INNOVATIVE DESIGN. **CLASSIC RESULTS.**

FINAL DRAINAGE REPORT
ADDENDUM NO. 2
BENT GRASS RESIDENTIAL FILING NO. 1
FOR
BENT GRASS EAST COMMERCIAL
FILING NO. 3

Prepared for:
LAND FIRST INC.
1378 PROMONTORY BLUFF VIEW
COLORADO SPRINGS, CO 80921
Contact: Ron Waldthausen

Prepared by:
CLASSIC CONSULTING
619 N. CASCADE AVE., SUITE 200
COLORADO SPRINGS, CO 80903
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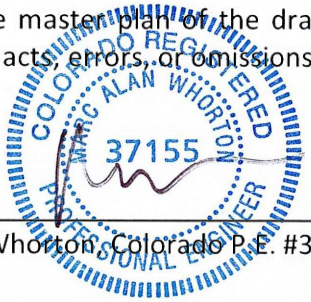
PCD File No. SP-20-010
Job no. 2177.64

FINAL DRAINAGE REPORT ADDENDUM NO. 2 BENT GRASS RESIDENTIAL FILING NO. 1 FOR BENT GRASS EAST COMMERCIAL FILING NO. 3

DRAINAGE REPORT STATEMENT

ENGINEER'S STATEMENT:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the applicable master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors, or omissions on my part in preparing this report.



Marc A. Whorton, Colorado P.E. #37155 — Date: 5/10/2021

OWNER'S/DEVELOPER'S STATEMENT:

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

Business Name: Land First Inc.

Title: President

Address: 1378 Promontory Bluff View

Colorado Springs, CO 80921

EL PASO COUNTY:

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

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

APPROVED
Engineering Department
11/02/2021 11:19:16 AM
dsdnijkamp
EPC Planning & Community Development Department

Conditions:

CLASSIC CONSULTING ENGINEERS & SURVEYORS

FINAL DRAINAGE REPORT ADDENDUM NO. 2 BENT GRASS RESIDENTIAL FILING NO. 1 FOR BENT GRASS EAST COMMERCIAL FILING NO. 3

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FINAL DRAINAGE REPORT ADDENDUM NO. 2 BENT GRASS RESIDENTIAL FILING NO. 1 FOR BENT GRASS EAST COMMERCIAL FILING NO. 3

PURPOSE

This portion of the Bent Grass East Commercial development was previously platted as Tract B within Bent Grass East Commercial Filing No. 2B. However, it was previously analyzed from a drainage standpoint and included in the Bent Grass Residential Filing No. 1 Final Drainage Report and latest Addendum filed in 2015. The previous drainage basins K, L and M1 encompass the proposed development and re-plat of Tract B. The purpose of this report is to confirm that the existing adjacent pond indeed accounted for this development and to better define the exact routing of the proposed storm sewer into the pond and associated concrete forebay design.

GENERAL DESCRIPTION

Tract B, Bent Grass East Commercial Filing No. 2B contains a total area of 219,877 SF (5.05 AC.), located in the county of El Paso within Section 1, Township 13 South, Range 65 West of the Sixth Principal Meridian, El Paso County, Colorado. The site is bounded on the north by Bent Grass Meadows Dr., on the east by Meridian Park Dr., on the west Bent Grass Residential Filing No. 1 and to the south by the existing detention pond within Tract A of the Bent Grass East Commercial development.

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

EXISTING/DEVELOPED DRAINAGE CONDITIONS

The entire proposed development area was previously overlot graded along with the adjacent developments. The revegetation consists of native grasses with slopes of 2%-4%. The entire property sheet flows in a southerly direction directly into the existing detention pond 2 just south of the property.

The proposed development plans to construct a private roadway in order to provide vehicular access to the 6 lots. This private road will connect to both Bent Grass Meadows Dr. to the north and Meridian Park Dr. to the east. High points are planned at each of these two connection points with a low point near the middle of the property. (See Developed Drainage Map in Appendix)

Design Point 1 (Q_5 = 4 cfs and Q_{100} = 8 cfs) represents developed flows from Basin A (lots 2 and 3 and north half of the private road). These flows will be routed towards Design Point 1 where a private 5' Type R Sump Inlet will completely collect both the 5 and 100 yr. developed flows.

Design Point 2 (Q_5 = 1 cfs and Q_{100} = 3 cfs) represents developed flows from Basin B (portion of lots 4 and 5 and south half of the private road). These flows will be routed towards Design Point 2 where a private 5' Type R Sump Inlet will completely collect both the 5 and 100 yr. developed flows.

Design Point 3 (Q_5 = 7 cfs and Q_{100} = 13 cfs) represents developed flows from Basin C (lots 4 and 6) and a portion of off-site Basin K (existing residential development to the west). These flows will be routed towards Design Point 3 where a private 24" RCP storm stub will collect both the 5 and 100 yr. developed flows. The individual site plans for each of these lots will show how curb and gutter will collect these developed flows and route them towards the provided 24" RCP private storm stub. These flows remain consistent with Basins L (Q_5 = 18 cfs and Q_{100} = 35 cfs) and K (Q_5 = 2 cfs and Q_{100} = 4 cfs) from the previous report. (See Appendix)

Design Point 4 (Q_5 = 11 cfs and Q_{100} = 22 cfs) represents the total developed flows that will enter the existing pond at this location (Basins A, B, C and a portion of Basin K). A concrete forebay is proposed within the existing pond at this location with the following criteria:
(See Appendix)

Per UD-BMP Spreadsheet – **Concrete Forebay sizing**

0.003 Ac-ft. or 131 SF min. Forebay with 12" high walls OR **88 SF min. with 18" high walls**

4.5" wide notch at end of forebay

Basin E (Q_5 = 0.3 cfs and Q_{100} = 1.0 cfs) represents developed flows from Basin E (landscape/setback area within lots 1, 2 and 3) that will continue to sheet flow in a northeasterly direction and directly into Bent Grass Meadows Dr. This minor developed flow was accounted for and remains consistent with the previously approved report. Also, per ECM I.7.1.C.1.a this basin of 0.3 ac. is not practical to be captured and will not drain towards the downstream control measures.

Basin D (Q_5 = 3 cfs and Q_{100} = 6 cfs) represents developed flows from Basin D (lots 1 and a portion of 5 and a portion of the private road). These flows will continue to sheet flow directly into Meridian Park Dr. They then travel as curb and gutter flows to the existing sump inlet within the cul-de-sac and then directly into the existing pond. These flows were accounted for in the previously approved drainage report and remain consistent with Basin M1 (Q_5 = 6 cfs and Q_{100} = 11 cfs) from the previous report. (See Appendix)

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 with County adopted Chapter 6 and Section 3.2.1 of Chapter 13 of the City of Colorado Springs/El Paso County Drainage Criteria Manual as revised in May 2014 along with the El Paso County Engineering Criteria Manual, updated October 2020. Individual on-site developed basin design used for detention/SWQ basin sizing, inlet sizing and storm system routing was calculated using the Rational Method. Runoff Coefficients are based on the imperviousness of the particular land

use and the hydrologic soil type in accordance with Table 6-6. The average rainfall intensity, by recurrence interval found in the Intensity-Duration-Frequency (IDF) curves in Figure 6-5. (See Appendix)

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

This site adheres to this **Four Step Process** as follows:

1. **Employ Runoff Reduction Practices:** Proposed urban commercial lot impervious areas (roof tops, parking lots, drive aisles, etc.) will to the extent possible, sheet flow across landscaped areas to slow runoff and increase time of concentration prior to being conveyed to the proposed private storm systems and stormwater quality facilities. This will minimize directly connected impervious areas within the project site.

2. **Stabilize Drainageways:** After developed flows utilize the runoff reduction practices through landscaped areas, developed flows will travel via curb and gutter and buried storm sewer systems. These collected flows are then routed directly to the existing stormwater quality facility adjacent to the site (Pond 2) that was originally constructed with Bent Grass Residential Filing No. 1.

3. **Provide Water Quality Capture Volume (WQCV):** Runoff from this development will be treated through capture and slow release of the WQCV in the existing stormwater quality facility (Pond 2).

4. **Consider need for Industrial and Commercial BMPs**: No industrial uses are proposed within this development. However, a site specific storm water quality and erosion control plan and narrative will be submitted along with the grading and erosion control plan. Details such as site specific sediment and erosion control construction BMP's as well as temporary and permanent BMP's will be detailed in this plan and narrative to protect receiving waters. BMP's will be constructed and maintained as the development has been graded and erosion control methods employed.

FLOODPLAIN STATEMENT

No portion of this site is located within a FEMA floodplain as determined by the Flood Insurance Rate Map (F.I.R.M.) Map Number 08041C0553G, with effective date of December, 7 2018. (See Appendix)

DRAINAGE AND BRIDGE FEES

This site lies entirely within the Falcon Drainage Basin boundaries.

The fees are calculated using the following impervious acreage method approved by El Paso County. Bent Grass East Commercial Filing No. 3 has a total area of 5.048 acres with a commercial land use designation.

The percent imperviousness for this subdivision is calculated as follows:

Fees for Commercial Land Use

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

5.048 Ac. x 95% = 4.796 **Impervious Ac.**

The following calculations are based on the 2020 Falcon drainage/bridge fees:

ESTIMATED FEES:

Bridge Fees

$ 4,232.00 x 4.796 Impervious Ac. = **$ 20,296.67**

Drainage Fees

$ 30,807.00 x 4.796 Impervious Ac. = **$ 147,750.37**

Per the ECM 3.10.4.a, this development requests a reduction of drainage fees based on the on-site detention pond 2 that was constructed as a part of the Bent Grass Residential Filing No. 1 development. This facility within the Falcon Drainage Basin seems to meet the following criteria for this reduction:

1. *Allowed only where regional system is not yet in place* – no downstream regional facility in place yet
2. *The pond is less than 15 acre-feet in volume from the lowest outlet structure to the crest of the emergency spillway* – The existing pond 2 has a volume of 2.32 ac.-ft.
3. *The on-site pond is not part of the regional plan (for approval ponds that are part of the regional plan, developers are given 100% credit)* – Pond 2 is not a part of the regional plan
4. *The outlet of the pond must be designed to release at historic levels for all precipitation events from the 2 yr. storm to the 100 yr. storm. A smaller outlet may be required by the County if adequate downstream channel improvement are not in place to protect residents from the 2 yr. storm* – Pond 2 was designed as a full spectrum facility
5. *County approves design and construction* – County approved the design and construction of Pond 2 along with the Bent Grass Residential Filing No. 1 development
6. *Landowners assume responsibility for maintenance* – Pond 2 is owned and maintained by the Bent Grass Metro. District

Per Bent Grass East Commercial Filing No. 2 Final Drainage Report – Dated Aug. 2014

Construction of Detention Pond 2 (Full Spectrum on-site Facility)	=	$75,000 *
50% credit was taken against drainage fees owed (See Appendix)	=	$37,500 – 26,860.65
Credit remaining within the Falcon Basin	=	$10,639.35

**Developer to provide receipts for previous pond const. and apply for drainage reimbursement in order to receive credit.*

TOTAL DRAINAGE FEES (after reduction):

Drainage Fees

$ 147,750.37 – 10,639.35 = **$ 137,111.02** *

SUMMARY

The proposed grading plan, drainage patterns and quantities remain consistent with the previously approved final drainage report for Bent Grass Residential Filing No. 1 and associated addendum. The proposed development will not adversely impact surrounding properties.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

mw/217764/Reports/217764FDR Addendum.doc

REFERENCES

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

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

3. "Falcon Drainage Basin Planning Study - Update," by Matrix Design Group, dated August 2013.

4. "Preliminary Drainage Report for Bent Grass East Commercial – Phase 1 and Final Drainage Report for Bent Grass East Commercial Filing No. 1 – Lot 1", by Classic Consulting, dated May 2013

5. "Final Drainage Report for Bent Grass East Commercial Filing No. 2", by Classic Consulting, dated May 2014.

6. "Final Drainage Report for Bent Grass Residential Filing No. 1", by Classic Consulting, Sept. 2014.

7. "Final Drainage Report Addendum for Bent Grass Residential Filing No. 1", by Classic Consulting, August 2015.

APPENDIX

VICINITY MAP

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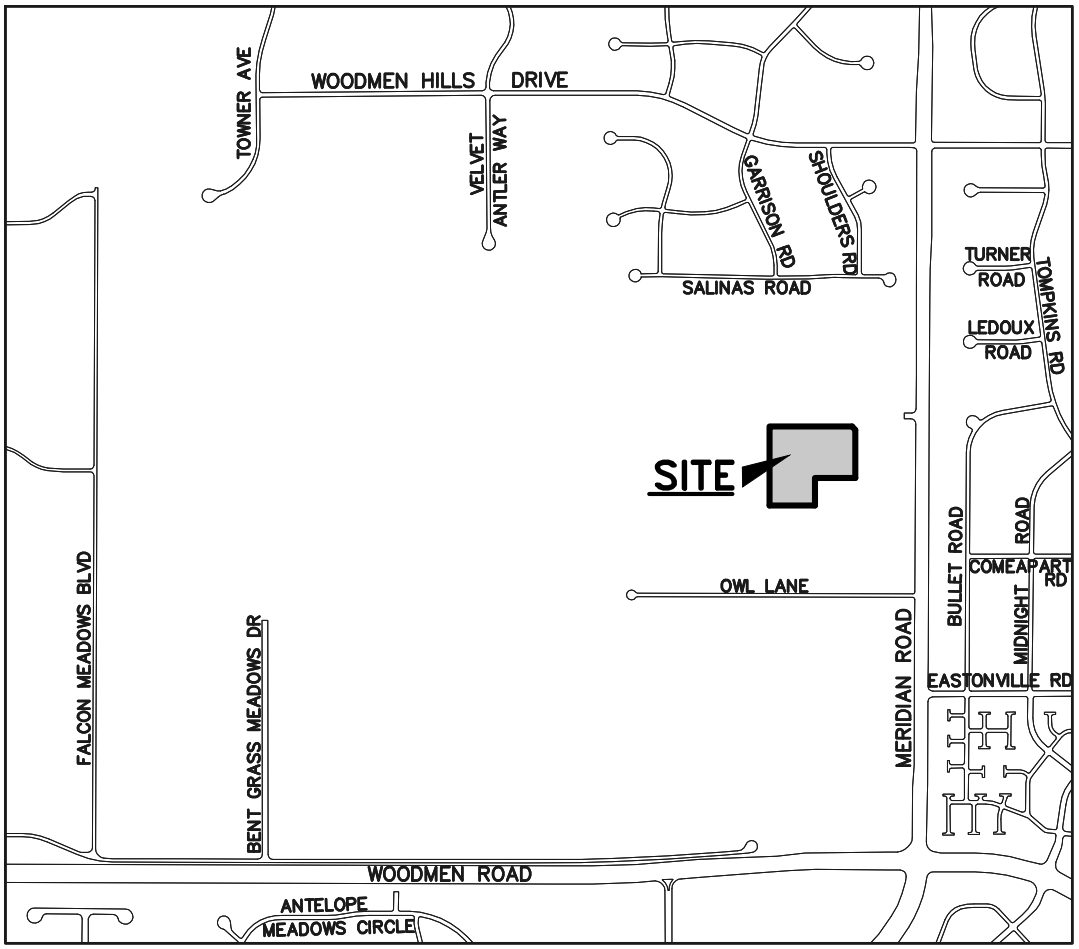
ENGINEERS & SURVEYORS



VICINITY MAP

N.T.S.

SOILS MAP (S.C.S. SURVEY)

CLASSIC
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ENGINEERS & SURVEYORS

Map Scale: 1:2,130 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

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

MAP LEGEND

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

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	22.5	100.0%
Totals for Area of Interest		**22.5**	**100.0%**

El Paso County Area, Colorado

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

Map Unit Setting

National map unit symbol: 367p
Elevation: 6,500 to 7,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Columbine and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Columbine

Setting

Landform: Fans, flood plains, fan terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 14 inches: gravelly sandy loam
C - 14 to 60 inches: very gravelly loamy sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB215CO - Gravelly Foothill
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit: 1 percent

Landform: Depressions
Hydric soil rating: Yes

Other soils
Percent of map unit: 1 percent
Hydric soil rating: No

Fluvaquentic haplaquolls
Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

F.E.M.A MAP

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ENGINEERS & SURVEYORS

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 13. The **horizontal datum** was NAD83, GRS80 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the **North American Vertical Datum of 1988 (NAVD88)**. These flood elevations must be compared to structure and ground elevations referenced to the **same vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, NINGS12
National Geodetic Survey
SSMC-3 #9202
1315 East-West Highway
Silver Spring, MD 20910-3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at (301) 713-3242 or visit its web site at http://www.ngs.noaa.gov.

Base Map information shown on this FIRM was provided in digital format by El Paso County, Colorado Springs Utilities, City of Fountain, Bureau of Land Management, National Oceanic and Atmospheric Administration, United States Geological Survey, and Anderson Consulting Engineers, Inc. These data are current as of 2006.

This map reflects **more detailed and up-to-date stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map. The profile baselines depicted on this map represent the hydraulic modeling baselines that match the flood profiles and Floodway Data Tables if applicable, in the FIS report. As a result, the profile baselines may deviate significantly from the new base map channel representation and may appear outside of the floodplain.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

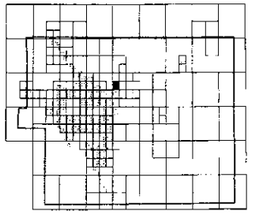
Contact **FEMA Map Service Center** (MSC) via the FEMA Map Information eXchange (FMIX) 1-877-336-2627 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. The MSC may also be reached by Fax at 1-800-358-9620 and its website at http://www.msc.fema.gov.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call 1-877-FEMA MAP (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

El Paso County Vertical Datum Offset Table

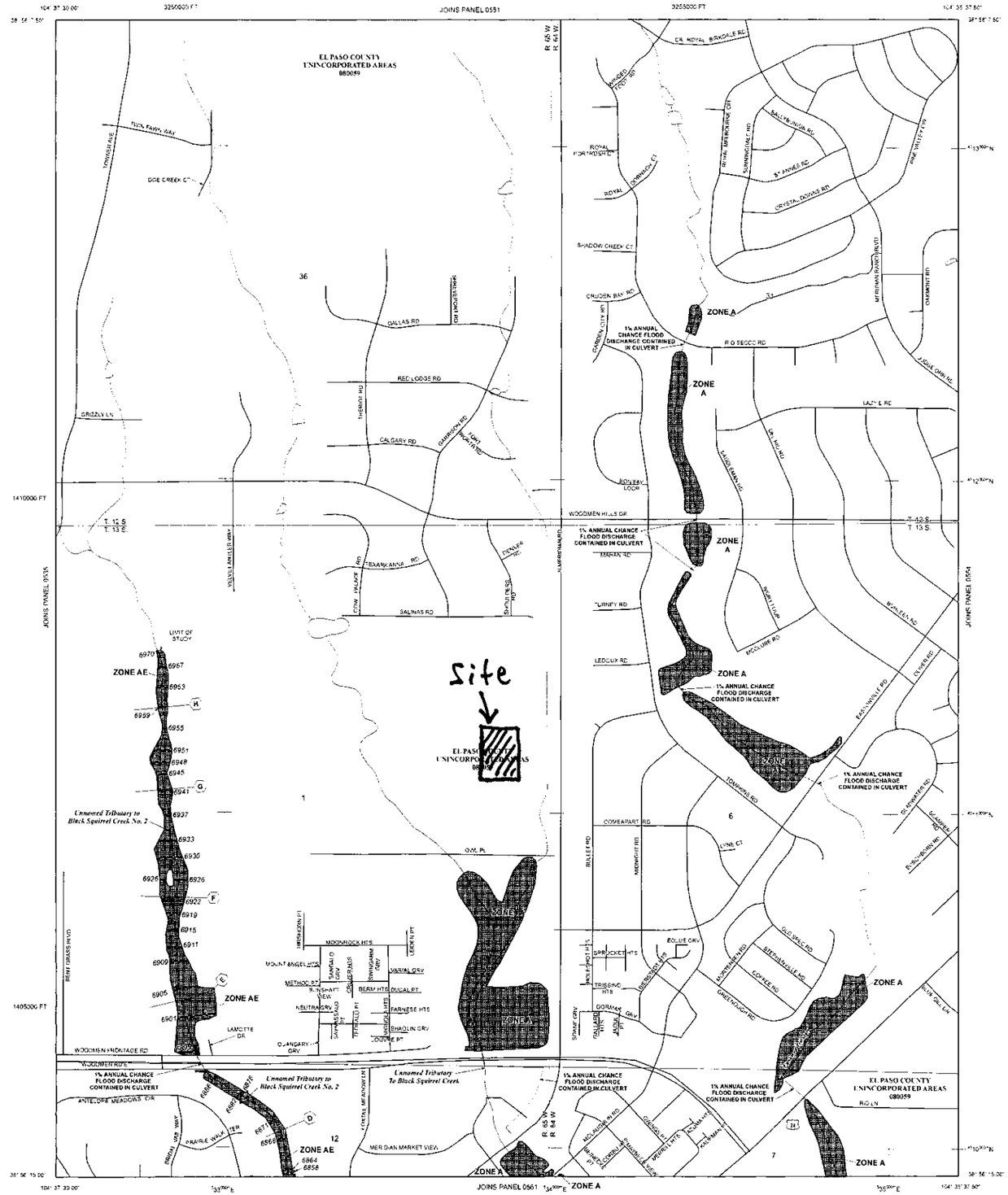
Flooding Source	Vertical Datum Offset (ft)
REFER TO SECTION 3.3 OF THE EL PASO COUNTY FLOOD INSURANCE STUDY FOR STREAM BY STREAM VERTICAL DATUM CONVERSION INFORMATION.	

Panel Location Map



This Digital Flood Insurance Rate Map (DFIRM) was produced through a Cooperating Technical Partner (CTP) agreement between the State of Colorado Water Conservation Board (CWCB) and the Federal Emergency Management Agency (FEMA).

Additional Flood Hazard information and resources are available from local communities and the Colorado Water Conservation Board.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAS) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood, also known as the base flood) is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

- **ZONE A** — No Base Flood Elevations determined.
- **ZONE AE** — Base Flood Elevations determined.
- **ZONE AH** — Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
- **ZONE AO** — Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **ZONE AR** — Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
- **ZONE A99** — Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
- **ZONE V** — Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
- **ZONE VE** — Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

- **ZONE X** — Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

- **ZONE X** — Areas determined to be outside the 0.2% annual chance floodplain.
- **ZONE D** — Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- Floodplain boundary
- Floodway boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

- A — A — Cross section line
- 23 — 23 — Transect line
- 97° 07' 30.00" / 32° 22' 30.00" — Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
- 4275000 mN — 1000-meter Universal Transverse Mercator grid ticks, zone 13
- 6500000 FT — 5000-foot grid ticks: Colorado State Plane coordinate system, central zone (FIPSZONE 0502), Lambert Conformal Conic Projection
- DX5510 — Bench mark (see explanation in Notes to Users section of this FIRM panel)
- M1.5 — River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE FLOOD INSURANCE RATE MAP
MARCH 17, 1997

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
DECEMBER 7, 2018 - to update corporate limits, to change Base Flood Elevations and Special Flood Hazard Areas, to update map format, to add roads and road names, and to incorporate previously issued Letters of Map Revision.

For communities' map revision history prior to countywide mapping, refer to the Community Map History Table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 500'

250 0 500 1000 FEET

150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0553G

FIRM

FLOOD INSURANCE RATE MAP

EL PASO COUNTY, COLORADO AND INCORPORATED AREAS

PANEL 553 OF 1300

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS

COMMUNITY	NUMBER	PANEL	SUFFIX
EL PASO COUNTY	080059	0553	G

Notice: This map was revised on 05/15/2020 to replace a panel. This map supersedes any previous versions. See the Notice to User for more information about this correction, or details.

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
08041C0553G

MAP REVISED
DECEMBER 7, 2018

Federal Emergency Management Agency

CALCULATIONS

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS

JOB NAME: ***BENT GRASS EAST COMMERCIAL FILING NO. 3***
JOB NUMBER: ***2177.64***
DATE: ***11/04/20***
CALCULATED BY: ***MAW***

FINAL DRAINAGE REPORT ~ BASIN RUNOFF COEFFICIENT SUMMARY

		IMPERVIOUS AREA / STREETS				LANDSCAPE/UNDEVELOPED AREAS				WEIGHTED			WEIGHTED CA		
BASIN	TOTAL AREA (AC)	AREA (AC)	C(2)	C(5)	C(100)	AREA (AC)	C(2)	C(5)	C(100)	C(2)	C(5)	C(100)	**CA(2)**	**CA(5)**	**CA(100)**
A	1.4	1.10	0.89	0.90	0.96	0.30	0.02	0.08	0.35	0.70	0.72	0.83	**0.99**	**1.01**	**1.16**
B	0.4	0.30	0.89	0.90	0.96	0.10	0.02	0.08	0.35	0.67	0.70	0.81	**0.27**	**0.28**	**0.32**
C	2.0	1.60	0.89	0.90	0.96	0.40	0.02	0.08	0.35	0.72	0.74	0.84	**1.43**	**1.47**	**1.68**
D	0.9	0.75	0.89	0.90	0.96	0.15	0.02	0.08	0.35	0.75	0.76	0.86	**0.67**	**0.69**	**0.77**
E	0.3	0.05	0.89	0.90	0.96	0.25	0.02	0.08	0.35	0.17	0.22	0.45	**0.05**	**0.07**	**0.14**
K	1.0	0.35	0.89	0.90	0.96	0.65	0.02	0.08	0.35	0.32	0.37	0.56	**0.32**	**0.37**	**0.56**

JOB NAME:	*BENT GRASS EAST COMMERCIAL FILING NO. 3*
JOB NUMBER:	*2177.64*
DATE:	*11/04/20*
CALC'D BY:	*MAW*

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad V = C_v S_w^{0.5} \qquad \text{Tc=L/V}$$

Table 6-7. Conveyance Coefficient, C_v

Type of Land Surface	C_v
Heavy meadow	2.5
Tillage/field	5
Riprap (not buried)*	6.5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

$t_c = \frac{L}{180} + 10$

*For buried riprap, select C_v value based on type of vegetative cover.

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	TOTAL AREA (AC)	WEIGHTED CA(2)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	TOTAL FLOWS Q(5) (cfs)	TOTAL FLOWS Q(100) (cfs)
A	1.4	0.99	1.01	1.16	0.08	30	2	5.4	250	2.0%	1.0	4.2	9.6	3.34	4.19	7.03	3	**4**	**8**
B	0.4	0.27	0.28	0.32	0.08	10	0.2	4.6	100	1.5%	0.9	1.9	6.6	3.79	4.76	7.99	1	**1**	**3**
C	2.0	1.43	1.47	1.68	0.08	30	1.5	5.9	400	2.0%	1.0	6.7	12.7	3.01	3.77	6.34	4	**6**	**11**
D	0.9	0.67	0.69	0.77	0.08	10	0.2	4.6	200	2.0%	1.4	2.4	7.0	3.72	4.67	7.83	2	**3**	**6**
E	0.3	0.05	0.07	0.14	0.08	25	0.5	7.3					7.3	3.67	4.60	7.72	0.2	**0.3**	**1.0**
K	1.0	0.32	0.37	0.56	0.08	65	3	9.0					9.0	3.43	4.29	7.21	1	**2**	**4**

JOB NAME: *BENT GRASS EAST COMMERCIAL FILING NO. 3*
JOB NUMBER: *2177.64*
DATE: *11/04/20*
CALCULATED BY: *MAW*

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Outfall / Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1	A	1.01	1.16	9.6	4.19	7.03	4	8	5' Type R Sump Inlet
2	B	0.28	0.32	6.6	4.76	7.99	1	3	5' Type R Sump Inlet
3	C, 70% K	1.73	2.07	12.7	3.77	6.34	7	13	24" RCP Stub
4	A, B, C, 70% K	3.02	3.55	12.8	3.76	6.32	11	22	Concrete Forebay

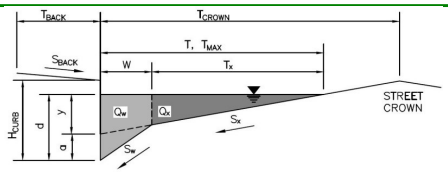
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: BENT GRASS EAST COMMERCIAL FILING NO. 3

Inlet ID: DP1



Gutter Geometry (Enter data in the blue cells)

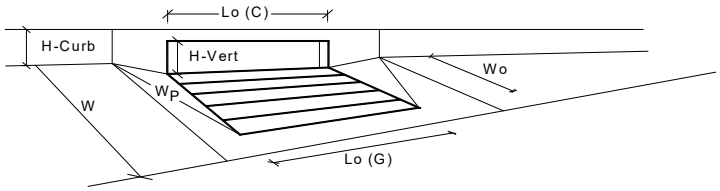
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.0	8.0	cfs

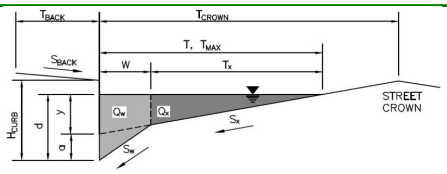
Version 4.05 Released March 2017

ALLOWABLE CAPACITY FOR ONE-HALF OF STREET (Minor & Major Storm)

(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project: BENT GRASS EAST COMMERCIAL FILING NO. 3

Inlet ID: DP2



Gutter Geometry (Enter data in the blue cells)

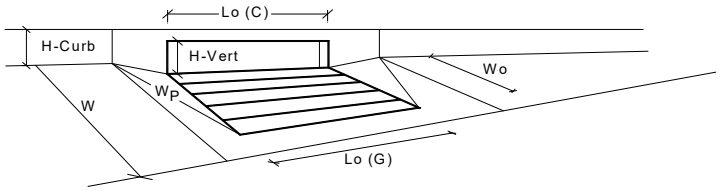
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	7.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	14.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.020	ft/ft
Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)	S_W =	0.083	ft/ft
Street Longitudinal Slope - Enter 0 for sump condition	S_O =	0.000	ft/ft
Manning's Roughness for Street Section (typically between 0.012 and 0.020)	n_{STREET} =	0.016	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	14.0	14.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	12.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

		Minor Storm	Major Storm	
MINOR STORM Allowable Capacity is based on Depth Criterion				
MAJOR STORM Allowable Capacity is based on Depth Criterion	**Q_{allow} =**	**SUMP**	**SUMP**	**cfs**

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



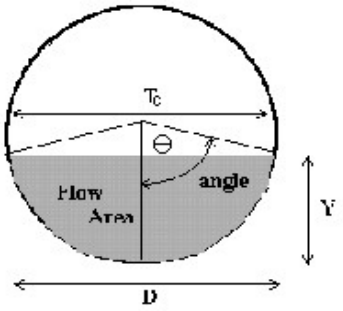
Design Information (Input)		MINOR	MAJOR	
Type of Inlet	Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	12.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	N/A	N/A	feet
Width of a Unit Grate	W_o =	N/A	N/A	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	N/A	N/A	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	N/A	N/A	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	N/A	N/A	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	N/A	N/A	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	5.00	5.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.00	6.00	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	6.00	6.00	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	63.40	63.40	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	2.00	2.00	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	0.10	0.10	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	3.60	3.60	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.67	0.67	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	N/A	N/A	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.33	0.83	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.77	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	N/A	N/A	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	**Q_a =**	**5.4**	**12.3**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	1.0	3.0	cfs

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: BENT GRASS EAST COMMERCIAL FILING NO. 3

Pipe ID: 24" RCP (DP-1)



Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	8.00	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	22.68	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.39	radians
Flow area	An =	1.21	sq ft
Top width	Tn =	1.97	ft
Wetted perimeter	Pn =	2.78	ft
Flow depth	Yn =	0.82	ft
Flow velocity	Vn =	6.59	fps
Discharge	Qn =	8.00	cfs
Percent of Full Flow	Flow =	35.3%	of full flow
Normal Depth Froude Number	Fr_n =	1.48	supercritical

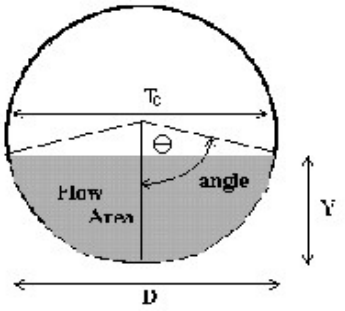
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.58	radians
Critical flow area	Ac =	1.58	sq ft
Critical top width	Tc =	2.00	ft
Critical flow depth	Yc =	1.01	ft
Critical flow velocity	Vc =	5.05	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: BENT GRASS EAST COMMERCIAL FILING NO. 3

Pipe ID: 24" RCP (DP-1 & DP-2)



Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	10.00	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	22.68	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.50	radians
Flow area	An =	1.43	sq ft
Top width	Tn =	2.00	ft
Wetted perimeter	Pn =	3.00	ft
Flow depth	Yn =	0.93	ft
Flow velocity	Vn =	6.99	fps
Discharge	Qn =	10.00	cfs
Percent of Full Flow	Flow =	44.1%	of full flow
Normal Depth Froude Number	Fr_n =	1.46	supercritical

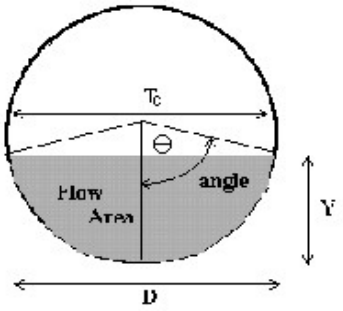
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.70	radians
Critical flow area	Ac =	1.83	sq ft
Critical top width	Tc =	1.98	ft
Critical flow depth	Yc =	1.13	ft
Critical flow velocity	Vc =	5.46	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: BENT GRASS EAST COMMERCIAL FILING NO. 3

Pipe ID: 24" RCP (DP-3)



Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	24.00	inches
Design discharge	Q =	13.00	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	3.14	sq ft
Full-flow wetted perimeter	Pf =	6.28	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	22.68	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.66	radians
Flow area	An =	1.74	sq ft
Top width	Tn =	1.99	ft
Wetted perimeter	Pn =	3.31	ft
Flow depth	Yn =	1.09	ft
Flow velocity	Vn =	7.47	fps
Discharge	Qn =	13.00	cfs
Percent of Full Flow	Flow =	57.3%	of full flow
Normal Depth Froude Number	Fr_n =	1.41	supercritical

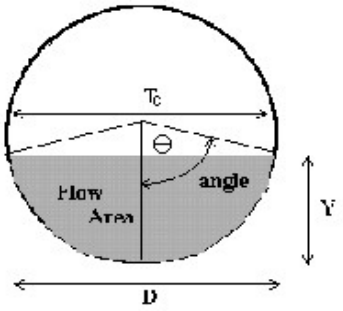
Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.87	radians
Critical flow area	Ac =	2.16	sq ft
Critical top width	Tc =	1.91	ft
Critical flow depth	Yc =	1.30	ft
Critical flow velocity	Vc =	6.03	fps
Critical Depth Froude Number	Fr_c =	1.00	

CIRCULAR CONDUIT FLOW (Normal & Critical Depth Computation)

MHFD-Culvert, Version 4.00 (May 2020)

Project: BENT GRASS EAST COMMERCIAL FILING NO. 3

Pipe ID: 30" RCP (DP-4)



Design Information (Input)			
Pipe Invert Slope	So =	0.0100	ft/ft
Pipe Manning's n-value	n =	0.0130	
Pipe Diameter	D =	30.00	inches
Design discharge	Q =	22.00	cfs

Full-Flow Capacity (Calculated)			
Full-flow area	Af =	4.91	sq ft
Full-flow wetted perimeter	Pf =	7.85	ft
Half Central Angle	Theta =	3.14	radians
Full-flow capacity	Qf =	41.13	cfs

Calculation of Normal Flow Condition			
Half Central Angle (0<Theta<3.14)	Theta =	1.61	radians
Flow area	An =	2.58	sq ft
Top width	Tn =	2.50	ft
Wetted perimeter	Pn =	4.03	ft
Flow depth	Yn =	1.30	ft
Flow velocity	Vn =	8.52	fps
Discharge	Qn =	22.00	cfs
Percent of Full Flow	Flow =	53.5%	of full flow
Normal Depth Froude Number	Fr_n =	1.48	supercritical

Calculation of Critical Flow Condition			
Half Central Angle (0<Theta-c<3.14)	Theta-c =	1.85	radians
Critical flow area	Ac =	3.31	sq ft
Critical top width	Tc =	2.40	ft
Critical flow depth	Yc =	1.59	ft
Critical flow velocity	Vc =	6.66	fps
Critical Depth Froude Number	Fr_c =	1.00	

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.07, March 2018)

Designer: Marc A. Whorton, P.E.
Company: Classic Consulting
Date: November 4, 2020
Project: Bent Grass East Commercial Filing No. 3
Location: Exist. Pond - Proposed Forebay for Commercial Development

1. Basin Storage Volume

A) Effective Imperviousness of Tributary Area, I_a — I_a = 90.0 %

B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$) — i = 0.900

C) Contributing Watershed Area — Area = 4.500 ac

D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm — d_6 = 0.42 in

E) Design Concept (Select EURV when also designing for flood control)
Choose One
- ○ Water Quality Capture Volume (WQCV)
- ◉ Excess Urban Runoff Volume (EURV)

F) Design Volume (WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area$) — V_{DESIGN} = ac-ft

G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$) — $V_{DESIGN\ OTHER}$ = 0.147 ac-ft

H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired) — $V_{DESIGN\ USER}$ = ac-ft

I) NRCS Hydrologic Soil Groups of Tributary Watershed
- i) Percentage of Watershed consisting of Type A Soils — HSG_A = 0 %
- ii) Percentage of Watershed consisting of Type B Soils — HSG_B = 100 %
- iii) Percentage of Watershed consisting of Type C/D Soils — $HSG_{C/D}$ = 0 %

J) Excess Urban Runoff Volume (EURV) Design Volume
For HSG A: $EURV_A = 1.68 * i^{1.28}$
For HSG B: $EURV_B = 1.36 * i^{1.08}$
For HSG C/D: $EURV_{C/D} = 1.20 * i^{1.08}$
— $EURV_{DESIGN}$ = 0.455 ac-f t

K) User Input of Excess Urban Runoff Volume (EURV) Design Volume (Only if a different EURV Design Volume is desired) — $EURV_{DESIGN\ USER}$ = ac-f t

2. Basin Shape: Length to Width Ratio
(A basin length to width ratio of at least 2:1 will improve TSS reduction.) — L : W = 2.0 : 1

3. Basin Side Slopes

A) Basin Maximum Side Slopes
(Horizontal distance per unit vertical, 4:1 or flatter preferred) — Z = 4.00 ft / ft

4. Inlet

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

5. Forebay

A) Minimum Forebay Volume
(V_{FMIN} = 2% of the WQCV) — V_{FMIN} = 0.003 ac-ft

B) Actual Forebay Volume — V_F = 0.003 ac-ft

C) Forebay Depth
(D_F = 18 inch maximum) — D_F = 18.0 in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge — Q_{100} = 22.00 cfs

ii) Forebay Discharge Design Flow
($Q_F = 0.02 * Q_{100}$) — Q_F = 0.44 cfs

E) Forebay Discharge Design
Choose One
- ○ Berm With Pipe
- ◉ Wall with Rect. Notch
- ○ Wall with V-Notch Weir

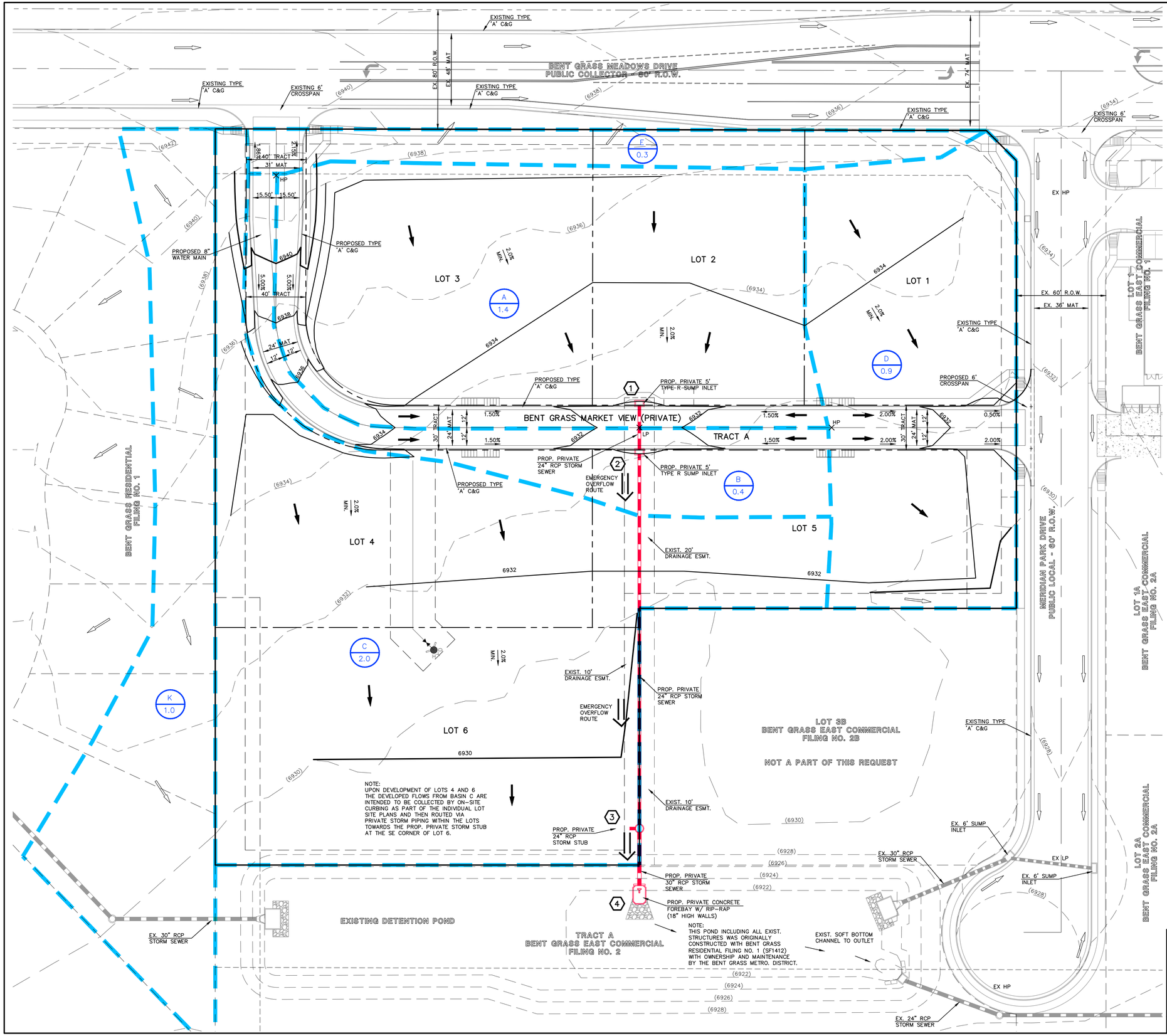
Flow too small for berm w/ pipe

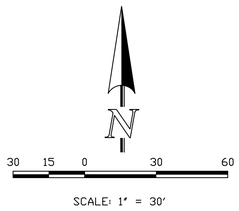
F) Discharge Pipe Size (minimum 8-inches) — Calculated D_P = in

G) Rectangular Notch Width — Calculated W_N = 4.5 in

DEVELOPED DRAINAGE MAP

CLASSIC SM
CONSULTING
ENGINEERS & SURVEYORS





LEGEND

DESCRIPTION	SYMBOL
PROPOSED CONTOUR–10	7090
PROPOSED CONTOUR–2	(7090)
EXISTING CONTOUR–10	
EXISTING CONTOUR–2	
PROPERTY LINE	
BOUNDARY LINE	
PROPOSED PRIVATE STORM SEWER	
PROPOSED PRIVATE STORM INLET	
EXISTING STORM SEWER	
EXISTING STORM INLET	
EXISTING FLOW DIRECTION	
PROPOSED FLOW	
HIGH POINT	HP
LOW POINT	LP
OVERFLOW ROUTE	
BASIN IDENTIFIER / AREA IN ACRES	B 0.4
DESIGN POINT	1
DRAINAGE BASIN	

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	TOTAL AREA (AC)	WEIGHTED CA(2)	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	STREET / CHANNEL FLOW Slope (%)	STREET / CHANNEL FLOW Velocity (fps)	STREET / CHANNEL FLOW Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	INTENSITY I(5) (in/hr)	INTENSITY I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	TOTAL FLOWS Q(5) (cfs)	TOTAL FLOWS Q(100) (cfs)
A	1.4	0.99	1.01	1.16	0.08	30	2	5.4	250	2.0%	1.0	4.2	9.6	3.34	4.19	7.03	3	4	8
B	0.4	0.27	0.28	0.32	0.08	10	0.2	4.6	100	1.5%	0.9	1.9	6.6	3.79	4.76	7.99	1	1	3
C	2.0	1.43	1.47	1.68	0.08	30	1.5	5.9	400	2.0%	1.0	6.7	12.7	3.01	3.77	6.34	4	6	11
D	0.9	0.67	0.69	0.77	0.08	10	0.2	4.6	200	2.0%	1.4	2.4	7.0	3.72	4.67	7.83	2	3	6
E	0.3	0.05	0.07	0.14	0.08	25	0.5	7.3					7.3	3.67	4.60	7.72	0.2	0.3	1.0
K	1.0	0.32	0.37	0.56	0.08	65	3	9.0					9.0	3.43	4.29	7.21	1	2	4

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Outfall / Inlet Size
1	A	1.01	1.16	9.6	4.19	7.03	4	8	5' Type R Sump Inlet
2	B	0.28	0.32	6.6	4.76	7.99	1	3	5' Type R Sump Inlet
3	C, 70% K	1.73	2.07	12.7	3.77	6.34	7	13	24" RCP Stub
4	A, B, C, 70% K	3.02	3.55	12.8	3.76	6.32	11	22	Concrete Forebay

CLASSIC CONSULTING SM
619 N. Cascade Avenue, Suite 200 (719)785-0790
Colorado Springs, Colorado 80903 (719)785-0799 (Fax)

BENT GRASS EAST COMMERCIAL FILING NO. 3

DEVELOPED DRAINAGE MAP

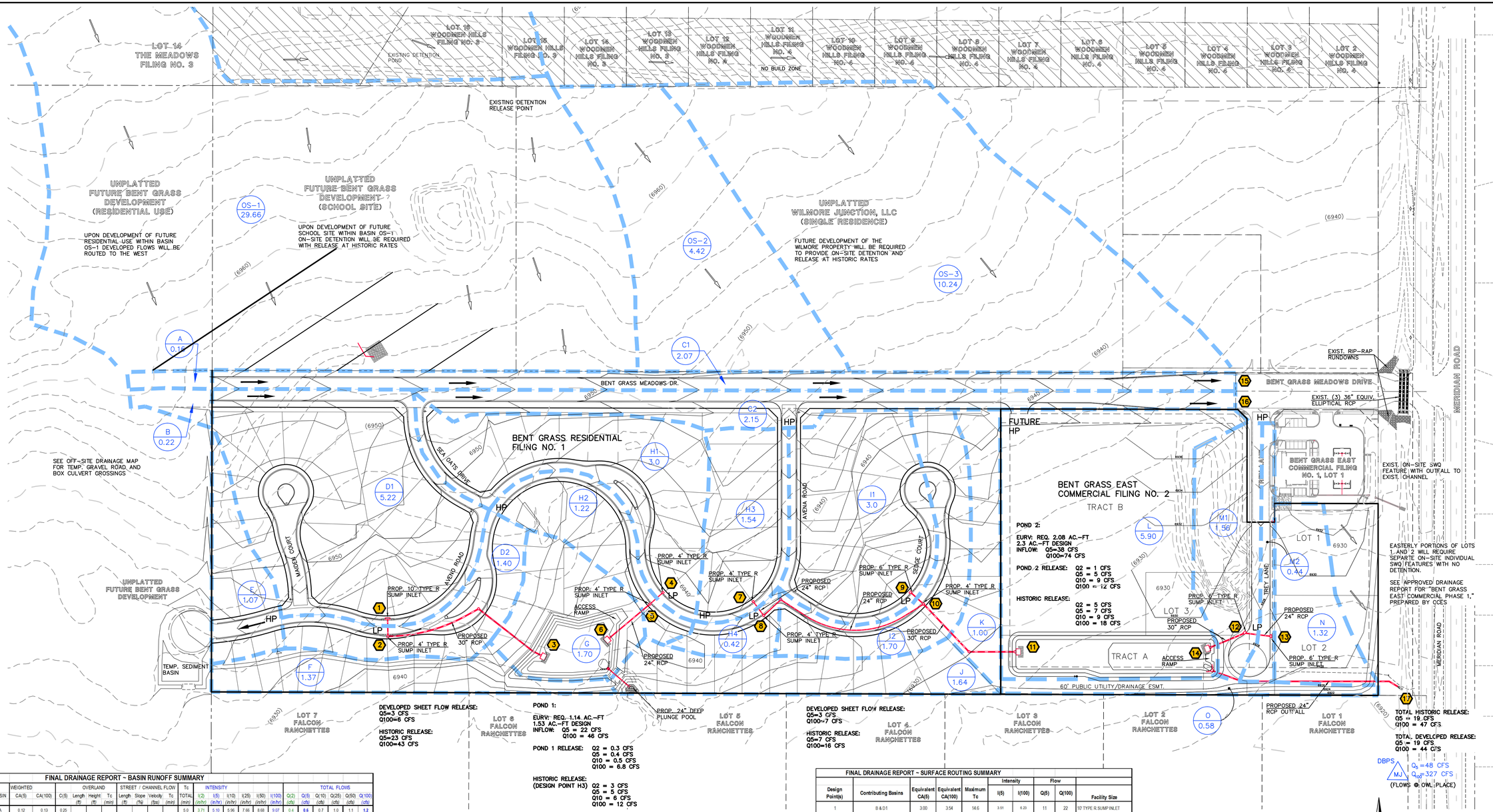
CLASSIC CONSULTING

DESIGNED BY	MAW	SCALE		DATE	10-27-20
DRAWN BY	MAW	(H) 1"= 30'		SHEET	1 OF 1
CHECKED BY		(V) 1"= N/A		JOB NO.	2177.64

PREVIOUS DRAINAGE MAP

(BENT GRASS RESIDENTIAL FILING NO. 1)

CLASSIC CONSULTING ENGINEERS & SURVEYORS



FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED CA(5)	WEIGHTED CA(100)	OVERLAND C(5)	OVERLAND Length (ft)	OVERLAND Height (ft)	OVERLAND Tc (min)	STREET / CHANNEL FLOW Length (ft)	Slope (%)	Velocity (fps)	Tc (min)	Tc TOTAL (min)	INTENSITY I(2) (in/hr)	I(5) (in/hr)	I(10) (in/hr)	I(25) (in/hr)	I(50) (in/hr)	I(100) (in/hr)	TOTAL FLOWS Q(2) (cfs)	Q(5) (cfs)	Q(10) (cfs)	Q(25) (cfs)	Q(50) (cfs)	Q(100) (cfs)
A	0.12	0.13	0.25								5.0	3.71	5.10	5.96	7.66	8.68	9.67	0.4	**0.6**	0.7	1.0	1.1	**1.2**
B	0.13	0.15	0.25								5.0	3.71	5.10	5.96	7.66	8.68	9.67	0.5	**0.7**	0.8	1.1	1.3	**1.4**
C1	1.56	1.68	0.25	12	0.24	4.4	2100	1.0%	3.5	10.0	14.4	2.56	3.53	4.12	5.29	6.00	6.27	4	5	6	9	10	**11**
C2	1.64	1.77	0.25	12	0.24	4.4	2100	1.0%	3.5	10.0	14.4	2.56	3.53	4.12	5.29	6.00	6.27	4	6	7	9	11	**11**
D1	2.87	3.39	0.25	100	2	12.6	500	1.5%	4.3	1.9	14.6	2.55	3.51	4.09	5.26	5.96	6.23	7	**10**	12	18	20	**21**
D2	0.77	0.91	0.25	50	1	8.9	400	1.0%	3.5	1.9	10.8	2.89	3.97	4.64	5.96	6.76	7.07	2	3	4	5	6	**6**
E	0.59	0.70	0.25	100	2	12.6	120	2.0%	4.9	0.4	13.0	2.68	3.68	4.30	5.52	6.26	6.55	2	2	3	4	4	**5**
F	0.55	0.75	0.25	80	7	6.9					6.9	3.38	4.65	5.43	6.98	7.91	8.27	2	3	3	5	6	**6**
G	0.68	0.85	0.25	240	7	17.3					17.3	2.35	3.24	3.78	4.86	5.51	5.76	2	3	3	4	5	**5**
H1	1.65	1.95	0.25	100	2	12.6	600	1.5%	4.3	2.3	15.0	2.52	3.46	4.04	5.20	5.89	6.16	4	**5**	7	10	11	**12**
H2	0.67	0.79	0.25	100	2	12.6	150	1.5%	4.3	0.6	13.2	2.55	3.66	4.27	5.49	6.22	6.51	2	2	3	4	5	**5**
H3	0.85	1.00	0.25	100	2	12.6	350	2.0%	4.9	1.2	13.8	2.61	3.59	4.19	5.39	6.11	6.38	2	3	4	5	6	**6**
H4	0.23	0.27	0.25	50	1	8.9	150	2.0%	4.9	0.5	9.4	3.05	4.19	4.89	6.29	7.12	7.45	0.7	**1.0**	1.1	1.7	1.9	**2.0**
I1	1.65	1.95	0.25	50	1	8.9	550	2.0%	4.9	1.9	10.8	2.89	3.98	4.65	5.97	6.77	7.08	5	7	8	12	13	**14**
I2	0.94	1.11	0.25	50	1	8.9	300	2.0%	4.9	1.0	10.0	2.99	4.11	4.79	6.16	6.99	7.31	3	4	4	7	8	**8**
J	0.66	0.90	0.25	75	4	7.9					7.9	3.24	4.46	5.20	6.69	7.58	7.93	2	3	3	6	7	**7**
K	0.40	0.55	0.25	65	3	7.7					7.7	3.27	4.49	5.24	6.74	7.64	7.99	1	2	2	4	4	**4**
L	4.60	4.93	0.25	30	0.6	6.9	800	1.0%	3.5	3.8	10.7	2.90	3.99	4.65	5.99	6.78	7.10	13	**18**	21	29	33	**35**
M1	1.33	1.40	0.25	30	0.6	6.9	300	1.0%	3.5	1.4	8.4	3.18	4.38	5.11	6.57	7.44	7.78	4	6	7	9	10	**11**
M2	0.37	0.40	0.25								5.0	3.71	5.10	5.96	7.66	8.68	9.67	1.4	**1.9**	2.2	3.0	3.4	**3.6**
N	1.12	1.19	0.25	20	0.4	5.7	330	2.0%	4.9	1.1	6.8	3.41	4.69	5.47	7.04	7.97	8.34	4	5	6	8	9	**10**
O	0.15	0.20	0.25	60	5	6.1					6.1	3.51	4.83	5.64	7.25	8.22	8.59	0.5	**0.7**	0.8	1.5	1.7	**1.7**

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity I(5)	Intensity I(100)	Flow Q(5)	Flow Q(100)	Facility Size
1	B & D1	3.00	3.54	14.6	3.51	6.23	11	22	10' TYPE R SUMP INLET
2	D2	0.77	0.91	10.8	3.97	7.07	3	6	4' TYPE R SUMP INLET
3	DP 1, DP 2 & G (Westerly Flow into Pond 1)	**4.45**	**5.30**	**17.3**	**3.24**	**5.76**	**14**	**31**	**30" RCP**
4	H1	1.65	1.95	15.0	3.46	6.16	6	12	4' TYPE R SUMP INLET
5	H2	0.67	0.79	13.2	3.66	6.51	2	5	4' TYPE R SUMP INLET
6	DP 4, DP 5 (Easterly Flow into Pond 1)	**2.32**	**2.74**	**16.0**	**3.36**	**5.98**	**8**	**16**	**24" RCP**
	Total Flow into Pond 1	**6.78**	**8.05**	**17.3**	**3.24**	**5.76**	**22**	**46**	**1.6 AC-FT, POND 1**
7	H3	0.85	1.00	13.8	3.59	6.38	3	6	4' TYPE R SUMP INLET
8	H4	0.23	0.27	9.4	4.19	7.45	1	2	4' TYPE R SUMP INLET
9	I1	1.65	1.95	10.8	3.98	7.08	7	14	6' TYPE R SUMP INLET
10	I2	0.94	1.11	10.0	4.11	7.31	4	8	4' TYPE R SUMP INLET
11	DP 7 - DP 10 (Westerly Flow into Pond 2)	**3.66**	**4.33**	**16.9**	**3.27**	**5.82**	**12**	**25**	**30" RCP**
12	M1	1.33	1.40	8.4	4.38	7.78	6	11	4' TYPE R SUMP INLET
13	M2 & N	1.50	1.58	6.8	4.69	8.34	7	13	6' TYPE R SUMP INLET
14	DP 12 & DP 13 (Easterly Flow into Pond 2)	**2.82**	**2.99**	**8.9**	**4.29**	**7.63**	**12**	**23**	**30" RCP**
	Total Flow into Pond 2 (Incl. Basins K & L)	**11.48**	**12.79**	**16.9**	**3.27**	**5.82**	**38**	**74**	**2.0 AC-FT, POND 2**
15	OS-1, OS-2, OS-3, C1 & EXIST LOT 15 POND RELEASE	SCS MODEL					6	19	
16	C2	1.64	1.77	14.4	3.53	6.27	6	11	
17	DP 15 and 16, Basin O, Exist. F, I1 & Pond 2 Release	SCS MODEL					19	44	

LEGEND

- EXISTING GROUND CONTOUR (5910)
- PROPOSED FINISHED CONTOUR (5910)
- SUBDIVISION BOUNDARY
- LOT LINE
- PROPOSED BASIN BOUNDARY
- DIRECTION OF DRAINAGE
- EXISTING STORM SEWER
- EXISTING STORM INLET
- PROPOSED STORM SEWER
- PROPOSED STORM INLET
- LOW POINT/HIGH POINT (LP/HP)
- BASIN IDENTIFIER (D) / AREA IN ACRES (1.41)
- DESIGN POINT (1)

CLASSIC CONSULTING ENGINEERS & SURVEYORS SM
6385 Corporate Drive, Suite 101
Colorado Springs, Colorado 80919
(719)785-0790
(719)785-0799 (Fax)

BENT GRASS RESIDENTIAL FILING NO. 1

FINAL DRAINAGE REPORT

DEVELOPED CONDITIONS MAP

CLASSIC CONSULTING ENGINEERS & SURVEYORS

DESIGNED BY	MAW	SCALE		DATE	09-03-14
DRAWN BY	MAW	(H) 1"= 100'		SHEET	1 OF 1
CHECKED BY		(V) 1"= N/A		JOB NO.	2430.00

N:\2430\00\DRAWINGS\DEVELOPMENT\2430DR [DR Map.dwg, 4/28/2016 11:45:45 AM, ILT.03671]

SP149

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

MAY 2014
REVISED JULY 2014

RETURN TO ENGINEERING LIBRARY

Prepared for:

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

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

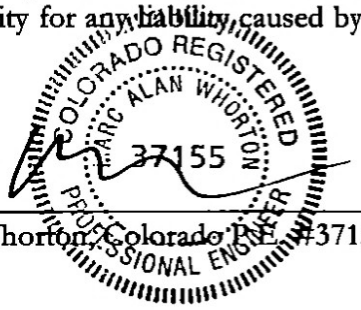
Job no. 2177.53

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

DRAINAGE REPORT STATEMENT

ENGINEER'S STATEMENT:

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



Marc A. Whorton, Colorado P.E. #37155 — Date: 8/20/14

DEVELOPER'S STATEMENT:

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

Business Name: Land First, Inc.

Title: Pres.

Address: 154 Del Oro Circle

Colorado Springs, CO 80919

EL PASO COUNTY:

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

For El Paso County Engineer/Director — Date: 8-24-14

Conditions:

CLASSIC CONSULTING ENGINEERS & SURVEYORS

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

Bridge Fees

$3,115 x 3.31 Impervious Ac. = $ 10,310.65

Drainage Fees

$8,115 x 3.31 Impervious Ac. = $ 26,860.65

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

Detention Pond 2 (Full Spectrum on-site facility) $75,000 x 50% = $37,500.00

(See FAE for Pond estimate)

Drainage Fee Total $26,860.65 - $37,500.00 = **N/A**

Bridge Fee Total **$10,310.65**

SUMMARY

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

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Marc A. Whorton, P.E.
Project Manager

mw/217753/Reports/217753FDR.doc