MASTER DEVELOPMENT DRAINAGE PLAN
FOR
BASS PRO AT NORTHGATE FILING NO. 1
&
FINAL DRAINAGE REPORT
FOR
LOT 4 BASS PRO AT NORTHGATE FILING NO. 1

Prepared for:
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July 2012

ATTN: Bob Yoo

Job no. 2363.00

CLASSIC CONSULTING ENGINEERS & SURVEYORS

MASTER DEVELOPMENT DRAINAGE PLAN FOR BASS PRO AT NORTHGATE FILING NO. 1 & FINAL DRAINAGE REPORT FOR LOT 4 BASS PRO AT NORTHGATE 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 City of Colorado Springs for drainage reports and said report is in conformity with the 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 LICENSED KYLE RAYE CAMPBELL 29794 PROFESSIONAL ENGINEER

Kyle R. Campbell, Colorado P.E. #29794 — Date: 7/12/12

DEVELOPER'S STATEMENT:

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

Business Name: Northgate Properties, LLC

By: _____

Title: Manager

Address: 13570 Meadowgrass Drive, Suite 200

Colorado Springs, CO 80921

CITY OF COLORADO SPRINGS:

Filed in accordance with Section 7.7.906 of the Code of the City of Colorado Springs, 2001, as amended.

City Engineer — Date: July 16, 2012

Conditions:

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PURPOSE

This document is the Master Development Drainage Plan (M.D.D.P.) for Bass Pro at Northgate Filing No. 1 and the Final Drainage Report for Lot 4 Bass Pro at Northgate Filing No. 1. The purpose of this report is to identify onsite and offsite drainage patterns, storm sewer, inlet locations, and areas tributary to the site, and to safely route developed storm water runoff to adequate storm water quality/detention and outfall facilities.

GENERAL DESCRIPTION

The Bass Pro at Northgate Filing No. 1 M.D.D.P. study area is 73.14 acres of proposed and future commercial use land development and incorporated roadways and parking lots. Lot 4 Bass Pro at Northgate Filing No. 1 is 19.25 acres containing the proposed Bass Pro Shops Retail Store with adjacent Tract A (4.38 acre) being for the proposed Public Retention Facility owned by City of Colorado Springs. Also being constructed with proposed Lot 4 and detailed within this report are the Collector roadways of Bass Pro Shop Drive and Tracker Drive. The development area is located in the northwest quarter of Section 7, Township 12 South, and Range 66 West of the Sixth Principal Meridian in the City of Colorado Springs, County of El Paso, and State of Colorado. The plat area associated with the proposed development is 35.027 acres containing Lots 1, 2, 4, 9, & 10 of Bass Pro at Northgate Filing No. 1, Bass Pro Shop Drive, and Tracker Drive.

The site is bound to the south by unplatted land and future Powers Boulevard right-of-way, to the west by Interstate 25 right-of-way and United States Air Force Academy property. The site is bound to the east by existing Meadowgrass Drive and the existing Federal Express complex. To the north of the site is existing Northgate Blvd. and north of that Northgate Point Office Park and Northgate Highlands subdivision. The existing zoning of the proposed site is PUD HR.

The average soil condition reflects Hydrologic Group "B". Per the Soil Map, the proposed site and tributary areas all consist of Group "B" (Pring coarse sandy loam). The soils types are determined by the "Web Soil Survey National Cooperative Soil Survey," prepared by the Natural Resources Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

The majority of the study area is located within the Monument Branch Drainage Basin along the ridgeline with Smith Creek Basin. A small portion of the study area (Basin EX-D) is located within Smith Creek Basin but the proposed conditions are to route this parcel into the Monument Branch Drainage Basin. This site was originally studied within the "Monument Branch Drainage Basin Planning Study," by URS Corporation last revised August 6, 1987 (referenced as the D.B.P.S. for the remainder of this report). The proposed study area is within Basins P1, P2, and Q2 of the D.B.P.S. . D.B.P.S. Basins P1 & P2 historically drain to the 48" northbound I-25 culvert crossing at D.B.P.S. Design Point 12 (shown on the Existing Conditions Drainage Map). From there the runoff is channelized to the southbound I-25 36" culvert crossing. Just south of the release point of the existing 36" within the I-25 right-of-way, a relatively small berm (approx. 2' in height) prevents the runoff from running south into the Monument Branch Channel; instead the water runs north, into Smith Creek Channel. Although these basins drain into Smith Creek, drainage, bridge and pond basin fees are defined by the drainage basin planning studies and therefore this development lies within the Monument Branch Drainage Basin and thus fees are defined as such. D.B.P.S. Basin Q2 (Basins EX-B, EX-C, and the existing roadways and Federal Express site of this report and the Existing Conditions Map) drains to a different I-25 crossing further to the south, a 6' x 7' concrete box culvert (D.B.P.S. Design Point 11). Upstream of both I-25 crossings are two design points (12A and 11A respectively) at the United States Air Force Boundary/I-25 R.O.W. corridor. D.B.P.S. DP-12A is shown on the Drainage Maps and is the point of release of the proposed retention/storm water quality facility.

The Monument Branch D.B.P.S. proposed to divert the majority of the developed flow from D.B.P.S. Basin P2 (this report Basin EX-A) from its drainage pattern of DP-12A to DP-12. Instead the majority of the developed flow was planned to be routed south, down the AFA Boundary to DP-11A where a sub-regional detention facility shall release the runoff at or below allowable rates. A large, off-site, sub-regional facility and necessary channel within others ownership boundaries is not feasible for this development. Therefore, as discussed in detail within the Proposed Drainage Conditions, the developed runoff at this location is to maintain the existing flow pattern. A retention/storm water quality facility is proposed at D.B.P.S. DP-12A that will release the restricted runoff at or below the "D.B.P.S. Present (1987) Conditions". As stated within that study, the 1987 conditions represent the 'historic' conditions and therefore the allowable release rates in all storm events at particular design points. The D.B.P.S. quantifies the historic flow rates at DP-12A of Q_{10}

= 42.0 cfs and Q_{100}= 115.0 cfs. Since this runoff is tributary to the Air Force Academy property, all storm level events must be released at or below the historic flow rates. Therefore, the other storm level event release rates have been extrapolated and are: Q_2 = 26.2 cfs, Q_5 = 36.0 cfs, Q_{25} = 97.0 cfs, and Q_{50} = 109.9 cfs. The proposed retention facility shall release runoff at or below all of these yearly event runoff rates.

The following is a detailed description of the existing drainage characteristics of the proposed study area, including the minor tributary runoff from the existing developments to the north and east.

Basin EX-A (Q_5 = 35.6 cfs, Q_{100}= 88.5 cfs) is the existing runoff tributary to D.B.P.S. Design Point 12A. The majority of the proposed site, including Lot 4, is within this 41.19 acre basin. This basin differs in size to that of the D.B.P.S. Basin P2 due to the construction of North Gate Blvd. and Meadowgrass Drive truncating some of the tributary area to Smith Creek Basin and toward Design Point 31. As stated before, the proposed retention facility for the entire Bass Pro at Northgate Filing No. 1 M.D.D.P. study area is proposed at DP-12A. The proposed facility will restrict runoff rates to that which was established in the D.B.P.S.; Q_2 = 26.2 cfs, Q_5 = 36.0 cfs, Q_{10} = 42.0, Q_{25} = 97.0 cfs, Q_{50} = 109.9 cfs, and Q_{100} = 115.0 cfs.

Basin EX-B (Q_5 = 14.2 cfs, Q_{100}= 35.4 cfs) is 18.65 acres of the study area that sheet flows south-west to D.B.P.S. DP-11A. This entire basin is within the MDDP defined developed study area.

Basin EX-C (Q_5 = 5.5 cfs, Q_{100}= 13.6 cfs) is 6.48 acres of the study area that sheet flows into the existing sediment basin at Design Point 31-EX. 1.48 acres of this existing basin is outside of the MDDP defined developed study area.

Basin EX-D (Q_5 = 8.7 cfs, Q_{100}= 21.6 cfs) is 9.99 acres of the study area that is within Smith Creek Basin and has previously been over lot graded as shown on the Existing Conditions Map. This runoff continues downstream within Smith Creek Basin around the existing Mining Museum. A future hotel site is planned to be constructed within this basin. As per the Proposed Conditions, this developed basin's runoff is to be routed to the proposed Retention Pond at D.B.P.S. DP-12A and into Monument Branch Drainage Basin. This will alleviate approx. 10 acres of tributary land to the downstream facilities within the Smith Creek Basin. No other portion of the study area is tributary to the existing Mining Museum or to Smith's Creek

Basin. If the Mining Museum were to re-develop, all runoff must remain within Smith's Creek Basin and not drain onto the proposed development.

Basin EX-P1 (Q_5 = 12.9 cfs, Q_{100}= 32.0 cfs) is the undeveloped, off-site land that sits between the proposed M.D.D.P./Air Force Academy property line and the existing northbound I-25 roadway. This runoff sheet flows into the existing roadside ditch and to the existing 48" RCP culvert crossing under Interstate 25 at D.B.P.S. Design Point 12. As per the D.B.P.S. the historic runoff rates to this culvert are; Q_2 = 28.1 cfs, Q_5 = 38.6 cfs, Q_{10} = 45.0, Q_{25} = 114.7 cfs, Q_{50} = 130.0 cfs, and Q_{100} = 136.0 cfs. This area is owned by the United States Air Force Academy.

Design Point 7 (Q_5 = 4.2 cfs, Q_{100}= 8.3 cfs) is the existing runoff from Basin OS-A, 1.30 acres of existing Meadowgrass Drive and the existing FED-EX Development. This runoff drains via the existing curb & gutter to an existing 10' at-grade D-10-R inlet. The intercepted runoff is routed into the FED-EX detention pond at DP-9 via the existing storm sewer. The bypass (flow-by) runoff continues south in Meadowgrass Drive to DP-10.

Design Point 8 (Q_5 = 3.8 cfs, Q_{100}= 7.2 cfs) is the existing runoff from Basin OS-B, 0.86 acres of existing Meadowgrass Drive and adjacent landscaping. This runoff drains via the existing curb & gutter to an existing 10' at-grade D-10-R inlet. The intercepted runoff is routed into the FED-EX detention pond at DP-9 via the existing storm sewer. The bypass runoff continues south in Meadowgrass Drive and across the undeveloped Basin EX-C into the sediment basin at DP-31.

Design Point 9 (Q_5 = 60.2 cfs, Q_{100}= 126.4 cfs) is the existing detention pond constructed with the existing Federal Express Development (Lot 1, Northgate Campus Filing No. 1 and Lots 1 & 2, Northgate Campus Filing No. 2A). Per the "Drainage Letter for Northgate Campus Filing No. 2A Lots 1 and 2," dated June 2, 2009, this pond contains features to provide water quality. However no storm water quality outlet box exists and a 36" RCP outlet pipe w/FES restricts the storm water release to Q_5 = 21.0 cfs and Q_{100} = 48.0 cfs as determined within the "Preliminary/Final Drainage Report for Northgate Campus Filing No. 1 (Project Rampart Phase 1A and 1B)," by JR Engineering, Revised August 2000. The existing 36" RCP daylights into an existing sediment catch basin at Design Point 31.

Design Point 10 (Q_5 = 6.2 cfs, Q_{100}= 12.7 cfs) is the existing runoff from Basin OS-C, 1.48 acres of existing Spectrum Loop roadway and the existing FED-EX Development. This runoff drains via the existing curb & gutter to the end of the constructed roadway at this design point. From the end of the Spectrum Loop roadway, the runoff continues south-west via existing swales to the sediment basin at DP-31.

Design Point 11 (Q_5 = 5.8 cfs, Q_{100}= 10.9 cfs) is the existing runoff from Basin OS-D, 1.27 acres of existing Spectrum Loop roadway and adjacent right-of-way. This runoff drains via the existing curb & gutter to the end of the constructed roadway at this design point. From the end of the Spectrum Loop roadway, the runoff continues south-west via existing swales to the sediment basin at DP-31.

Design Point 31-EX (Q_5 = 34.9 cfs, Q_{100}= 79.0 cfs) is the existing sediment basin and release point of the existing 36" RCP outfall of the FED-EX detention pond. This storm water simply ponds within the depressed sediment basin and overtops into the natural drainage path. Development of the parcel to the south of Spectrum Loop will be required to re-route the existing 36" FED-EX outfall main thru the future development and to an adequate release point. With the proposed development this sediment basin and the existing 36" pipe will remain in tact and unchanged.

PROPOSED DRAINAGE CONDITIONS

The Bass Pro at Northgate Filing No. 1 overall development is proposed to be entirely of Commercial level development and roadway and parking infrastructure. Developed runoff is to be collected in the proposed and future storm sewer systems and routed into the Storm Water Quality/Retention Facility at Design Point 28a, 28b, & 28c (D.B.P.S. DP-12A). A detailed description of the developed flows is as follows:

Design Point 1 (Q_5 = 13.9 cfs, Q_{100}= 25.0 cfs) is the runoff collected from Basin A, 3.27 acres of the future commercial development Lots 1 & 2, Bass Pro at Northgate Filing No. 1. A separate Final Drainage Report is required with the development of these lots that will detail the developed site drainage conditions and storm sewer system. With the proposed construction of Bass Pro Shop and Tracker Drives a Private 24" storm sewer stub (Pipe 1) is provided into this basin for future connection. An interim sediment basin shall be installed with the proposed overlot grading to intercept the undeveloped runoff and route into the storm

stub via a perforated stand pipe as specified in the Drainage Criteria Manual Vol. 2 Figures SB-1 & SB-2. The 24" Pipe 1 flows west within Tracker Drive R.O.W. to the intersection of Bass Pro Shop Drive. Storm water quality and detention for this basin is covered with the proposed Public Retention Facility.

Design Point 2 (Q_5 = 16.9 cfs, Q_{100}= 30.0 cfs) is the runoff collected from Basin B, 3.67 acres of the future commercial development Lot 3, Bass Pro at Northgate Filing No. 1. A separate Final Drainage Report is required with the development of this parcel that will detail the developed site drainage conditions and storm sewer system. A Private 24" storm sewer stub (Pipe 2) is provided into this basin for future connection. An interim sediment basin shall be installed with the proposed overlot grading to intercept the undeveloped runoff and route into the storm stub. Pipe 3 (Private 36" Storm, Q_5 = 29.2 cfs, Q_{100}= 52.3 cfs) conveys the combined developed runoff from Pipes 1 & 2 south within Bass Pro Shop Drive to the inlet at DP-3. Storm water quality and detention for this basin is covered with the proposed Public Retention Facility.

Design Point 3 (Q_5 = 6.2 cfs, Q_{100}= 11.7 cfs) is the proposed Public 10' At-Grade D-10-R curb inlet that intercepts a portion of the runoff from Basin C, 1.48 acres of proposed Bass Pro Shop Drive and Tracker Drive. The proposed inlet intercepts Q_5 = 4.2 cfs and Q_{100}= 6.7 cfs while the by-pass (flow-by) runoff continues down Bass Pro Shop Drive to DP-6b. Pipe 4 (Public 36" Storm, Q_5 = 32.9 cfs, Q_{100}= 58.2 cfs) conveys the combined storm to the south within Bass Pro Shop Drive right-of-way.

Design Point 4 (Q_5 = 22.0 cfs, Q_{100}= 39.0 cfs) is the runoff collected from Basin D, 6.22 acres of a future hotel site just south-west of the proposed intersection of Bass Pro Shop Drive and North Gate Blvd. Upon development of this hotel site, or of Basin H, the private storm sewer main (Pipe 24) shall be extended to this design point with the ability to release the entire developed runoff into storm main (no detention required). Storm water quality for this parcel, as well as the entire study area, is covered by the proposed Storm Water Quality/Retention Pond at Design Point 28. With the proposed development of Lot 4, the private storm sewer main will be stubbed just north of the Lot 4 property line into Basin H. Basin D has already been previously overlot graded and the undeveloped runoff will continue within Smith Creek as it currently does and always has. A separate Final Drainage Report is required with the development of Basin D that describes the future storm sewer system. The Basin D (Future Hotel Site) is currently and will remain unplatted with the proposed Lot 4 development. The addition of this historically Smith Creek Basin

to the Monument Branch Basin causes no significant downstream impacts due to the proposed pond releasing the combined developed runoff to the historic and allowable Monument Branch release rates.

Design Point 5 (Q_5 = 37.1 cfs, Q_{100}= 67.3 cfs) is the runoff collected from Basin H, 11.14 acres of a future commercial development north of the proposed Lot 4 (Bass Pro Shops). Developed runoff is to be collected in the future site specific storm system and connected to Pipe 25, Private 36" storm stub provided with the proposed Lot 4 development. A separate Final Drainage Report is required with any development within this Basin that details the future storm sewer system. An interim sediment basin shall be installed with the proposed overlot grading to intercept the undeveloped runoff and route into the storm stub via a perforated stand pipe as specified in the Drainage Criteria Manual Vol. 2 Figures SB-1 & SB-2. A Private storm manhole just north of the Lot 4 boundary will connect Pipe 24 from DP-4 with this 36" Pipe 25 and outfall Pipe 26 (Private 42" Storm, Q_5 = 52.8 cfs, Q_{100}= 95.0 cfs) will convey the runoff toward the proposed Public Storm Water Quality/Retention Facility.

Design Point 6a (Q_5 = 5.3 cfs, Q_{100}= 10.0 cfs) is the proposed Public 10' At-Grade D-10-R curb inlet that intercepts a portion of the runoff from Basin E, 1.26 acres of proposed Bass Pro Shop Drive. The proposed inlet intercepts Q_5 = 3.7 cfs and Q_{100}= 5.5 cfs while the by-pass runoff surface flows into the parking lot of proposed Lot 4 Bass Pro at Northgate Filing No. 1 (DP-22). An 18" storm Pipe 12 conveys the intercepted runoff to the public storm main within Bass Pro Shop Drive, from DP-3.

Design Point 6b (Q_5 = 5.9 cfs, Q_{100}= 12.2 cfs) is the proposed Public 20' At-Grade D-10-R curb inlet that intercepts a portion of the runoff from Basin F, 0.86 acres of proposed Bass Pro Shop Drive and the flow-by from the inlet at DP-3. The proposed inlet intercepts the majority of this runoff (Q_5 = 5.2 cfs and Q_{100}= 9.2 cfs) while the flow-by runoff surface flows into the proposed Lot 4 Bass Pro Shops roadway entrance and to DP-24. A Public 30" storm Pipe 10 (Q_5 = 24.9 cfs and Q_{100}= 44.2 cfs) conveys the combined intercepted runoff from this inlet with that from Pipe 8 to Pipe 13 (Public 54" Storm, Q_5 = 78.2 cfs, Q_{100}= 137.9 cfs) within Bass Pro Shop Drive, which continues south toward the proposed Public Retention Facility.

Design Points 7 – 11:

The tributary runoff to these design points remain as described in the Existing Conditions portion of this report. Spectrum Loop is to be continued to the south with future development, but prior to that, the existing runoff will continue to the existing sediment basin at DP-31. With the future Spectrum Loop extension, the runoff at DP-10 and DP-11 will flow within the curb and gutter to the future At-Grade inlets at DP-12 and DP-13. The proposed public storm water quality/retention facility has adequate capacity for the entire developed runoff at these design points. However, the proposed overlot grading does not implement a low point to capture all of this runoff prior to the future roadway intersection shown on the drainage map (Design Points 12 & 13). Therefore, only a portion is intercepted by the future at-grade inlets at DP 12 & DP-13. If with the extension of Spectrum Loop, additional at-grade inlets are installed to intercept more of this runoff, the proposed pond has excess capacity to handle the additional water.

Design Point 12 (Q_5 = 10.5 cfs, Q_{100}= 22.0 cfs) is the future Public 20' At-Grade D-10-R curb inlet within the future Spectrum Loop roadway, which will intercept a portion of the runoff from DP-10 and Basin M, 1.00 acres of future Spectrum Loop. The proposed 20' inlet intercepts Q_5 = 7.5 cfs and Q_{100}= 13.5 cfs while the remaining runoff surface flows down future Spectrum Loop to DP-29 or it may run to the future low point and inlet at DP-16, depending on the final street grade design of the future roadway. Both directions are acceptable and for conservative purposes of downstream facilities, this report assumes the runoff continues south within future Spectrum Loop. With the extension of Spectrum Loop, a separate drainage report is required that will detail the final storm sewer design and may deem additional at-grade inlets are necessary. The pond has capacity for all of Spectrum Loop roadway drainage if feasible to collect in the future storm system.

Design Point 13 (Q_5 = 9.4 cfs, Q_{100}= 17.6 cfs) is the future Public 20' At-Grade D-10-R curb inlet within the future Spectrum Loop roadway, which will intercept a portion of the runoff from DP-11 and Basin N, 0.77 acres of future Spectrum Loop. The proposed 20' inlet intercepts Q_5 = 7.1 cfs and Q_{100}= 11.6 cfs while the remaining runoff surface flows down future Spectrum Loop to DP-30. With the extension of Spectrum Loop, a separate drainage report is required that will detail the final storm sewer design and may deem additional at-grade inlets are necessary. Pipe 15 (Public 24" Storm) will convey the intercepted runoff to the inlet at DP-12. From there, Pipe 16 (Public 30" Storm, Q_5 = 16.2 cfs, Q_{100}= 28.0 cfs) takes the combined runoff to the west toward DP-16.

Design Point 14 (Q_5 = 29.6 cfs, Q_{100}= 52.7 cfs) is the runoff collected from Basin I, 6.60 acres of the future commercial development. A separate Final Drainage Report is required with any development within this basin that will detail the developed site drainage conditions and storm sewer system. With the proposed Lot 4 and roadway construction a Private 36" storm sewer stub (Pipe 5) is provided into this basin for future connection. Storm water quality and detention for this basin is covered with the proposed Public Retention Facility. An interim sediment basin shall be installed with the proposed overlot grading to intercept the undeveloped runoff and route into the storm stub via a perforated stand pipe as specified in the Drainage Criteria Manual Vol. 2 Figures SB-1 & SB-2. Pipe 5 connects to the Bass Pro Shop Drive public storm main (Pipe 6) and continues south to the previously described Design Points 6a and 6b.

Design Point 15 (Q_5 = 20.4 cfs, Q_{100}= 36.2 cfs) is the runoff collected from Basin J, 5.21 acres of the future commercial development. A separate Final Drainage Report is required with any development within this basin that will detail the developed site drainage conditions and storm sewer system. A Private 30" storm sewer stub (Pipe 8) is provided into this Basin with the proposed construction and an interim sediment basin shall be installed with the proposed overlot grading to intercept the undeveloped runoff. Storm water quality and detention for this basin is covered with the proposed Retention Facility. Pipe 8 connects with the at-grade inlet and outlet pipe of Design Point 6b.

Design Point 16 (Q_5 = 2.3 cfs, Q_{100}= 4.2 cfs) is the future dual public 4' D-10-R sump inlets that are to be installed within the future roadway Basin K, 0.49 acres. With the construction of this future public roadway, a separate Final Drainage Report is required and may change the assumed drainage features described in this report. All of the runoff from Basin K is to be conveyed into the public storm main (Pipe 9) provided with the proposed construction. Pipe 16 from the at-grade inlets of future Spectrum Loop is to combine with the main from these two sump inlets (Public Pipe 7, 30" Storm, Q_5 = 17.6 cfs, Q_{100}= 30.6 cfs). Pipe 7 is to continue west toward the public storm main within Bass Pro Shop Drive (Public Pipe 14, 54" Storm, Q_5 = 92.5 cfs, Q_{100}= 162.8 cfs).

Design Point 17 (Q_5 = 18.2 cfs, Q_{100}= 32.4 cfs) is the runoff collected from Basin L, 4.24 acres of the future commercial development at the southerly corner of the study area. A separate Final Drainage Report is required with any development within this basin that will detail the developed site drainage conditions and

storm sewer system. A Private 30" storm sewer stub (Pipe 17) is provided into this Basin with the proposed construction and an interim sediment basin and temporary swale shall be installed with the proposed overlot grading to intercept all of the undeveloped runoff, including that at design points 29 & 30. Storm water quality and detention for this basin is covered with the proposed Retention Facility. Pipe 17 outfalls directly into the southern proposed forebay of the Public Storm Water Quality/Retention Facility (DP-28b).

Design Point 18 (Q_5 = 2.1 cfs, Q_{100}= 4.1 cfs) is the proposed private trench drain located at the base of the truck loading dock at the back of the proposed Bass Pro Shops Building. A total of 0.62 acres of the loading dock and adjacent drive aisle drain to this low point created. The trench drain is to be as designed with the architectural drawings for the Lot 4 (Bass Pro Shops) development. A Private 18" storm Pipe 27 conveys the intercepted runoff to the north-west toward the storm main from Design Points 4 & 5.

Design Point 19 (Q_5 = 8.2 cfs, Q_{100}= 15.3 cfs) represents the roof drain system associated with the northern portion of the proposed Bass Pro Shops building. A total of 1.78 acres of building rooftop is tributary to this design point. A roof drain system designed with the architectural drawings for the building will collect this runoff and connect to the provided Pipe 28, a proposed Private 24" storm pipe that will run parallel to the north side of the building. Pipe 28 combines with Pipe 27 from DP-18 and Pipe 29 (Private 24" Storm, Q_5 = 10.3 cfs, Q_{100}= 19.5 cfs) conveys both north to the storm main Pipe 30 (Private 48" Storm, Q_5 = 59.5 cfs, Q_{100}= 107.8 cfs).

Design Point 20 (Q_5 = 7.7 cfs, Q_{100}= 15.3 cfs) is a Private 6' D-10-R sump inlet located at the northern corner of proposed Lot 4 (Bass Pro Shops). Basin BP-1 is 2.79 acres of proposed asphalt and adjacent undeveloped off-site land that drains to this 6' sump inlet. Pipe 31, Private 24" storm, conveys the intercepted runoff to the storm main running parallel to the overall site boundary, Pipe 32 (Private 48" Storm, Q_5 = 65.2 cfs, Q_{100}= 119.3 cfs). Pipe 32 continues to the south-west to the northerly forebay of the proposed Public Storm Water Quality/Retention Facility.

Design Point 21 (Q_5 = 4.7 cfs, Q_{100}= 8.9 cfs) represents the roof drain system associated with the southern portion of the proposed Bass Pro Shops building. A total of 1.03 acres of building rooftop is tributary to this design point. A roof drain system designed with the architectural drawings for the building will collect this runoff and connect to the provided Pipe 18, a proposed Private 18" storm pipe that will run parallel to

the south side of the building. This storm lateral connects with the northerly D-9 grated inlet in the parking lot of Basin BP-3.

Design Point 22 (Q_5 = 17.9 cfs, Q_{100}= 35.4 cfs) is a Private 20' D-10-R sump inlet located at the southern corner of main parking lot in front of the Bass Pro Shops building. Basin BP-3 is 4.36 acres of proposed parking lot, drive aisles, and adjacent landscaping. Two additional D-9 grated inlets are proposed to be placed within the flow path to intercept nuisance flows and help keep the depth of water lower. As a conservative measure, the sump inlet at this DP-22 is sized to intercept the entire basin runoff. An 18"/24" private pipe system connects the roof drain from DP-21 to the two Private D-9 grated inlets into the face of the proposed 20' sump inlet. Pipe 19 (Private 30" Storm, Q_5 = 22.2 cfs, Q_{100}= 43.6 cfs) conveys the combined storm water to the south into the southerly forebay of the proposed Storm Water Quality/Retention Facility.

Design Point 23 (Q_5 = 11.1 cfs, Q_{100}= 21.1 cfs) is a Private 10' D-10-R sump inlet located at the southern corner of main parking lot in front of the Bass Pro Shops building. Basin BP-6 is 2.67 acres of proposed parking lot, drive aisles, and adjacent landscaping that surface drains to this sump inlet. A Private 24" Pipe 20 conveys this runoff to the storm main from DP-22, Pipe 21 (Public 54" Storm, Q_5 = 115.1 cfs, Q_{100}= 207.4 cfs). Pipe 21 combines runoff within Pipes 19, 20, and 14 (the large public main within Bass Pro Drive) and routes the water directly into the southerly forebay of the proposed Public Storm Water Quality/Retention Facility (DP-28b).

Design Point 24 (Q_5 = 8.0 cfs, Q_{100}= 17.3 cfs) is a proposed 20' curb cut with riprap rundown into the proposed Storm Water Quality/Retention Facility (DP-28c). The riprap rundown drops directly into the Retention Pond/Area 'B'. The tributary flow to this curb cut is Basin BP-7; 2.29 acres of Lot 4 entrance drive aisle and landscaping, plus the flow-by from Design Point 6b. A curb inlet with outlet pipe is not feasible at this location due to not being able to provide a positive pipe grade into a dry portion of the facility. Constructing an inlet with pipe that outfalls below the permanent water elevation of retention area 'B' would only cause the storm pipe to sit with standing water and lead to potential ponding within the entrance drive aisle. Significant measures of riprap erosion protection are necessary due to the frequency this rundown will be used. Metal bollards are to be placed as needed within the curb cut area in order to prevent vehicular access into the Retention Facility.

Design Point 25 (Q_5 = 3.0 cfs, Q_{100}= 5.6 cfs) is a Private 6' D-10-R sump inlet located within the north-westerly parking lot area in front of the Bass Pro Shops building. Basin BP-11 is 0.69 acres of proposed parking lot, drive aisles, and adjacent landscaping that drains to this sump inlet. A Private 18" Pipe 33 conveys this runoff to the north into the sump inlet at DP-26.

Design Point 26 (Q_5 = 4.0 cfs, Q_{100}= 7.5 cfs) is a Private 6' D-10-R sump inlet located within the north-westerly parking lot area in front of the Bass Pro Shops building. Basin BP-12 is 0.96 acres of proposed parking lot, drive aisles, and adjacent landscaping that drains to this sump inlet. A Private 24" Pipe 34 (Q_5 = 6.9 cfs, Q_{100}= 12.9 cfs) conveys the combined runoff from Pipe 33 and this Design Point to the north into the sump inlet at DP-27.

Design Point 27 (Q_5 = 10.9 cfs, Q_{100}= 21.3 cfs) is a proposed Private 10' D-10-R sump inlet located within the very north-westerly corner of the Lot 4 development. Basin BP-8 is 3.52 acres of proposed parking lot, drive aisles, and adjacent landscaping that drains to this sump inlet. A Private 30" Pipe 35 (Q_5 = 17.4 cfs, Q_{100}= 33.6 cfs) conveys the combined runoff from Pipe 34 and this Design Point to the north into the Private 48" storm main previously discussed with DP-20. This Private 48" Pipe 36 (Q_5 = 74.9 cfs, Q_{100}= 138.3 cfs) outfalls directly into the northerly forebay of the proposed Public Storm Water Quality/Retention Facility (Design Point 28a).

Design Point 28a (Q_5 = 74.9 cfs, Q_{100}= 138.3 cfs) is the northerly forebay and retention pond 'A' of the proposed Public Storm Water Quality/Retention Facility. Private Pipe 36 outfalls into this 0.046 acre-feet forebay with a concrete bottom and riprap berm. A 12" storm pipe located within the riprap berm will convey the water from the forebay onto a 4.0' wide low flow concrete curb channel (1.0% min. slope). This curb channel will stop at the limits of Retention Pond 'A' (elevation 6705.00). This low flow curb channel is required to prevent over-saturation of the dry pond bottom and to prevent erosion from the release of the forebay. Retention Pond 'A' has a bottom elevation of 6700.00 and contains a volume of 0.160 acre-feet. A berm at elevation 6708.00 just south of Retention Pond 'A' separates the retention pond area from the rest of the facility and thus traps an additional 3.0' of water before overtopping to the south. Therefore, an 18" storm pipe is to be placed just above the permanent retention pond water surface elevation (6705.00) that

will intercept the increasing water level and route to Retention Pond 'B' at a 0.50% minimum slope. This will prevent capturing 3.0' of the storm water without releasing any to the downstream corridor. In large events, this 18" pipe will flow at full capacity and overtopping will occur of the interior berm at elevation 6708. The overtopping water will then travel south within a 6.0' wide curb chase to the limits of Retention Pond 'B'. This curb chase will prevent erosion within this narrow portion of the proposed facility. Although this is a public facility located within a City of Colorado Springs owned tract, maintenance of the entire facility and structures is to be by the Northgate Business Owners Association.

Design Point 28b (Q_5 = 129.8 cfs, Q_{100}= 233.5 cfs) is the southerly forebay and retention pond 'C' of the proposed Public Storm Water Quality/Retention Facility. Pipe 17 & Pipe 21 outfalls into this 0.082 acre-feet forebay with a concrete bottom and riprap berm. The bottom of the forebay is at elevation 6706.00, 3.0' above the adjacent permanent retention pond. A 2.0' high, 8'0 wide, riprap berm with (1) 12" storm pipe will convey the water from the forebay onto a 4.0' wide low flow concrete curb channel (1.0% min. slope). This curb channel will stop at the limits of Retention Pond 'C' (elevation 6703.00). This low flow curb channel is required to prevent over-saturation of the dry pond bottom and to prevent erosion from the release of the forebay. Retention Pond 'C' has a bottom elevation of 6698.00 and contains a volume of 0.966 acre-feet. An interior berm at elevation 6704.00 sits between Retention Pond 'C' and Retention Pond 'B'. Thus the storm water will pond 1.0' within the retention area 'C' before it overtops into Pond 'B' and is then restricted by the proposed storm water quality outlet box.

Design Point 28c (D.B.P.S. DP-12A) (Q_2 = 146.1 cfs, Q_5 = 201.1 cfs, Q_{10} = 234.6 cfs, Q_{25} = 311.8 cfs, Q_{50} = 353.4 cfs, Q_{100}= 369.6 cfs) is the developed runoff from the entire Bass Pro at Northgate Filing No. 1 M.D.D.P. study area. This overall runoff quantity into the proposed Public Storm Water Quality/Full Spectrum Retention Facility consists of Design Point 28a (Pipe 36), Design Point 28b (Pipe 21 & Pipe 17), Design Point 24, and Basin BP-9 (the 4.26 acres of the retention facility). The proposed Public Retention Facility is to be constructed with the Lot 4 Bass Pro at Northgate Filing No. 1 development. The facility is designed and to be constructed as specified within the "Urban Storm Drainage Criteria Manual Volume 3, Section T-7 (Retention Pond) and Section T-12 (Outlet Structures)," dated November 2010 (included in the Appendix of this report). This facility is a Public Drainage Facility located in a City of Colorado Springs owned Tract A of Bass Pro at Northgate Filing No. 1. <u>All aesthetic and functional maintenance of the</u>

Retention Facility is by the Northgate Business Owners Association. This includes the storm flared-end sections into the forebays, and the public outlet box, outlet pipe, and catch pool at the edge of the property.

As previously mentioned this Facility contains the un-restricted developed runoff from the entire Bass Pro at Northgate Filing No. 1 M.D.D.P. study area (71.83 tributary acres); including the future hotel site (Basin D). The calculated imperviousness of the tributary area is 85.5% (See Calculations within Appendix of this report). Using the current Urban Storm Drainage BMP Design-Aid Workbook, a required EURV (Excess Urban Runoff Volume (Full Spectrum)) of 6.933 acre-feet is required to treat and detain the storm water into the facility. Retention Pond 'B' is within the central portion of the proposed facility and includes the proposed outlet box. As previously described the water released into retention pond A and C overtop the facilities and flow into this central pond area. Pond B has a bottom elevation of 6698 and permanent water surface elevation of 6703. All of the retention ponds have 3:1 side slopes with a minimum of 0.5% slope of the bottom pond liner for draining purposes. The overall retention pond permanent water volume (2.733 acre-feet) is greater than the required minimum volume of 2.053 acre-feet determined by the BMP Workbook.

The EURV storage volume begins at the permanent water surface elevation of the retention ponds B & C (6703.00) and ends at the established top of the outlet box (6708.50). A total volume of 7.523 acre-feet is contained within these elevations of this facility, more than the minimum required EURV of 6.933 acre-feet. The side slopes of the Retention Facility are 4:1 until the permanent water surface limits (Retention Pond limits) where the side slopes increase to 3:1 (as per the UDFCD Criteria and BMP Workbook, in Appendix of this report). The outlet box for this facility is an 8.0' x 4.0' inside dimensions riser box with a top of box elevation at 6708.50. The inside face of the box contains an orifice plate with (1) column, (16) rows of 2" high x 5.18" wide rectangular orifice holes (4" center to center vertical spacing). The lowest rectangular orifice elevation is at 6703.16. The width of opening within the concrete box face for the installation of the orifice plate and trash screen is 6.1' (as per the UDFCD Workbook). A trash rack screen of 8.0' high is to be installed on the outside face of the box as detailed in the "Urban Storm Drainage Criteria Manual Vol. 3, Section T-12 (Outlet Structures)" located in the Appendix of this report. This trash screen is to extend 2.5' into the permanent water surface of Retention Pond 'B' as required. The UDFCD Workbook and Sections T-6 & T-12 (in Appendix) are to be used to design and construct this retention facility and outlet box.

The proposed outlet box previously described along with a proposed 36" RCP outlet pipe (1.0% minimum) restricts the release rate of the Facility to Q_2 = 7.8 cfs, Q_5 = 9.9 cfs, Q_{10} = 11.1 cfs, Q_{25} = 15.0 cfs, Q_{50} = 34.9 cfs, and Q_{100}= 43.9 cfs. The release rates in all storm events from this facility are much less than the allowable (historic) rates determined in the Monument Branch Drainage Basin Planning Study (DPBS DP-12A) of Q_2 = 26.2 cfs, Q_5 = 36.0 cfs, Q_{10} = 42.0 cfs, Q_{25} = 97.0 cfs, Q_{50} = 109.9 cfs, and Q_{100}= 115.0 cfs. A 20+ feet retaining wall is proposed between the limits of the Public Retention Facility and the overall site/Air Force Academy boundary. Providing energy dissipation of the concentrated release of the Retention Facility is of the upmost importance as tributary runoff onto the Air Force Academy property has caused erosion and downstream issues in the recent past. Restricting the release at this location to below historic conditions will help alleviate some of the downstream erosion issues. A potential solution to provide energy dissipation at the outlet of the pond is to install a concrete catch pool at the bottom of the wall which will allow significant ponding to slow down the exiting storm water from the outfall pipe. The water will overtop the catch pool and flow onto the proposed riprap surrounding the pool and continue into the downstream corridor to D.B.P.S. Design Point 12. This is only a conceptual solution to provide adequate energy dissipation of the storm water. The exact outfall structure design is to be completed with the final construction drawings for the proposed public facility and is to be reviewed and approved by the City of Colorado Springs prior to construction. As shown on the Drainage Map, Powers Blvd. is planned to connect to Interstate 25 just south and west of the proposed facility and outfall location. The development of Powers Blvd. will require a separate drainage report that specifies the measures taken to maintain the drainage pattern of the release water from this facility to the downstream I-25 culvert crossings. Any modifications to the proposed retention facility or outlet structure will be specified at that time and within that drainage report.

The 100-year water surface elevation is 6709.06 and the emergency spillway elevation is at 6710.00. The 115' wide spillway is located along the south end of the pond and is to consist of buried riprap with 6" of top soil for vegetation planting. The top of the pond is a 12.0' wide berm along the south and west side of the facility, at elevation 6713.00. A retaining wall is also located along the west side of the facility and has a maximum height of approx. 24' (See Drainage Map for location). In the State of Colorado a "Jurisdictional size dam is a dam creating a reservoir with a capacity of more than 100 acre-feet, or creates a reservoir with a surface area in excess of 20 acres at the high water line, or exceeds 10 feet in height measured vertically from the elevation of the lowest point of the natural surface of the ground where that point occurs along

the longitudinal centerline of the dam up to the crest of the emergency spillway of the dam" State of Colorado Dept. of Natural Resources, Rules and Regulations for Dam Safety and Dam Construction, Januray 1, 2007. The proposed facility has a total capacity, including the retention ponds, of 13.87 acre-feet, and an area at the high water line (elevation 6710.00) of 2.59 acres. The natural ground (existing) elevation at the centerline of the emergency spillway is 6700.00, exactly 10' lower than the proposed spillway elevation. Although the height of the retaining wall on the west side of the facility is 24' in height, per the State's Rules and Regulations, the jurisdictional height is measured at the spillway and in this case is equal to 10.0'. Therefore, the proposed facility is not considered a jurisdictional size facility and does not require review and approval from the State of Colorado.

In order to satisfy Water Rights Laws, the retention ponds are to be filled with metered water from a Colorado Springs Utilities water main. Anytime the retention ponds are drained for cleaning, they must be filled using the metered water, not storm water. Regular maintenance is essential for proper function of the retention ponds and outlet box. A "Stormwater Best Management Practices Inspection and Maintenance Plan (IM Plan)" is required by the City of Colorado Springs that specifies the responsible party and schedule of the required inspection and maintenance of the facility. This report is to be processed with the final construction drawings for the facility.

As previously mentioned, the 100-year water surface elevation is 6709.06 while releasing water at a rate of 44 cfs. The available volume from this water elevation to the spillway is approximately 2.3 acre-feet. Therefore there is some excess capacity, but if any other future development not specified within this report is to drain into this facility, the outlet structure must be verified that it still meets less than historic release rates in all of the storm events.

D.B.P.S. Design Point 12 (Q_2 = 17.3 cfs, Q_5 = 23.8 cfs, Q_{10} = 27.8 cfs, Q_{25} = 63.5 cfs, Q_{50} = 72.0 cfs, Q_{100}= 75.3 cfs) is the restricted release from the proposed Storm Water Quality/Retention Facility and Basin EX-P1, 15.32 acres of un-developed land between the overall site boundary and the northbound Interstate 25 roadway. Per the Monument Branch D.B.P.S. runoff to this existing 48" RCP culvert crossing of I-25 is not to exceed: Q_2 = 28.1 cfs, Q_5 = 38.6 cfs, Q_{10} = 45.0 cfs, Q_{25} = 114.7 cfs, Q_{50} = 130.0 cfs, and Q_{100}= 136.0 cfs. With the proposed development of the entire Bass Pro at Northgate Filing No. 1 study area, at no times is the storm water at this location greater than the historic runoff rates. Therefore,

construction of the proposed development does not hinder downstream facilities and provides the required storm water quality treatment for the entire tributary area.

Design Point 29 (Q_5 = 3.0 cfs, Q_{100}= 8.5 cfs) is the surface runoff of the future Spectrum Loop roadway that by-passes the at-grade inlet located at Design Point 12. This runoff will continue south to the future Spectrum Loop/Powers Blvd. intersection. A final drainage report will be completed with the future development of Powers Blvd. that will detail the future storm sewer and collection point of this surface flow. In the interim, a temporary swale shall be installed at the southern edge of the proposed overlot grading (site boundary) that conveys the undeveloped runoff to the storm stub at Design Point 17. A temporary sediment basin with outlet pipe shall convey the undeveloped runoff into the proposed Retention/Storm Water Quality Facility.

Design Point 30 (Q_5 = 2.3 cfs, Q_{100}= 5.9 cfs) is the surface runoff of future Spectrum Loop that by-passes the future at-grade inlet at DP-13. This design point exhibits the same characteristics of that at Design Point 29.

EROSION CONTROL PLAN

The City of Colorado Springs Drainage Criteria Manual specifies an Erosion Control Plan and associated cost estimate be submitted with the Final Drainage Report. We respectfully request that the Erosion Control Plan and cost estimate be submitted in conjunction with the Grading Plan and construction assurances posted prior to obtaining a grading permit. Adequate erosion control measures including the specified temporary sediment basins for those parcels to be overlot graded now, but not developed until a future time, shall be installed to prevent sediment build up within the storm sewer facilities.

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in November 1991 and October 1994. Stormwater quality analysis and calculations were performed in accordance with the City of Colorado Springs/El Paso County Drainage Criteria Manual, Volume 2 and more specifically per the Urban Drainage and Flood Control District, Urban

Storm Drainage Criteria Manual Volume 3. The Rational Method was used to estimate stormwater runoff anticipated from design storms for the 2 year, 5 year, 10 year, 25 year, 50 year and 100 year recurrence intervals.

FLOODPLAIN STATEMENT

No portion of this site is located within a floodplain as determined by the Flood Insurance Rate Maps (F.I.R.M.) Map Number 08041C 0290F effective date, March 17, 1997 (See Appendix).

DRAINAGE AND BRIDGE FEES

The proposed platted area is entirely within the Monument Branch Drainage Basin. This basin was officially closed as approved by the Drainage Board and City Council at the October 12, 2010 Council meeting (Reference Resolution #177-10). Therefore there is no Drainage or Bridge Fees due with the proposed development. Basin D, the future hotel site, is within the Smith Creek Drainage Basin; however it is not being platted at this time and will be done so by others.

CONSTRUCTION COST OPINION

Public Drainage Facilities (Non-Reimbursable)

The majority of the proposed storm sewer infrastructure is considered Private with the exception of the main within Bass Pro Drive and Tracker Drive. The City of Colorado Springs shall own all of the specified Public storm sewer system. However, maintenance of the public storm ends at the limits of the SWQ/Retention Facility. The Northgate Business Owners Association will maintain the facility and all structures within. Below is a cost opinion of the proposed public storm sewer facilities. The storm sewer pipe, where within a Colorado Springs Utilities sanitary main trench, are required to be HDPE (ADS or equivalent). The remainder of the storm system (not within a sanitary trench) can be either HDPE or RCP.

1.	10' D-10-R Inlet	2 EACH	$6,000/EA	$ 12,000.00
2.	20' D-10-R Inlet	1 EACH	$9,000/EA	$ 9,000.00
3.	Type 1 Storm Manhole	3 EACH	$8,000/EA	$ 24,000.00
4.	Retention Pond Outlet Box	1 EACH	$20,000/EA	$ 20,000.00
5.	18" Storm HDPE	8 LF	$31/LF	$ 248.00

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6.	30" Storm HDPE	38 LF	$64/LF	$ 2,432.00
7.	36" Storm HDPE	689 LF	$79/LF	$ 54,431.00
8.	42" Storm HDPE	675 LF	$95/LF	$ 64,125.00
9.	48" Storm HDPE	59 LF	$118/LF	$ 6,962.00
10.	54" Storm HDPE	423 LF	$186/LF	$ 78,678.00

SUB-TOTAL	**$ 271,876.00**
15% ENGINEERING & CONTINGENCIES	**$ 40,781.40**
TOTAL	**$ 312,657.40**

Private Drainage Facilities (Non-Reimbursable) Lot 4 Bass Pro Filing No. 1

11.	6' D-10-R Inlet	3 EACH	$4,800/EA	$ 14,400.00
12.	10' D-10-R Inlet	2 EACH	$6,000/EA	$ 12,000.00
13.	20' D-10-R Inlet	1 EACH	$9,000/EA	$ 9,000.00
14.	D-9 Grated Inlet	2 EACH	$5,000/EA	$ 10,000.00
15.	Type 1 Storm Manhole	4 EACH	$8,000/EA	$ 32,000.00
16.	12" Storm	44 LF	$20/LF	$ 880.00
17.	18" Storm	808 LF	$31/LF	$ 25,048.00
18.	24" Storm	1,373 LF	$46/LF	$ 63,158.00
19.	30" Storm	286 LF	$64/LF	$ 18,304.00
20.	36" Storm	128 LF	$79/LF	$ 10,112.00
21.	48" Storm	704 LF	$118/LF	$ 83,072.00

SUB-TOTAL	**$ 277,974.00**
15% ENGINEERING & CONTINGENCIES	**$ 41,696.10**
TOTAL	**$ 319,670.10**

Classic Consulting Engineers & Surveyors cannot and does not guarantee that the construction cost will not vary from these opinions of probable construction costs. These opinions represent our best judgment as design professionals familiar with the construction industry and this development in particular.

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SUMMARY

The proposed overall development of the entire Bass Pro at Northgate Filing No. 1 M.D.D.P. study area is to drain into the proposed Storm Water Quality/Retention Facility that is to be constructed with Lot 4 Bass Pro Filing No. 1 (Bass Pro Shops). This facility treats all of the tributary runoff for storm water quality and adequately restricts the release rate to well below historic conditions. Riprap and energy dissipation protection is to be installed out the outlet of the proposed Retention Facility to prevent erosion of the existing, natural downstream drainage corridor. There is relatively minor off-site runoff tributary to the proposed study area. With the proposed construction of Lot 4 (Bass Pro Shops), the Full Spectrum Retention/Storm Water Quality Facility within Tract A, Bass Pro Shop Drive and Tracker Drive are also to be constructed. This includes the public storm sewer main within Bass Pro Drive and the stubs for future connection. All of the other basins and roadways shown on the proposed drainage map will be constructed at a future time and will require separate drainage reports that detail the developed runoff and future storm systems. All drainage facilities were sized using the current City of Colorado Springs and the Urban Drainage and Flood Control District Criteria and will safely discharge storm water runoff to adequate downstream facilities.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Matthew Larson
Project Engineer

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REFERENCES

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

2. City of Colorado Springs/County of El Paso Drainage Criteria Manual Vol. 2 dated November 2002.

3. Urban Drainage and Flood Control District, Urban Storm Drainage Criteria Manual Volume 3, dated November 2010.

4. "Monument Branch Drainage Basin Planning Study," by URS Corporation, last revised August 6, 1987.

5. "Preliminary/Final Drainage Report for Northgate Campus Filing No. 1 (Project Rampart Phase 1A and 1B)," by JR Engineering, last revised August 2000.

6. "Drainage Letter for Northgate Campus Filing No. 2A Lots 1 and 2," by JR Engineering, dated June 2, 2009.

APPENDIX

VICINITY MAP

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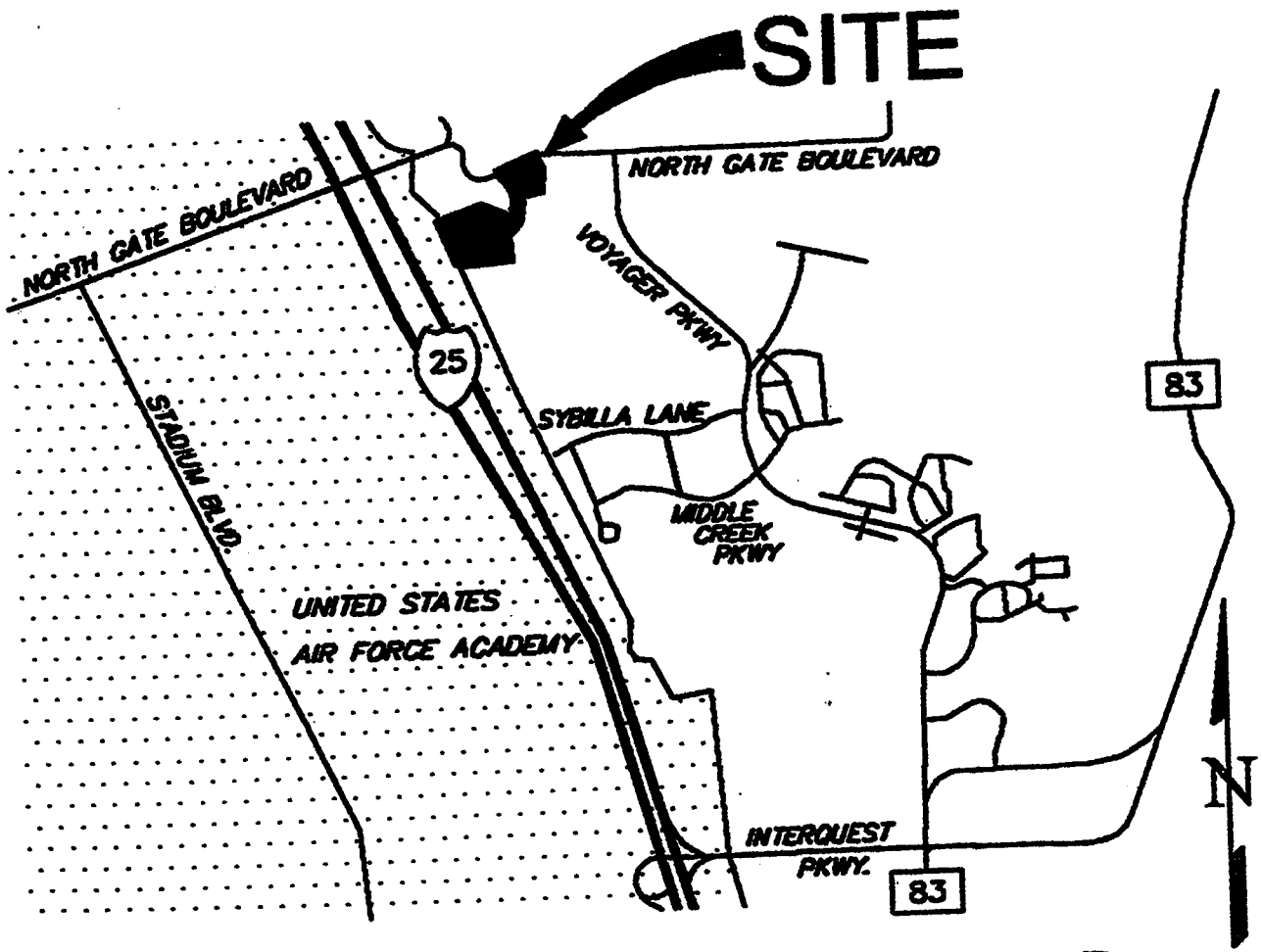


VICINITY MAP

NOT TO SCALE

FINAL PLAT

BASS PRO AT NORTHGATE FILING NO. 1

REPLAT OF TRACT C, NORTHGATE CAMPUS FILING NO. 2, AND A PORTION OF LOT 2, MINING MUSEUM SUBDIVISION NO. 1 AND A PORTION OF SEC. 7, T12S, R66W, 6th P.M. CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

KNOW ALL MEN BY THESE PRESENTS:

THAT NORTHGATE PROPERTIES, LLC, A COLORADO LIMITED LIABILITY COMPANY, BY GARY ERICKSON, MANAGER, BEING THE OWNER OF THE FOLLOWING DESCRIBED TRACT OF LAND, TO WIT:

LEGAL DESCRIPTION:

A REPLAT OF TRACT C, NORTHGATE CAMPUS FILING NO. 2, AND A REPLAT OF A PORTION OF LOT 2, MINING MUSEUM SUBDIVISION NO. 1 AND BEING A PORTION OF SECTION 7 , TOWNSHIP 12 SOUTH, RANGE 66 WEST OF THE 6TH PRINCIPAL MERIDIAN, CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO, AND BEING MORE PARTICULARLY DESCRIBED AS FOLLOWS:

BASIS OF BEARINGS: THE EASTERLY BOUNDARY OF THE UNITED STATES AIR FORCE ACADEMY BEING MONUMENTED AT THE SOUTH END BY A NO. 5 REBAR WITH A 1" ORANGE PLASTIC CAP STAMPED "EDWARD-JAMES PLS 17502" AND AT THE NORTH END BY A FOUND NO. 5 REBAR BEING ASSUMED TO BEAR N25°23'25"W A DISTANCE OF 403.18 FEET.

COMENCING AT THE NORTHWEST CORNER OF NORTHGATE CAMPUS FILING NO. 2 AS PLATTED IN THE EL PASO COUNTY RECORDS UNDER RECEPTION NUMBER 206712642, SAID POINT BEING THE POINT OF BEGINNING, THENCE EASTERLY AND SOUTHERLY AND ON THE WESTERLY RIGHT-OF-WAY LINE OF MEADOWGRASS DRIVE AS PLATTED IN SAID NORTHGATE CAMPUS FILING NO. 2 THE FOLLOWING SIX (6) COURSES:

1. S62°55'37"E A DISTANCE OF 36.86 FEET TO A POINT OF CURVE;
2. ON THE ARC OF A CURVE TO THE RIGHT HAVING A DELTA OF 58°01'35", A RADIUS OF 36.00 FEET, AND A LENGTH OF 36.46 FEET TO A POINT OF COMPOUND CURVE;
3. ON THE ARC OF A CURVE TO THE RIGHT HAVING A DELTA OF 17°03'34", A RADIUS OF 414.49 FEET, AND A LENGTH OF 123.41 FEET TO THE POINT OF TANGENT;
4. S12°09'20"W A DISTANCE OF 22.03 FEET;
5. S08°58'43"W A DISTANCE OF 54.13 FEET;
6. S12°09'20"W A DISTANCE OF 313.24 FEET;

THENCE N77°50'40"W A DISTANCE OF 286.55 FEET TO A POINT OF CURVE; THENCE ON THE ARC OF A CURVE TO THE LEFT HAVING A DELTA OF 29°05'30", A RADIUS OF 417.50 FEET, AND A LENGTH OF 212.01 FEET; THENCE S23°51'15"E A DISTANCE OF 41.70 FEET TO A POINT ON CURVE; THENCE ON THE ARC OF A CURVE TO THE RIGHT WHOSE CENTER BEARS S58°42'41"W HAVING A DELTA OF 58°24'38", A RADIUS OF 635.00 FEET, AND A LENGTH OF 647.36 FEET TO A POINT OF TANGENT; THENCE S37°08'20"W A DISTANCE OF 159.23 FEET TO A POINT OF CURVE; THENCE ON THE ARC OF A CURVE TO THE LEFT HAVING A DELTA OF 15°22'32", A RADIUS OF 435.00 FEET, AND A LENGTH OF 116.84 FEET TO THE POINT OF TANGENT; THENCE S21°44'55"W A DISTANCE OF 357.92 FEET; THENCE S41°56'21"W A DISTANCE OF 81.53 FEET TO A POINT OF CURVE; THENCE ON THE ARC OF A CURVE TO THE RIGHT HAVING A DELTA OF 08°45'34", A RADIUS OF 458.50 FEET, AND A LENGTH OF 69.83 FEET; THENCE S13°29'07"W A DISTANCE OF 275.22 FEET TO A POINT ON THE NORTHERLY RIGHT-OF-WAY LINE OF PROPOSED POWERS BOULEVARD; THENCE WESTERLY AND NORTHERLY AND ON THE NORTHERLY RIGHT-OF-WAY LINE OF PROPOSED POWERS BOULEVARD THE FOLLOWING FOUR (4) COURSES:

1. ON THE ARC OF A CURVE TO THE RIGHT WHOSE CENTER BEARS N08°02'37"E HAVING A DELTA OF 11°44'16", A RADIUS OF 1,200.00 FEET, AND A LENGTH OF 245.85 FEET TO THE POINT OF TANGENT;
2. N70°13'05"W A DISTANCE OF 326.69 FEET;
3. N25°14'10"W A DISTANCE OF 118.18 FEET;
4. N34°26'01"W A DISTANCE OF 320.27 FEET TO A POINT ON THE EASTERLY BOUNDARY OF THE UNITED STATES AIR FORCE ACADEMY;

THENCE N25°23'25"W AND ON THE EASTERLY BOUNDARY OF THE UNITED STATES AIR FORCE ACADEMY A DISTANCE OF 403.18 FEET TO THE SOUTHWEST CORNER OF LOT 1, MINING MUSEUM SUBDIVISION NO. 1 AS PLATTED IN THE EL PASO COUNTY RECORDS IN PLAT BOOK F-3, AT PAGE 73; THENCE N54°49'40"E AND ON THE SOUTH LINE OF SAID LOT 1, MINING MUSEUM SUBDIVISION NO. 1 A DISTANCE OF 775.86 FEET; THENCE S55°48'17"E A DISTANCE OF 907.11 FEET; THENCE N37°08'20"E A DISTANCE OF 118.48 FEET TO A POINT OF CURVE; THENCE ON THE ARC OF A CURVE TO THE LEFT HAVING A DELTA OF 62°40'19", A RADIUS OF 570.00 FEET, AND A LENGTH OF 623.48 FEET TO THE POINT OF TANGENT; THENCE N25°28'39"W A DISTANCE OF 200.28 FEET TO A POINT OF CURVE; THENCE ON THE ARC OF A CURVE TO THE RIGHT HAVING A DELTA OF 56°57'01", A RADIUS OF 483.50 FEET, AND A LENGTH OF 479.58 FEET TO THE POINT OF TANGENT; THENCE N31°25'38"E A DISTANCE OF 36.21 FEET TO A POINT ON THE SOUTHERLY RIGHT-OF-WAY LINE OF NORTH GATE BOULEVARD AS PLATTED IN THE EL PASO COUNTY RECORDS UNDER RECEPTION NUMBER 206024522; THENCE ON THE ARC OF A CURVE TO THE LEFT WHOSE CENTER BEARS N33°20'35"E HAVING A DELTA OF 41°07'35", A RADIUS OF 967.00 FEET, AND A LENGTH OF 694.10 FEET TO THE POINT OF BEGINNING.

CONTAINING A CALCULATED AREA OF 1,525,790 SQ. FEET, OR 35.027 ACRES.

NOTICE:

ACCORDING TO COLORADO LAW YOU MUST COMMENCE ANY LEGAL ACTION BASED UPON ANY DEFECT IN THIS SURVEY WITHIN THREE YEARS AFTER YOU FIRST DISCOVER SUCH DEFECT. IN NO EVENT MAY ANY ACTION BASED UPON ANY DEFECT IN THIS SURVEY BE COMMENCED MORE THAN TEN YEARS FROM THE DATE OF THE CERTIFICATION SHOWN HEREON.

DEDICATION:

THE UNDERSIGNED OWNERS HAVE CAUSED SAID TRACT OF LAND TO BE PLATTED INTO LOTS, STREETS, TRACTS AND EASEMENTS AS SHOWN ON THE PLAT, THE UNDERSIGNED DOES HEREBY DEDICATE, GRANT AND CONVEY TO THE CITY OF COLORADO SPRINGS ALL PUBLIC STREETS, TRACT A, RIGHTS-OF-WAY AND PUBLIC EASEMENTS AS SHOWN ON THE PLAT, AND FURTHER RESTRICTS THE USE OF ALL PUBLIC EASEMENTS TO THE CITY OF COLORADO SPRINGS AND/OR ITS ASSIGNS, PROVIDED HOWEVER, THAT THE SOLE RIGHT AND AUTHORITY TO VACATE, RELEASE OR QUITCLAIM ALL OR ANY SUCH DEDICATED PUBLIC STREETS, TRACTS AND PUBLIC EASEMENTS SHALL REMAIN EXCLUSIVELY VESTED IN THE CITY OF COLORADO SPRINGS. THIS TRACT OF LAND AS HEREIN PLATTED SHALL BE KNOWN AS " BASS PRO AT NORTHGATE FILING NO. 1 " IN THE CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO.

OWNER:

THE AFOREMENTIONED, NORTHGATE PROPERTIES, LLC, A COLORADO LIMITED LIABILITY COMPANY, BY GARY ERICKSON, MANAGER, HAS EXECUTED THIS DOCUMENT ON THIS _____ DAY OF _____, 2012 A.D.

_____
GARY ERICKSON
MANAGER, NORTHGATE PROPERTIES, LLC., A COLORADO LIMITED LIABILITY COMPANY

NOTARIAL:

STATE OF COLORADO)
) SS
COUNTY OF EL PASO)

THE FOREGOING INSTRUMENT WAS ACKNOWLEDGED BEFORE ME THIS _____ DAY OF _____, 2012 A.D., BY GARY ERICKSON OF NORTHGATE PROPERTIES, LLC, A COLORADO LIMITED LIABILITY COMPANY.

WITNESS MY HAND AND OFFICIAL SEAL:

MY COMMISSION EXPIRES: _____

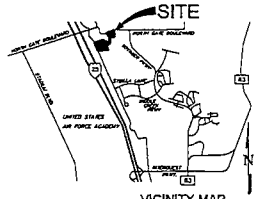
_____
NOTARY PUBLIC

EASEMENTS:

AS SHOWN HEREON WITH THE MAINTENANCE RESPONSIBILITY TO EACH INDIVIDUAL LOT OWNER.

GENERAL NOTES:

1. BASIS OF BEARINGS: THE EASTERLY BOUNDARY OF THE UNITED STATES AIR FORCE ACADEMY BEING MONUMENTED AT THE SOUTH END BY A NO. 5 REBAR WITH A 1" ORANGE PLASTIC CAP STAMPED "EDWARD-JAMES PLS 17502" AND AT THE NORTH END BY A FOUND NO. 5 REBAR BEING ASSUMED TO BEAR N25°23'25"W A DISTANCE OF 403.18 FEET.
2. ALL REFERENCES HEREON TO BOOKS, PAGES, MAPS, AND RECEPTION NUMBERS ARE PUBLIC DOCUMENTS FILED IN THE RECORDS OF EL PASO COUNTY, STATE OF COLORADO.
3. "THE AREA INCLUDED IN THIS PLAT DESCRIBED HERE IN IS SUBJECT TO THE CODE OF THE CITY OF COLORADO SPRINGS, 2001, AS AMENDED."
4. THIS PROPERTY IS SUBJECT TO THE FINDINGS, SUMMARY, AND CONCLUSIONS OF A GEOLOGIC HAZARD EXEMPTION REPORT PREPARED BY ENTECH ENGINEERING, INC. DATED DECEMBER 15, 2008. A COPY OF SAID REPORT HAS BEEN PLACED WITHIN THE FILE OF THE CITY OF COLORADO SPRINGS LAND USE REVIEW. CONTACT LAND USE REVIEW, 30 SOUTH NEVADA AVENUE, SUITE 105, COLORADO SPRINGS, COLORADO, IF YOU WOULD LIKE TO REVIEW SAID LETTER.
5. FLOODPLAIN STATEMENT: THIS PROPERTY LIES WITHIN ZONE "X", AREAS DETERMINED TO BE OUTSIDE OF A 500-YEAR FLOODPLAIN, PER THE FLOOD INSURANCE RATE MAP, COMMUNITY PANELS 08041C0290F AND 08041C0295F, EFFECTIVE DATE MARCH 17, 1997.
6. "NO BUILDING PERMITS SHALL BE ISSUED FOR BUILDING SITES WITHIN THIS PLAT UNTIL ALL REQUIRED FEES HAVE BEEN PAID AND ALL REQUIRED PUBLIC AND PRIVATE IMPROVEMENTS HAVE BEEN INSTALLED AS SPECIFIED BY THE CITY OF COLORADO SPRINGS OR ALTERNATIVELY UNTIL ACCEPTABLE ASSURANCES INCLUDING BUT LIMITED TO LETTERS OF CREDIT, CASH SUBDIVISION BONDS OR COMBINATIONS THEREOF GUARANTEEING THE COMPLETION OF ALL REQUIRED PUBLIC IMPROVEMENTS INCLUDING, BUT NOT LIMITED TO, DRAINAGE, STREET AND EROSION CONTROL HAVE BEEN PLACED ON FILE WITH THE CITY OF COLORADO SPRINGS".
7. "ALL EASEMENTS SHOWN OR DEDICATED HEREON FOR PUBLIC UTILITY PURPOSES SHALL BE SUBJECT TO THOSE TERMS AND CONDITIONS AS SPECIFIED IN THE INSTRUMENT RECORDED AT RECEPTION NUMBER 209056689 OF THE RECORDS OF EL PASO COUNTY, COLORADO (EXCEPT FOR DUAL EASEMENTS AS DEFINED IN 7.7.607) OF THE CITY CODE."
8. NOTICE: THIS PROPERTY MAY BE IMPACTED BY NOISE AND OTHER SIMILAR SENSORY EFFECTS OF FLIGHT CAUSED BY AIRCRAFT USED IN THE UNITED STATES AIR FORCE ACADEMY'S AIRMANSHIP PROGRAM. THIS NOTICE SHALL REMAIN IN EFFECT UNTIL THE AIR FORCE ACADEMY SHALL CEASE TO BE USED FOR FLIGHT TRAINING PURPOSES, OR UNTIL ALL AIRPORTS ON THE AIR FORCE ACADEMY SHALL CEASE TO BE ACTIVELY USED. THIS NOTICE SHALL RUN WITH THE LAND.
9. ANY PERSON WHO KNOWINGLY REMOVES, ALTERS OR DEFACES ANY PUBLIC LAND SURVEY MONUMENT OR LAND MONUMENT OR ACCESSORY, COMMITS A CLASS TWO (2) MISDEMEANOR PURSUANT TO STATE STATUTE 18-4-508, C.R.S.
10. TRACT A IS A DRAINAGE DETENTION FACILITY AND WILL BE OWNED AND BY THE CITY OF COLORADO SPRINGS AND MAINTAINED BY THE BASS PRO OWNERS ASSOCIATION.
11. THIS FINAL PLAT WAS CREATED WITHOUT THE BENEFIT OF A TITLE COMMITMENT OR TITLE INSURANCE POLICY. A TITLE INSURANCE COMMITMENT OR TITLE INSURANCE POLICY MAY DISCLOSE FACTS NOT REFLECTED ON THIS SURVEY. THIS LAND SURVEY DOES NOT CONSTITUTE A TITLE SEARCH BY EDWARD-JAMES SURVEYING, INC., TO DETERMINE OWNERSHIP OF THIS TRACT, VERIFY THE DESCRIPTION SHOWN, VERIFY COMPATIBILITY WITH ADJACENT TRACTS, OR VERIFY EASEMENTS OF RECORD.
12. THE APPROVAL OF THIS PLAT VACATES ALL PRIOR PLATS FOR THE AREA DESCRIBED BY THIS FINAL PLAT.
13. THE 20' SANITARY SEWER EASEMENT RECORDED UNDER RECEPTION NO. 200056904 WILL BE RELOCATED AND VACATED BY SEPERATE PROCESS AND INSTRUMENT.
14. NO ACCESS SHALL BE PERMITTED DIRECTLY ON TO INTERSTATE 25 AND FUTURE POWERS BOULEVARD FROM ANY LOTS IN THIS SUBDIVISION.
15. DATE OF PREPARATION APRIL 12, 2012.
16. CROSS ACCESS AND PARKING SHALL NOT BE PERMITTED THROUGHOUT THE LOT 4, BASS PRO AT NORTHGATE FILING NO. 1 AREA, FOR THE USE OF ALL PROPERTY OWNERS, TENANTS, AND CUSTOMERS/GUESTS.



VICINITY MAP
NOT TO SCALE

SURVEYOR'S STATEMENT:

I, JAMES L. SINCOVEC, A PROFESSIONAL LAND SURVEYOR IN THE STATE OF COLORADO, DO HEREBY STATE THAT THIS PLAT HAS BEEN PREPARED UNDER MY DIRECTION IN ACCORDANCE WITH THE COLORADO REVISED STATUTES, AS AMENDED, AND THAT THIS PLAT DOES ACCURATELY SHOW THE DESCRIBED TRACTS OF LAND AND THE SUBDIVISION THEREOF, AND THAT THE REQUIREMENTS OF TITLE 38 OF THE COLORADO REVISED STATUTES, 1973 AS AMENDED, HAVE BEEN MET TO THE BEST OF MY KNOWLEDGE AND BELIEF.

_____
JAMES L. SINCOVEC, PROFESSIONAL LAND SURVEYOR
COLORADO P.L.S. NO. 17502
FOR AND ON BEHALF OF EDWARD-JAMES SURVEYING, INC.

CITY APPROVAL:

ON BEHALF OF THE CITY OF COLORADO SPRINGS, THE UNDERSIGNED HEREBY APPROVE FOR FILING THE ACCOMPANYING PLAT FOR " BASS PRO AT NORTHGATE FILING NO. 1 " IN THE CITY OF COLORADO SPRINGS, COUNTY OF EL PASO.

_____ _____
DIRECTOR OF CITY PLANNING DATE

_____ _____
CITY ENGINEER DATE

_____ _____
CITY CLERK DATE

RECORDING:

STATE OF COLORADO)
) SS
COUNTY OF EL PASO)

I HEREBY CERTIFY THAT THIS INSTRUMENT WAS FILED FOR RECORD IN MY OFFICE AT ___ O'CLOCK ___M., THIS _____ DAY OF _____, 2012 A.D., AND IS DULY RECORDED UNDER RECEPTION NUMBER _____ OF THE RECORDS OF EL PASO COUNTY, COLORADO.

WAYNE W. WILLIAMS, RECORDER

SURCHARGE: _____

FEE: _____

BY: _____
DEPUTY

FEES:

SCHOOL FEE: _____
BRIDGE FEE: _____
PARK FEE: _____
DRAINAGE FEE: _____

NO.	REVISIONS DESCRIPTION	DATE
1	REVISED PER CITY AGENCIES COMMENTS	06/07/12

EDWARD-JAMES SURVEYING, INC.
2764 Ianiell Road
Colorado Springs, CO 80906
Office: (719) 576-1216
Fax: (719) 576-1206

4732 Eagleridge Circle
Pueblo, CO 81008
Office: (719) 545-6240
Fax: (719) 545-6247

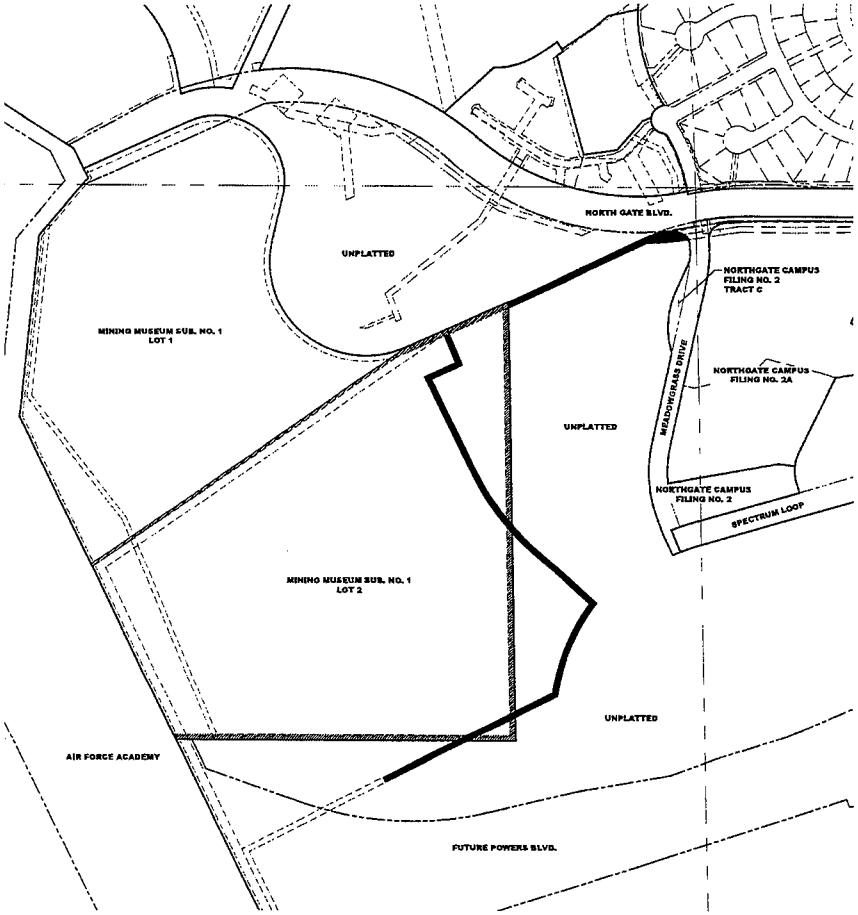
BASS PRO AT NORTHGATE FILING NO. 1
FINAL PLAT

REPLAT OF TRACT C, NORTHGATE CAMPUS FILING NO. 2, AND A PORTION OF LOT 2, MINING MUSEUM SUBDIVISION NO. 1 AND A PORTION OF SEC. 7, T12S, R66W, 6th P.M. CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

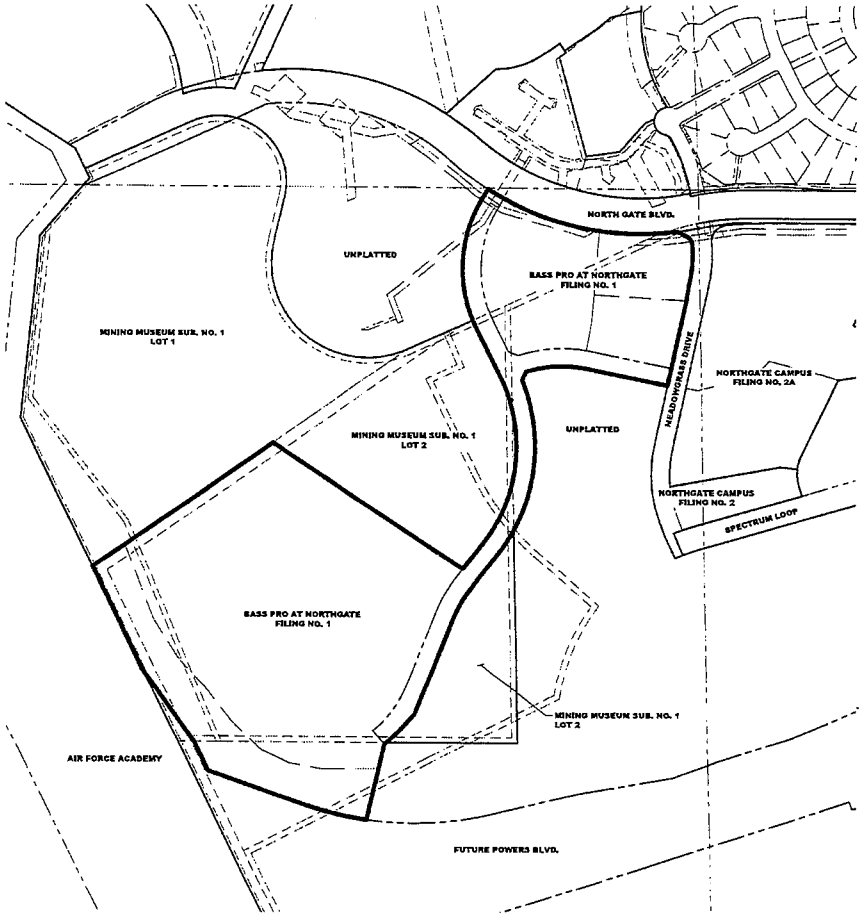
DRAWN BY	RJS
CHECKED BY	PJH
H-SCALE	N/A
JOB NO.	1048.00
DATE CREATED	04/12/12
DATE ISSUED	06/07/12
SHEET NO	1 OF 3

BASS PRO AT NORTHGATE FILING NO. 1

FINAL PLAT



"AS PLATTED"



"AS REPLATTED"

Existing recorded easements to be vacated after construction of the new alignment.

Lot 2, Mining Museum Sub. No. 1 easements to be vacated soon.

N

200' 0 200' 400'

SCALE: 1" = 200'

NO.	REVISIONS	DESCRIPTION	DATE
1		REVISED PER CITY / AGENCY COMMENTS	04/07/12

EDWARD-JAMES SURVEYING, INC.
2764 Janitell Road
Colorado Springs, CO 80906
Office: (719) 576-1216
Fax: (719) 576-1206
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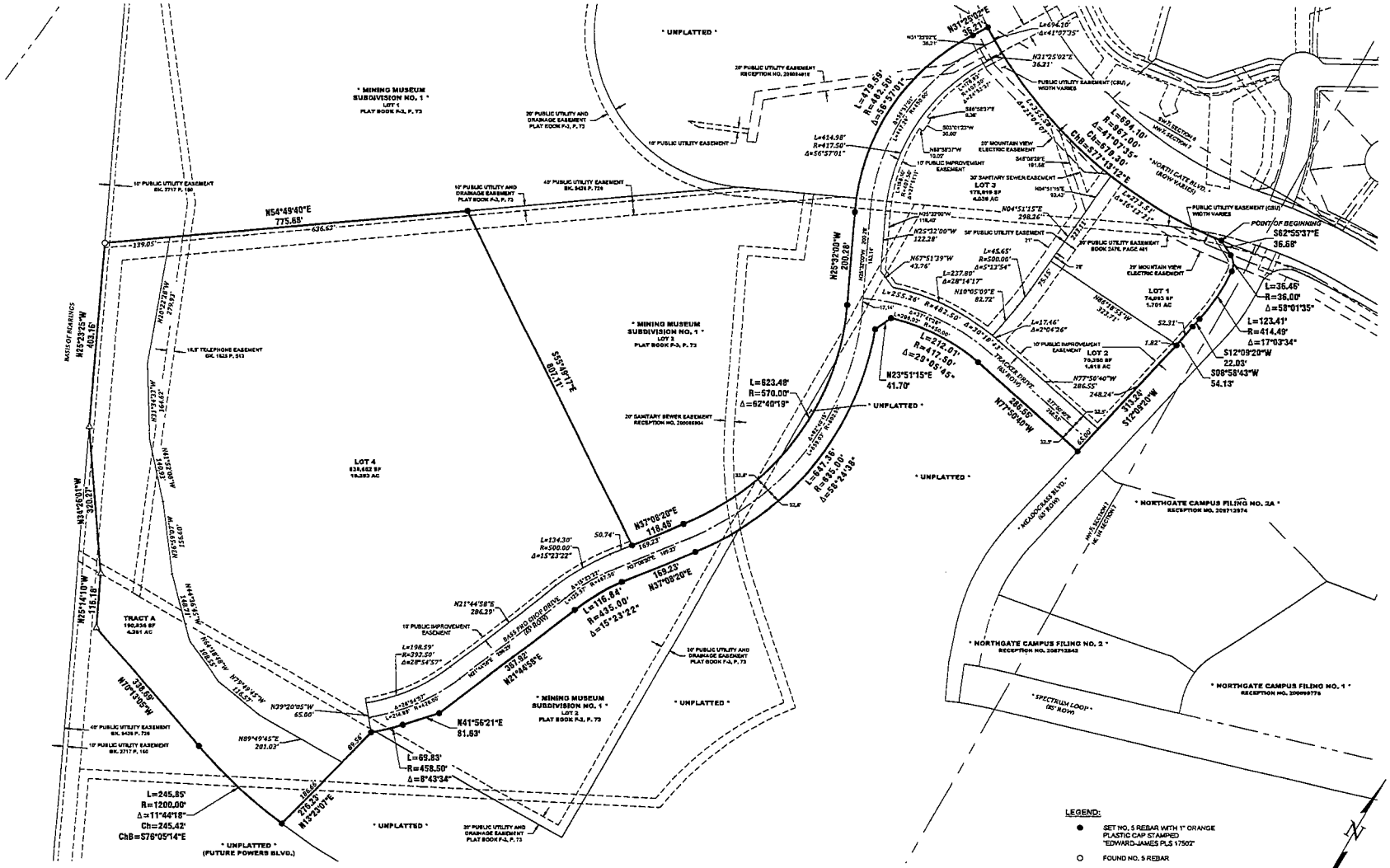
BASS PRO AT NORTHGATE FILING NO. 1
FINAL PLAT

REPLAT OF TRACT C, NORTHGATE CAMPUS FILING NO. 2, AND A PORTION OF LOT 2, MINING MUSEUM SUBDIVISION NO. 1 AND A PORTION OF SEC. 7, T12S, R66W, 6th P.M. CITY OF COLORADO SPRINGS, COUNTY OF EL PASO, STATE OF COLORADO

DRAWN BY	RJS
CHECKED BY	PJH
H-SCALE	1" = 200'
JOB NO.	1048.00
DATE CREATED	04/12/12
DATE ISSUED	06/07/12
SHEET NO	2 OF 3

BASS PRO AT NORTHGATE FILING NO. 1

FINAL PLAT



REVISIONS		
NO.	DESCRIPTION	DATE
1.	REVISED PER CITY/AGENCY COMMENTS	06/07/12

EDWARD-JAMES SURVEYING, INC.
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BASS PRO AT NORTHGATE FILING NO. 1
FINAL PLAT

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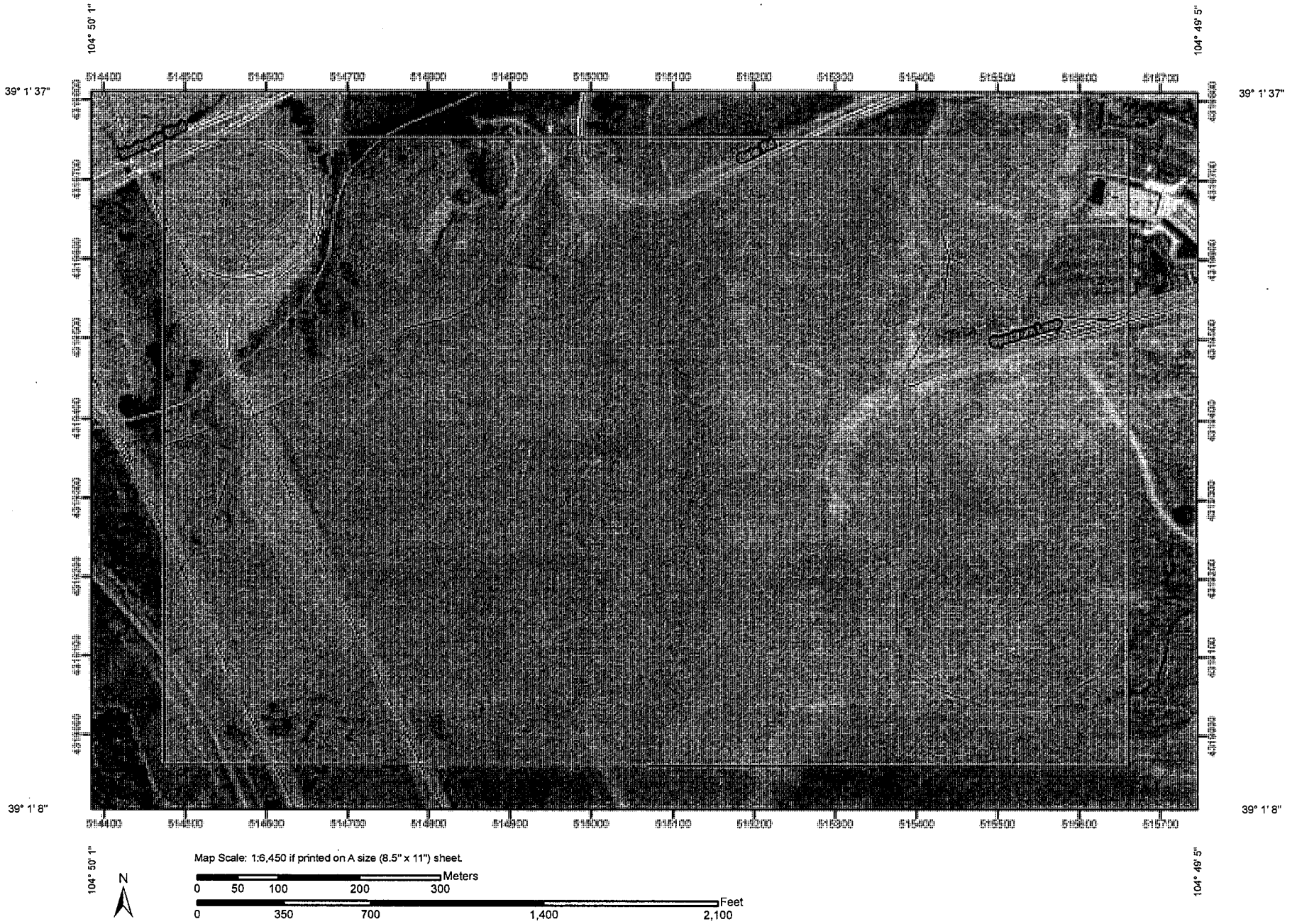
DRAWN BY	RJS
CHECKED BY	PJH
H-SCALE	1" = 100'
JOB NO.	1048.00
DATE CREATED	04/12/12
DATE ISSUED	06/07/12
SHEET NO	3 OF 3

SOILS MAP (S.C.S SURVEY)

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

AASHTO Group Classification (Surface)—El Paso County Area, Colorado
(BASS PRO SHOPS)



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Units

Soil Ratings
- A-1
- A-1-a
- A-1-b
- A-2
- A-2-4
- A-2-5
- A-2-6
- A-2-7
- A-3
- A-4
- A-5
- A-6
- A-7
- A-7-5
- A-7-6
- A-8
- Not rated or not available

Political Features
- Cities

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

MAP INFORMATION

Map Scale: 1:6,450 if printed on A size (8.5" × 11") sheet.

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 13N NAD83

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 8, Apr 6, 2011

Date(s) aerial images were photographed: 7/30/2005

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.

AASHTO Group Classification (Surface)

AASHTO Group Classification (Surface)— Summary by Map Unit — El Paso County Area, Colorado (CO625)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Blendon sandy loam, 0 to 3 percent slopes	A-2-4	8.2	3.5%
42	Kettle-Rock outcrop complex	A-1-b	0.0	0.0%
71	Pring coarse sandy loam, 3 to 8 percent slopes	A-2-4	152.1	65.8%
92	Tomah-Crowfoot loamy sands, 3 to 8 percent slopes	A-2-4	32.7	14.1%
93	Tomah-Crowfoot complex, 8 to 15 percent slopes	A-2-4	14.7	6.4%
101	Ustic Torrifluvents, loamy		23.5	10.2%
Totals for Area of Interest			**231.1**	**100.0%**

Description

AASHTO group classification is a system that classifies soils specifically for geotechnical engineering purposes that are related to highway and airfield construction. It is based on particle-size distribution and Atterberg limits, such as liquid limit and plasticity index. This classification system is covered in AASHTO Standard No. M 145-82. The classification is based on that portion of the soil that is smaller than 3 inches in diameter.

The AASHTO classification system has two general classifications: (i) granular materials having 35 percent or less, by weight, particles smaller than 0.074 mm in diameter and (ii) silt-clay materials having more than 35 percent, by weight, particles smaller than 0.074 mm in diameter. These two divisions are further subdivided into seven main group classifications, plus eight subgroups, for a total of fifteen for mineral soils. Another class for organic soils is used.

For each soil horizon in the database one or more AASHTO Group Classifications may be listed. One is marked as the representative or most commonly occurring. The representative classification is shown here for the surface layer of the soil.

Rating Options

Aggregation Method: Dominant Condition

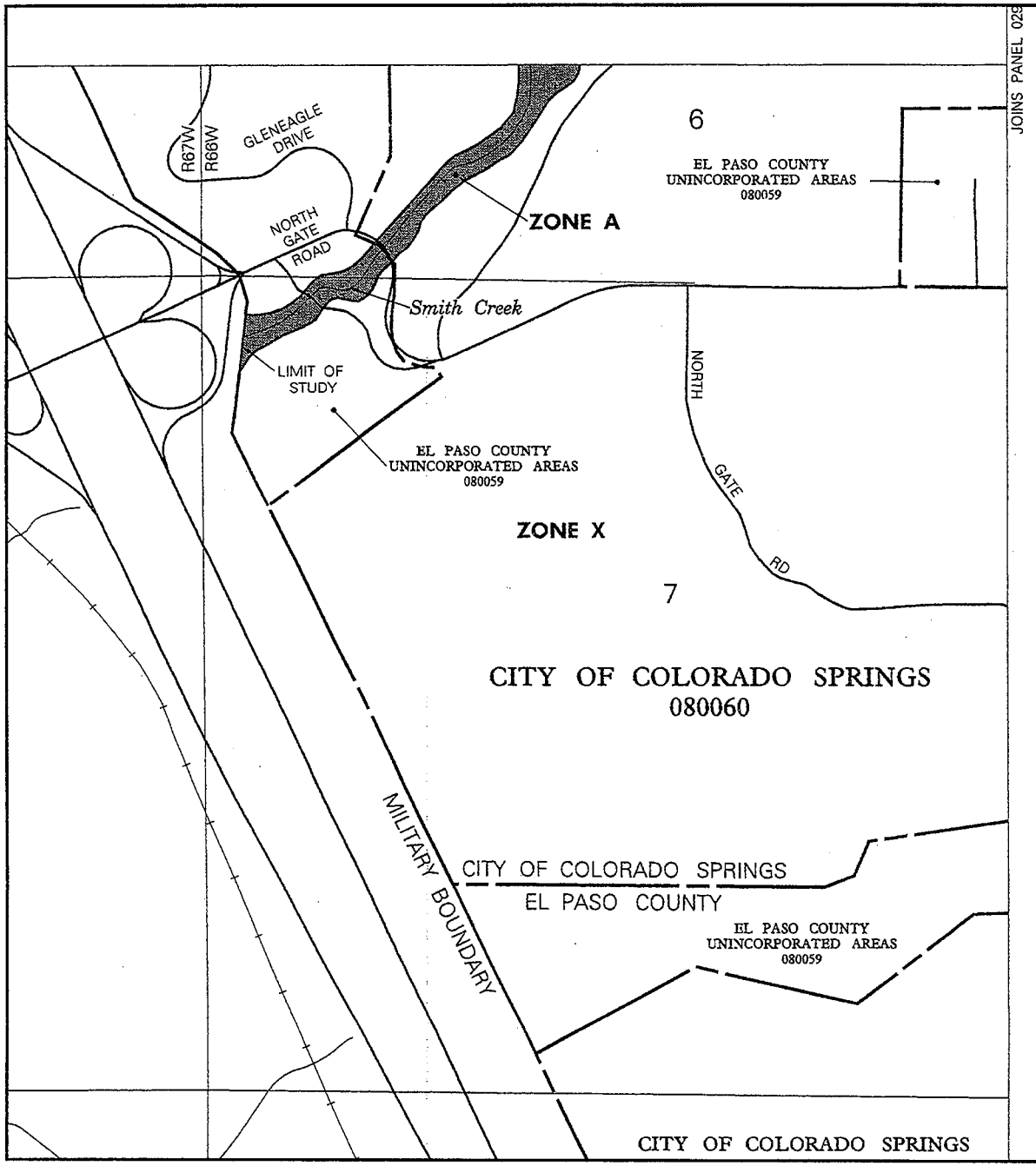
Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Layer Options: Surface Layer

F.E.M.A. MAP

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS



APPROXIMATE SCALE IN FEET

1000 0 1000

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 290 OF 1300

(SEE MAP INDEX FOR PANELS NOT PRINTED)

CONTAINS: COMMUNITY	NUMBER	PANEL	SUFFIX
COLORADO SPRINGS, CITY OF	080060	0290	F
EL PASO COUNTY, UNINCORPORATED AREAS	080059	0290	F

MAP NUMBER
08041C0290 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

HYDROLOGIC CALCULATIONS

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME: *BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER: *2363.00*
DATE: *06/18/12*
CALCULATED BY: *MAL*

MDDP & FDR ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS			LANDSCAPE/UNDEVELOPED AREAS			WEIGHTED		WEIGHTED CA	
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	CA(5)	CA(100)
A	3.27	2.92	0.90	0.90	0.35	0.25	0.35	0.83	0.84	**2.72**	**2.75**
B	3.67	3.67	0.90	0.90	0.00	0.25	0.35	0.90	0.90	**3.30**	**3.30**
C	1.48	1.29	0.90	0.95	0.19	0.25	0.35	0.82	0.87	**1.21**	**1.29**
D	6.22	6.22	0.90	0.90	0.00	0.25	0.35	0.90	0.90	**5.60**	**5.60**
E	1.26	1.26	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**1.13**	**1.20**
F	0.86	0.86	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**0.77**	**0.82**
H	11.14	9.27	0.90	0.90	1.87	0.25	0.35	0.79	0.81	**8.81**	**9.00**
I	6.60	6.60	0.90	0.90	0.00	0.25	0.35	0.90	0.90	**5.94**	**5.94**
J	5.21	5.21	0.90	0.90	0.00	0.25	0.35	0.90	0.90	**4.69**	**4.69**
K	0.49	0.49	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**0.44**	**0.47**
L	4.24	4.24	0.90	0.90	0.00	0.25	0.35	0.90	0.90	**3.82**	**3.82**
M	1.00	1.00	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**0.90**	**0.95**
N	0.77	0.77	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**0.69**	**0.73**
P	0.33	0.33	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**0.30**	**0.31**
Q	0.32	0.32	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**0.29**	**0.30**
BP-1	2.79	1.59	0.90	0.95	1.20	0.25	0.35	0.62	0.69	**1.73**	**1.93**
BP-2	0.62	0.40	0.90	0.95	0.22	0.25	0.35	0.67	0.74	**0.42**	**0.46**
BP-3	4.36	3.64	0.90	0.95	0.72	0.25	0.35	0.79	0.85	**3.46**	**3.71**

JOB NAME: *BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER: *2363.00*
DATE: *06/18/12*
CALCULATED BY: *MAL*

MDDP & FDR ~ BASIN RUNOFF COEFFICIENT SUMMARY

BASIN	TOTAL AREA (AC)	IMPERVIOUS AREA / STREETS			LANDSCAPE/UNDEVELOPED AREAS			WEIGHTED		WEIGHTED CA	
		AREA (AC)	C(5)	C(100)	AREA (AC)	C(5)	C(100)	C(5)	C(100)	CA(5)	CA(100)
BP-4	1.03	1.03	0.90	0.95	0.00	0.30	0.40	0.90	0.95	**0.93**	**0.98**
BP-5	1.78	1.78	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**1.60**	**1.69**
BP-6	2.67	2.31	0.90	0.95	0.36	0.25	0.35	0.81	0.87	**2.17**	**2.32**
BP-7	2.29	1.49	0.90	0.95	0.80	0.25	0.35	0.67	0.74	**1.54**	**1.70**
BP-8	3.52	2.31	0.90	0.95	1.21	0.25	0.35	0.68	0.74	**2.38**	**2.62**
BP-9	4.26	1.00	0.90	0.95	3.26	0.25	0.35	0.40	0.49	**1.72**	**2.09**
BP-10	1.31	0.00	0.90	0.95	1.31	0.25	0.35	0.25	0.35	**0.33**	**0.46**
BP-11	0.69	0.65	0.90	0.95	0.04	0.25	0.35	0.86	0.92	**0.60**	**0.63**
BP-12	0.96	0.91	0.90	0.95	0.05	0.25	0.35	0.87	0.92	**0.83**	**0.88**
EX-P1	15.32	0.00	0.90	0.95	15.32	0.25	0.35	0.25	0.35	**3.83**	**5.36**
OS-A	1.30	0.86	0.90	0.95	0.44	0.25	0.35	0.68	0.75	**0.88**	**0.97**
OS-B	0.86	0.82	0.90	0.95	0.04	0.25	0.35	0.87	0.92	**0.75**	**0.79**
OS-C	1.48	1.27	0.90	0.95	0.21	0.25	0.35	0.81	0.86	**1.20**	**1.28**
OS-D	1.27	1.27	0.90	0.95	0.00	0.25	0.35	0.90	0.95	**1.14**	**1.21**
EX-A	41.19	41.19	0.25	0.35	0.00	0.25	0.35	0.25	0.35	**10.30**	**14.42**
EX-B	18.65	18.65	0.25	0.35	0.00	0.25	0.35	0.25	0.35	**4.66**	**6.53**
EX-C	6.48	6.48	0.25	0.35	0.00	0.25	0.35	0.25	0.35	**1.62**	**2.27**
EX-D	9.99	9.99	0.25	0.35	0.00	0.25	0.35	0.25	0.35	**2.50**	**3.50**

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALC'D BY:	*MAL*

MDDP & FDR ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS					
	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(10) (cfs)	Q(25) (cfs)	Q(50) (cfs)	Q(100) (cfs)
A	2.72	2.75	0.25	25	6	2.8	460	4.0%	7.0	1.1	5.0	3.71	5.10	5.96	7.66	8.68	9.07	10.1	13.9	16.2	21.1	23.9	25.0
B	3.30	3.30	0.25	30	6	3.2	400	3.3%	6.3	1.1	5.0	3.71	5.10	5.96	7.66	8.68	9.07	12.3	16.9	19.7	25.3	28.7	30.0
C	1.21	1.29	0.25	5	0.5	1.7	620	2.2%	5.2	2.0	5.0	3.71	5.10	5.96	7.66	8.68	9.07	4.5	6.2	7.2	9.9	11.2	11.7
D	5.60	5.60	0.25	100	4	10.1	450	3.5%	6.5	1.1	11.2	2.85	3.92	4.58	5.89	6.67	6.98	16.0	22.0	25.6	32.9	37.3	39.0
E	1.13	1.20	0.25	5	0.5	1.7	1620	2.3%	5.3	5.1	6.7	3.41	4.69	5.48	7.04	7.98	8.35	3.9	5.3	6.2	8.4	9.6	10.0
F	0.77	0.82	0.25	5	0.5	1.7	1150	2.3%	5.3	3.6	5.3	3.66	5.03	5.87	7.55	8.56	8.95	2.8	3.9	4.5	6.2	7.0	7.3
H	8.81	9.00	0.25	80	5	7.8	600	3.3%	6.4	1.6	9.3	3.06	4.21	4.91	6.31	7.16	7.48	27.0	37.1	43.3	56.8	64.4	67.3
I	5.94	5.94	0.25	40	6	4.1	600	4.5%	7.4	1.3	5.5	3.63	4.99	5.82	7.48	8.48	8.87	21.5	29.6	34.6	44.4	50.4	52.7
J	4.69	4.69	0.25	50	2	7.1	500	2.8%	5.9	1.4	8.5	3.16	4.35	5.07	6.52	7.39	7.73	14.8	20.4	23.8	30.6	34.6	36.2
K	0.44	0.47	0.25	5	0.5	1.7	250	1.7%	4.6	0.9	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.6	2.3	2.6	3.6	4.0	4.2
L	3.82	3.82	0.25	35	2	5.3	315	2.0%	4.9	1.1	6.4	3.47	4.78	5.58	7.17	8.13	8.50	13.3	18.2	21.3	27.4	31.0	32.4
M	0.90	0.95	0.25	5	0.5	1.7	1000	3.0%	6.1	2.7	5.0	3.71	5.10	5.96	7.66	8.68	9.07	3.3	4.6	5.4	7.3	8.2	8.6
N	0.69	0.73	0.25	5	0.5	1.7	740	3.0%	6.1	2.0	5.0	3.71	5.10	5.96	7.66	8.68	9.07	2.6	3.5	4.1	5.6	6.3	6.6
P	0.30	0.31	0.25	5	0.5	1.7	300	3.0%	6.1	0.8	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.1	1.5	1.8	2.4	2.7	2.8
Q	0.29	0.30	0.25	5	0.5	1.7	300	3.0%	6.1	0.8	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.1	1.5	1.7	2.3	2.6	2.8

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALC'D BY:	*MAL*

MDDP & FDR ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS					
	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(10) (cfs)	Q(25) (cfs)	Q(50) (cfs)	Q(100) (cfs)
BP-1	1.73	1.93	0.25	130	18	7.6	100	1.5%	4.3	0.4	8.0	3.23	4.44	5.18	6.67	7.55	7.90	5.6	7.7	9.0	12.9	14.6	15.3
BP-2	0.42	0.46	0.25	20	2	3.3	220	2.5%	5.5	0.7	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.5	2.1	2.5	3.5	4.0	4.1
BP-3	3.46	3.71	0.25	30	5	3.4	660	2.0%	4.9	2.2	5.7	3.59	4.94	5.76	7.41	8.40	8.78	12.4	17.1	19.9	27.5	31.2	32.6
BP-4	0.93	0.98	0.9	5	1	0.3	250	2.0%	4.9	0.8	5.0	3.71	5.10	5.96	7.66	8.68	9.07	3.4	4.7	5.5	7.5	8.5	8.9
BP-5	1.60	1.69	0.9	5	1	0.3	250	2.0%	4.9	0.8	5.0	3.71	5.10	5.96	7.66	8.68	9.07	5.9	8.2	9.5	12.9	14.7	15.3
BP-6	2.17	2.32	0.9	100	2	3.0	330	2.0%	4.9	1.1	5.0	3.71	5.10	5.96	7.66	8.68	9.07	8.0	11.1	12.9	17.8	20.1	21.1
BP-7	1.54	1.70	0.25	30	2	4.7	550	2.7%	5.8	1.6	6.2	3.49	4.80	5.60	7.21	8.17	8.54	5.4	7.4	8.6	12.2	13.8	14.5
BP-8	2.38	2.62	0.25	80	8	6.6	275	4.0%	7.0	0.7	7.3	3.33	4.58	5.34	6.87	7.78	8.14	7.9	10.9	12.7	18.0	20.4	21.3
BP-9	1.72	2.09	0.25	160	15	9.6	480	2.0%	4.9	1.6	11.2	2.85	3.92	4.57	5.88	6.67	6.97	4.9	6.7	7.8	12.3	13.9	14.6
BP-10	0.33	0.46	0.25	10	3	1.6	500	5.6%	8.3	1.0	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.2	1.7	2.0	3.5	4.0	4.2
BP-11	0.60	0.63	0.25	5	0.5	1.7	1125	2.1%	5.1	3.7	5.4	3.64	5.01	5.85	7.52	8.52	8.91	2.2	3.0	3.5	4.7	5.4	5.6
BP-12	0.83	0.88	0.25	30	2	4.7	550	2.7%	5.8	1.6	6.2	3.49	4.80	5.60	7.21	8.17	8.54	2.9	4.0	4.7	6.4	7.2	7.5

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALC'D BY:	*MAL*

MDDP & FDR ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED		OVERLAND				STREET / CHANNEL FLOW				Tc	INTENSITY						TOTAL FLOWS					
	CA(5)	CA(100)	C(5)	Length (ft)	Height (ft)	Tc (min)	Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	TOTAL (min)	I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(10) (cfs)	Q(25) (cfs)	Q(50) (cfs)	Q(100) (cfs)
EX-P1	3.83	5.36	0.25	200	8	14.2	725	3.8%	6.8	1.8	16.0	2.44	3.36	3.92	5.04	5.71	5.97	9.4	12.9	15.0	27.0	30.6	32.0
OS-A	0.88	0.97	0.25	20	1	4.2	850	3.8%	6.8	2.1	6.3	3.49	4.80	5.60	7.20	8.16	8.54	3.1	4.2	5.0	7.0	7.9	8.3
OS-B	0.75	0.79	0.25	5	1	1.3	850	3.8%	6.8	2.1	5.0	3.71	5.10	5.96	7.66	8.68	9.07	2.8	3.8	4.5	6.1	6.9	7.2
OS-C	1.20	1.28	0.25	80	10	6.2	1000	2.5%	5.5	3.0	9.2	3.08	4.23	4.94	6.35	7.20	7.53	3.7	5.1	5.9	8.1	9.2	9.6
OS-D	1.14	1.21	0.25	5	1	1.3	1000	2.5%	5.5	3.0	5.0	3.71	5.10	5.96	7.66	8.68	9.07	4.2	5.8	6.8	9.2	10.5	10.9
EX-A	10.30	14.42	0.25	200	16	11.3	1500	3.6%	6.6	3.8	15.1	2.51	3.45	4.03	5.18	5.87	6.14	25.8	35.6	41.5	74.7	84.6	88.5
EX-B	4.66	6.53	0.25	250	10	15.9	1500	3.8%	6.8	3.7	19.6	2.21	3.05	3.56	4.57	5.18	5.42	10.3	14.2	16.6	29.8	33.8	35.4
EX-C	1.62	2.27	0.25	200	10	13.2	830	2.4%	5.4	2.6	15.8	2.46	3.38	3.95	5.08	5.75	6.02	4.0	5.5	6.4	11.5	13.0	13.6
EX-D	2.50	3.50	0.25	180	8	13.0	615	2.6%	5.6	1.8	14.9	2.53	3.48	4.06	5.22	5.91	6.18	6.3	8.7	10.1	18.2	20.7	21.6

HYDRAULIC CALCULATIONS
INCLUDING STORM WATER QUALITY CALCULATIONS

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME: *BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER: *2363.00*
DATE: *06/18/12*
CALCULATED BY: *MAL*

MDDP & FDR ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity						Flow						
					I(2)	I(5)	I(10)	I(25)	I(50)	I(100)	Q(2)	Q(5)	Q(10)	Q(25)	Q(50)	Q(100)	Inlet Size
1	BASIN A	2.72	2.75	5.0	3.71	5.10	5.96	7.66	8.68	9.07	10.1	13.9	16.2	21.1	23.9	25.0	FUT. DEVELOPMENT
2	BASIN B	3.30	3.30	5.0	3.71	5.10	5.96	7.66	8.68	9.07	12.3	16.9	19.7	25.3	28.7	30.0	FUT. DEVELOPMENT
3	BASIN C	1.21	1.29	5.0	3.71	5.10	5.96	7.66	8.68	9.07	4.5	6.2	7.2	9.9	11.2	11.7	10' AT-GRADE D-10-R
4	BASIN D	5.60	5.60	11.2	2.85	3.92	4.58	5.89	6.67	6.98	16.0	22.0	25.6	32.9	37.3	39.0	FUT. DEVELOPMENT
5	BASIN H	8.81	9.00	9.3	3.06	4.21	4.91	6.31	7.16	7.48	27.0	37.1	43.3	56.8	64.4	67.3	FUT. DEVELOPMENT
6a	BASIN E	1.13	1.20	6.7	3.41	4.69	5.48	7.04	7.98	8.35	3.9	5.3	6.2	8.4	9.6	10.0	10' AT-GRADE D-10-R
6b	Flow-By DP-3 + BASIN F	1.17	1.37	5.3	3.66	5.03	5.87	7.55	8.56	8.95	4.3	5.9	6.9	10.3	11.7	12.2	20' AT-GRADE D-10-R
7	BASIN OS-A	0.88	0.97	6.3	3.49	4.80	5.60	7.20	8.16	8.54	3.1	4.2	5.0	7.0	7.9	8.3	EX. 10' AT-GRADE
8	BASIN OS-B	0.75	0.79	5.0	3.71	5.10	5.96	7.66	8.68	9.07	2.8	3.8	4.5	6.1	6.9	7.2	EX. 10' AT-GRADE
9	FED-EX EXISTING POND	17.13	20.22	14.5	2.55	3.52	4.10	5.27	5.98	6.25	43.8	60.2	70.3	106.6	120.9	126.4	EX. FEDEX POND
10	Flow-By DP-7 + BASIN OS-C	1.47	1.68	9.2	3.08	4.23	4.94	6.35	7.20	7.53	4.5	6.2	7.2	10.7	12.1	12.7	STREET FLOW
11	BASIN OS-D	1.14	1.21	5.0	3.71	5.10	5.96	7.66	8.68	9.07	4.2	5.8	6.8	9.2	10.5	10.9	STREET FLOW
12	Flow-By DP-8 + BASIN M + DP-10	2.48	2.92	9.2	3.08	4.23	4.94	6.35	7.20	7.53	7.6	10.5	12.3	18.6	21.0	22.0	20' AT-GRADE INLET
13	DP-11 + BASIN N	1.84	1.94	5.0	3.71	5.10	5.96	7.66	8.68	9.07	6.8	9.4	10.9	14.8	16.8	17.6	20' AT-GRADE INLET
14	BASIN I	5.94	5.94	5.5	3.63	4.99	5.82	7.48	8.48	8.87	21.5	29.6	34.6	44.4	50.4	52.7	FUT. DEVELOPMENT
15	BASIN J	4.69	4.69	8.5	3.16	4.35	5.07	6.52	7.39	7.73	14.8	20.4	23.8	30.6	34.6	36.2	FUT. DEVELOPMENT
16	BASIN K	0.44	0.47	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.6	2.3	2.6	3.6	4.0	4.2	(2) 4' D-10-R SUMP INLETS
17	BASIN L	3.82	3.82	6.4	3.47	4.78	5.58	7.17	8.13	8.50	13.3	18.2	21.3	27.4	31.0	32.4	FUT. DEVELOPMENT

JOB NAME: *BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER: *2363.00*
DATE: *06/18/12*
CALCULATED BY: *MAL*

MDDP & FDR ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity						Flow						Inlet Size
					I(2)	I(5)	I(10)	I(25)	I(50)	I(100)	Q(2)	Q(5)	Q(10)	Q(25)	Q(50)	Q(100)	
18	BASIN BP-2	0.42	0.46	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.5	2.1	2.5	3.5	4.0	4.1	TRENCH DRAIN
19	BASIN BP-5	1.60	1.69	5.0	3.71	5.10	5.96	7.66	8.68	9.07	5.9	8.2	9.5	12.9	14.7	15.3	ROOF DRAIN SYSTEM
20	BASIN BP-1	1.73	1.93	8.0	3.23	4.44	5.18	6.67	7.55	7.90	5.6	7.7	9.0	12.9	14.6	15.3	6' D-10-R SUMP INLET
21	BASIN BP-4	0.93	0.98	5.0	3.71	5.10	5.96	7.66	8.68	9.07	3.4	4.7	5.5	7.5	8.5	8.9	ROOF DRAIN SYSTEM
22	Flow-By DP-6a + BASIN BP-3	3.81	4.24	6.7	3.41	4.69	5.48	7.04	7.98	8.35	13.0	17.9	20.8	29.9	33.9	35.4	20' D-10-R SUMP INLET + (2) AT-GRADE D-9 INLETS
23	BASIN BP-6	2.17	2.32	5.0	3.71	5.10	5.96	7.66	8.68	9.07	8.0	11.1	12.9	17.8	20.1	21.1	10' D-10-R SUMP INLET
24	Flow-By DP-6b + BASIN BP-7	1.67	2.03	6.2	3.49	4.80	5.60	7.21	8.17	8.54	5.8	8.0	9.4	14.6	16.6	17.3	20' CURB CUT W/RIPRAP RUN
25	BASIN BP-11	0.60	0.63	5.4	3.64	5.01	5.85	7.52	8.52	8.91	2.2	3.0	3.5	4.7	5.4	5.6	6' D-10-R SUMP INLET
26	BASIN BP-12	0.83	0.88	6.2	3.49	4.80	5.60	7.21	8.17	8.54	2.9	4.0	4.7	6.4	7.2	7.5	6' D-10-R SUMP INLET
27	BASIN BP-8	2.38	2.62	7.3	3.33	4.58	5.34	6.87	7.78	8.14	7.9	10.9	12.7	18.0	20.4	21.3	10' D-10-R SUMP INLET
28a	PIPE 36	21.96	22.81	15.5	2.48	3.41	3.98	5.12	5.80	6.06	54.4	74.9	87.4	116.7	132.2	138.3	RET. POND A - DET./SWQ FACILITY
28b	PIPE 17 + PIPE 21	33.62	34.02	11.7	2.81	3.86	4.50	5.79	6.56	6.86	94.3	129.8	151.4	197.1	223.3	233.5	RET. POND C - DET./SWQ FACILITY
28c	BASIN BP-9 + DP-28a + DP-28b + DP-24	58.97	60.95	15.5	2.48	3.41	3.98	5.12	5.80	6.06	146.1	201.1	234.6	311.8	353.4	369.6	TOTAL FLOW IN POND TO OUTLET BOX
29	Flow-By DP-12	0.71	1.12	9.2	3.08	4.23	4.94	6.35	7.20	7.53	2.2	3.0	3.5	7.1	8.1	8.5	STREET FLOW TO FUT. DEV.
30	Flow-By DP-13	0.44	0.65	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.6	2.3	2.6	5.0	5.7	5.9	STREET FLOW TO FUT. DEV.
31-EX	PIPE EX-FX + Flow-By DP-8 + DP-10 + DP-11 + BASIN EX-C	10.31	13.13	15.8	2.46	3.38	3.95	5.08	5.75	6.02	25.4	34.9	40.7	66.6	75.5	79.0	EXISTING SEDIMENT BASIN
31-DEV	PIPE EX-FX	5.97	7.68	14.5	2.55	3.52	4.10	5.27	5.98	6.25	15.2	21.0	24.5	40.5	45.9	48.0	EXISTING SEDIMENT BASIN
DBPS DP-12	PIPE 37 (POND RELEASE) + BASIN EX-P1	7.09	12.60	16.0	2.44	3.36	3.92	5.04	5.71	5.97	17.3	23.8	27.8	63.5	72.0	75.3	DPBS DP-12 (I-25 CULVERT)
DBPS DP-12A	EX-DBPS DP-12A	9.77	17.53	13.0	2.68	3.69	4.30	5.53	6.27	6.56	26.2	36.0	42.0	97.0	109.9	115.0	ALLOWABLE RELEASE FROM POND
DBPS DP-12	EX-DBPS DP-12	10.47	20.73	13.0	2.68	3.69	4.30	5.53	6.27	6.56	28.1	38.6	45.0	114.7	130.0	136.0	ALLOWABLE RELEASE FROM BASIN

JOB NAME: *BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER: *2363.00*
DATE: *06/18/12*
CALCULATED BY: *MAL*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

MDDP AND FDR ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity						Flow						
					I(2)	I(5)	I(10)	I(25)	I(50)	I(100)	Q(2)	Q(5)	Q(10)	Q(25)	Q(50)	Q(100)	Pipe Size*
1	DP-1	2.72	2.75	5.0	3.71	5.10	5.96	7.66	8.68	9.07	10.1	13.9	16.2	21.1	23.9	25.0	24"
2	DP-2	3.30	3.30	5.0	3.71	5.10	5.96	7.66	8.68	9.07	12.3	16.9	19.7	25.3	28.7	30.0	24"
3	PIPE 1 + PIPE 2	6.02	6.05	6.0	3.53	4.86	5.67	7.29	8.26	8.64	21.2	29.2	34.1	44.1	50.0	52.3	36"
4	PIPE 3 + DP-3 (Intercepted)	6.83	6.80	6.2	3.50	4.82	5.62	7.22	8.19	8.56	23.9	32.9	38.4	49.1	55.6	58.2	36"
5	DP-14	5.94	5.94	5.5	3.63	4.99	5.82	7.48	8.48	8.87	21.5	29.6	34.6	44.4	50.4	52.7	36"
6	PIPE 4 + PIPE 5	12.77	12.74	8.0	3.23	4.45	5.19	6.67	7.56	7.91	41.3	56.8	66.3	85.0	96.3	100.7	42"
7	DP-16 + PIPE 16	3.61	3.55	6.0	3.53	4.86	5.67	7.29	8.26	8.64	12.8	17.6	20.5	25.8	29.3	30.6	30"
8	DP-15	4.69	4.69	8.5	3.16	4.35	5.07	6.52	7.39	7.73	14.8	20.4	23.8	30.6	34.6	36.2	30"
10	DP-6b (Intercepted) + PIPE 8	5.73	5.72	8.5	3.16	4.35	5.07	6.52	7.39	7.73	18.1	24.9	29.0	37.3	42.3	44.2	30"
12	DP-6a (Intercepted)	0.78	0.66	6.7	3.41	4.69	5.48	7.04	7.98	8.35	2.7	3.7	4.3	4.7	5.3	5.5	18"
13	PIPE 6 + PIPE 10 + PIPE 12	19.28	19.12	10.3	2.95	4.06	4.73	6.08	6.89	7.21	56.8	78.2	91.2	116.3	131.8	137.9	54"
14	PIPE 7 + PIPE 13	22.90	22.67	10.4	2.94	4.04	4.71	6.06	6.87	7.18	67.2	92.5	108.0	137.4	155.7	162.8	54"
15	DP-13 (Intercepted)	1.40	1.28	5.0	3.71	5.10	5.96	7.66	8.68	9.07	5.2	7.1	8.3	9.8	11.1	11.6	24"
16	PIPE 15 + DP-12 (Intercepted)	3.17	3.08	5.0	3.71	5.10	5.96	7.66	8.68	9.07	11.8	16.2	18.9	23.6	26.7	28.0	30"
17	DP-17	3.82	3.82	6.4	3.47	4.78	5.58	7.17	8.13	8.50	13.3	18.2	21.3	27.4	31.0	32.4	30"
18	DP-21	0.93	0.98	5.0	3.71	5.10	5.96	7.66	8.68	9.07	3.4	4.7	5.5	7.5	8.5	8.9	18"
19	PIPE 18 + DP-22	4.73	5.22	6.7	3.41	4.69	5.48	7.04	7.98	8.35	16.1	22.2	25.9	36.8	41.7	43.6	30"

JOB NAME: *BASS PRO SHOPS - MDDP & FDR*
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DATE: *06/18/12*
CALCULATED BY: *MAL*

* PIPES ARE LISTED AT MAXIMUM SIZE REQUIRED TO ACCOMMODATE Q100 FLOWS AT MINIMUM GRADE.
REFER TO INDIVIDUAL PIPE SHEETS FOR HYDRAULIC INFORMATION.

MDDP AND FDR ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity						Flow						
					I(2)	I(5)	I(10)	I(25)	I(50)	I(100)	Q(2)	Q(5)	Q(10)	Q(25)	Q(50)	Q(100)	Pipe Size*
20	DP-23	2.17	2.32	5.0	3.71	5.10	5.96	7.66	8.68	9.07	8.0	11.1	12.9	17.8	20.1	21.1	24"
21	PIPE 14 + PIPE 19 + PIPE 20	29.80	30.21	11.7	2.81	3.86	4.50	5.79	6.56	6.86	83.6	115.1	134.2	175.0	198.3	207.4	54"
24	DP-4	5.60	5.60	11.2	2.85	3.92	4.58	5.89	6.67	6.98	16.0	22.0	25.6	32.9	37.3	39.0	30"
25	DP-5	8.81	9.00	9.3	3.06	4.21	4.91	6.31	7.16	7.48	27.0	37.1	43.3	56.8	64.4	67.3	36"
26	PIPE 24 + PIPE 25	14.41	14.60	13.2	2.66	3.66	4.27	5.49	6.22	6.51	38.3	52.8	61.5	80.2	90.9	95.0	42"
27	DP-18	0.42	0.46	5.0	3.71	5.10	5.96	7.66	8.68	9.07	1.5	2.1	2.5	3.5	4.0	4.1	18"
28	DP-19	1.60	1.69	5.0	3.71	5.10	5.96	7.66	8.68	9.07	5.9	8.2	9.5	12.9	14.7	15.3	24"
29	PIPE 27 + PIPE 28	2.02	2.15	5.0	3.71	5.10	5.96	7.66	8.68	9.07	7.5	10.3	12.0	16.4	18.6	19.5	24"
30	PIPE 26 + PIPE 29	16.43	16.74	13.6	2.63	3.62	4.23	5.43	6.16	6.44	43.2	59.5	69.4	91.0	103.1	107.8	48"
31	DP-20	1.73	1.93	8.0	3.23	4.44	5.18	6.67	7.55	7.90	5.6	7.7	9.0	12.9	14.6	15.3	24"
32	PIPE 30 + PIPE 31	18.16	18.67	13.8	2.61	3.59	4.19	5.39	6.11	6.39	47.4	65.2	76.1	100.6	114.0	119.3	48"
33	DP-25	0.60	0.63	5.4	3.64	5.01	5.85	7.52	8.52	8.91	2.2	3.0	3.5	4.7	5.4	5.6	18"
34	PIPE 33 + DP-26	1.43	1.51	6.2	3.49	4.80	5.60	7.21	8.17	8.54	5.0	6.9	8.0	10.9	12.4	12.9	24"
35	PIPE 34 + DP-27	3.81	4.13	7.3	3.33	4.58	5.34	6.87	7.78	8.14	12.7	17.4	20.3	28.4	32.2	33.6	30"
36	PIPE 32 + PIPE 35	21.96	22.81	15.5	2.48	3.41	3.98	5.12	5.80	6.06	54.4	74.9	87.4	116.7	132.2	138.3	48"
37	POND RELEASE	3.26	7.24	15.5	2.48	3.41	3.98	5.12	5.80	6.06	7.8	9.9	11.1	15.0	34.9	43.9	48"
EX-FX	DP-9 (FED-EX) POND RELEASE	5.97	7.68	14.5	2.55	3.52	4.10	5.27	5.98	6.25	15.2	21.0	24.5	40.5	45.9	48.0	EX. 36"

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
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FINAL DRAINAGE REPORT ~ PIPE TRAVEL TIMES

PIPE RUN	STREET / CHANNEL FLOW			
	Length *(ft)*	Slope *(%)*	Velocity *(fps)*	Tc *(min)*
1	300	2.0%	4.9	1.0
3	55	2.0%	4.9	0.2
4	530	2.0%	4.9	1.8
6	690	2.0%	4.9	2.3
13	28	2.0%	4.9	0.1
14	265	1.0%	3.5	1.3
16	300	2.0%	4.9	1.0
24	600	2.0%	4.9	2.0
26	100	2.0%	4.9	0.3
30	75	2.0%	4.9	0.3
32	500	2.0%	4.9	1.7

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
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CALCULATED BY:	*MAL*

DESIGN POINT 3 **100 YEAR FLOW**

Q(100)	11.7	I(100)	9.1		
DEPTH	0.36	Fr	1.96	Inlet size ? L(i) =	10
SPREAD	11.5	L(1)	17.4	If Li < L(2) then Qi =	6.7
CROSS SLOPE	2.0%	L(2)	10.4	If Li > L(2) then Qi =	7
STREET SLOPE	2.5%	L(3)	37.2	FB =	5.0
				CA(eqv.)=	0.55

5 YEAR FLOW

Q(5)	6.2	I(5)	5.1		
DEPTH	0.30	Fr	1.85	Inlet size ? L(i) =	10
SPREAD	8.8	L(1)	12.5	If Li < L(2) then Qi =	5
CROSS SLOPE	2.0%	L(2)	7.5	If Li > L(2) then Qi =	4.2
STREET SLOPE	2.5%	L(3)	26.8	FB =	2.0
				CA(eqv.)=	0.39

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
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CALCULATED BY:	*MAL*

DESIGN POINT 6a **100 YEAR FLOW**

Q(100)	10.0	I(100)	8.3		
DEPTH	0.38	Fr	1.87	Inlet size ? L(i) =	10
SPREAD	12.5	L(1)	18.0	If Li < L(2) then Qi =	5.5
CROSS SLOPE	2.0%	L(2)	10.8	If Li > L(2) then Qi =	6
STREET SLOPE	2.2%	L(3)	38.6	FB =	4.4
				CA(eqv.)=	0.53

5 YEAR FLOW

Q(5)	5.3	I(5)	4.7		
DEPTH	0.30	Fr	1.74	Inlet size ? L(i) =	10
SPREAD	8.8	L(1)	11.7	If Li < L(2) then Qi =	5
CROSS SLOPE	2.0%	L(2)	7.0	If Li > L(2) then Qi =	3.7
STREET SLOPE	2.2%	L(3)	25.1	FB =	1.6
				CA(eqv.)=	0.35

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DESIGN POINT 6b **100 YEAR FLOW**

Q(100)	12.2	I(100)	9.0		
DEPTH	0.39	Fr	1.89	Inlet size ? L(i) =	20
SPREAD	13.0	L(1)	18.9	If Li < L(2) then Qi =	13
CROSS SLOPE	2.0%	L(2)	11.3	If Li > L(2) then Qi =	9.2
STREET SLOPE	2.2%	L(3)	40.5	FB =	3.0
				CA(eqv.)=	0.34

5 YEAR FLOW

Q(5)	5.9	I(5)	5.0		
DEPTH	0.31	Fr	1.76	Inlet size ? L(i) =	20
SPREAD	9.3	L(1)	12.5	If Li < L(2) then Qi =	9
CROSS SLOPE	2.0%	L(2)	7.5	If Li > L(2) then Qi =	5.2
STREET SLOPE	2.2%	L(3)	26.9	FB =	0.7
				CA(eqv.)=	0.13

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
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CALCULATED BY:	*MAL*

DESIGN POINT 7 **100 YEAR FLOW**

Q(100)	8.3	I(100)	8.5		
DEPTH	0.30	Fr	2.61	Inlet size ? L(i) =	10
SPREAD	8.5	L(1)	17.1	If Li < L(2) then Qi =	5
CROSS SLOPE	2.0%	L(2)	10.2	If Li > L(2) then Qi =	5
STREET SLOPE	5.0%	L(3)	36.6	FB =	3.4
				CA(eqv.)=	0.40

5 YEAR FLOW

Q(5)	4.2	I(5)	4.8		
DEPTH	0.25	Fr	2.43	Inlet size ? L(i) =	10
SPREAD	6.3	L(1)	11.7	If Li < L(2) then Qi =	4
CROSS SLOPE	2.0%	L(2)	7.0	If Li > L(2) then Qi =	3
STREET SLOPE	5.0%	L(3)	25.0	FB =	1.3
				CA(eqv.)=	0.27

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
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DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 8 **100 YEAR FLOW**

Q(100)	7.2	I(100)	9.1		
DEPTH	0.28	Fr	2.53	Inlet size ? L(i) =	10
SPREAD	7.5	L(1)	14.6	If Li < L(2) then Qi =	5
CROSS SLOPE	2.0%	L(2)	8.8	If Li > L(2) then Qi =	5
STREET SLOPE	5.0%	L(3)	31.4	FB =	2.6
				CA(eqv.)=	0.29

5 YEAR FLOW

Q(5)	3.8	I(5)	5.1		
DEPTH	0.21	Fr	2.18	Inlet size ? L(i) =	10
SPREAD	4.3	L(1)	7.1	If Li < L(2) then Qi =	5
CROSS SLOPE	2.0%	L(2)	4.3	If Li > L(2) then Qi =	3
STREET SLOPE	5.0%	L(3)	15.3	FB =	0.6
				CA(eqv.)=	0.12

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 12 **100 YEAR FLOW**

Q(100)	22.0	I(100)	7.5		
DEPTH	0.48	Fr	2.33	Inlet size ? L(i) =	20
SPREAD	17.5	L(1)	31.4	If Li < L(2) then Qi =	14
CROSS SLOPE	2.0%	L(2)	18.9	If Li > L(2) then Qi =	13.5
STREET SLOPE	3.0%	L(3)	67.4	FB =	8.5
				CA(eqv.)=	1.12

5 YEAR FLOW

Q(5)	10.5	I(5)	4.2		
DEPTH	0.38	Fr	2.20	Inlet size ? L(i) =	20
SPREAD	12.8	L(1)	21.6	If Li < L(2) then Qi =	10
CROSS SLOPE	2.0%	L(2)	12.9	If Li > L(2) then Qi =	7.5
STREET SLOPE	3.0%	L(3)	46.2	FB =	3.0
				CA(eqv.)=	0.71

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
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CALCULATED BY:	*MAL*

DESIGN POINT 13 **100 YEAR FLOW**

Q(100)	17.6	I(100)	9.1		
DEPTH	0.43	Fr	2.27	Inlet size ? L(i) =	20
SPREAD	15.0	L(1)	26.2	If Li < L(2) then Qi =	13
CROSS SLOPE	2.0%	L(2)	15.7	If Li > L(2) then Qi =	11.6
STREET SLOPE	3.0%	L(3)	56.1	FB =	5.9
				CA(eqv.)=	0.65

5 YEAR FLOW

Q(5)	9.4	I(5)	5.1		
DEPTH	0.35	Fr	2.14	Inlet size ? L(i) =	20
SPREAD	11.3	L(1)	18.5	If Li < L(2) then Qi =	10
CROSS SLOPE	2.0%	L(2)	11.1	If Li > L(2) then Qi =	7.1
STREET SLOPE	3.0%	L(3)	39.7	FB =	2.3
				CA(eqv.)=	0.44

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 16

Total Flow: Q_5 = 2.3 cfs

Q_{100} = 4.2 cfs

Maximum allowable ponding depth at sump:

D_5 = 0.50

D_{100} = 0.67 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: [4] foot inlet required

100-Year Event: [4] foot inlet required

INSTALL A PUBLIC [4] FT D-10-R INLET TO ACCEPT BOTH 5YR & 100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 20

Total Flow: Q_5 = 7.7 cfs

Q_{100} = 15.3 cfs

Maximum allowable ponding depth at sump:

D_5 = 0.50

D_{100} = 0.67 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: [4] foot inlet required

100-Year Event: [6] foot inlet required

INSTALL A PUBLIC [6] FT D-10-R INLET TO ACCEPT BOTH 5YR & 100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 22

Total Flow: Q_5 = 17.9 cfs

Q_{100} = 35.4 cfs

Maximum allowable ponding depth at sump:

D_5 = 0.50

D_{100} = 0.67 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: [12] foot inlet required

100-Year Event: [20] foot inlet required

INSTALL A PUBLIC [20] FT D-10-R INLET TO ACCEPT BOTH 5YR & 100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 23

Total Flow: Q_5 = 11.1 cfs

Q_{100} = 21.1 cfs

Maximum allowable ponding depth at sump:

D_5 = 0.50

D_{100} = 0.67 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: 6 foot inlet required

100-Year Event: 10 foot inlet required

INSTALL A PUBLIC 10 FT D-10-R INLET TO ACCEPT BOTH 5YR & 100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 24

Total Flow: Q_5 = 8.0 cfs

Q_{100} = 17.3 cfs

Maximum allowable ponding depth at sump:

D_5 = 0.50

D_{100} = 0.67 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: [4] foot inlet required

100-Year Event: [6] foot inlet required

INSTALL A PUBLIC [6] FT D-10-R INLET TO ACCEPT BOTH 5YR & 100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 25

Total Flow: Q_5 = 3.0 cfs

Q_{100} = 5.6 cfs

Maximum allowable ponding depth at sump:

D_5 = 0.50

D_{100} = 0.67 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: [4] foot inlet required

100-Year Event: [4] foot inlet required

INSTALL A PUBLIC [6] FT D-10-R INLET TO ACCEPT BOTH 5YR & 100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 26

Total Flow: Q_5 = 4.0 cfs

Q_{100} = 7.5 cfs

Maximum allowable ponding depth at sump:

D_5 = 0.50

D_{100} = 0.67 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: [4] foot inlet required

100-Year Event: [4] foot inlet required

INSTALL A PUBLIC [6] FT D-10-R INLET TO ACCEPT BOTH 5YR & 100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.

JOB NAME:	*BASS PRO SHOPS - MDDP & FDR*
JOB NUMBER:	*2363.00*
DATE:	*06/18/12*
CALCULATED BY:	*MAL*

DESIGN POINT 27

Total Flow: Q_5 = 10.9 cfs

Q_{100} = 21.3 cfs

Maximum allowable ponding depth at sump:

D_5 = 0.50

D_{100} = 0.67 (dmax)

Qi = 1.7(Li+1.8(W))(dmax + w/12)^1.85

Clogging Factor = 1.25

Li (1.25) = Length of inlet opening

5-Year Event: [6] foot inlet required

100-Year Event: [10] foot inlet required

INSTALL A PUBLIC [10] FT D-10-R INLET TO ACCEPT BOTH 5YR & 100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.

JOB NAME:	Bass Pro Shops - Retention Pond
JOB NUMBER:	2363.00
BY:	MAL
DATE:	6/18/12

LAND USE		% IMPERVIOUS PER DCM	AREA (ENTER ACRES)	**IMPERVIOIUS AREA**
BUSINESS				
	COMMERCIAL	95	37.08	**35.23**
	NEIGHBORHOOD	70	-	-
			-	-
RESIDENTIAL			-	-
(AC)	1/8	65	-	-
	1/4	40	-	-
	1/3	30	-	-
	1/2	25	-	-
	1	20	-	-
			-	-
INDUSTRIAL			-	-
	LIGHT	80	-	-
	HEAVY	90	-	-
			-	-
PARKS & CEMETARY		7	-	-
PLAYGROUND		13	-	-
RAILROAD YARD		40	-	-
			-	-
UNDEVELOPED			-	-
	HISTORIC FLOW	2	-	-
	PASTURE/MEADOW	0	-	-
	FOREST	0	-	-
	EXPOSED ROCK	100	-	-
	OFFSITE FLOW	45	-	-
			-	-
STREETS			-	-
	PAVED	100	24.49	**24.49**
	GRAVEL	80	-	-
			-	-
DRIVES AND WALKS		100	-	-
LANDSCAPED		25	11.70	**2.93**
ROOFS		90	-	-
LAWNS		0	-	-
			-	-
TOTALS			*73.27*	***62.64***
WEIGHTED AVERAGE (%IMP)				**85.49%**

Design Procedure Form: Retention Pond (RP)

Designer: M. Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: June 16, 2012
Project: Bass Pro Shops - Retention Facility
Location: Northgate Business

1. Baseflow A) Is the permanent pool established by groundwater?	Choose One: ○ YES ◉ NO THE NET INFLUX OF WATER MUST BE AVAILABLE THROUGH A PERENNIAL BASEFLOW AND MUST EXCEED THE LOSSES.
2. Surcharge Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 85.5 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.855
C) Contributing Watershed Area	Area = 71.830 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) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time ($V_{WQCV} = (0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)	V_{WQCV} = 1.751 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) ($V_{WQCV\ OTHER} = (d_6 * (V_{WQCV} / 0.43))$)	$V_{WQCV\ OTHER}$ = 1.711 ac-ft
H) User Input of Water Quality Capture Volume (WQCV) (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$ = _____ 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: $EURV_A = (0.1878i - 0.0104) * Area$ For HSG B: $EURV_B = (0.1178i - 0.0042) * Area$ For HSG C/D: $EURV_{C/D} = (0.1043i - 0.0031) * Area$	EURV = 6.933 ac-ft
3. Basin Shape (It is recommended to have a basin length to width ratio between 2:1 and 3:1)	L : W = 15.0 : 1
4. Permanent Pool	
A) Minimum Permanent Pool Volume	V_{POOL} = 2.053 ac-ft
B) Depth of the Safety Wetland Bench (Recommended to be 6 to 12 inches deep)	D_{LZ} = 12 in
C) Depth of the Open Water Zone (Maximum depth of 12 feet)	D_{OWZ} = 5.0 ft
5. Side Slopes	
A) Maximum Side Slopes Above the Safety Wetland Bench (Horiz. dist. per unit vertical, should be no steeper than 4:1)	Z_{PP} = 4.00 ft / ft
B) Maximum Side Slopes Below the Safety Wetland Bench (Horiz. dist. per unit vertical, should be no steeper than 3:1)	Z_{OWZ} = 3.00 ft / ft
6. Inlet A) Describe means of providing energy dissipation at concentrated inflow locations:	Forebays with riprap berms

Design Procedure Form: Retention Pond (RP)

Designer: M. Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: June 16, 2012
Project: Bass Pro Shops - Retention Facility
Location: Northgate Business

7. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV): V_{FMIN} = 0.051 ac-ft

B) Actual Forebay Volume: V_F = 0.082 ac-ft

8. Outlet

A) Outlet Type

Choose One
- (•) Orifice Plate
- ( ) Other (Describe):

B) Depth of Surcharge Volume (Depth of WQCV or EURV depending on design concept): H = 5.5 feet

C) Volume to Drain Over Prescribed Time: EURV = 6.933 ac-ft

D) Drain Time (Min T_D for WQCV= 12 hours; Max T_D for EURV= 72 hours): T_D = 72 hours

E) Recommended Outlet Area per Row, (A_o): A_o = 10.365 square inches

F) Orifice Dimensions:
i) Circular Orifice Diameter or: $D_{orifice}$ = inches
ii) Width of 2" High Rectangular Orifice: $W_{orifice}$ = 5.18 inches

G) Number of Columns: nc = 1 number

H) Actual Design Outlet Area per Row (A_o): A_o = 10.36 square inches

I) Number of Rows (nr): nr = 16 number

J) Total Outlet Area (A_{ot}): A_{ot} = 170.9 square inches

K) Depth of WQCV (H_{WQCV}) (Estimate using actual stage-area-volume relationship and V_{WQCV}): H_{WQCV} = feet

L) Ensure Minimum 12 Hour Drain Time for WQCV: $T_{D\,WQCV}$ = hours

9. Trash Rack

A) Type of Outlet Opening

Choose One
- ( ) Circular (up to 2" diameter)
- (•) Rectangular (2" high)

B) Trash Rack Open Area: $A_t = 0.5 * 77(e^{-0.124D})*A_{ot}$: A_t = 5,442 square inches

C) For 2", or Smaller, Circular Opening (Reference figure in Fact Sheet T-12):

i) Depth of Trash Rack below Permanent Pool WS (28 inch min.): $D_{trashrack}$ = inches

ii) Width of Trash Rack and Concrete Opening ($W_{opening}$): $W_{opening}$ = inches

iii) Height of Trash Rack Screen (H_{TR}): H_{TR} = inches

iv) Type of Screen. Describe if "Other"

Choose One
- ( ) S.S. Well Screen with 60% Open Area*
- ( ) Other (Describe):

Design Procedure Form: Retention Pond (RP)

Designer: M. Larson
Company: Classic Consulting Engineers & Surveyors, LLC
Date: June 16, 2012
Project: Bass Pro Shops - Retention Facility
Location: Northgate Business

D) For 2" High **Rectangular Opening** (See Fact Sheet T-12):

i) Depth of Trash Rack below Permanent Pool WS (28 inch min.) — $D_{inundation}$ = 30.0 inches

ii) Width of Rectangular Opening ($W_{orifice}$) — W = 5.18 inches

iii) Width of Trash Rack Opening ($W_{opening}$) — $W_{opening}$ = 6.1 feet

iv) Height of Trash Rack Screen (H_{TR}) — H_{TR} = 8.0 feet

v) Type of Screen, (Describe if "Other")

Choose One
- (●) Aluminum Amico-Klemp SR Series (or equal)
- ( ) Other (Describe):

vi) Cross-bar Spacing — 4.00

vii) Minimum Bearing Bar Size — 2-1/4 in x 3/16 in

10. Overflow Embankment

A) Describe embankment protection for 100-year and greater overtopping: — Buried Riprap with 6" top soil cover for Vegetation planting

B) Maximum Embankment Side Slopes
(Horiz. dist. per unit vertical, should be no steeper than 4:1) — Z_E = 4.00 ft / ft

11. Maintenance Considerations

A) Describe Means of Draining the Pond — Retention Areas to be drained using pumps

12. Vegetation

Choose One
- (●) Irrigated
- ( ) Not Irrigated

13. Access

A) Describe Sediment Removal Procedures

Notes:

POND VOLUMES &
MODELING INFORMATION

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME:	Bass Pro Shops
JOB NUMBER:	2363.00
DATE:	06/18/12
CALCULATED BY:	MAL

Retention Area 'A'

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):	
6700.00	0.000	acres
6700.00	290	0.007 acres
6702.00	1,035	0.024 acres
6704.00	2,230	0.051 acres
6705.00	2,952	0.068 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	6,700	to	6,700	
0.03	AC-FT	from	6,700	to	6,702	0.03
0.07	AC-FT	from	6,702	to	6,704	0.10
0.06	AC-FT	from	6,704	to	6,705	0.16
-	AC-FT	from	6,705	to	-	0.16
-	AC-FT	from	-	to	-	0.16
-	AC-FT	from	-	to	-	0.16
-	AC-FT	from	-	to	-	0.16
-	AC-FT	from	-	to	-	0.16
-	AC-FT	from	-	to	-	0.16
-	AC-FT	from	-	to	-	0.16

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.160 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	0.16	=	6,950	1,738
6	0.16	=	6,950	1,158
8	0.16	=	6,950	869
10	0.16	=	6,950	695

JOB NAME: Bass Pro Shops
JOB NUMBER: 2363.00
DATE: 06/18/12
CALCULATED BY: MAL

Retention Area 'B'

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
6698.00
6698.00
6700.00
6702.00
6703.00

AREA (BTM to TOP):		
	0.000	acres
10,547	0.242	acres
15,212	0.349	acres
20,647	0.474	acres
23,427	0.538	acres
	0.000	acres
	0.000	acres
	0.000	acres
	0.000	acres
	0.000	acres
	0.000	acres
	0.000	acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

							CUMMULATIVE VOLUME:
-	AC-FT	from	6,698	to	6,698		
0.58	AC-FT	from	6,698	to	6,700		0.58
0.81	AC-FT	from	6,700	to	6,702		1.39
0.50	AC-FT	from	6,702	to	6,703		1.89
-	AC-FT	from	6,703	to	-		1.89
-	AC-FT	from	-	to	-		1.89
-	AC-FT	from	-	to	-		1.89
-	AC-FT	from	-	to	-		1.89
-	AC-FT	from	-	to	-		1.89
-	AC-FT	from	-	to	-		1.89
-	AC-FT	from	-	to	-		1.89

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 1.895 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	1.89	=	82,527	20,632
6	1.89	=	82,527	13,754
8	1.89	=	82,527	10,316
10	1.89	=	82,527	8,253

JOB NAME:	Bass Pro Shops
JOB NUMBER:	2363.00
DATE:	06/18/12
CALCULATED BY:	MAL

Retention Area 'C'

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):	
6698.00	0.000	acres
6698.00	3,313	0.076 acres
6700.00	5,311	0.122 acres
6702.00	7,690	0.177 acres
6703.00	9,092	0.209 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	6,698	to	6,698	
0.19	AC-FT	from	6,698	to	6,700	0.19
0.29	AC-FT	from	6,700	to	6,702	0.49
0.19	AC-FT	from	6,702	to	6,703	0.68
-	AC-FT	from	6,703	to	-	0.68
-	AC-FT	from	-	to	-	0.68
-	AC-FT	from	-	to	-	0.68
-	AC-FT	from	-	to	-	0.68
-	AC-FT	from	-	to	-	0.68
-	AC-FT	from	-	to	-	0.68
-	AC-FT	from	-	to	-	0.68

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.678 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	0.68	=	29,555	7,389
6	0.68	=	29,555	4,926
8	0.68	=	29,555	3,694
10	0.68	=	29,555	2,956

JOB NAME: Bass Pro Shops
JOB NUMBER: 2363.00
DATE: 06/18/12
CALCULATED BY: MAL

North Forebay

POND SIZING WITH PONDPACK EQUATION:

INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):	
6706.00		0.000 acres
6706.00	586	0.013 acres
6708.00	1,486	0.034 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

							CUMMULATIVE VOLUME:
-	AC-FT	from	6,706	to	6,706		
0.05	AC-FT	from	6,706	to	6,708		0.05
-	AC-FT	from	6,708	to	-		0.05
-	AC-FT	from	-	to	-		0.05
-	AC-FT	from	-	to	-		0.05
-	AC-FT	from	-	to	-		0.05
-	AC-FT	from	-	to	-		0.05
-	AC-FT	from	-	to	-		0.05
-	AC-FT	from	-	to	-		0.05
-	AC-FT	from	-	to	-		0.05

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.046 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	0.05	=	1,984	496
6	0.05	=	1,984	331
8	0.05	=	1,984	248
10	0.05	=	1,984	198

JOB NAME: Bass Pro Shops
JOB NUMBER: 2363.00
DATE: 06/18/12
CALCULATED BY: MAL

South Forebay

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):	
6706.00	0.000	acres
6706.00	1,229	0.028 acres
6708.00	2,469	0.057 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	6,706	to	6,706	
0.08	AC-FT	from	6,706	to	6,708	0.08
-	AC-FT	from	6,708	to	-	0.08
-	AC-FT	from	-	to	-	0.08
-	AC-FT	from	-	to	-	0.08
-	AC-FT	from	-	to	-	0.08
-	AC-FT	from	-	to	-	0.08
-	AC-FT	from	-	to	-	0.08
-	AC-FT	from	-	to	-	0.08
-	AC-FT	from	-	to	-	0.08
-	AC-FT	from	-	to	-	0.08

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 0.082 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	0.08	=	3,590	898
6	0.08	=	3,590	598
8	0.08	=	3,590	449
10	0.08	=	3,590	359

JOB NAME: Bass Pro Shops
JOB NUMBER: 2363.00
DATE: 06/18/12
CALCULATED BY: MAL

PROVIDED EURV

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):	
6703.00	0.000	acres
6703.00	32,519	0.747 acres
6704.00	36,758	0.844 acres
6705.00	55,595	1.276 acres
6706.00	62,349	1.431 acres
6708.00	84,599	1.942 acres
6708.50	96,348	2.212 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	6,703	to	6,703	
0.79	AC-FT	from	6,703	to	6,704	0.79
1.04	AC-FT	from	6,704	to	6,705	1.83
1.34	AC-FT	from	6,705	to	6,706	3.17
3.33	AC-FT	from	6,706	to	6,708	6.50
1.03	AC-FT	from	6,708	to	6,709	7.52
-	AC-FT	from	6,709	to	-	7.52
-	AC-FT	from	-	to	-	7.52
-	AC-FT	from	-	to	-	7.52
-	AC-FT	from	-	to	-	7.52
-	AC-FT	from	-	to	-	7.52

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 7.523 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	7.52	=	#######	81,922
6	7.52	=	#######	54,615
8	7.52	=	#######	40,961
10	7.52	=	#######	32,769

JOB NAME: Bass Pro Shops
JOB NUMBER: 2363.00
DATE: 06/18/12
CALCULATED BY: MAL

VOLUME TO SPILLWAY

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)	AREA (BTM to TOP):	
6703.00	0.000	acres
6703.00	32,519	0.747 acres
6704.00	36,758	0.844 acres
6705.00	45,561	1.046 acres
6706.00	62,349	1.431 acres
6708.00	84,508	1.940 acres
6710.00	112,880	2.591 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres
		0.000 acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

						CUMMULATIVE VOLUME:
-	AC-FT	from	6,703	to	6,703	
0.79	AC-FT	from	6,703	to	6,704	0.79
0.93	AC-FT	from	6,704	to	6,705	1.72
1.22	AC-FT	from	6,705	to	6,706	2.94
3.32	AC-FT	from	6,706	to	6,708	6.27
4.47	AC-FT	from	6,708	to	6,710	10.74
-	AC-FT	from	6,710	to	-	10.74
-	AC-FT	from	-	to	-	10.74
-	AC-FT	from	-	to	-	10.74
-	AC-FT	from	-	to	-	10.74
-	AC-FT	from	-	to	-	10.74

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 10.737 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	10.74	=	#######	116,927
6	10.74	=	#######	77,952
8	10.74	=	#######	58,464
10	10.74	=	#######	46,771

JOB NAME: Bass Pro Shops
JOB NUMBER: 2363.00
DATE: 06/18/12
CALCULATED BY: MAL

EXCESS VOLUME

POND SIZING WITH PONDPACK EQUATION:
INSERT POND DESIGN SIZE INFO: (RED)

POND ELEVATION : (from lowest to highest)
6709.06
6709.06
6710.00

AREA (BTM to TOP):	
	0.000 acres
102,508	2.353 acres
112,880	2.591 acres
	0.000 acres
	0.000 acres
	0.000 acres
	0.000 acres
	0.000 acres
	0.000 acres
	0.000 acres
	0.000 acres
	0.000 acres

PRELIMINARY SIZE:

VOLUME = 1/3{(EL2-EL1)*(A1+A2+((A1*A2)^.5))}

							CUMMULATIVE VOLUME:
-	AC-FT	from	6,709	to	6,709		
2.30	AC-FT	from	6,709	to	6,710		2.30
-	AC-FT	from	6,710	to	-		2.30
-	AC-FT	from	-	to	-		2.30
-	AC-FT	from	-	to	-		2.30
-	AC-FT	from	-	to	-		2.30
-	AC-FT	from	-	to	-		2.30
-	AC-FT	from	-	to	-		2.30
-	AC-FT	from	-	to	-		2.30
-	AC-FT	from	-	to	-		2.30
-	AC-FT	from	-	to	-		2.30

*SIZING IS FOR PRELIMINARY PURPOSES ONLY.

VOLUME = 2.300 AC-FT

APPROXIMATE SURFACE AREA REQUIREMENT

POND DEPTH (FT)	POND VOLUME AC-FT		CF	SURFACE AREA (SF)
4	2.30	=	######	25,045
6	2.30	=	######	16,697
8	2.30	=	######	12,523
10	2.30	=	######	10,018

Bass Pro at Northgate Filing No. 1 Developed Conditions

Project Summary	
Title	Bass Pro Shops Filing No. 1
Engineer	M. Larson
Company	Classic Consulting
Date	4/17/2012

Notes

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Catchments Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
CM-1	Post-Development 2 year	2	3.901	0.259	128.64
CM-1	Post-Development 5 year	5	5.368	0.259	177.04
CM-1	Post-Development 10 year	10	6.264	0.259	206.57
CM-1	Post-Development 25 year	25	8.052	0.259	265.54
CM-1	Post-Development 50 year	50	9.127	0.259	300.98
CM-1	Post-Development 100 year	100	9.545	0.259	314.76

Node Summary

Label	Scenario	Return Event (years)	Hydrograph Volume (ac-ft)	Time to Peak (hours)	Peak Flow (ft^3/s)
O-1	Post-Development 2 year	2	5.954	0.600	7.82
O-1	Post-Development 5 year	5	8.227	0.600	9.94
O-1	Post-Development 10 year	10	9.601	0.600	11.11
O-1	Post-Development 25 year	25	12.328	0.600	14.97
O-1	Post-Development 50 year	50	13.960	0.600	34.91
O-1	Post-Development 100 year	100	14.595	0.600	43.92

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)
PO-1 (IN)	Post-Development 2 year	2	6.582	0.300	128.64	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 2 year	2	5.954	0.600	7.82	6,706.35	3.658

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)
PO-1 (IN)	Post-Development 5 year	5	9.059	0.300	177.04	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 5 year	5	8.227	0.600	9.94	6,707.22	5.050
PO-1 (IN)	Post-Development 10 year	10	10.570	0.300	206.57	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 10 year	10	9.601	0.600	11.11	6,707.69	5.904
PO-1 (IN)	Post-Development 25 year	25	13.588	0.300	265.54	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 25 year	25	12.328	0.600	14.97	6,708.54	7.618
PO-1 (IN)	Post-Development 50 year	50	15.401	0.300	300.98	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 50 year	50	13.960	0.600	34.91	6,708.92	8.487
PO-1 (IN)	Post-Development 100 year	100	16.106	0.300	314.76	(N/A)	(N/A)
PO-1 (OUT)	Post-Development 100 year	100	14.595	0.600	43.92	6,709.06	8.792

Subsection: Outlet Input Data
Return Event: 100 years

Label: Composite Outlet Structure - 1
Storm Event: C/S - Type IIA - Rational - 100 Year

Requested Pond Water Surface Elevations	
Minimum (Headwater)	6,703.00 ft
Increment (Headwater)	0.50 ft
Maximum (Headwater)	6,710.00 ft

Outlet Connectivity

Structure Type	Outlet ID	Direction	Outfall	E1 (ft)	E2 (ft)
Inlet Box	Riser - 1	Forward	Culvert - 1	6,708.50	6,710.00
Orifice-Area	Orifice - 1	Forward	Culvert - 1	6,703.17	6,710.00
Culvert-Circular	Culvert - 1	Forward	TW	6,697.62	6,710.00
Tailwater Settings	Tailwater			(N/A)	(N/A)

Subsection: Outlet Input Data
Return Event: 100 years

Label: Composite Outlet Structure - 1
Storm Event: C/S - Type IIA - Rational - 100 Year

Structure ID: Riser - 1 Structure Type: Inlet Box	
Number of Openings	1
Elevation	6,708.50 ft
Orifice Area	24.0 ft²
Orifice Coefficient	0.600
Weir Length	24.00 ft
Weir Coefficient	3.00 (ft^0.5)/s
K Reverse	1.000
Manning's n	0.000
Kev, Charged Riser	0.000
Weir Submergence	False
Orifice H to crest	False

Subsection: Outlet Input Data
Return Event: 100 years

Label: Composite Outlet Structure - 1
Storm Event: C/S - Type IIA - Rational - 100 Year

Structure ID: Culvert - 1 Structure Type: Culvert-Circular	
Number of Barrels	1
Diameter	36.0 in
Length	95.35 ft
Length (Computed Barrel)	95.97 ft
Slope (Computed)	0.115 ft/ft

Outlet Control Data	
Manning's n	0.013
Ke	0.200
Kb	0.007
Kr	0.000
Convergence Tolerance	0.00 ft

Inlet Control Data	
Equation Form	Form 1
K	0.0045
M	2.0000
C	0.0317
Y	0.6900
T1 ratio (HW/D)	1.038
T2 ratio (HW/D)	1.140
Slope Correction Factor	-0.500

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

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

T1 Elevation	6,700.73 ft	T1 Flow	42.85 ft^3/s
T2 Elevation	6,701.04 ft	T2 Flow	48.97 ft^3/s

Structure ID: Orifice - 1 Structure Type: Orifice-Area	
Number of Openings	16
Elevation	6,703.17 ft
Orifice Area	0.1 ft²
Top Elevation	6,708.25 ft
Datum Elevation	6,703.17 ft
Orifice Coefficient	0.600

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

Convergence Tolerances	
Maximum Iterations	30
Tailwater Tolerance (Minimum)	0.01 ft
Tailwater Tolerance (Maximum)	0.50 ft
Headwater Tolerance (Minimum)	0.01 ft
Headwater Tolerance (Maximum)	0.50 ft
Flow Tolerance (Minimum)	0.001 ft³/s
Flow Tolerance (Maximum)	10.000 ft³/s

Subsection: Level Pool Pond Routing Summary
Return Event: 2 years

Label: PO-1 (IN)
Storm Event: C/S - Type IIA - Rational - 2 Year

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,703.00 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

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	128.64 ft³/s	Time to Peak (Flow, In)	0.300 hours
Flow (Peak Outlet)	7.82 ft³/s	Time to Peak (Flow, Outlet)	0.600 hours

Elevation (Water Surface, Peak)	6,706.35 ft
Volume (Peak)	3.658 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	6.582 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	5.954 ac-ft
Volume (Retained)	0.619 ac-ft
Volume (Unrouted)	-0.009 ac-ft
Error (Mass Balance)	0.1 %

Subsection: Level Pool Pond Routing Summary
Return Event: 5 years

Label: PO-1 (IN)
Storm Event: C/S - Type IIA - Rational - 5 Year

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,703.00 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

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	177.04 ft³/s	Time to Peak (Flow, In)	0.300 hours
Flow (Peak Outlet)	9.94 ft³/s	Time to Peak (Flow, Outlet)	0.600 hours

Elevation (Water Surface, Peak)	6,707.22 ft
Volume (Peak)	5.050 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	9.059 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	8.227 ac-ft
Volume (Retained)	0.823 ac-ft
Volume (Unrouted)	-0.009 ac-ft
Error (Mass Balance)	0.1 %

Subsection: Level Pool Pond Routing Summary
Return Event: 10 years

Label: PO-1 (IN)
Storm Event: C/S - Type IIA - Rational - 10 Year

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,703.00 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

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	206.57 ft³/s	Time to Peak (Flow, In)	0.300 hours
Flow (Peak Outlet)	11.11 ft³/s	Time to Peak (Flow, Outlet)	0.600 hours

Elevation (Water Surface, Peak)	6,707.69 ft
Volume (Peak)	5.904 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	10.570 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	9.601 ac-ft
Volume (Retained)	0.954 ac-ft
Volume (Unrouted)	-0.015 ac-ft
Error (Mass Balance)	0.1 %

Subsection: Level Pool Pond Routing Summary
Return Event: 25 years

Label: PO-1 (IN)
Storm Event: C/S - Type IIA - Rational - 25 Year

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,703.00 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

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	265.54 ft³/s	Time to Peak (Flow, In)	0.300 hours
Flow (Peak Outlet)	14.97 ft³/s	Time to Peak (Flow, Outlet)	0.600 hours

Elevation (Water Surface, Peak)	6,708.54 ft
Volume (Peak)	7.618 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	13.588 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	12.328 ac-ft
Volume (Retained)	1.244 ac-ft
Volume (Unrouted)	-0.017 ac-ft
Error (Mass Balance)	0.1 %

Subsection: Level Pool Pond Routing Summary
Return Event: 50 years

Label: PO-1 (IN)
Storm Event: C/S - Type IIA - Rational - 50 Year

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,703.00 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

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	300.98 ft³/s	Time to Peak (Flow, In)	0.300 hours
Flow (Peak Outlet)	34.91 ft³/s	Time to Peak (Flow, Outlet)	0.600 hours

Elevation (Water Surface, Peak)	6,708.92 ft
Volume (Peak)	8.487 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	15.401 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	13.960 ac-ft
Volume (Retained)	1.421 ac-ft
Volume (Unrouted)	-0.020 ac-ft
Error (Mass Balance)	0.1 %

Subsection: Level Pool Pond Routing Summary
Return Event: 100 years

Label: PO-1 (IN)
Storm Event: C/S - Type IIA - Rational - 100 Year

Infiltration	
Infiltration Method (Computed)	No Infiltration

Initial Conditions	
Elevation (Water Surface, Initial)	6,703.00 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

Inflow/Outflow Hydrograph Summary			
Flow (Peak In)	314.76 ft³/s	Time to Peak (Flow, In)	0.300 hours
Flow (Peak Outlet)	43.92 ft³/s	Time to Peak (Flow, Outlet)	0.600 hours

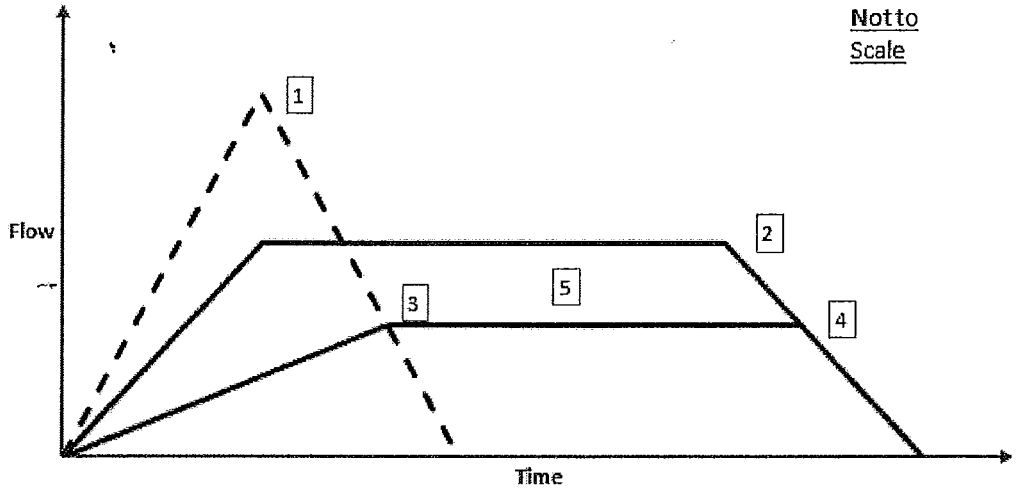
Elevation (Water Surface, Peak)	6,709.06 ft
Volume (Peak)	8.792 ac-ft

Mass Balance (ac-ft)	
Volume (Initial)	0.000 ac-ft
Volume (Total Inflow)	16.106 ac-ft
Volume (Total Infiltration)	0.000 ac-ft
Volume (Total Outlet Outflow)	14.595 ac-ft
Volume (Retained)	1.489 ac-ft
Volume (Unrouted)	-0.022 ac-ft
Error (Mass Balance)	0.1 %

Subsection: Modified Rational Graph
Return Event: 2 years

Label: CM-1
Storm Event: C/S - Type IIA - Rational - 2 Year

Method Type	Method T
Time of Duration (Modified Rational, Critical)	0.367 hours



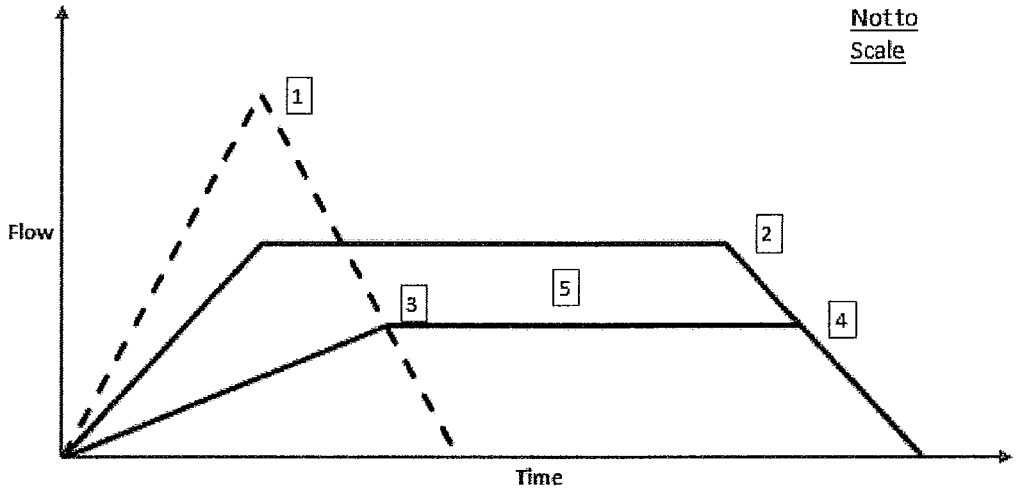
[1]			[2]		
Time of Concentration (Modified Rational, Composite)	0.258	hours	Time of Duration (Modified Rational, Critical)	0.367	hours
Intensity (Modified Rational, Peak)	2.484	in/h	Intensity (Modified Rational, Critical)	2.093	in/h
Flow (Modified Rational, Peak)	152.63	ft³/s	Flow (Modified Rational, Critical)	128.64	ft³/s

[3]	
First Outflow Breakpoint (Modified Rational, Method T)	0.489 hours
Flow (Modified Rational, Allowable)	67.50 ft³/s

[4]			[5]		
Second Outflow Breakpoint (Modified Rational)	0.402	hours	Storage (Modified Rational, Estimated)	1.912	ac-ft
Flow (Modified Rational, Allowable)	67.50	ft³/s			

Subsection: Modified Rational Graph
Return Event: 5 years
Label: CM-1
Storm Event: C/S - Type IIA - Rational - 5 Year

Method Type	Method T
Time of Duration (Modified Rational, Critical)	0.367 hours



[1]			[2]		
Time of Concentration (Modified Rational, Composite)	0.258	hours	Time of Duration (Modified Rational, Critical)	0.367	hours
Intensity (Modified Rational, Peak)	3.417	in/h	Intensity (Modified Rational, Critical)	2.881	in/h
Flow (Modified Rational, Peak)	210.02	ft³/s	Flow (Modified Rational, Critical)	177.04	ft³/s

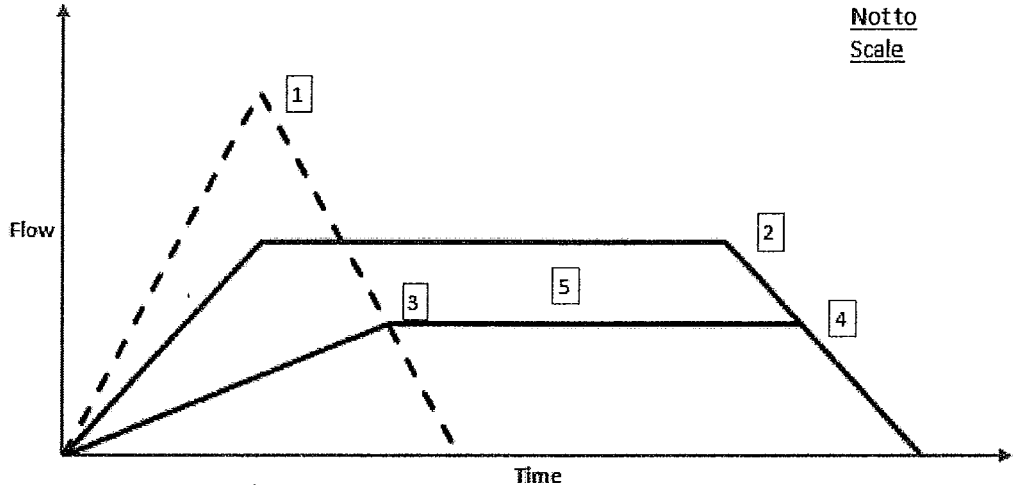
[3]	
First Outflow Breakpoint (Modified Rational, Method T)	0.489 hours
Flow (Modified Rational, Allowable)	92.90 ft³/s

[4]			[5]		
Second Outflow Breakpoint (Modified Rational)	0.402	hours	Storage (Modified Rational, Estimated)	2.631	ac-ft
Flow (Modified Rational, Allowable)	92.90	ft³/s			

Subsection: Modified Rational Graph
Label: CM-1

Return Event: 10 years
Storm Event: C/S - Type IIA - Rational - 10 Year

Method Type	Method T
Time of Duration (Modified Rational, Critical)	0.367 hours



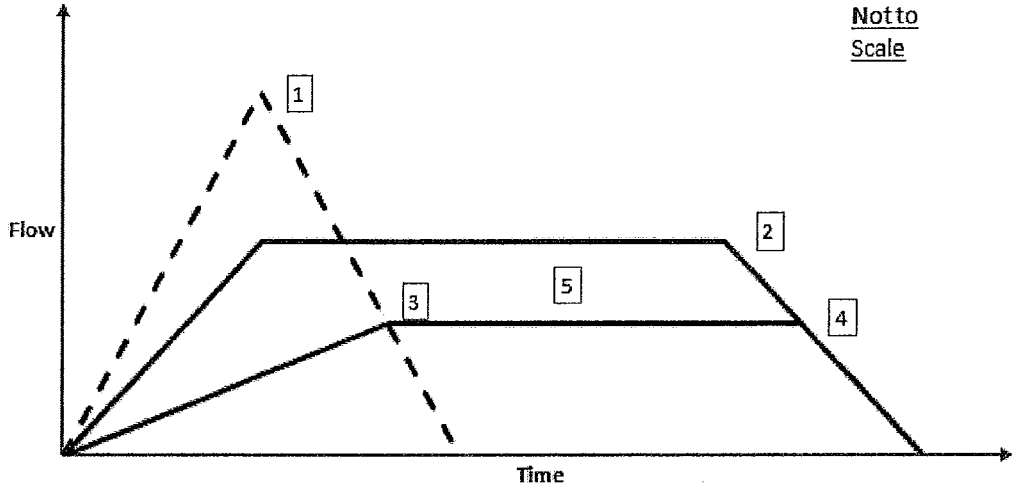
[1]			[2]		
Time of Concentration (Modified Rational, Composite)	0.258	hours	Time of Duration (Modified Rational, Critical)	0.367	hours
Intensity (Modified Rational, Peak)	3.987	in/h	Intensity (Modified Rational, Critical)	3.361	in/h
Flow (Modified Rational, Peak)	245.02	ft³/s	Flow (Modified Rational, Critical)	206.57	ft³/s

[3]	
First Outflow Breakpoint (Modified Rational, Method T)	0.489 hours
Flow (Modified Rational, Allowable)	108.39 ft³/s

[4]			[5]		
Second Outflow Breakpoint (Modified Rational)	0.402	hours	Storage (Modified Rational, Estimated)	3.071	ac-ft
Flow (Modified Rational, Allowable)	108.39	ft³/s			

Subsection: Modified Rational Graph
Return Event: 25 years
Label: CM-1
Storm Event: C/S - Type IIA - Rational - 25 Year

Method Type	Method T
Time of Duration (Modified Rational, Critical)	0.367 hours



[1]			[2]		
Time of Concentration (Modified Rational, Composite)	0.258	hours	Time of Duration (Modified Rational, Critical)	0.367	hours
Intensity (Modified Rational, Peak)	5.126	in/h	Intensity (Modified Rational, Critical)	4.321	in/h
Flow (Modified Rational, Peak)	315.02	ft³/s	Flow (Modified Rational, Critical)	265.54	ft³/s

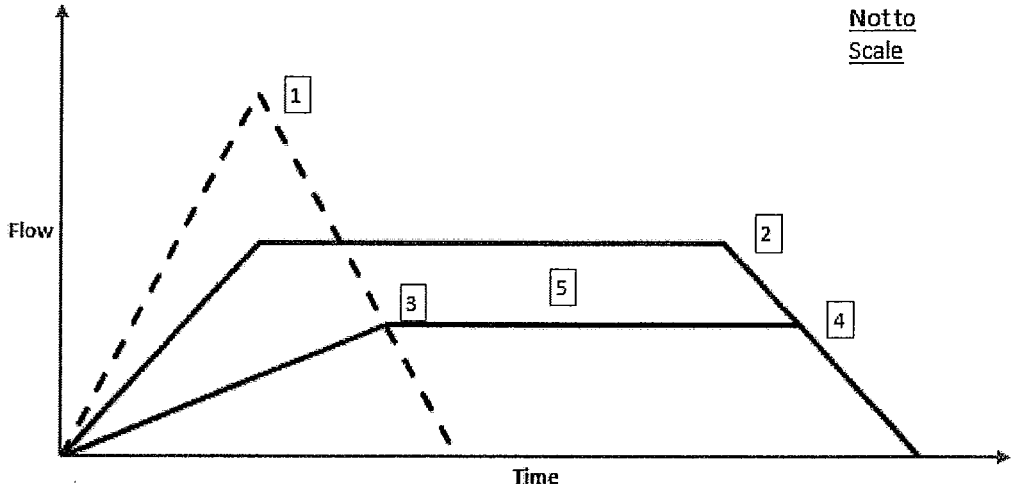
[3]	
First Outflow Breakpoint (Modified Rational, Method T)	0.489 hours
Flow (Modified Rational, Allowable)	139.33 ft³/s

[4]			[5]		
Second Outflow Breakpoint (Modified Rational)	0.402	hours	Storage (Modified Rational, Estimated)	3.947	ac-ft
Flow (Modified Rational, Allowable)	139.33	ft³/s			

Subsection: Modified Rational Graph
Label: CM-1

Return Event: 50 years
Storm Event: C/S - Type IIA - Rational - 50 Year

Method Type	Method T
Time of Duration (Modified Rational, Critical)	0.367 hours



[1]			[2]		
Time of Concentration (Modified Rational, Composite)	0.258	hours	Time of Duration (Modified Rational, Critical)	0.367	hours
Intensity (Modified Rational, Peak)	5.810	in/h	Intensity (Modified Rational, Critical)	4.897	in/h
Flow (Modified Rational, Peak)	357.06	ft³/s	Flow (Modified Rational, Critical)	300.98	ft³/s

[3]	
First Outflow Breakpoint (Modified Rational, Method T)	0.489 hours
Flow (Modified Rational, Allowable)	157.94 ft³/s

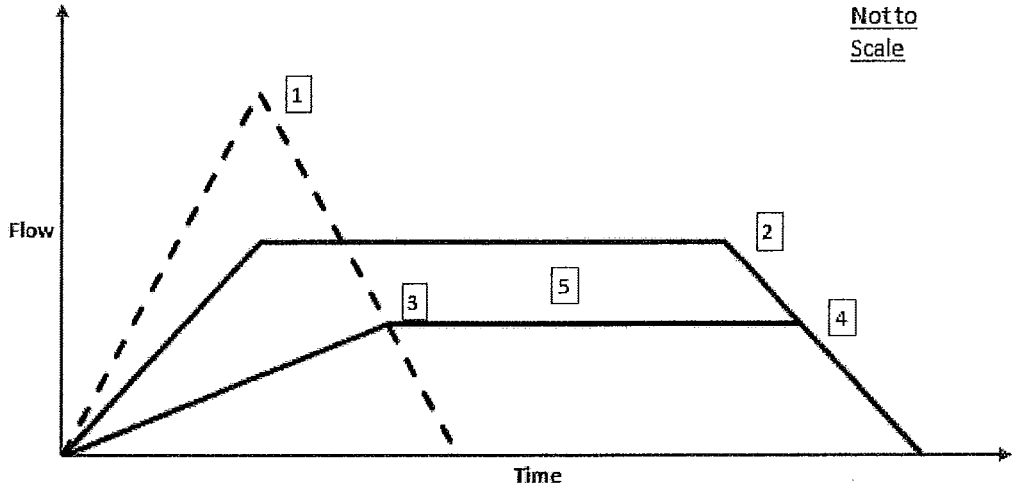
[4]			[5]		
Second Outflow Breakpoint (Modified Rational)	0.402	hours	Storage (Modified Rational, Estimated)	4.474	ac-ft
Flow (Modified Rational, Allowable)	157.94	ft³/s			

Bass Pro at Northgate Filing No. 1 Developed Conditions

Subsection: Modified Rational Graph
Label: CM-1

Return Event: 100 years
Storm Event: C/S - Type IIA - Rational - 100 Year

Method Type	Method T
Time of Duration (Modified Rational, Critical)	0.367 hours



[1]			[2]		
Time of Concentration (Modified Rational, Composite)	0.258	hours	Time of Duration (Modified Rational, Critical)	0.367	hours
Intensity (Modified Rational, Peak)	6.076	in/h	Intensity (Modified Rational, Critical)	5.122	in/h
Flow (Modified Rational, Peak)	373.39	ft³/s	Flow (Modified Rational, Critical)	314.76	ft³/s

[3]	
First Outflow Breakpoint (Modified Rational, Method T)	0.489 hours
Flow (Modified Rational, Allowable)	165.14 ft³/s

[4]			[5]		
Second Outflow Breakpoint (Modified Rational)	0.402	hours	Storage (Modified Rational, Estimated)	4.679	ac-ft
Flow (Modified Rational, Allowable)	165.14	ft³/s			

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DRAINAGE CRITERIA
REFERENCE SECTIONS

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

Sediment Basin

What it is

A temporary sediment basin detains sediment-laden runoff long enough to allow much of the sediment to settle out. Sediment basins are constructed by excavation and/or by placing an earthen embankment across a low area or drainage swale. Basins can be designed to maintain a permanent pool or to drain completely dry through a controlled outlet structure.

When and Where to use it

- Required in disturbed areas draining more than one acre.
- Where there is sufficient space and appropriate topography.
- In areas that allow access for maintenance and sediment removal.
- Positioned so that it captures sediment from the entire upstream disturbed area.
- Where a permanent detention basin is planned for the site.

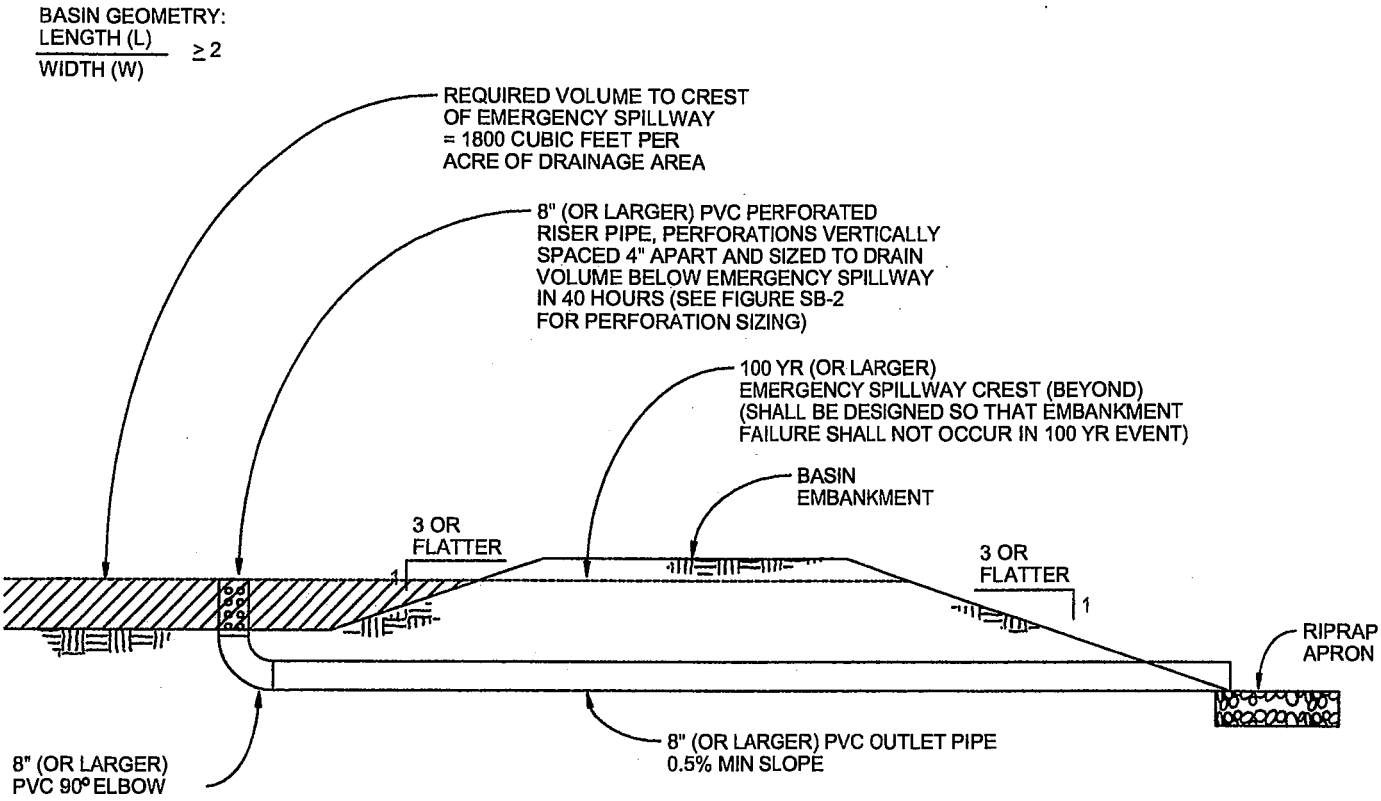
When and Where NOT to use it

- Sediment basins are not to be installed in active streams.

This low area will provide for some removal of sediment; however, it lacks a designed outlet structure.

Construction Detail and Maintenance Requirements

Figure SB-1 provides a construction detail and maintenance requirements for a sediment basin.



SEDIMENT BASIN

NTS

SEDMENT BASIN NOTES

INSTALLATION REQUIREMENTS

1. SEDIMENT BASINS SHALL BE INSTALLED BEFORE ANY CLEARING AND/OR GRADING IS UNDERTAKEN.

2. THE AREA UNDER WHICH THE EMBANKMENT IS TO BE INSTALLED SHALL BE CLEARED, GRUBBED, AND STRIPPED OF ALL VEGETATION AND ROOT MAT.

3. THE OUTLET OF THE BASIN SHALL BE DESIGNED TO DRAIN ITS VOLUME IN 40 HOURS.

4. THE OUTLET IS TO BE LOCATED AT THE FURTHEST DISTANCE FROM THE INLET OF THE BASIN. BAFFLES MAY BE NEEDED TO INCREASE THE FLOW LENGTH AND SETTLING TIME.

5. EMBANKMENT MATERIAL SHALL CONSIST OF SOIL WITH A MINIMUM OF 15% PASSING A #200 SIEVE. EXCAVATED SOIL CAN BE USED IF IT MEETS THIS REQUIREMENT.

6. EMBANKMENT IS TO BE COMPACTED TO AT LEAST 90% OF MAXIMUM DENSITY AND WITHIN 2% OF OPTIMUM MOISTURE CONTENT ACCORDING TO ASTM D 698.

7. WHEN A BASIN IS INSTALLED NEAR A RESIDENTIAL AREA, FOR SAFETY REASONS, A SIGN SHALL BE POSTED AND THE AREA SECURED WITH A FENCE.

MAINTENANCE REQUIREMENTS

1. CONTRACTOR SHALL INSPECT SEDIMENT BASINS AFTER EACH RAINFALL, AT LEAST DAILY DURING PROLONGED RAINFALL, AND WEEKLY DURING PERIODS NO RAINFALL.

2. SEDIMENT BASINS SHALL BE CLEANED OUT BEFORE SEDIMENT HAS FILLED HALF THE VOLUME OF THE BASIN.

3. SEDIMENT BASINS SHALL REMAIN OPERATIONAL AND PROPERLY MAINTAINED UNTIL THE SITE AREA IS PERMANENTLY STABILIZED WITH ADEQUATE VEGETATIVE COVER AND/OR OTHER PERMANENT STRUCTURE AS APPROVED BY THE CITY.

City of Colorado Springs Stormwater Quality	Figure SB-1 Sediment Basin Construction Detail and Maintenance Requirements

Required Area per Row (in^2)

Design Volume (acre-ft)	Depth at Outlet (ft)							
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5
2	15.04	7.71	5.10	3.76	2.95	2.41	2.02	1.73
1	7.52	3.86	2.55	1.88	1.48	1.21	1.01	0.87
0.6	4.51	2.31	1.53	1.13	0.89	0.72	0.61	0.52
0.4	3.01	1.54	1.02	0.75	0.59	0.48	0.40	0.35
0.2	1.50	0.77	0.51	0.38	0.30	0.24	0.20	0.17
0.1	0.75	0.39	0.26	0.19	0.15	0.12	0.10	0.09
0.06	0.45	0.23	0.15	0.11	0.09	0.07	0.06	0.05
0.04	0.30	0.15	0.10	0.08	0.06	0.05	0.04	0.03
0.02	0.15	0.08	0.05	0.04	0.03	0.02	0.02	0.02
0.01	0.08	0.04	0.03	0.02	0.01	0.01	0.01	0.01

TABLE SB-1

Circular Perforation Sizing

Hole Diameter (in)	Hole Diameter (in)	Area per Row (in^2)		
		n = 1	n = 2	n = 3
1/4	0.250	0.05	0.10	0.15
5/16	0.313	0.08	0.15	0.23
3/8	0.375	0.11	0.22	0.33
7/16	0.438	0.15	0.30	0.45
1/2	0.500	0.20	0.39	0.59
9/16	0.563	0.25	0.50	0.75
5/8	0.625	0.31	0.61	0.92
11/16	0.688	0.37	0.74	1.11
3/4	0.750	0.44	0.88	1.33
7/8	0.875	0.60	1.20	1.80
1	1.000	0.79	1.57	2.36
1 1/8	1.125	0.99	1.99	2.98
1 1/4	1.250	1.23	2.45	3.68
1 3/8	1.375	1.48	2.97	4.45
1 1/2	1.500	1.77	3.53	5.30
1 5/8	1.625	2.07	4.15	6.22
1 3/4	1.750	2.41	4.81	7.22
1 7/8	1.875	2.76	5.52	8.28
2	2.000	3.14	6.28	9.42
n = Number of columns of perforations				
Minimum steel plate thickness		1/4"	5/16"	3/8"

TABLE SB-2

Retention Pond T-7

Description

Photograph RP-1. Retention ponds treat stormwater though sedimentation and biological processes including uptake.

A retention pond, sometimes called a "wet pond," has a permanent pool of water with capacity above the permanent pool designed to capture and slowly release the water quality capture volume (WQCV) over 12 hours. The permanent pool is replaced, in part, with stormwater during each runoff event so stormwater runoff mixes with the permanent pool water. This allows for a reduced residence time compared to that of the extended detention basin (EDB). The 12-hour drain time helps to both better replicate pre-development flows for frequent events and reduce the potential for short circuiting treatment in smaller ponds. Retention ponds can be very effective in removing suspended solids, organic matter and metals through sedimentation, as well as removing soluble pollutants like dissolved metals and nutrients through biological processes.

Retention ponds can also be designed to provide Full Spectrum Detention. Widespread use of full spectrum detention is anticipated to reduce impacts on major drainageways by reducing post-development peak discharges to better resemble pre-development peaks.

Retention	
Functions	
LID/Volume Red.	Somewhat
WQCV Capture	Yes
WQCV+Flood Control	Yes
Fact Sheet Includes EURV Guidance	Yes
Typical Effectiveness for Targeted Pollutants[3]	
Sediment/Solids	Very Good
Nutrients	Moderate
Total Metals	Moderate
Bacteria	Moderate
Other Considerations	
Life-cycle Costs[4]	Moderate

[3] Based primarily on data from the International Stormwater BMP Database (www.bmpdatabase.org).

[4] Based primarily on BMP-REALCOST available at www.udfcd.org. Analysis is based on a single installation (not based on the maximum recommended watershed tributary to each BMP).

Site Selection

Retention ponds require groundwater or a dry-weather base flow if the permanent pool elevation is to be maintained year-round. They also require legal and physical use of water. In Colorado, the availability of this BMP can be limited due to water rights issues.

The designer should consider the overall water budget to ensure that the baseflow will exceed evaporation, evapotranspiration, and seepage losses (unless the pond is lined). High exfiltration rates can initially make it difficult to maintain a permanent pool in a new pond, but the bottom can eventually seal with fine sediment and become relatively impermeable over time. However, it is best to seal the bottom and the sides of a permanent pool if the pool is located on permeable soils and to leave the areas above the permanent pool unsealed to promote infiltration of the stormwater detained in the surcharge WQCV.

Studies show that retention ponds can cause an increase in temperature from influent to effluent. Retention ponds are discouraged upstream of receiving waters that are sensitive to increases in temperature (e.g., fish spawning or hatchery areas).

Use caution when placing this BMP in a basin where development will not be completed for an extended period, or where the potential for a chemical spill is higher than typical. When these conditions exists, it is critical to provide adequate containment and/or pretreatment of flows. In developing watersheds, frequent maintenance of the forebay may be necessary.

Benefits

- Creates wildlife and aquatic habitat.
- Provides recreation, aesthetics, and open space opportunities.
- Can increase adjacent property values.
- Cost-effective BMP for larger tributary watersheds.

Limitations

- Safety concerns associated with open water.
- Requires both physical supply of water and a legal availability (in Colorado) to impound water.
- Sediment, floating litter, and algae blooms can be difficult to remove or control.
- Ponds can attract water fowl which can add to the nutrients and bacteria leaving the pond.
- Ponds increase water temperature.

Designing for Maintenance

Recommended ongoing maintenance practices for all BMPs are provided in Chapter 6 of this manual. During design, the following should be considered to ensure ease of maintenance over the long-term.

- Provide pretreatment upstream of the permanent pool.
- Provide maintenance access to the outlet structure as well as the forebay.
- Exceed the minimum criterion for the permanent pool volume. Greater depth will help deter algae growth by reducing temperature and the area of the pond bottom that receives sunlight.

Design Procedure and Criteria

The following steps outline the retention pond design procedure and criteria, and Figure RP-1 shows a typical configuration.

1. **Baseflow**: Unless the permanent pool is establish by groundwater, a perennial baseflow that exceeds losses must be physically and legally available. Net influx calculations should be conservative to account for significant annual variations in hydrologic conditions. Low inflow in relation to the pond volume can result in poor water quality. Losses include evaporation, evapotranspiration, and seepage. Evaporation can be estimated from existing local studies or from the National Weather Service (NWS) Climate Prediction website. Data collected from Chatfield Reservoir from 1990 to 1997 show an average annual evaporation of 37 inches, while the NWS shows approximately 40 inches of evaporation per year in the Denver metropolitan area. Potential evapotranspiration (which occurs when water supply to both plant and soil surface is unlimited) is approximately equal to the evaporation from a large, free-water surface such as a lake (Bedient and Huber, 1992). When retention ponds are placed above the groundwater elevation, a pond liner is recommended unless evaluation by a geotechnical engineer determines this to be unnecessary.

2. **Surcharge Volume**: Provide a surcharge volume based on a 12-hour drain time.

   - Determine the imperviousness of the watershed (or effective imperviousness where LID elements are used upstream).
   - Find the required storage volume. Determine the required WQCV or EURV (watershed inches of runoff) using Figure 3-2 located in Chapter 3 of this manual (for WQCV) or equations provided in the *Storage* chapter of Volume 2 (for EURV).
   - Calculate the design volume (surcharge volume above the permanent pool) as follows:

     For WQCV:

     $$V = \left[\frac{\text{WQCV}}{12}\right] A \qquad \text{Equation RP-1}$$

     For EURV:

     $$V = \left[\frac{\text{EURV}}{12}\right] A \qquad \text{Equation RP-2}$$

     Where:

     V = design volume (acre ft)

     A = tributary catchment drainage area (acres)

3. **Basin Shape:** Always maximize the distance between the inlet and the outlet. A basin length to width ratio between 2:1 and 3:1 is recommended to avoid short-circuiting. It may be necessary to modify the inlet and outlet locations through the use of pipes, swales, or channels to accomplish this.

4. **Permanent Pool**: The permanent pool provides stormwater quality enhancement between storm runoff events through biochemical processes and continuing sedimentation.

   - Volume of the permanent pool:

     $$V_p \geq 1.2\left[\frac{\text{WQCV}}{12}\right] A \qquad \text{Equation RP-3}$$

     Where:

     V_p = permanent pool volume (acre ft)

     A = tributary catchment drainage area (acres)

- Depth Zones: The permanent pool should have two zones:
  - Safety Wetland Bench: This area should be located along the perimeter of the pond, 6 to 12 inches deep and a minimum of 4 feet wide. Aquatic plant growth along the perimeter of the permanent pool can help strain surface flow into the pond, protect the banks by stabilizing the soil at the edge of the pond, and provide biological uptake. The safety wetland bench is also constructed as a safety precaution. It provides a shallow area that allows people or animals who inadvertently enter the open water to gain footing to get out of the pond.
  - Open Water Zone: The remaining pond area should be open, providing a volume to promote sedimentation and nutrient uptake by phytoplankton. To avoid anoxic conditions, the maximum depth in the pool should not exceed 12 feet.

5. **Side Slopes**: Side slopes should be stable and sufficiently gentle to limit rill erosion and to facilitate maintenance. Side slopes above the safety wetland bench should be no steeper than 4:1, preferably flatter. The safety wetland bench should be relatively flat with the depth between 6 to 12 inches. The side slope below this bench should be 3:1 (or flatter when access is required or when the surface could be slippery). The steeper 3:1 slope below the safety wetland bench can be beneficial to deterring algae growth as it will reduce the shallow area of the pond, thus reducing the amount of sunlight that penetrates the pond bottom.

6. **Inlet**: Dissipate energy at the inlet to limit erosion and to diffuse the inflow plume. Inlets should be designed in accordance with the *Hydraulic Structures* chapter of Volume 2. This chapter includes design of impact basins and drop structures.

7. **Forebay**: Forebays provide an opportunity for larger particles to settle out, which will reduce the required frequency of sediment removal in the permanent pool. Install a solid driving surface on the bottom and sides below the permanent water line to facilitate sediment removal. A soil riprap berm should be constructed to contain the forebay opposite of the inlet. This should have a minimum top width of 8 feet and side slopes no steeper than 4:1. The forebay volume within the permanent pool should be sized for anticipated sediment loads from the watershed and should be at least 3% of the WQCV. If the contributing basin is not fully developed, additional measures should be taken to maintain a relatively clean forebay. This includes more frequent maintenance of the forebay and/or providing and maintaining temporary erosion control.

8. **Outlet:** The outlet should be designed to release the WQCV over a 12-hour period. This can be done through an orifice place as detailed in BMP Fact Sheet T-12. Use reservoir routing calculations as discussed in the *Storage* chapter of Volume 2 or use equation RP-4, a simplified orifice sizing equation (see Technical Memorandum dated July 13, 2010 available at www.udfcd.org).

$$A_O = \frac{201V^{(0.95/H^{0.085})}}{T_D H^{0.164}} \qquad \text{Equation RP-4}$$

Where:

A_O = area per row of orifices spaced on 4-inch centers (in^2)

V = design volume (WQCV or EURV) (acre ft)

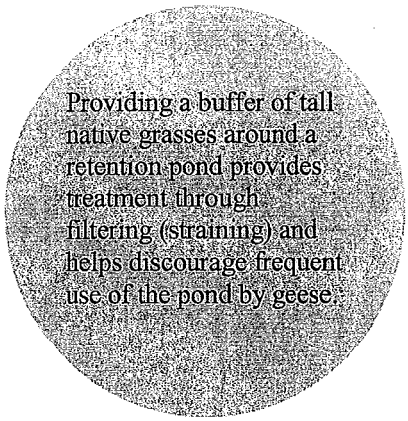
T_D = time to drain the prescribed volume (hrs) (i.e., 12 for WQCV or 72 for EURV)

H = depth of surcharge volume (ft)

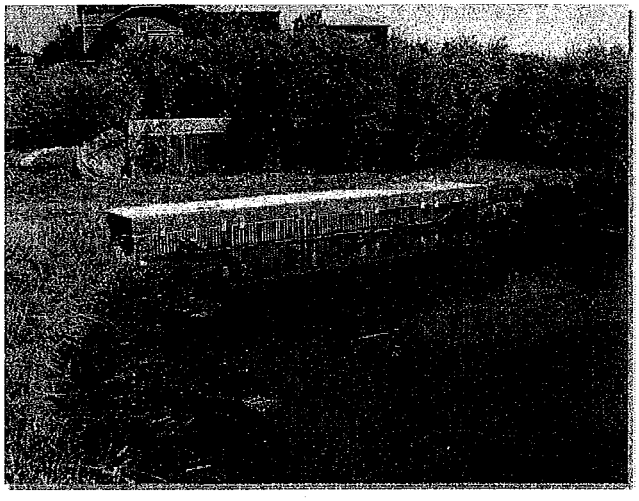
Refer to BMP Fact Sheet T-12 for schematics pertaining to structure geometry, grates, trash racks, orifice plate, and all other necessary components.

9. **Trash Rack**: Provide a trash rack of sufficient size to prevent clogging of the primary water quality outlet. Similar to the trash rack design for the extended detention basin, extend the water quality trash rack into the permanent pool a minimum of 28 inches. The benefit of this is documented in Fact Sheet T-5. BMP Fact Sheet T-12 provides additional guidance on trash rack design including standard tables for most designs.

10. **Overflow Embankment**: Design the embankment not to fail during the 100-year storm. If the embankment falls under the jurisdiction of the State Engineer's Office, it should be designed to meet the requirements of the State Engineer's Office. Embankment slopes should be no steeper than 4:1, preferably flatter, and planted with turf grasses. Poorly compacted native soils should be excavated and replaced. Embankment soils should be compacted to 95% of maximum dry density for ASTM D698 (Standard Proctor) or 90% for ASTM D1557 (Modified Proctor). Spillway structures and overflows should be designed in accordance with local drainage criteria and should consider the use of stabilizing materials such as buried soil riprap or reinforced turf mats installed per manufacturer's recommendations.



11. **Maintenance Considerations:** The design should include a means of draining the pond to permit drying out of the pond when it has to be "mucked out" to restore volume lost due to sediment deposition. A means to drain the pond or a portion of the pond by gravity is preferred but not always practicable. Some level of pumping is typically required. Past versions of this manual included an underdrain at the perimeter of the pond with a valved connection to the outlet structure for this purpose. This remains an acceptable method for draining the pond. Additional alternatives include providing a drywell with a piped connection to the outlet structure or to a downstream conveyance element or connecting a valved pipe directly to the outlet structure. The pipe should include a valve that will only be opened for maintenance.



Photograph RP-2. This retention pond outlet structure is both accessible and functional while not interfering with the natural aesthetic.

12. **Vegetation:** Vegetation provides erosion control and enhances site stability. Berms and side-sloping areas should be planted with native grasses or irrigated turf, depending on the local setting and proposed uses for the pond area. The safety wetland bench should be vegetated with aquatic species. This vegetation around the perimeter of an open water body can discourage frequent use of the pond by geese.

13. **Access:** All weather stable access to the bottom, forebay, and outlet works area should be provided for maintenance vehicles. Grades should not exceed 10% for haul road surfaces and should not exceed 20% for skid-loader and backhoe access. Provide a solid driving surface such as gravel, concrete, articulated concrete block, concrete grid pavement, or reinforced grass pavement. The recommended cross slope is 2%.

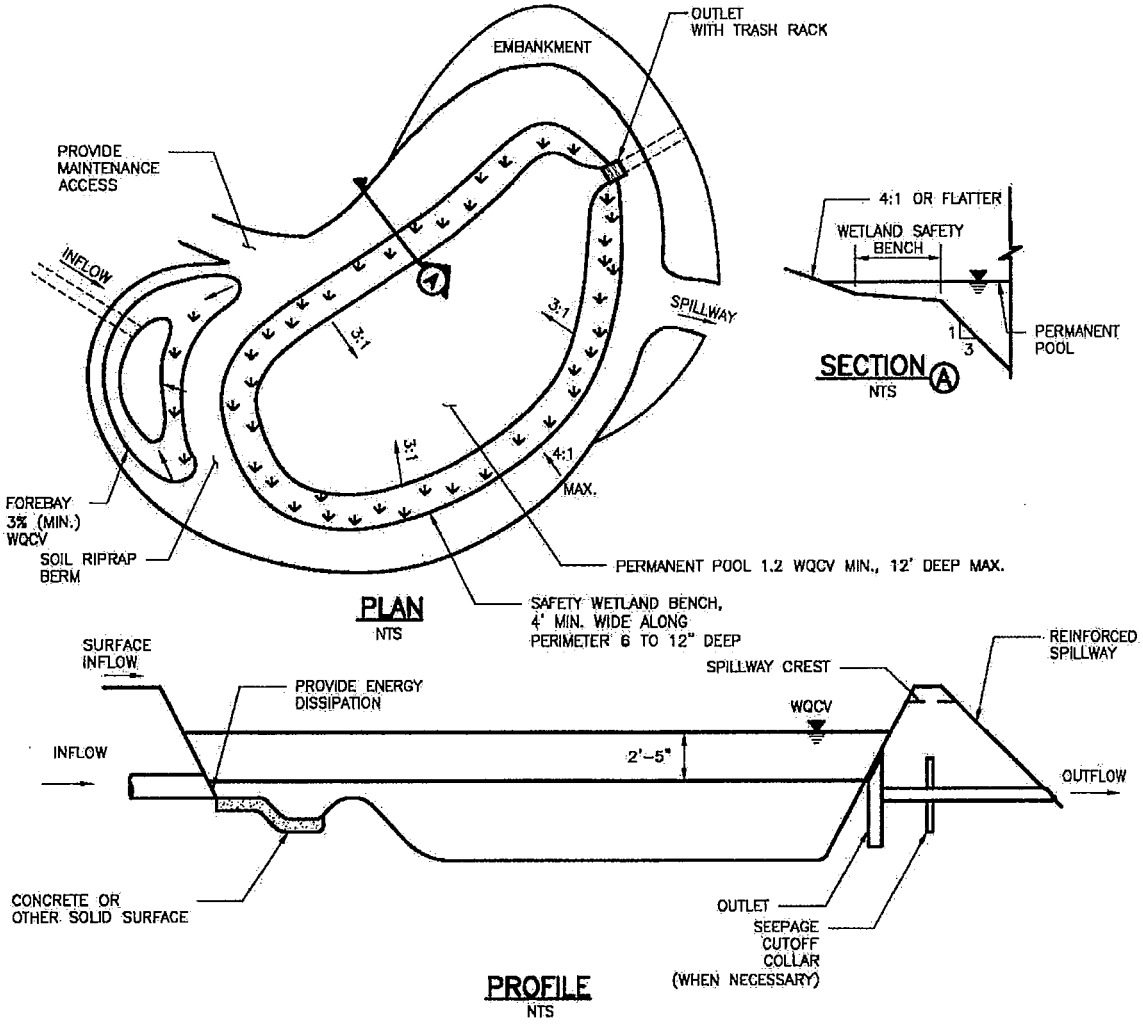


Figure RP-1. Retention Pond Plan and Sections

Aesthetic Design

Since all land owners and managers wish to use land in the most efficient manner possible, it is important that retention basins become part of a multi-use system. This encourages the design of retention ponds as an aesthetic part of a naturalized environment or to be expanded to include passive and/or active open space. Within each scenario, the retention basin can begin to define itself as more than just a drainage facility. When this happens, the basin becomes a public amenity. This combination of public amenity and drainage facility is of much greater value to a landowner. Softened and varied slopes, interspersed irrigated fields, planting areas and wetlands can all be part of a retention pond.

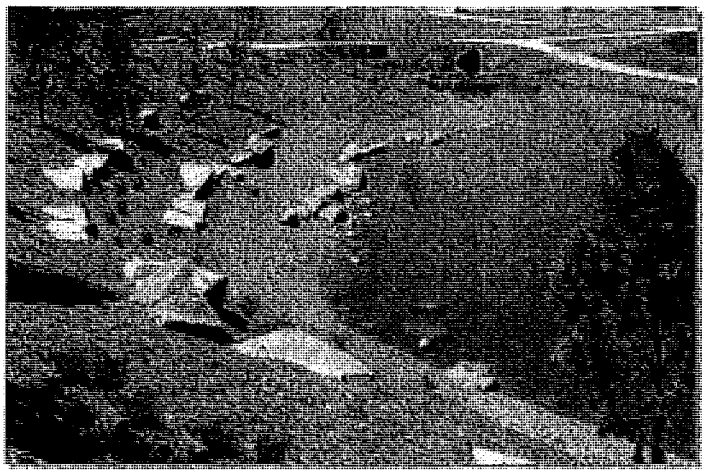
The design should be aesthetic whether it is considered to be an architectural or naturalized basin. Architectural basins incorporate design borrowed or reflective of the surrounding architecture or urban forms. An architectural basin is intended to appear as part of the built environment, rather than hiding the cues that identify it as a stormwater structure. A naturalized basin is designed to appear as though it is a natural part of the landscape. This section provides suggestions for designing a naturalized basin. The built environment, in contrast to the natural environment, does not typically contain the randomness of form inherent in nature. Constructed slopes typically remain consistent, as do slope transitions. Even dissipation structures are usually a hard form and have edges seldom seen in nature. If the retention pond is to appear as though it is a natural part of the landscape, it is important to minimize shapes that provide visual cues indicating the presence of a drainage structure. For example, the pond sides in the area of the surcharge volume should be shaped more naturally and with varying slopes for a naturalized pond. See Figure RP-2 for an example.

Suggested Methods for Creating the Look of a Naturalized Pond:

- Create a flowing overall form that looks like it was shaped by water. This includes the banks of the retention pond, which should have an undulating outline rather than a straight line.
- One side of the pond can be higher than the other side. This may require a berm.
- The shape of the permanent pool should vary from the shape of the surcharge volume.
- The slopes on at least three sides of the pond (above the permanent pool) should be varied and gentle. To achieve this, one or more sides of the basin may have to be stabilized by a retaining structure, i.e., stacked boulders and walls.
- Vary slope transitions.

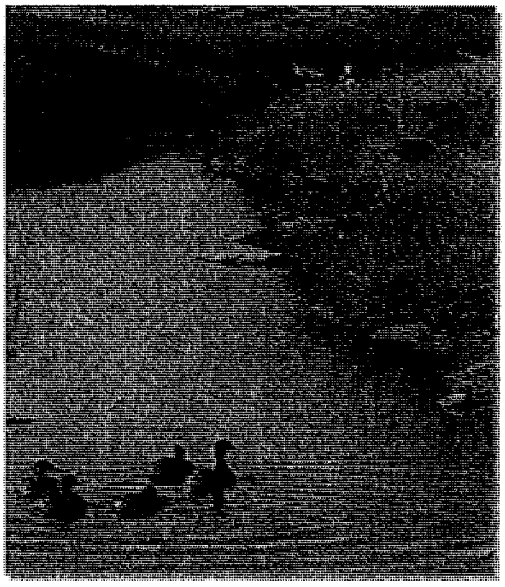
Photograph RP-3. (altered photo) When incorporating rock into a structure, use other matching, functional rock to prevent the structure from looking out of context. Photo courtesy of Design Concepts.

- Any use of rock for energy dissipation or for erosion control should graduate away from the area of hard edge into the surrounding landscape. Other functional matching rock should occur in other areas of the pond to prevent the energy dissipation structure from appearing out of context. Photo RP-3 serves as an example of this.
- If concrete is required in the basin, colored concrete matching the rocks or other site features of the surrounding landscape can be used to prevent the structure from appearing out of context. Colored concrete, form liners and veneers for construction walls are preferred for outlet structures.

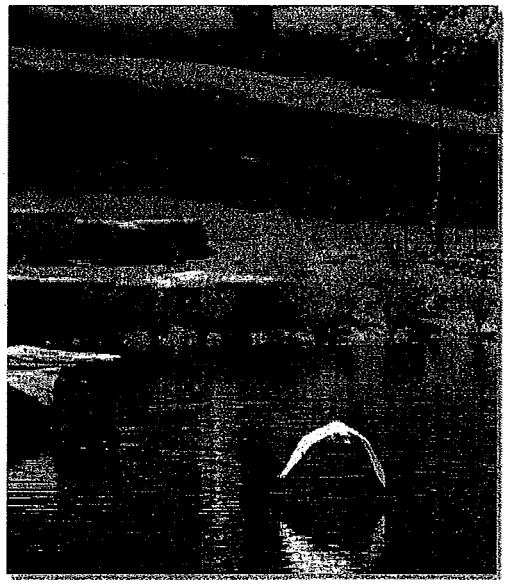


Photograph RP-4. (altered photo) Variations in slope and texture around the pond are brought together by mass groupings of local stone boulders. The boulders are placed intermittently around the pond in groups and interspersed with plantings. Photo courtesy of Design Concepts. Note: A minimum 4-foot vegetated buffer (littoral zone) is recommended to strain surface flow into the pond, protect the banks by stabilizing the soil at the edge of the pond, and provide biological uptake.

- Adjust the vegetation to the different uses of the pond surrounding.
- Ground cover should reflect the type of water regime expected for the location within the basin. For example, riparian plants would be placed around the edge of the retention pond, groups of trees and shrubs would be placed in more manicured areas that have no retention or detention function.

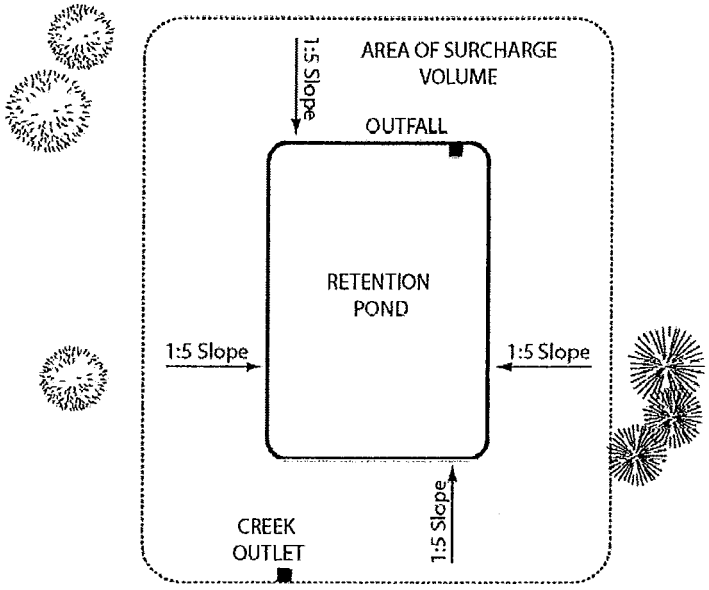


Photograph RP-5. A curving stream with vegetated edges provides habitat for wildlife. Photo courtesy of Design Concepts.



Photograph RP-6. Landscape elements such as vegetation and stone highlight the irregularly-shaped pond edge, making it appear more natural. Photo courtesy of Design Concepts.

BEFORE



AFTER

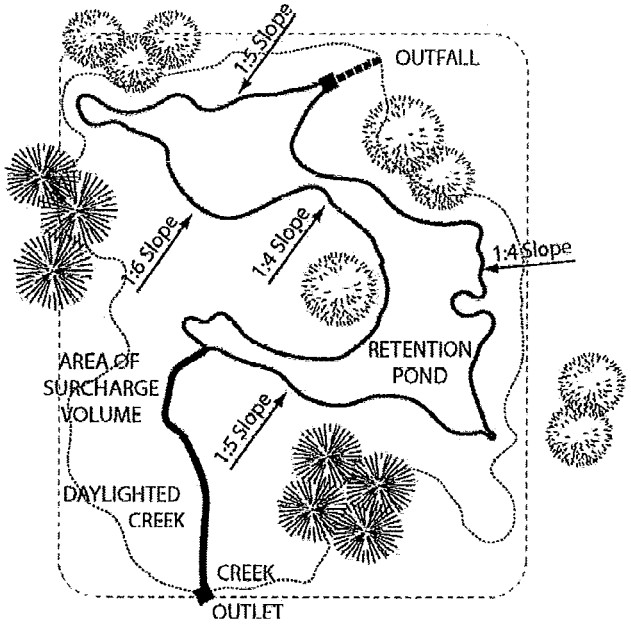


Figure RP-2. Example of a Naturalized Retention Pond

Design Example

The *UD-BMP* workbook, designed as a tool for both designer and reviewing agency is available at www.udfcd.org. This section provides a completed design form from this workbook as an example.

Design Procedure Form: Retention Pond (RP)

Sheet 1 of 3

Designer:	L. Gibson
Company:	BMP, Inc.
Date:	November 29, 2010
Project:	Subdivision B
Location:	NE Corner of 67th Ave. and 88th St.

1. Baseflow A) Is the permanent pool established by groundwater?	Choose One: (●) YES ( ) NO
2. Surcharge Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 80.0 %
B) Tributary Area's Imperviousness Ratio (i = I_a / 100)	i = 0.800
C) Contributing Watershed Area	Area = 50.000 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ____ 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) Water Quality Capture Volume (WQCV) Based on 12-hour Drain Time (V_{WQCV} = (0.8 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)	V_{WQCV}= 1.094 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) ($V_{WQCV\ OTHER}$ = (d_6*(V_{WQCV}/0.43))	$V_{WQCV\ OTHER}$= ____ ac-ft
H) User Input of Water Quality Capture Volume (WQCV) (Only if a different WQCV Design Volume is desired)	$V_{WQCV\ USER}$= ____ 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: $EURV_A$ = (0.1878i - 0.0104)*Area For HSG B: $EURV_B$ = (0.1178i - 0.0042)*Area For HSG C/D: $EURV_{C/D}$ = (0.1043i - 0.0031)*Area	EURV = 4.017 ac-ft
3. Basin Shape (It is recommended to have a basin length to width ratio between 2:1 and 3:1)	L : W = 3.0 : 1
4. Permanent Pool	
A) Minimum Permanent Pool Volume	V_{POOL} = 1.313 ac-ft
B) Depth of the Safety Wetland Bench (Recommended to be 6 to 12 inches deep)	D_{LZ} = 6 in
C) Depth of the Open Water Zone (Maximum depth of 12 feet)	D_{OWZ} = 12.0 ft
5. Side Slopes	
A) Maximum Side Slopes Above the Safety Wetland Bench (Horiz. dist. per unit vertical, should be no steeper than 4:1)	Z_{PP} = 5.00 ft / ft
B) Maximum Side Slopes Below the Safety Wetland Bench (Horiz. dist. per unit vertical, should be no steeper than 3:1)	Z_{OWZ} = 3.00 ft / ft
6. Inlet A) Describe means of providing energy dissipation at concentrated inflow locations:	Adequate tailwater during events exceeding the WQCV.

Design Procedure Form: Retention Pond (RP)

Sheet 2 of 3

Designer:	L. Gibson
Company:	BMP, Inc.
Date:	November 29, 2010
Project:	Subdivision B
Location:	NE Corner of 67th Ave. and 88th St.

7. Forebay	
A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV)	V_{FMIN} = 0.033 ac-ft
B) Actual Forebay Volume	V_F = 0.037 ac-ft
8. Outlet	
A) Outlet Type	Choose One: (•) Orifice Plate ( ) Other (Describe):
B) Depth of Surcharge Volume (Depth of WQCV or EURV depending on design concept)	H = 3.0 feet
C) Volume to Drain Over Prescribed Time	EURV = 4.017 ac-ft
D) Drain Time (Min T_D for WQCV= 12 hours; Max T_D for EURV= 72 hours)	T_D = 72 hours
E) Recommended Outlet Area per Row, (A_o)	A_o = 7.77 square inches
F) Orifice Dimensions: i) Circular Orifice Diameter or	$D_{orifice}$ = inches
ii) Width of 2" High Rectangular Orifice	$W_{orifice}$ = 3.88 inches
G) Number of Columns	nc = 1 number
H) Actual Design Outlet Area per Row (A_o)	A_o = 7.8 square inches
I) Number of Rows (nr)	nr = 9 number
J) Total Outlet Area (A_{ot})	A_{ot} = 69.8 square inches
K) Depth of WQCV (H_{WQCV}) (Estimate using actual stage-area-volume relationship and V_{WQCV})	H_{WQCV} = feet
L) Ensure Minimum 12 Hour Drain Time for WQCV	$T_{D\,WQCV}$ = hours
9. Trash Rack	
A) Type of Outlet Opening	Choose One: ( ) Circular (up to 2" diameter) (•) Rectangular (2" high)
B) Trash Rack Open Area: $A_t = 0.5 * 77(e^{-0.124D})*A_{ot}$	A_t = 2,224 square inches
C) For 2", or Smaller, Circular Opening (Reference figure in Fact Sheet T-12)	
i) Depth of Trash Rack below Permanent Pool WS (28 inch max.)	$D_{trashrack}$ = inches
ii) Width of Trash Rack and Concrete Opening ($W_{opening}$)	$W_{opening}$ = inches
iii) Height of Trash Rack Screen (H_{TR})	H_{TR} = inches
iv) Type of Screen, Describe if "Other"	Choose One: ( ) S.S. Well Screen with 60% Open Area* ( ) Other (Describe):

Design Procedure Form: Retention Pond (RP)

Sheet 3 of 3

Designer: L. Gibson
Company: BMP, Inc.
Date: November 29, 2010
Project: Subdivision B
Location: NE Corner of 67th Ave. and 88th St.

D) For 2" High Rectangular Opening (See Fact Sheet T-12):	
i) Depth of Trash Rack below Permanent Pool WS (28 inch min.)	$D_{inundation}$ = 28.0 inches
ii) Width of Rectangular Opening ($W_{orifice}$)	W = 3.88 inches
iii) Width of Trash Rack Opening ($W_{opening}$)	$W_{opening}$ = 4.1 feet
iv) Height of Trash Rack Screen (H_{TR})	H_{TR} = 5.3 feet
v) Type of Screen, (Describe if "Other")	Choose One: (●) Aluminum Amico-Klemp SR Series (or equal) ( ) Other (Describe):
vi) Cross-bar Spacing	2.00
vii) Minimum Bearing Bar Size	1-1/4 in x 3/16 in
10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	soil riprap
B) Maximum Embankment Side Slopes (Horiz. dist. per unit vertical, should be no steeper than 4:1)	Z_E = 4.00 ft / ft
11. Maintenance Considerations	
A) Describe Means of Draining the Pond	The pond can be partially gravity drained with the valve located in the outlet structure. Remaining water must be pumped.
12. Vegetation	Choose One: ( ) Irrigated (●) Not Irrigated
13. Access	
A) Describe Sediment Removal Procedures	Sediment may be removed from the forebay via the maintenance access located on the maintenance plan.

Notes:

References

Bedient, Philip B. and Wayne C. Huber. 1992. *Hydrology and Floodplain Analysis (Second Edition).* Addison-Wesley Publishing Company.

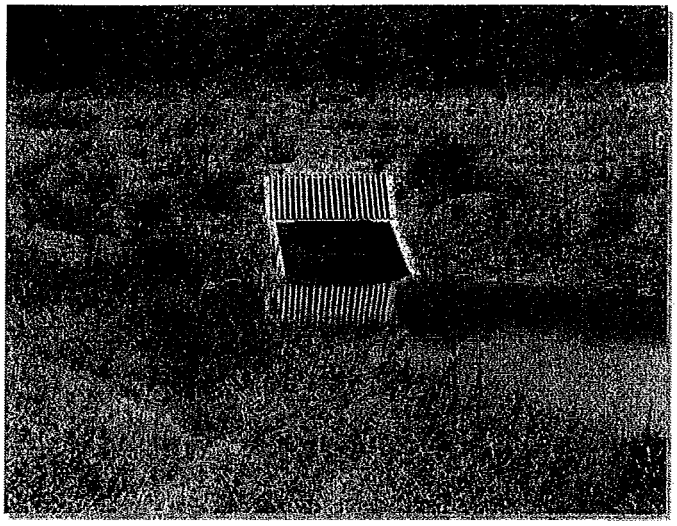
United States Environmental Protection Agency (EPA). 1999. *Storm Water Technology Fact Sheet: Wet Detention Ponds.*

Outlet Structures T-12

Description

This section provides guidance and details for outlet structures for use primarily with BMPs utilizing sedimentation, (i.e., extended detention basins (EDBs), retention ponds, and constructed wetland ponds). The information provided in this section includes guidance for different size watersheds as well as for incorporating Full Spectrum Detention as described in the *Storage* chapter of Volume 2.

The details contained in this Fact Sheet are intended to provide a starting point for design. UDFCD recommends that design details for outlet structures be specific for each site with structural details drawn to scale. The details provided in this Fact Sheet are not intended to be used without modification or additional detail.



Photograph OS-1. Although each site is different, most sedimentation BMPs have similar outlet structures. Each structure should include a partially submerged orifice plate with a screen (or grate) protecting the orifice plate from clogging, and an overflow weir for flows exceeding the WQCV or excess urban runoff volume (EURV), when full spectrum detention is used.

Outlet Design

Large Watershed Considerations

UDFCD recommends that water quality treatment be provided close to the pollutant source. This is a fundamental concept of Low Impact Development (LID). Although flood control facilities, including Full Spectrum Detention facilities, have been shown to be very effective for watersheds exceeding one square mile, this is not the case for water quality facilities. One reason for this is that the baseflow associated with a larger watershed will vary and can be difficult to estimate. The orifice plate should be designed to pass the baseflow while detaining the water quality capture volume (WQCV) for approximately 40 hours. When the baseflow is overestimated, the WQCV is not detained for the recommended time, passing through without treatment. When the baseflow is underestimated, the elevation of the permanent pool will be higher than designed, causing maintenance issues as well as reducing the volume available for detention of the WQCV, which also allows for a portion of this volume to pass through without treatment. For this reason, UDFCD recommends that facilities designed for both water quality and flood control be limited, where possible, to watersheds without a baseflow. The maximum recommended watershed for combined facilities is one square mile. Additional discussion on designing for baseflows is provided in the EDB BMP Fact Sheet (T-5).

Designing for Maintenance

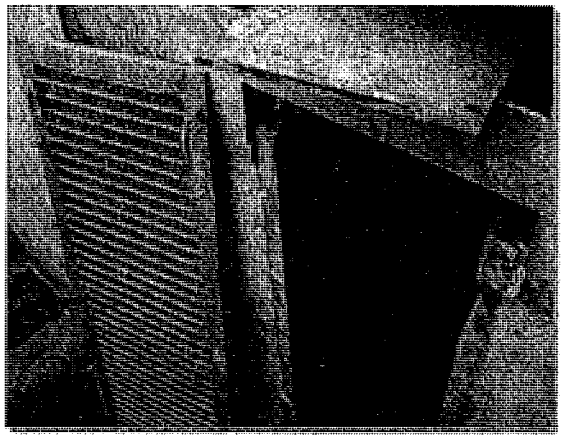
Rather than using the minimum criteria, consider maximizing the width of the trash rack to the geometry of the outlet. This will reduce clogging and frequency of maintenance. Reduced clogging in EDB outlet structures will preserve the initial surcharge volume thus reducing frequency of inundation in the bottom of the basin. This will benefit the grasses and reduce long-term EDB maintenance requirements (including sediment removal in the grassed area) and may reduce the life-cycle cost of the BMP.

Orifice Plates and Trash Racks

An orifice plate is used to release the WQCV slowly over 40 hours. For Full Spectrum Detention, the orifice plate is extended to drain a larger volume, the EURV, over approximately 72 hours. The figures and tables in this section provide recommendations for orifice configurations and trash rack type and size. Guidance is provided for plates using both circular and rectangular orifices.

Orifice Sizing

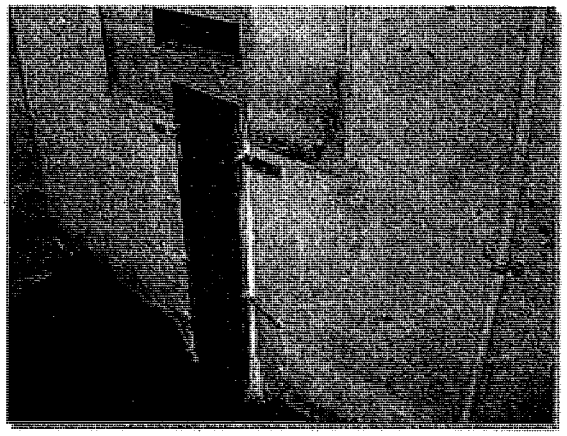
Follow the design steps included in the BMP Fact Sheet for the appropriate BMP. The UD-BMP workbook, available at www.udfcd.org, can also be used to calculate the required orifice area per row. This is the first step in detailing the outlet structure for sedimentation BMPs. It is good practice to maximize the area of each orifice to avoid clogging. The *UD-BMP* workbook will allow up to two columns of circular orifices before recommending a single rectangular orifice. A rectangular orifice is recommended when the required open area per row is equal to approximately 4 square inches or greater. Details showing orifice configurations are provided in Figure OS-4. Table OS-1 can be used to determine orifice shape and number of columns based on the required area per row.



Photograph OS-2. This trash rack could not be properly attached due to its inadequate flange width.

Trash Rack Sizing

Once the size of the orifice has been determined, this information, along with the total orifice area in the water quality plate, is used to determine the total open area of the grate (see Figure OS-1). The trash rack should be sized using this figure. This Fact Sheet also includes standard tables that can be used when the outlet is designed per UDFCD criteria, including inundation of trash rack into the permanent pool for a depth of approximately 2.5 feet. The standard tables assume the use of the specified stainless steel screen with circular orifices and the specified aluminum bar grate for use with rectangular orifices. Use Figure OS-1 when using a different track rack material or when the geometry of the structure does not fit within the assumptions of the tables. Use Tables OS-2a and OS-2b for circular orifices and Tables OS-3a and OS-3b for rectangular orifices. Be aware, these tables provide the minimum width clear for the trash rack frame. It is also important to provide adequate width for attachment to the outlet structure (see Photos OS-2 and OS-3). Also, consider maximizing the width of the trash rack to the geometry of the outlet. This will reduce clogging and maintenance requirements associated with cleaning the trash rack.



Photograph OS-3. Trash rack after repair.

Table OS-1. Orifice Sizing

Hole Dia. (in) [1]	Hole Dia. (in)	Area per Row (in^2)	
		n = 1	n = 2
1/4	0.250	0.05	-
5/16	0.313	0.08	-
3/8	0.375	0.11	-
7/16	0.438	0.15	-
1/2	0.500	0.2	-
9/16	0.563	0.25	-
5/8	0.625	0.31	-
11/16	0.688	0.37	-
3/4	0.750	0.44	-
13/16	0.813	0.52	-
7/8	0.875	0.6	-
15/16	0.938	0.69	-
1	1.000	0.79	-
1-1/16	1.063	0.89	-
1-1/8	1.125	0.99	-
1-3/16	1.188	1.11	-
1-1/4	1.250	1.23	-
1-5/16	1.313	1.35	-
1-3/8	1.375	1.48	-
1-7/16	1.438	1.62	3.24
1-1/2	1.500	1.77	3.54
1-9/16	1.563	1.92	3.84
1-5/8	1.625	2.07	-
1-11/16	1.688	2.24	-
1-3/4	1.750	2.41	-
1-13/16	1.813	2.58	-
1-7/8	1.875	2.76	-
1-15/16	1.938	2.95	-
2	2.000	3.14	-
n = Number of Columns of Orifices			
Steel Thickness (Min.)		1/4"	5/16"
[1] If desired, interpolate to the nearest 32" to better match the needed area.			

Use one column of rectangular orifices when the needed area exceeds 3.84 in^2

Rectangular Height (in) = 2
Rectangular Width (in) = Required Area / 2 in

Rectangular Width (in)	Steel Thickness (in)
≤6	≥1/4
≤8	≥5/16
≤10	≥3/8
>10	≥1/2

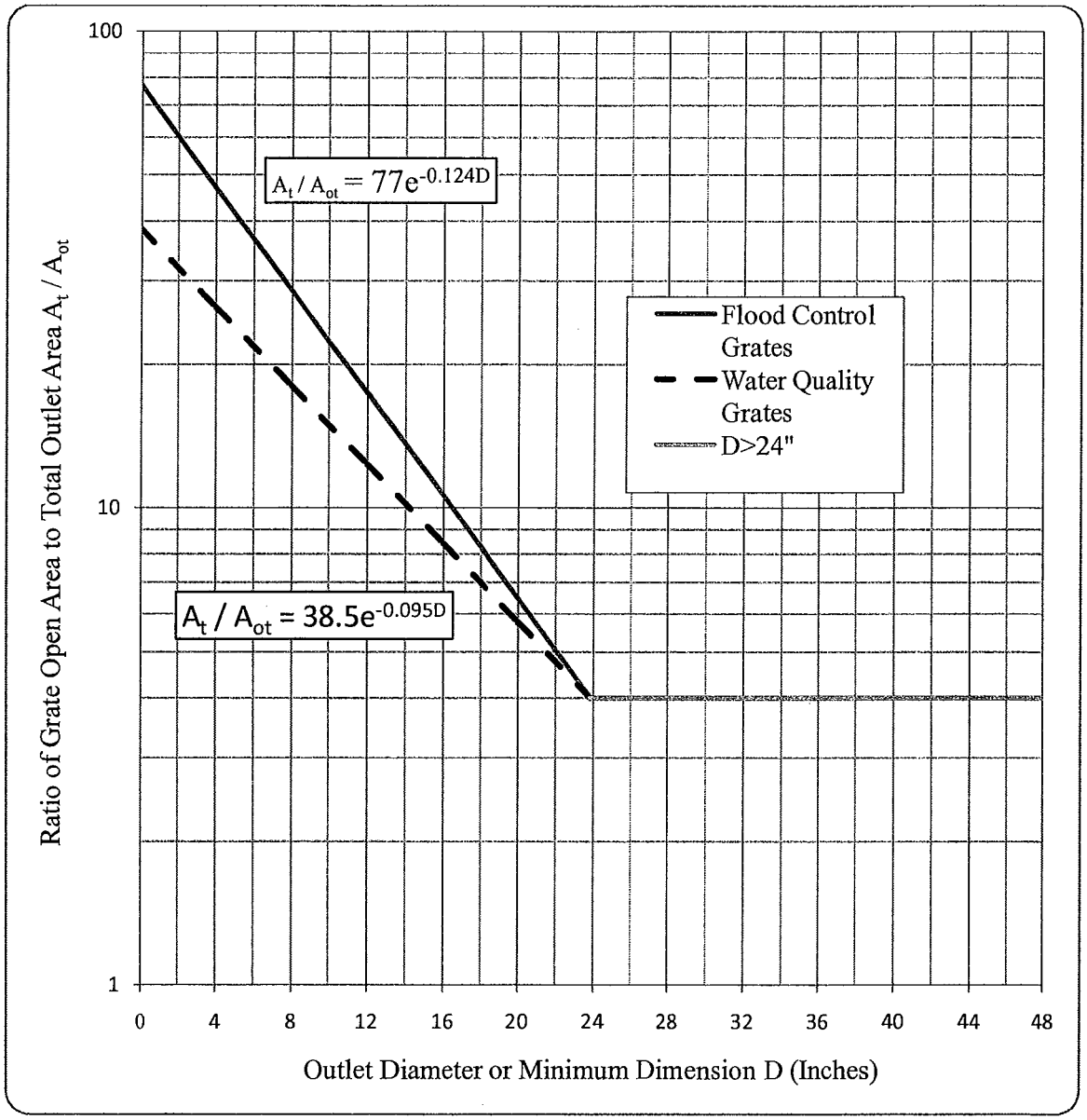


Figure OS-1. Trash Rack Sizing

Table OS-2a. Trash Rack Sizing for Circular Orifices[1,3]

Number of Columns	Diameter of Circular Orifice (in)	Width of Trash Rack Opening ($W_{opening}$) as a Function of Water Depth H Above Lowest Perforation				
		H=2.0'	H=3.0'	H=4.0'	H=5.0'	H=6.0'
1	≤ 1-1/4	12"[2]	12"[2]	12"[2]	12"	13"
1	≤ 1-1/2	12"[2]	14"	16"	17"	18"
1	≤ 1-3/4	15"	18"	21"	22"	24"
1	≤ 2	19"	23"	26"	28"	30"
2	1-7/16	21"	26"	29"	31"	33"
2	1-1/2	23"	28"	31"	34"	35"
2	1-9/16	24"	30"	34"	36"	38"

[1] For use with Johnson VEE WireTM Stainless Steel Screenl (or equivalent screen with 60% open area). Assumes inundation of well screen into the permanent pool 2'4".

[2] Represents the minimum recommended width of 12 inches, otherwise width is calculated based on Figure OS-1.

[3] This table provides the minimum opening in the concrete, not the minimum width of the well screen. Ensure the well screen is wide enough to properly attach to the structure.

Table OS-2b. Trash Rack Specifications for Circular Orifice Plates

Max. Width of Trash Rack Opening (in)	Screen #93 VEE Wire Slot Opening (in)	Support Rod Type	Support Rod, On Center, Spacing	Total Screen Thickness	Carbon Steel Frame Type
≤9	0.139	#156 VEE	¾"	0.31"	$^3/_8$"x1.0" flat bar
≤18	0.139	TE 0.074"x0.50"	1"	0.655"	¾" x 1.0 angle
≤24	0.139	TE 0.074"x0.75"	1"	1.03"	1.0" x 1½" angle
≤27	0.139	TE 0.074"x0.75"	1"	1.03"	1.0" x 1½" angle
≤30	0.139	TE 0.074"x1.0"	1"	1.155"	1 $^1/_4$"x 1½" angle
≤36	0.139	TE 0.074"x1.0"	1"	1.155"	1 $^1/_4$"x 1½" angle
≤42	0.139	TE 0.105"x1.0"	1"	1.155"	1 $^1/_4$"x 1½" angle

[1] Johnson Screens, St. Paul, Minnesota, USA (1-800-833-9473)

Table OS-3a. Trash Rack Sizing for 2" High Rectangular Orifices

Width (W) of 2" Rectangular Orifice (in)	Minimum Width of Trash Rack Opening ($W_{opening}$) as a Function of Water Depth H Above Lowest Perforation					
	H≤2.0 ft.	H≤3.0 ft.	H≤4.0 ft.	H≤5.0 ft.	H≤6.0 ft.	Spacing of Bearing Bars, Cross Rods
2	1.7'	2.1'	2.4'	2.5'	2.7'	1-3/16", 2"
≤ 2.5	2.2'	2.6'	3'	3.2'	3.4'	1-3/16", 2"
≤ 3.0	2.6'	3.2'	3.5'	3.8'	4.0'	1-3/16", 2"
≤ 3.5	3.0'	3.7'	4.1'	4.5'	4.7'	1-3/16", 2"
≤ 4.0	3.4'	4.2'	4.7'	5.1'	5.4'	1-3/16", 2"
≤ 4.5	3.6'	4.4'	4.9'	5.3'	5.6'	1-3/16", 4"
≤ 5.0	4.0'	4.8'	5.4'	5.9'	6.2'	1-3/16", 4"
≤ 5.5	4.4'	5.3'	6.0'	6.5'	6.8'	1-3/16", 4"
≤ 6.0	4.8'	5.8'	6.5'	7.0'	7.4'	1-3/16", 4"
≤ 6.5	5.2'	6.3'	7.1'	7.6'	8.1'	1-3/16", 4"
≤ 7.0	5.6'	6.8'	7.6'	8.2'	8.7'	1-3/16", 4"
≤ 7.5	6.0'	7.3'	8.2'	8.8'	9.3'	1-3/16", 4"
≤ 8.0	6.4'	7.8'	8.7'	9.4'	9.9'	1-3/16", 4"
≤ 8.5	6.8'	8.2'	9.2'	10'	*	1-3/16", 4"
≤ 9.0	7.2'	8.7'	9.8'	*	*	1-3/16", 4"
≤ 9.5	7.6'	9.2'	*	*	*	1-3/16", 4"
≤ 10.0	8.0'	9.7'	*	*	*	1-3/16", 4"
≤ 10.5	8.3'	*	*	*	*	1-3/16", 4"
≤ 11.0	8.7'	*	*	*	*	1-3/16", 4"
≤ 11.5	9.1'	*	*	*	*	1-3/16", 4"
≤ 12.0	9.5'	*	*	*	*	1-3/16", 4"

* Size trash rack per Figure OS-1. Use 4-inch high staggered rectangular orifices to limit size of the structure.

Notes:

1. Width shown based on Figure OS-1 assuming inundation of trash rack into the permanent pool 2'4".
2. This table provides the minimum opening in the concrete, not the minimum width of the trash rack. Ensure the trash rack is wide enough to properly attach to the structure.

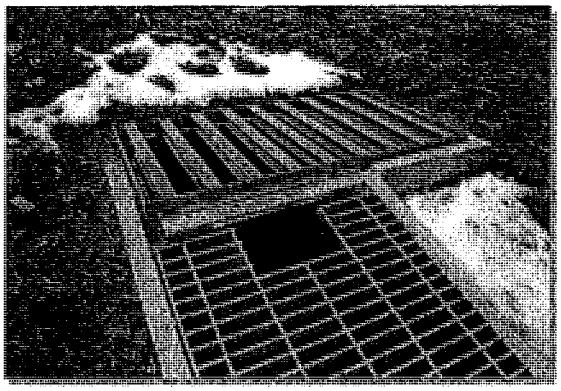
Table OS-3b. Trash Rack Specifications for 2" High Rectangular Orifices

Water Depth Above Lowest Opening, H (ft)	Minimum Bearing Bar Size, Bearing Bars Aligned Vertically (in)
2.0'	1" x 3/16"
3.0'	1-1/4" x 3/16"
4.0'	1-3/4" x 3/16"
5.0'	2" x 3/16"
6.0'	2-1/4" x 3/16"

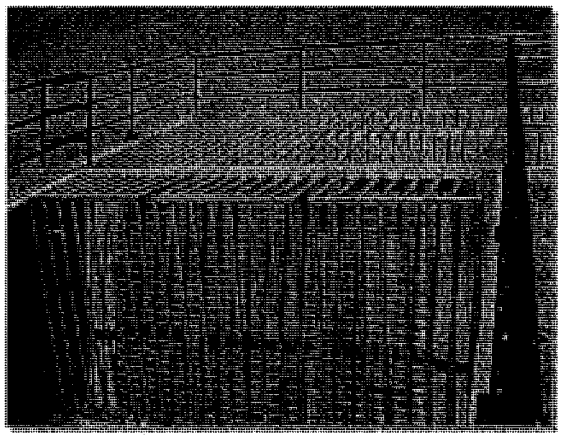
Outlet Geometry

Outlets for small watersheds will typically be sized for maintenance operations while the geometry of outlets for larger watersheds may be determined based on the required size of the trash rack. For all watershed sizes, the outlet should be set back into the embankment of the pond to better allow access to the structure. This also provides a more attractive BMP. For larger watersheds, this will require wing walls. Wing walls are frequently cast-in-place concrete, although other materials, such as grouted boulders, may be used where appropriate. Consider safety, aesthetics, and maintenance when selecting materials and determining the geometry. A safety rail should be included for vertical drops of 3 feet or more. Depending on the location of the structure in relation to pedestrian trails, safety rails may also be required for lesser drops. Stepped grouted boulders can be used to reduce the height of vertical drops.

As shown in Figures EDB-1 and EDB-2 provided in BMP Fact Sheet T-5, wing walls can be flared or parallel. There are advantages to both configurations. Parallel wing walls may be more aesthetic; however, depending on the geometry of the pond, may limit accessibility to the trash rack. Flared wing walls can call attention to the structure but provide better accessibility and sometimes a vertical barrier from the micropool of an EDB, which can increase safety of the structure. Parallel walls can also be used with a second trash rack that is secured flush with the top of the wall as shown in Photo OS-4. This eliminates the need for a safety rail and may provide additional protection from clogging; however, it creates a maintenance issue by restricting access to the water quality screen. The rack shown in Photo OS-4 was modified after construction due to this problem.



Photograph OS-4. Maintenance access to the water quality trash rack was compromised by the location of a secondary trash rack on this outlet. This may have been included as a safety rack or as additional protection from clogging. The owner modified the structure for better access. A safety rail would have been a better solution.



Photograph OS-5. Interruptions in the horizontal members of this trash rack and the spacing of the vertical members allow easier access to clean the water quality grate. A raking tool can be used to scrape the water quality trash rack.

Micropools within the Outlet Structure

The micropool of an EDB may be placed inside the structure when desired. This is becoming increasingly common for smaller watersheds and near airfields where large bird populations can be problematic. When designing this type of structure, consider maintenance of the water quality trash rack. The secondary trash rack should be designed to allow maintenance of the water quality trash rack similar to that shown in Photo OS-5. This concept can easily be incorporated into smaller outlet structures (see Figures OS-7 and OS-8 for details).

Outlet Structure Details

A number of details are presented in this section to assist designers with detailing outlet structures. Table OS-2 provides a list of details available at www.udfcd.org. These details are not intended to be used in construction plans without proper modifications as indicated in Table OS-4.

Table OS-4. Summary of Outlet Structure Details and Use

Figure	Detail	Use of Detail
OS-2	Typical Outlet Structure for Full Spectrum Detention	Conceptual.
OS-3	Typical Outlet Structure for WQCV Treatment and Attenuation	Conceptual.
OS-4	Orifice Plate and Trash Rack	Outlet section. Modify per true structure geometry and concrete reinforcement. Modify notes per actual design.
OS-5	Typical Outlet Structure with Circular Orifice Plate	Outlet sections. Modify per true structure geometry and concrete reinforcement. Add additional sections and detailing as necessary. Modify notes per actual design.
OS-6	Typical Outlet Structure with Rectangular Orifice Plate	Outlet sections. Modify per true structure geometry and concrete reinforcement. Add additional sections and detailing as necessary. Modify notes per actual design.
OS-7	Full Spectrum Detention Outlet Structure for 5-acre Impervious Area or Less	Outlet profile and section. Modify per true EURV elevation and concrete reinforcement. Add additional sections and detailing as necessary.
OS-8	WQCV Outlet Structure for 5-acre Impervious Area or Less	Outlet sections. Modify per true WQCV elevation and concrete reinforcement. Add additional sections and detailing as necessary.

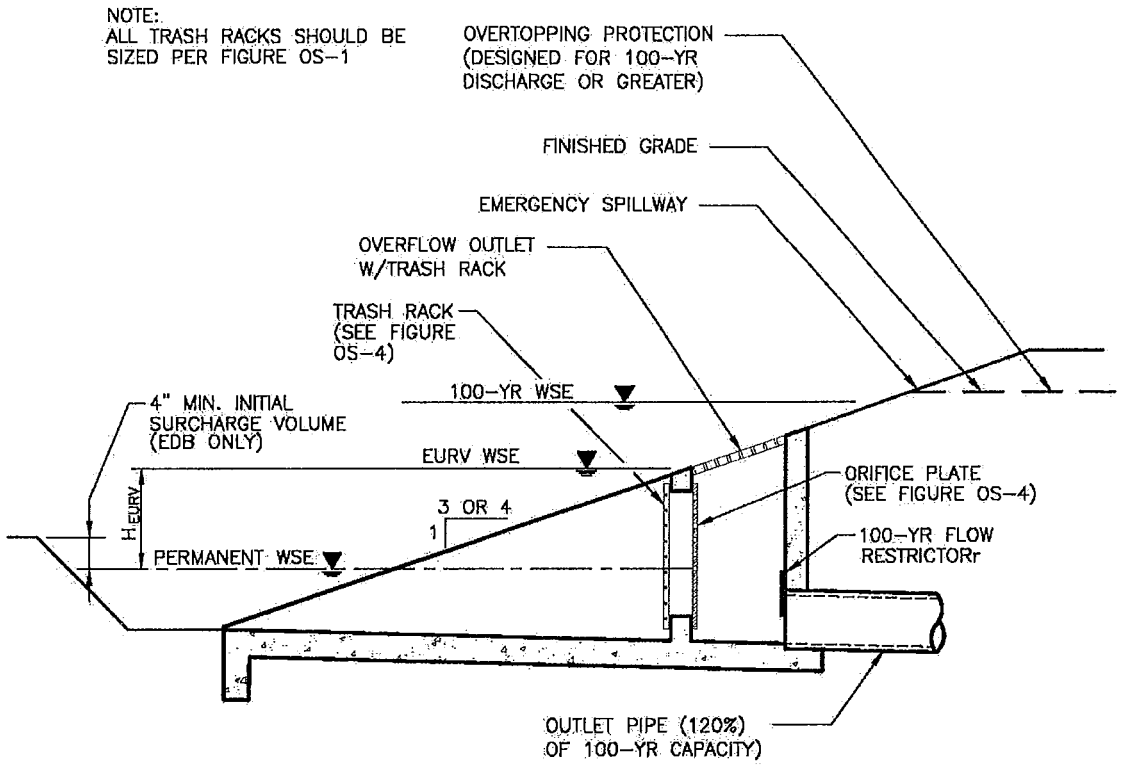


Figure OS-2. Typical Outlet Structure for Full Spectrum Detention

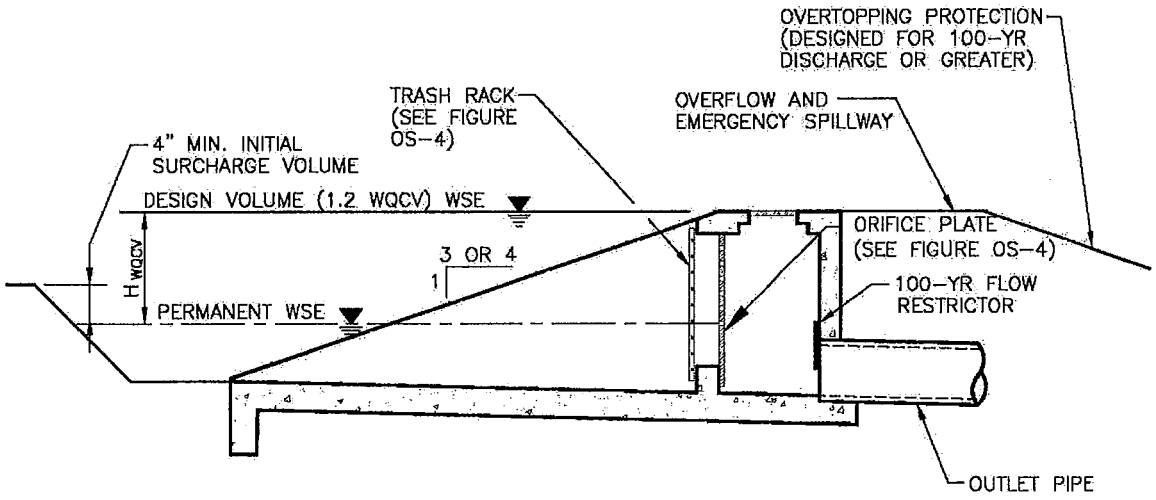
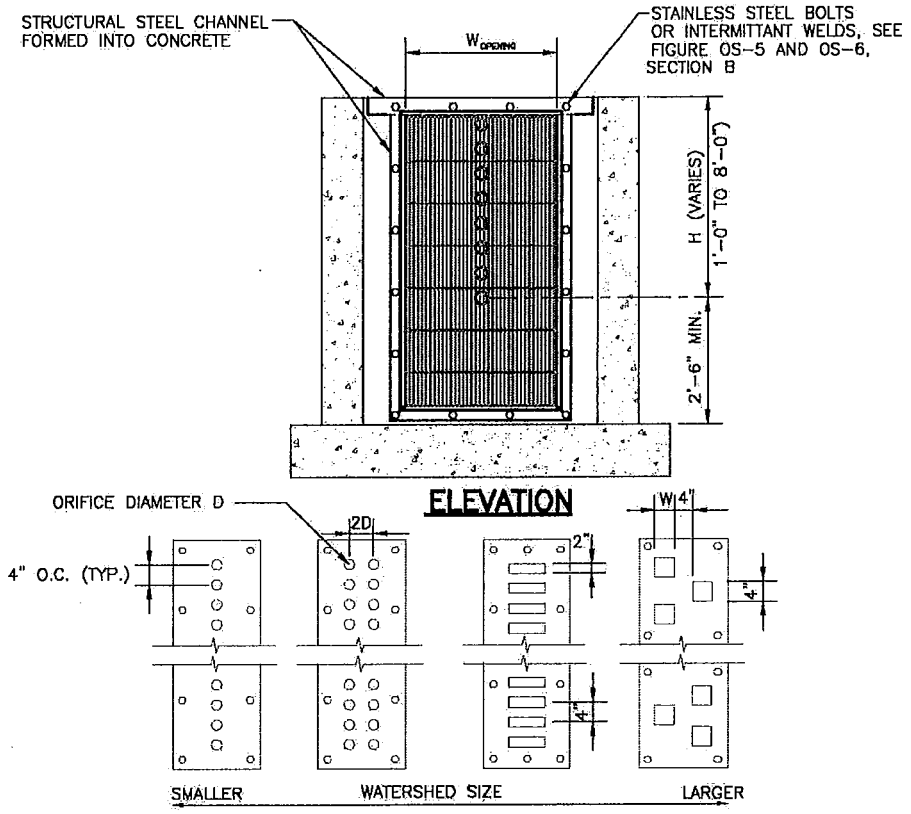


Figure OS-3. Typical Outlet Structure for WQCV Treatment and Attenuation



ORIFICE PLATE NOTES:

1. MINIMIZE THE NUMBER OF COLUMNS.
2. PROVIDE GASKET MATERIAL BETWEEN THE ORIFICE PLATE AND CONCRETE.
3. BOLT PLATE TO CONCRETE 12" MAX. ON CENTER.

EURV AND WQCV TRASH RACKS:

1. WELL-SCREEN TRASH RACKS (FOR CIRCULAR ORIFICES) SHALL BE STAINLESS STEEL AND SHALL BE ATTACHED BY INTERMITTENT WELDS ALONG THE EDGE OF THE MOUNTING FRAME.
2. BAR GRATE TRASH RACKS (FOR RECTANGULAR ORIFICES) SHALL BE ALUMINUM AND SHALL BE BOLTED USING STAINLESS STEEL HARDWARE.
3. TRASH RACK WIDTHS PROVIDED IN TABLE OS-2A AND OS-3A ARE FOR SPECIFIED TRASH RACK MATERIAL AND NEED TO BE ADJUSTED FOR MATERIALS HAVING A DIFFERENT OPEN AREA/GROSS AREA RATIO (R VALUE)
4. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

OVERFLOW TRASH RACKS:

1. ALL TRASH RACKS SHALL BE MOUNTED USING STAINLESS STEEL HARDWARE AND PROVIDED WITH HINGED AND LOCKABLE OR BOLTABLE ACCESS PANELS.
2. TRASH RACKS SHALL BE STAINLESS STEEL, ALUMINUM, OR STEEL. STEEL TRASH RACKS SHALL BE HOT DIP GALVANIZED AND MAY BE HOT POWDER COATED AFTER GALVANIZING.
3. TRASH RACKS SHALL BE DESIGNED SUCH THAT THE DIAGONAL DIMENSION OF EACH OPENING IS SMALLER THAN THE DIAMETER OF THE OUTLET PIPE.
4. STRUCTURAL DESIGN OF TRASH RACKS SHALL BE BASED ON FULL HYDROSTATIC HEAD WITH ZERO HEAD DOWNSTREAM OF THE RACK.

Figure OS-4. Orifice Plate and Trash Rack

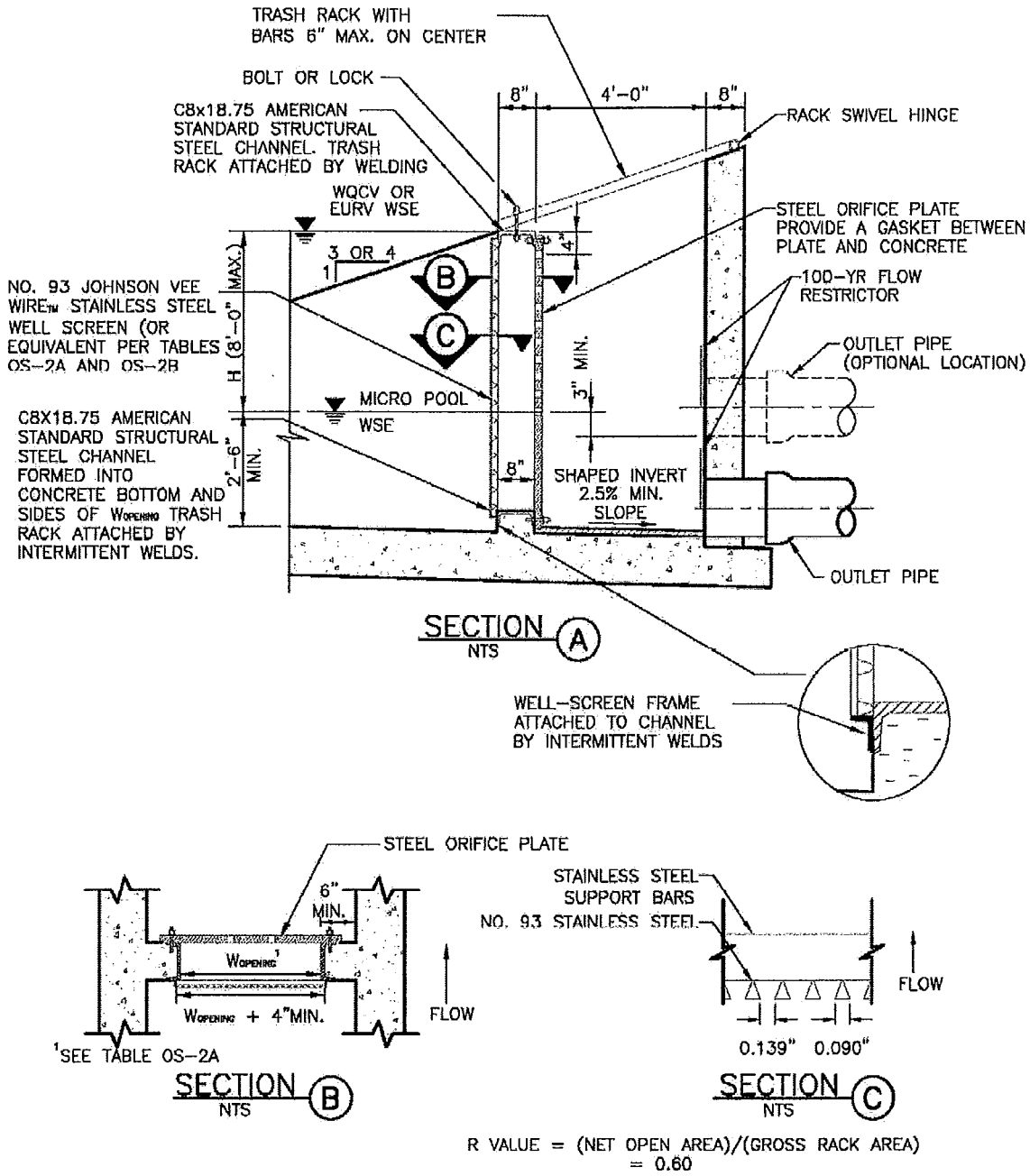


Figure OS-5. Typical Outlet Structure with Circular Orifice Plate

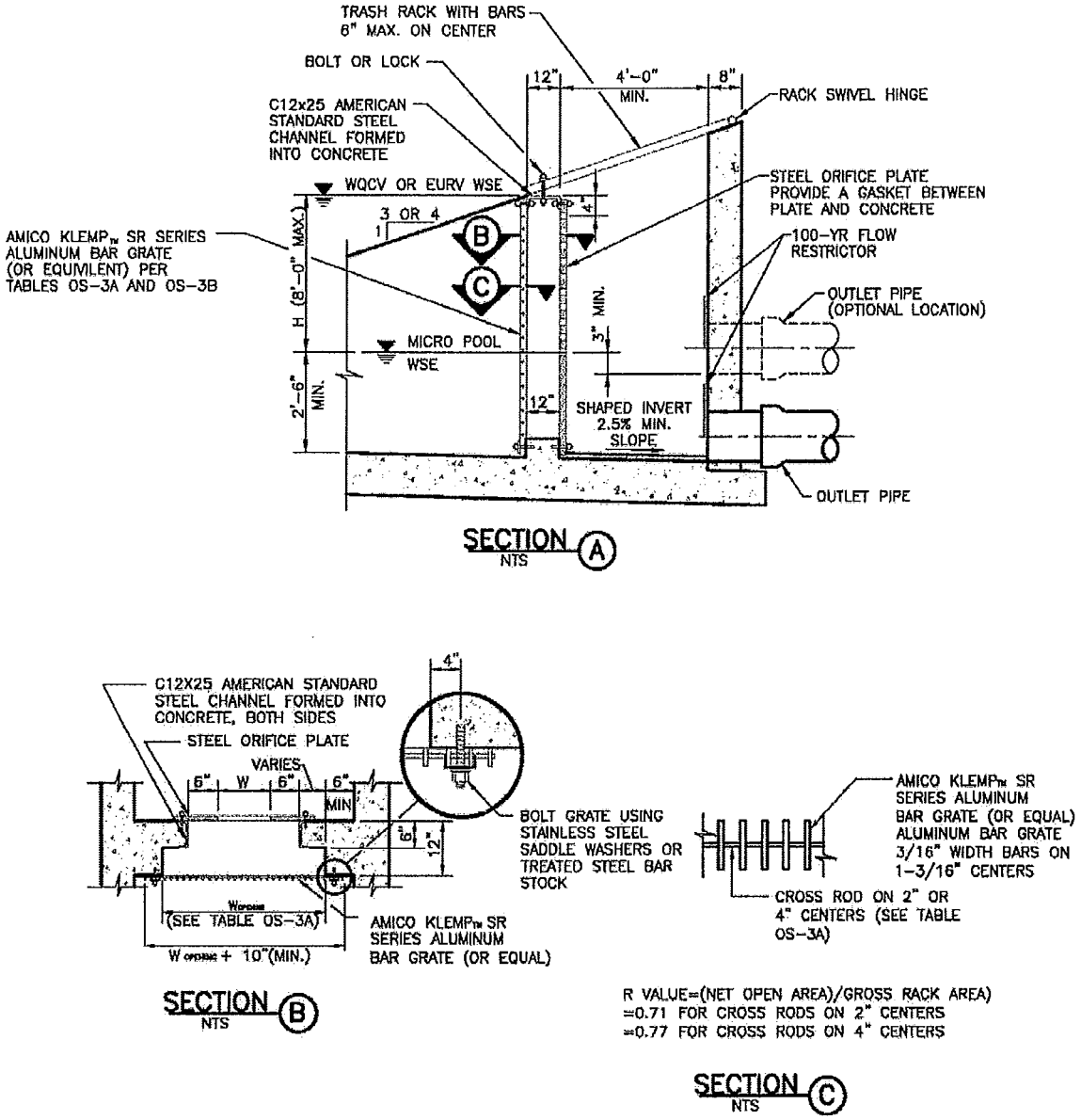


Figure OS-6. Typical Outlet Structure with Rectangular Orifice Plate

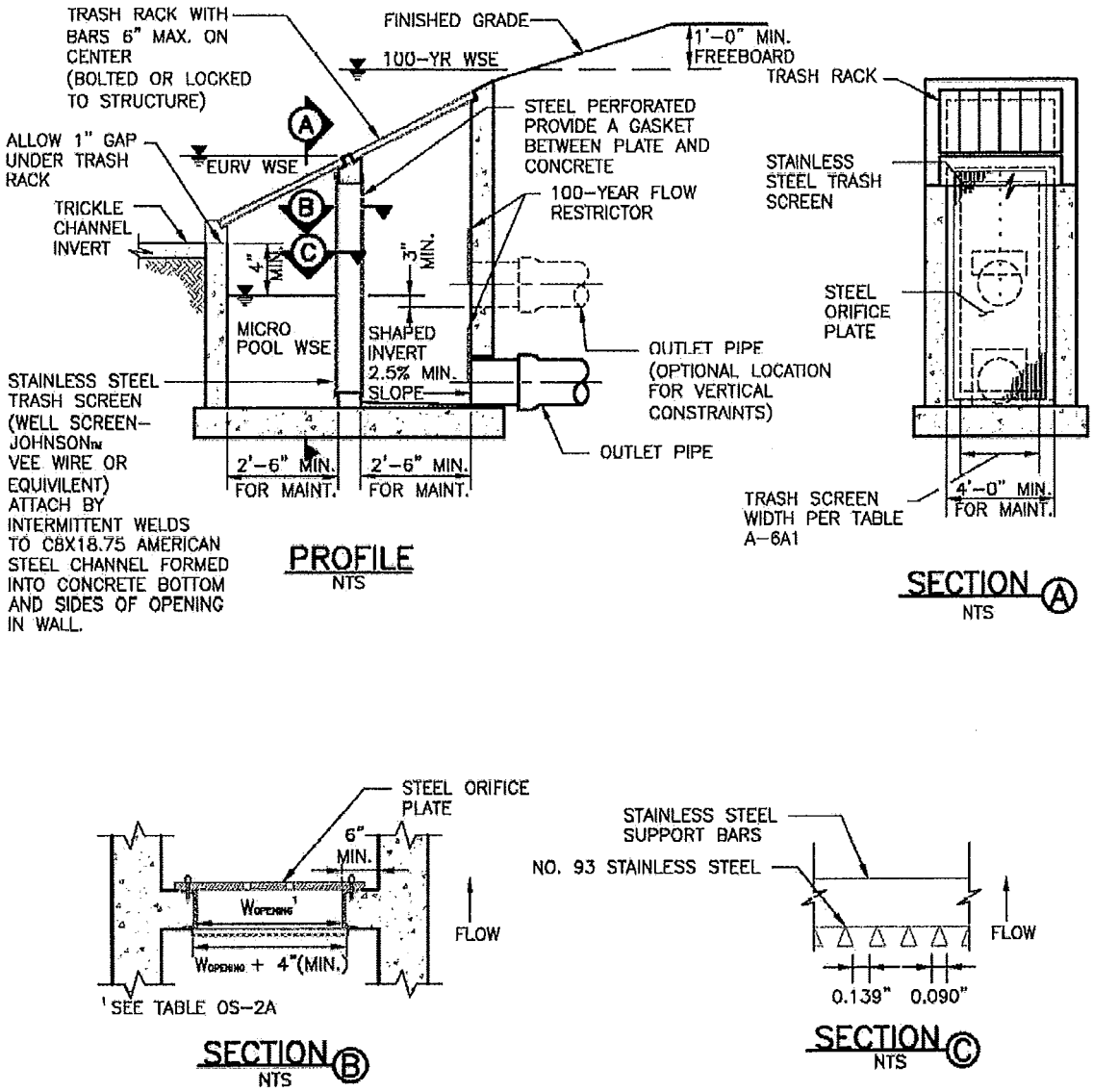


Figure OS-7. Full Spectrum Detention Outlet Structure for 5-acre Impervious Area or Less

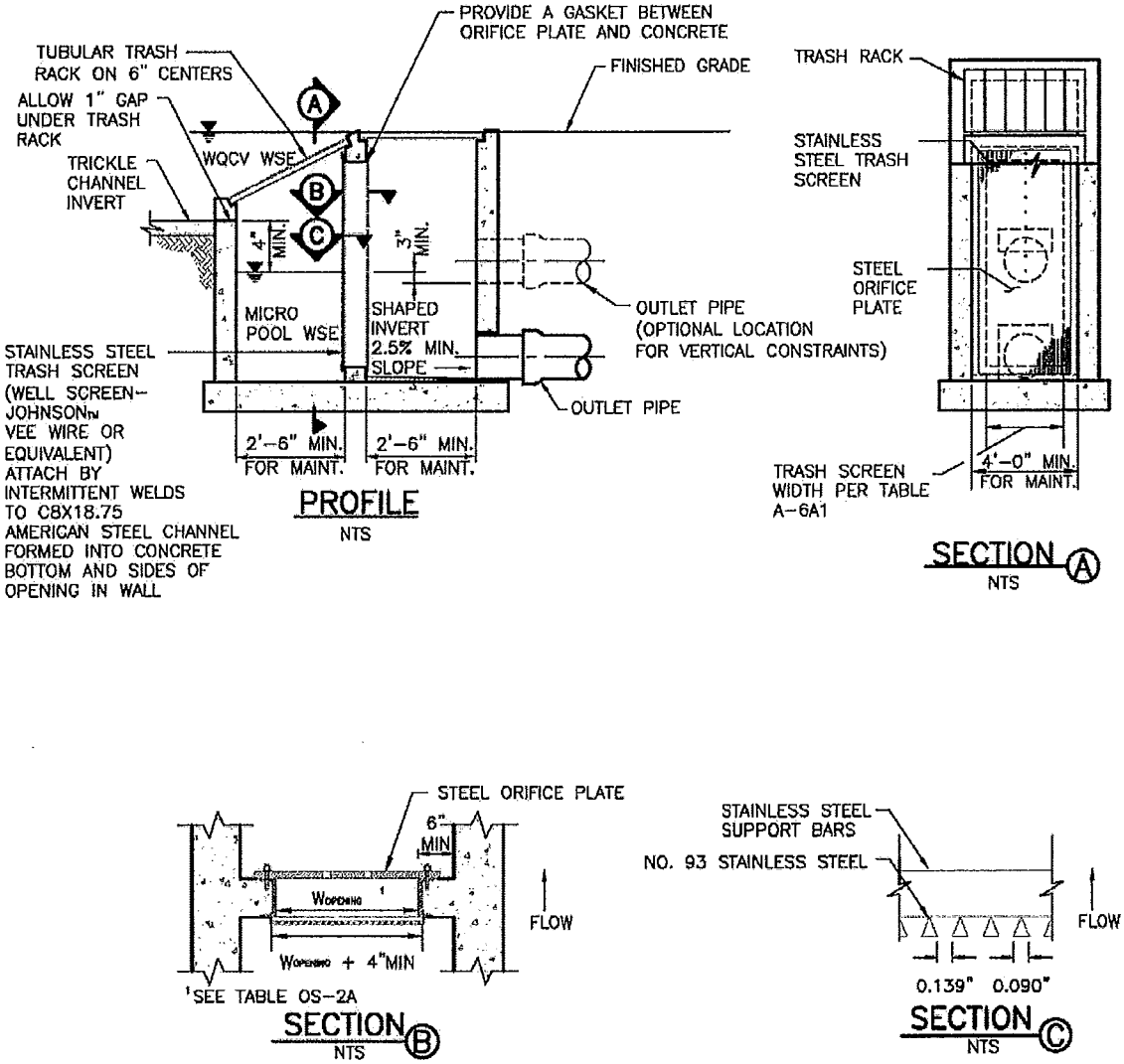


Figure OS-8. WQCV Outlet Structure for 5-acre Impervious Area or Less

DRAINAGE MAPS

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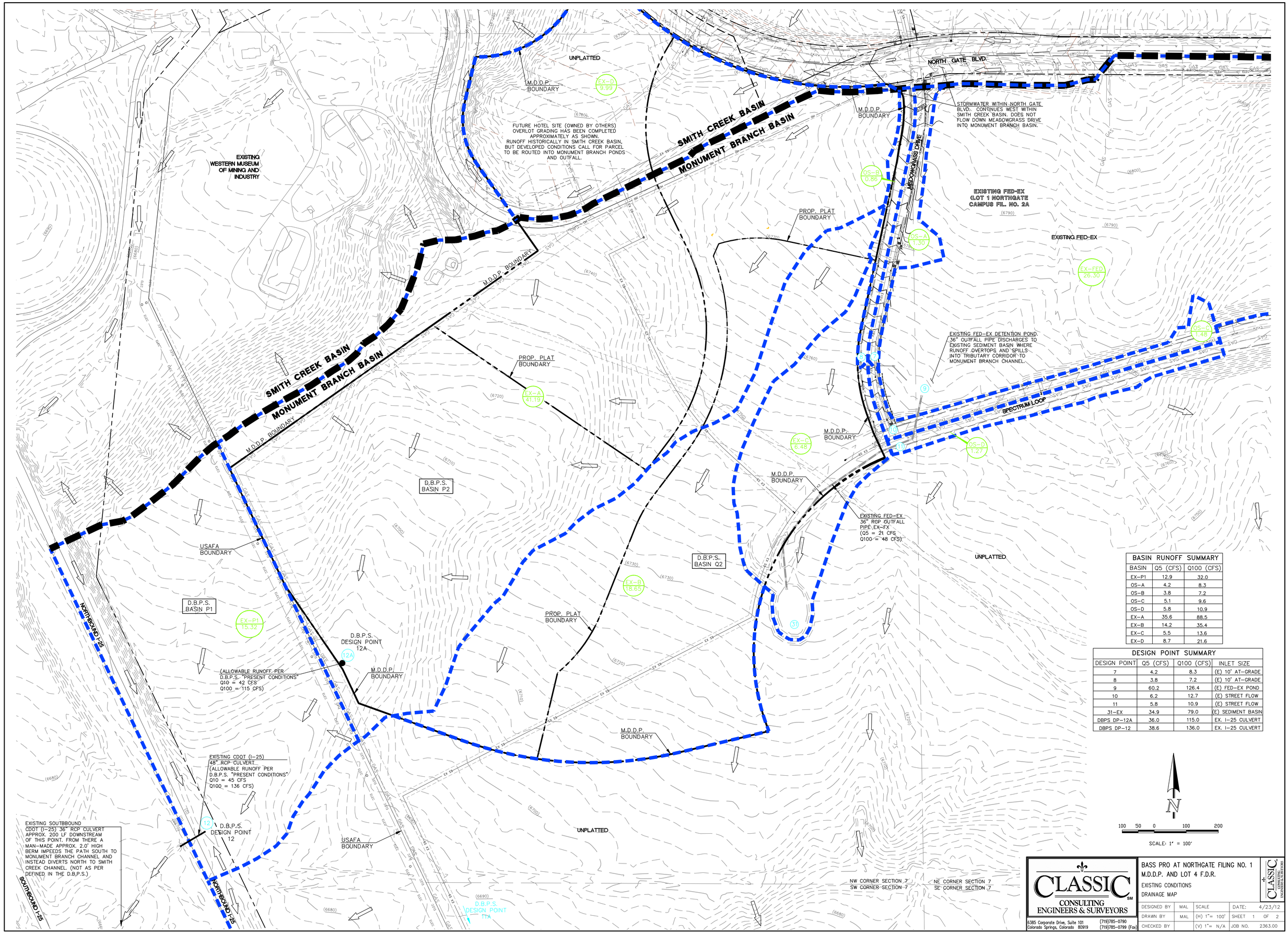

BASIN RUNOFF SUMMARY		
BASIN	Q5 (CFS)	Q100 (CFS)
EX-P1	12.9	32.0
OS-A	4.2	8.3
OS-B	3.8	7.2
OS-C	5.1	9.6
OS-D	5.8	10.9
EX-A	35.6	88.5
EX-B	14.2	35.4
EX-C	5.5	13.6
EX-D	8.7	21.6

DESIGN POINT SUMMARY			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	INLET SIZE
7	4.2	8.3	(E) 10' AT-GRADE
8	3.8	7.2	(E) 10' AT-GRADE
9	60.2	126.4	(E) FED-EX POND
10	6.2	12.7	(E) STREET FLOW
11	5.8	10.9	(E) STREET FLOW
31-EX	34.9	79.0	(E) SEDIMENT BASIN
DBPS DP-12A	36.0	115.0	EX. I-25 CULVERT
DBPS DP-12	38.6	136.0	EX. I-25 CULVERT

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(719)785-0799 (Fax)

BASS PRO AT NORTHGATE FILING NO. 1
M.D.D.P. AND LOT 4 F.D.R.
EXISTING CONDITIONS
DRAINAGE MAP

DESIGNED BY	MAL	SCALE		DATE:	4/23/12
DRAWN BY	MAL	(H) 1"= 100'		SHEET	1 OF 2
CHECKED BY		(V) 1"= N/A		JOB NO.	2363.00

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BASIN RUNOFF SUMMARY		
BASIN	Q5 (CFS)	Q100 (CFS)
EX-P1	12.9	32.0
OS-A	4.2	8.3
OS-B	3.8	7.2
OS-C	5.1	9.6
OS-D	5.8	10.9
A	13.9	25.0
B	16.9	30.0
C	6.2	11.7
D	22.0	39.0
E	5.3	10.0
F	3.9	7.3
H	37.1	67.3
I	29.6	52.7
J	20.4	36.2
K	2.3	4.2
L	18.2	32.4
M	4.6	8.6
N	3.5	6.6
P	1.5	2.8
Q	1.5	2.8
BP-1	7.7	15.3
BP-2	2.1	4.1
BP-3	17.1	32.6
BP-4	4.7	8.9
BP-5	8.2	15.3
BP-6	11.1	21.1
BP-7	7.4	14.5
BP-8	10.9	21.3
BP-9	6.7	14.6
BP-10	1.7	4.2
BP-11	3.0	5.6
BP-12	4.0	7.5

LEGEND

- EXISTING GROUND CONTOUR (6800)
- PROPOSED FINISHED CONTOUR 6800
- SITE BOUNDARY
- PROPOSED BASIN BOUNDARY
- EXISTING STORM SEWER
- EXISTING STORM INLET
- PROPOSED STORM SEWER
- PROPOSED STORM INLET
- BASIN IDENTIFIER / AREA IN ACRES (D / 1.41)
- PIPE RUN (1)
- DESIGN POINT (1)

N

100 50 0 100 200

SCALE: 1" = 100'

DESIGN POINT SUMMARY			
DESIGN POINT	Q5 (CFS)	Q100 (CFS)	INLET SIZE
1	13.9	25.0	FUTURE DEV.
2	16.9	30.0	FUTURE DEV.
3	6.2	11.7	(P) 10' AT-GRADE
4	22.0	39.0	FUTURE DEV.
5	37.1	67.3	FUTURE DEV.
6a	5.3	10.0	(P) 10' AT-GRADE
6b	5.9	12.2	(P) 20' AT-GRADE
7	4.2	8.3	(E) 10' AT-GRADE
8	3.8	7.2	(E) 10' AT-GRADE
9	60.2	126.4	(E) FED-EX POND
10	6.2	12.7	(E) STREET FLOW
11	5.8	10.9	(E) STREET FLOW
12	10.5	22.0	(P) 20' AT-GRADE
13	9.4	17.6	(P) 20' AT-GRADE
14	29.6	52.7	FUTURE DEV.
15	20.4	36.2	FUTURE DEV.
16	2.3	4.2	(P) 2 – 4' SUMPS
17	18.2	32.4	FUTURE DEV.
18	2.1	4.1	TRENCH DRAIN
19	8.2	15.3	ROOF DRAINS
20	7.7	15.3	(P) 6' SUMP
21	4.7	8.9	ROOF DRAINS
22	17.9	35.4	(P) 20' SUMP (2) D-9 AT-GRADE
23	11.1	21.1	(P) 10' SUMP
24	8.0	17.3	20' CURB CUT
25	3.0	5.6	(P) 4' SUMP
26	4.0	7.5	(P) 4' SUMP
27	10.9	21.3	(P) 10' SUMP
28a	74.9	138.3	RET. POND A
28b	129.8	233.5	RET. POND C
28c	201.1	369.6	SWQ/DETENTION
29	3.0	8.5	STREET FLOW
30	2.3	5.9	STREET FLOW
31-DEV	21.0	48.0	(E) SEDIMENT BASIN
DBPS DP-12	23.8	75.3	EX. I-25 CULVERT

PIPE ROUTING SUMMARY				PUBLIC/ PRIVATE
PIPE RUN	Q5 (CFS)	Q100 (CFS)	PIPE SIZE	
1	13.9	25.0	(P) 24"	PRIVATE
2	16.9	30.0	(P) 24"	PRIVATE
3	29.2	52.3	(P) 36"	PRIVATE
4	32.9	58.2	(P) 36"	PUBLIC
5	29.6	52.7	(P) 36"	PRIVATE
6	56.8	100.7	(P) 42"	PUBLIC
7	17.6	30.6	(F) 30"	PUBLIC
8	20.4	36.2	(P) 30"	PRIVATE
10	24.9	44.2	(P) 30"	PUBLIC
12	3.7	5.5	(P) 18"	PUBLIC
13	78.2	137.9	(P) 54"	PUBLIC
14	92.5	162.8	(P) 54"	PUBLIC
15	7.1	11.6	(F) 24"	PUBLIC
16	16.2	28.0	(F) 30"	PUBLIC
17	18.2	32.4	(P) 30"	PRIVATE
18	4.7	8.9	(P) 18"	PRIVATE
19	22.2	43.6	(P) 30"	PRIVATE
20	11.1	21.1	(P) 24"	PRIVATE
21	115.1	207.4	(P) 54"	PUBLIC
24	22.0	39.0	(F) 30"	PRIVATE
25	37.1	67.3	(P) 36"	PRIVATE
26	52.8	95.0	(P) 42"	PRIVATE
27	2.1	4.1	(P) 18"	PRIVATE
28	8.2	15.3	(P) 24"	PRIVATE
29	10.3	19.5	(P) 24"	PRIVATE
30	59.5	107.8	(P) 48"	PRIVATE
31	7.7	15.3	(P) 24"	PRIVATE
32	65.2	119.3	(P) 48"	PRIVATE
33	3.0	5.6	(P) 18"	PRIVATE
34	6.9	12.9	(P) 24"	PRIVATE
35	17.4	33.6	(P) 30"	PRIVATE
36	74.9	138.3	(P) 48"	PRIVATE
37	5.5	90.0	(P) 48"	PUBLIC
EX-FX	21.0	48.0	(E) 36"	PRIVATE

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Colorado Springs, Colorado 80919 (719)785-0799 (Fax)

BASS PRO AT NORTHGATE FILING NO. 1
M.D.D.P. AND LOT 4 F.D.R.
DEVELOPED CONDITIONS
DRAINAGE MAP

DESIGNED BY	MAL	SCALE	DATE: 4/23/12
DRAWN BY	MAL	(H) 1"= 100'	SHEET 1 OF 2
CHECKED BY		(V) 1"= N/A	JOB NO. 2363.00

X:\2363\DWG\DRAWINGS\DEVELOPMENT\MDDP Haus.dwg, 7/16/2012 9:17:52 PM, DWG To PDF.pc3