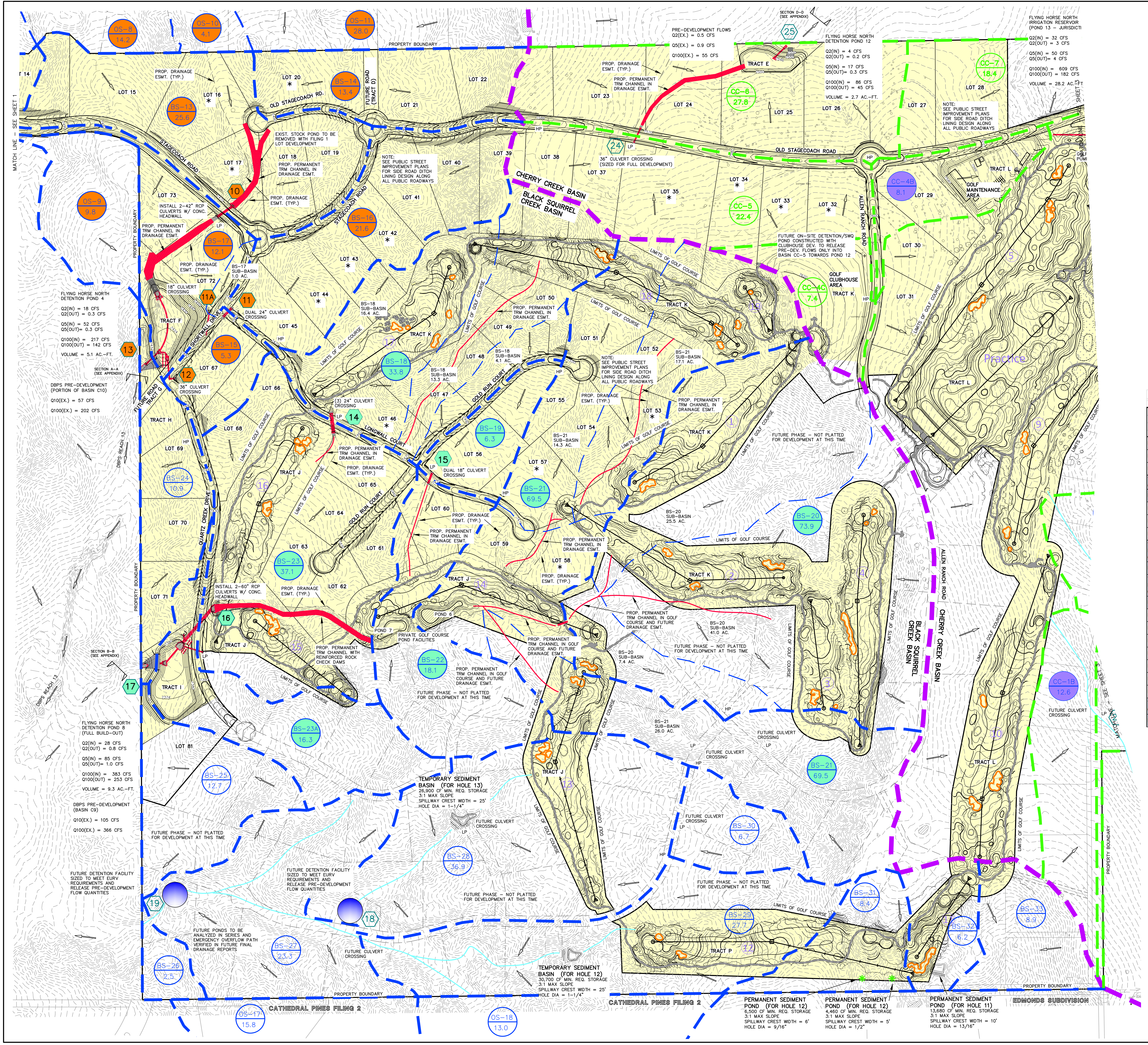
200 100 0 200 400

SCALE: 1" = 200'

CLASSIC CONSULTING ENGINEERS & SURVEYORS
619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 10-20-17
DRAWN BY	MAW	(H) 1"= 200'	SHEET 1 OF 4
CHECKED BY		(V) 1"= N/A	JOB NO. 1096.11



BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-8	14.20	65.0	0.27	2.1	6.2	24.7
OS-9	9.80	60.0	0.37	0.1	1.0	9.1
OS-10	4.10	65.0	0.17	0.7	2.1	8.2
OS-11	28.00	65.0	0.35	2.4	8.2	38.7
OS-12	68.10	62.7	0.37	2.2	11.9	75.8
OS-13	36.90	63.0	0.33	1.4	7.4	45.0
OS-14	26.40	62.0	0.31	0.7	4.6	31.0
OS-15	70.80	63.9	0.38	3.3	14.8	84.2
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
BS-13	25.60	65.0	0.23	3.7	10.2	40.7
BS-14	13.40	65.0	0.23	2.6	6.8	26.5
BS-15	5.30	65.0	0.18	1.6	3.7	12.2
BS-16	21.60	65.0	0.34	4.6	11.8	44.1
BS-17	12.10	65.0	0.21	3.1	7.7	26.7
BS-18	33.80	63.6	0.41	3.5	12.4	56.0
BS-19	6.30	65.0	0.18	2.1	4.6	15.0
BS-20	73.90	63.4	0.31	7.4	24.6	112.4
BS-21	69.50	64.3	0.35	7.8	23.9	103.0
BS-22	18.10	64.4	0.22	3.7	9.6	36.5
BS-23	37.10	63.3	0.33	4.5	13.6	58.2
BS-23A	16.30	64.4	0.29	5.5	12.0	38.3
BS-24	10.90	63.0	0.17	0.6	3.3	17.6
EX-24 (Pre-Dev.)	13.20	60.0	0.17	0.2	2.2	17.8
BS-25	12.70	63.0	0.23	0.4	2.7	17.3
BS-26	2.50	60.0	0.18	0.0	0.4	3.4
BS-27	23.30	65.0	0.22	2.1	8.0	38.8
BS-28	36.90	64.4	0.32	2.2	9.3	49.4
BS-29	27.70	64.0	0.33	1.4	6.5	35.9
BS-30	6.70	65.0	0.20	0.7	2.4	11.7
BS-31	8.40	62.5	0.23	0.3	1.9	11.8
BS-32	6.20	62.6	0.20	0.3	1.6	9.4
BS-33	8.90	64.7	0.19	0.8	3.2	15.3
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-2C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev.)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-10 DEV	OS-8, OS-10, OS-11, BS-13, BS-14	10.7	32.0	143
DP-11 DEV	BS-16	4.6	11.8	36
DP-12 DEV	DP-11, 1.0 Ac. Portion of BS-17 and BS-15	4.2	11.8	46
TOTAL INFLOW TO POND 4 (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**10**	**16**	**217**
DP-13 DEV	**Release from FHN Pond 4**	**0.3**	**0.3**	**142**
DP-14 DEV	BS-18	3.5	12.4	56
DP-15 DEV	BS-19	2.1	4.6	15
DP-16 DEV	DP-14, DP-15, BS-20, BS-21, BS-22, BS-23	25.0	78.0	362
TOTAL INFLOW TO FHN POND 8 (Full Build-out) (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**24**	**37**	**390**
DP-17 DEV (Full Build-out)	**Release from FHN Pond 8**	**0.8**	**1.0**	**253**
TOTAL INFLOW TO FHN POND 8 (Filing 1 Only) (UD Detention hydrograph)	**DP-10, DP-12, BS-17, OS-9**	**9**	**14**	**301**
DP-17 DEV (Filing 1 Only)	**Release from FHN Pond 8**	**0.4**	**0.5**	**219**
DP-18 DEV	BS-28, BS-29, BS-30, OS-18	5.0	21.6	115
DP-19 DEV	BS-27, OS-17, Release from DP-18	3.8	16.8	126
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev.), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	**CC-4C, CC-5, CC-6**	**6**	**9**	**85**
DP-25 DEV	**Release from FHN Pond 12**	**0.2**	**0.3**	**45**

LEGEND

DESCRIPTION	SYMBOL
EXISTING GROUND CONTOUR	6910
PROPOSED FINISHED CONTOUR	6910
BASIN BOUNDARY EAST CHERRY CREEK	
MAJOR BASIN BOUNDARY	
BASIN BOUNDARY BLACK SQUIRREL	
DESIGN POINT	3
LOTS WITH NON-STANDARD CULVERT SIZE	*
BASIN IDENTIFIER / AREA IN ACRES	BB 10.0
EXISTING DIRECTION OF FLOW	
PROPOSED DIRECTION OF FLOW	
STORM SEWER	
FILING NO. 1 PLAT AREA	

200 100 0 200 400

SCALE: 1" = 200'

CLASSIC CONSULTING ENGINEERS & SURVEYORS SM

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Colorado Springs, Colorado 80903
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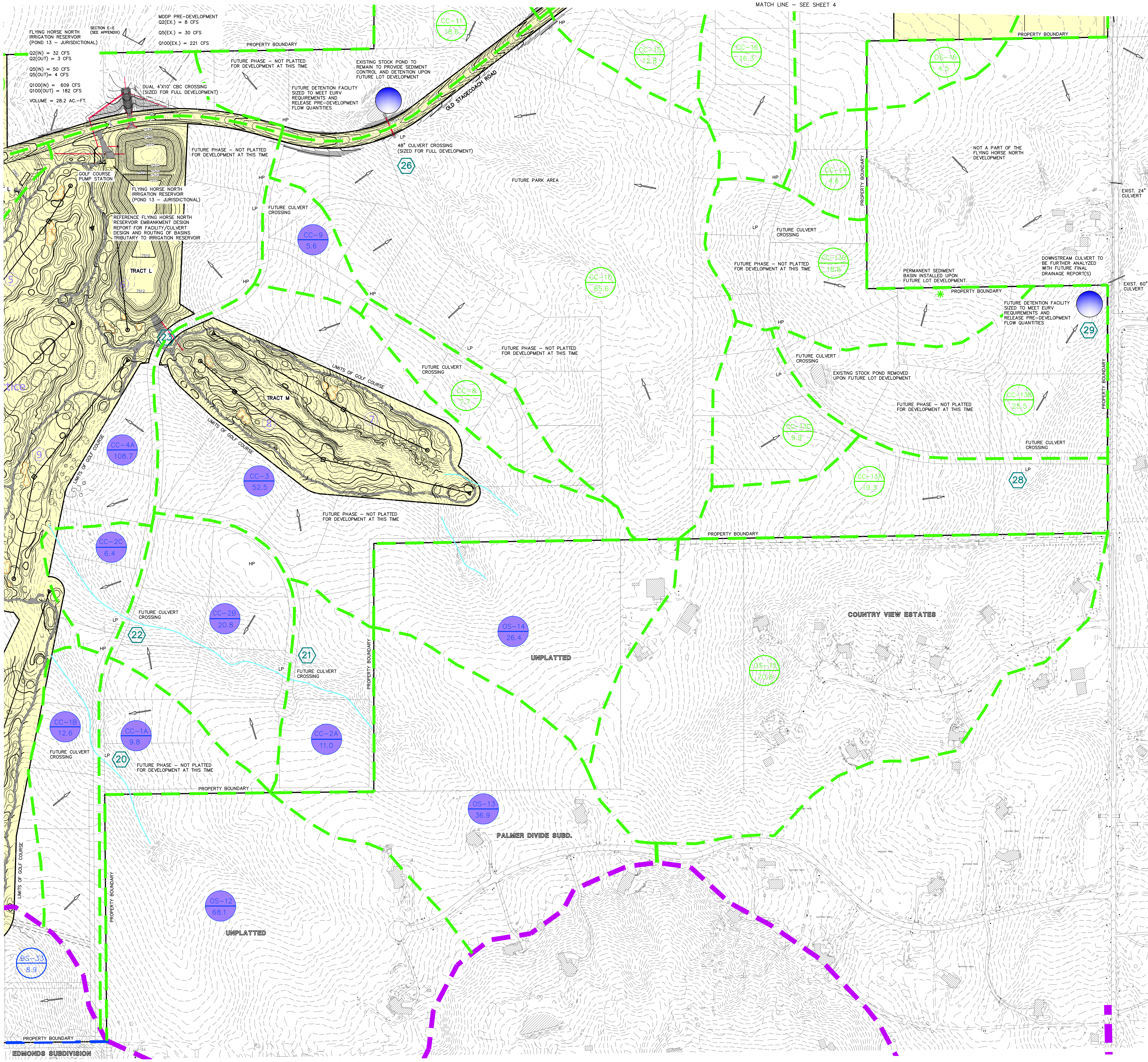
(719)785-0799 (Fax)

FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 10-25-17
DRAWN BY	MAW	(H) 1"= 200'	SHEET 2 OF 4
CHECKED BY		(V) 1"= N/A	JOB NO. 1096.11



BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-8	14.20	65.0	0.27	2.1	6.2	24.7
OS-9	9.80	60.0	0.37	0.1	1.0	9.1
OS-10	4.10	65.0	0.17	0.7	2.1	8.2
OS-11	28.00	65.0	0.35	2.4	8.2	38.7
OS-12	68.10	62.7	0.37	2.2	11.9	75.8
OS-13	36.90	63.0	0.33	1.4	7.4	45.0
OS-14	26.40	62.0	0.31	0.7	4.6	31.0
OS-15	70.80	63.9	0.38	3.3	14.8	84.2
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
CC-1A	9.80	65.0	0.23	0.8	3.3	16.0
CC-1B	12.60	64.8	0.25	1.0	4.0	19.4
CC-2A	11.00	65.0	0.22	1.0	3.8	18.3
CC-2B	20.80	65.0	0.22	1.9	7.1	34.6
CC-2C	6.40	65.0	0.18	0.7	2.5	11.5
CC-3	52.50	63.1	0.43	1.8	8.8	54.5
CC-4A	108.70	62.6	0.44	15.4	39.0	156.0
CC-4B	8.10	76.1	0.26	4.0	7.3	20.6
CC-4C (Pre-Dev.)	7.40	61.0	0.13	0.2	1.8	11.2
CC-5	22.40	65.0	0.26	1.8	7.1	34.3
CC-6	27.80	65.0	0.25	2.3	9.1	43.2
CC-7	18.40	65.0	0.29	1.4	5.4	27.0
CC-8	7.70	65.0	0.25	0.6	2.5	12.0
CC-9	5.60	65.0	0.19	0.6	2.1	9.8
CC-10	85.60	62.6	0.39	2.6	14.1	91.9
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-20 DEV	CC-1A, OS-12	3.2	14.3	88
DP-21 DEV	CC-2A, OS-13	2.1	10.5	62
DP-22 DEV	CC-2B, Release from DP-21	3.7	16.6	92
DP-23 DEV	CC-3, OS-14	2.5	13.0	84
DP-24 DEV	CC-4C (Pre-Dev.), CC-5	1.9	8.4	45
TOTAL INFLOW TO POND 12 (UD Detention hydrograph)	**CC-4C, CC-5, CC-6**	**6**	**9**	**85**
DP-25 DEV	**Release from FHN Pond 12**	**0.2**	**0.3**	**45**
DP-26 DEV	CC-8, CC-10	3.0	15.9	102
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168

LEGEND

DESCRIPTION — SYMBOL

EXISTING GROUND CONTOUR — 6910
PROPOSED FINISHED CONTOUR — 6910
BASIN BOUNDARY EAST CHERRY CREEK
MAJOR BASIN BOUNDARY
DESIGN POINT — 3
BASIN IDENTIFIER
AREA IN ACRES — BB 10.0
EXISTING DIRECTION OF FLOW
PROPOSED DIRECTION OF FLOW
STORM SEWER
FILING NO. 1 PLAT AREA

200 100 0 200 400

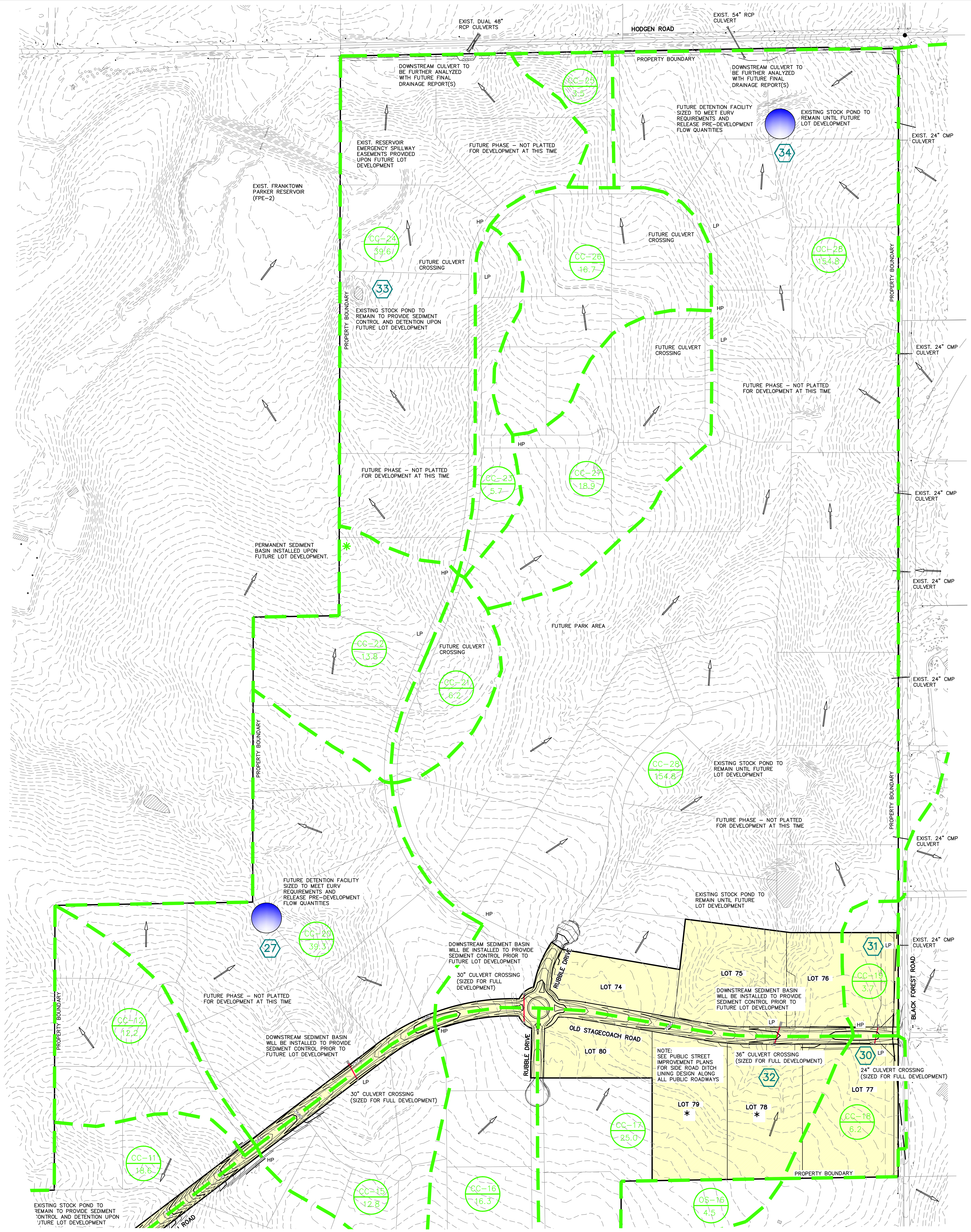
SCALE: 1" = 200'

CLASSIC CONSULTING ENGINEERS & SURVEYORS

619 N. Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903
(719)785-0790
(719)785-0799 (Fax)

FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 AND
PRELIMINARY PLAN DRAINAGE MAP

DESIGNED BY	MAW	SCALE	DATE 10–25–17
DRAWN BY	MAW	(H) 1"= 200'	SHEET 3 OF 4
CHECKED BY		(V) 1"= N/A	JOB NO. 1096.11



BASIN SUMMARY - DEVELOPED CONDITIONS

BASIN (label)	AREA (acres)	COMPOSITE CN	TOTAL LAG TIME (hours)	Q 2 Yr. (cfs)	Q 5 Yr. (cfs)	Q 100 Yr. (cfs)
OS-16	4.50	65.0	0.24	0.4	1.5	7.2
OS-17	15.80	65.0	0.19	1.6	5.9	27.7
OS-18	13.00	65.0	0.20	1.3	4.7	22.6
CC-11	18.60	63.1	0.21	0.9	5.0	28.1
CC-12	12.20	65.0	0.26	1.0	3.9	18.7
CC-13A	19.30	65.0	0.31	1.4	5.4	27.3
CC-13B	25.50	65.0	0.31	1.8	7.2	36.1
CC-13C	9.90	65.0	0.22	0.9	3.4	16.5
CC-13D	18.80	65.0	0.25	1.5	6.2	29.2
CC-14	4.60	65.0	0.21	0.4	1.6	7.8
CC-15	12.80	65.0	0.24	1.1	4.3	20.4
CC-16	16.30	65.0	0.30	1.2	4.6	23.6
CC-17	25.00	65.0	0.35	1.7	6.5	32.8
CC-18	6.20	66.5	0.30	0.7	2.2	9.7
CC-19	3.70	65.0	0.25	0.3	1.2	5.8
CC-20	39.30	65.0	0.25	3.2	12.9	61.0
CC-21	6.20	61.0	0.20	0.1	1.2	8.5
CC-22	13.80	65.0	0.25	1.1	4.5	21.4
CC-23	5.70	64.7	0.33	0.4	1.5	7.7
CC-24	39.60	65.0	0.25	3.3	13.0	61.5
CC-25	3.50	65.0	0.23	0.3	1.2	5.7
CC-26	16.70	65.0	0.26	1.4	5.3	25.6
CC-27	18.90	64.4	0.31	1.2	4.9	25.8
CC-28	154.80	64.4	0.63	6.5	24.7	136.3

DESIGN POINTS SURFACE ROUTING SUMMARY - DEVELOPED CONDITIONS

Design Point (label)	Contributing Basins	Q 2 Yr. Q (cfs)	Q 5 Yr. Q (cfs)	Q 100 Yr. Q (cfs)
DP-27 DEV	CC-15, CC-20	4.3	17.2	81
DP-28 DEV	CC-13A, OS-15	4.6	19.8	110
DP-29 DEV	CC-13B, CC-13C, Release from DP-28	5.8	26.6	155
DP-30 DEV	CC-18	0.7	2.2	10
DP-31 DEV	CC-19, Release from DP-30	0.9	3.2	15
DP-32 DEV	CC-17, OS-16	2.0	7.8	40
DP-33 DEV	CC-23, CC-24	3.6	14.4	69
DP-34 DEV	CC-26, CC-27, CC-28 and Release from CC-16 & DP-32	6.0	23.5	168

LEGEND

DESCRIPTION / SYMBOL

EXISTING GROUND CONTOUR

PROPOSED FINISHED CONTOUR

BASIN BOUNDARY EAST CHERRY CREEK

MAJOR BASIN BOUNDARY

BASIN BOUNDARY BLACK SQUIRREL

DESIGN POINT

LOTS WITH NON-STANDARD CULVERT SIZE

BASIN IDENTIFIER

AREA IN ACRES

EXISTING DIRECTION OF FLOW

PROPOSED DIRECTION OF FLOW

STORM SEWER

FILING NO. 1 PLAT AREA

200 100 0 200 400

SCALE: 1" = 200'

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FLYING HORSE NORTH
PRELIMINARY/FINAL DRAINAGE REPORT
FILING NO. 1 AND
PRELIMINARY PLAN DRAINAGE MAP

DESIGNED BY MAW	SCALE	DATE 10-17-17	
DRAWN BY MAW	(H) 1"= 200'	SHEET 4 OF 4	
CHECKED BY	(V) 1"= N/A	JOB NO. 1096.11	