



INNOVATIVE DESIGN. **CLASSIC RESULTS.**

**FINAL DRAINAGE REPORT
FOR
BARNES CENTER APARTMENTS FILING NO. 2**

Prepared for:
Cortland.
3424 Peachtree Road NE Suite 300
Atlanta, GA 30326
404-978-1432
ATTN: Mr. Jared Bankos

Job no. 2451.41



FINAL DRAINAGE REPORT FOR BARNES CENTER APARTMENTS FILING NO. 2

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 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.

CERTIFICATION STATEMENT:

This report and plan for the final drainage design for Barnes Center Apartments Filing No. 2 was prepared by me (or under my direct supervision) in accordance with the provisions of City of Colorado Springs Drainage Criteria Manual Drainage Design and Technical Criteria for the owners thereof. I understand that the City of Colorado Springs does not and will not assume liability for drainage facilities designed by others.

Kyle Campbell, Colorado P.E. #29794

Date

DEVELOPER'S STATEMENT:

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

Cortland hereby certifies that the drainage facilities for Barnes Center Apartments Filing No. 2 shall be constructed according to the design presented in this report. I understand that the City of Colorado Springs does not and will not assume liability for the drainage facilities designed and or certified by my engineer and that the City of Colorado Springs reviews drainage plans pursuant to Colorado Revised Statutes, Title 30, Article 28; but cannot, on behalf of Barnes Center Apartments Filing No. 2, guarantee that final drainage design review will absolve Cortland on and/or their successors and/or assigns of future liability for improper design. I further understand that approval of the final plat does not imply approval of my engineer's drainage design.

Business Name: Cortland

By: _____

Title: _____

Address: 3424 Peachtree Road NE Suite 300
Atlanta, GA 30326

CITY OF COLORADO SPRINGS ONLY:

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



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FINAL DRAINAGE REPORT FOR BARNES CENTER APARTMENTS FILING NO. 2

PURPOSE

This document is the Final Drainage Report for Barnes Center Apartments Filing No. 2. 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 outfall facilities.

GENERAL DESCRIPTION

Barnes Center Apartments Filing No. 2 is a 6.664-acre site located in portion of Section 25, Township 13 South, Range 66 West of the Sixth Principal Meridian in the City of Colorado Springs, County of El Paso, State of Colorado. The site is bounded on the north by an existing apartment complex (Barnes Center Apartment Filing No. 1) owned by the developer of this parcel, to the south by Lots 1 and 2, Nowell and Associates at Integrity Center Point (existing commercial and restaurant buildings), to the west by existing Integrity Center Point (a private drive aisle), and to the east by Powers Boulevard (CO State Highway 21). This site will contain multi-family apartments.

The average soil condition reflects Hydrologic Group "B" (Stapleton Bernal sandy loams), as determined by the "Web Soil Survey," prepared by the Natural Resources Conservation Service (see map in Appendix).

EXISTING DRAINAGE CONDITIONS

The Barnes Center Apartments Filing No. 2 site is located within the Sand Creek Drainage Basin. Historically, this site drains in a southerly and southwesterly direction, with the majority of the undeveloped surface runoff entering existing Integrity CenterPoint and heading south toward Barnes Road. An existing 54" public storm system in Integrity Center Point does not currently intercept the existing condition flows. This site has been previously studied as part of the "High Chaparral and Surrounding Parcel Preliminary Drainage Plan and Report," approved February 2014, prepared by Rockwell Consulting, Inc. This report covers approximately 110 acres of tributary area, and serves as an MDDP (High Chaparral MDDP) for the purposes of this report as it relates to the requirements for Detention, & Stormwater Quality, public storm pipe extensions and Drainage Basin reimbursements.

Subsequently, a newer report was approved, "Barnes Center Apartments Filing No. 1" by Classic Consulting Engineers & Surveyors, LLC, dated March 18, 2015 that further detailed the MDDP requirements and on-site existing apartment site. (This report indicates that these MDDP Basins will be required to provide on-site detention and stormwater quality upon final development).



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The proposed Filing No. 2 site is contained within Basin F and the north portion of Basin H. Based upon the existing 30" RCP stub to service this area, $Q_5 = 17$ cfs and $Q_{100} = 31$ cfs is approved as the allowable released rate for development from this site. This existing developed condition 100 year storm system was installed to transfer fully developed flows from this site to a proposed Full Spectrum Detention Facility previously proposed on the west side of Integrity Center Point as on-site capture and treatment is proposed for this site. Only existing flows will now be tributary to existing storm stub.

PROPOSED DRAINAGE CONDITIONS

Developed runoff from the Barnes Center Apartments Filing No. 2 development will be conveyed into proposed on-site private storm sewer systems as shown on the enclosed proposed conditions Drainage Map, and ultimately outfall in to the existing 30" public storm sewer stub provided in Integrity Center Point (Final Drainage Report Design Point #6 location).

Design Point 1 ($Q_5 = 22$ cfs, $Q_{100} = 41$ cfs) consists of flows from the north portion of the Barnes Center Apartments site shown as Basin A, 5.81 acres. Developed runoff within the apartment site will be conveyed to private onsite inlets and landscape area drains. A proposed 30" RCP (Pipe 1) will convey the stormwater to the proposed SWQ extended detention basin.

Design Point 2 ($Q_5 = 2$ cfs, $Q_{100} = 4$ cfs) consists of flows from future private access drive extension (Integrity Center Point) labeled Basin B (0.28 acres) and B2 (0.17 acres). Developed runoff within the private drive will be conveyed to private proposed 4'x5' D-9 grated inlet. A proposed 18" RCP (Pipe 2) will combine with Pipe 1 in a proposed private 30" RCP (Pipe 3) and will be conveyed the proposed SWQ extended detention basin.

Design Point 3 ($Q_5 = 20$ cfs, $Q_{100} = 39$ cfs) consists of flows from the south portion of the Barnes Center Apartments site shown as Basin C, 6.00 acres. Developed runoff within the apartment site will be conveyed to private onsite inlets and landscape area drains. A proposed 30" RCP (Pipe 4) will convey the stormwater to the proposed SWQ extended detention basin.

Design Point 4 ($Q_5 = 46$ cfs, $Q_{100} = 88$ cfs) consists of flows from the Basin D (0.42 acres), Pipe 3 and Pipe 4. Stormwater at this location will be treated in a proposed 0.407 ac-ft Extended Detention Basin. This stormwater quality facility meets the required size using UDFCD spreadsheets, attached in the Appendix of this



FINAL DRAINAGE REPORT FOR BARNES CENTER APARTMENTS FILING NO. 2

report. All final design including forebays, micropools, and outlet structure details will be reviewed and approved with final construction drawings for Barnes Center Apartments Filing No. 1 and will conform to the current requirements of UDFCD and City of Colorado Springs DCM Volume 2, dated January 2014. Pipe 5 is a proposed private 48" RCP that will convey the total $Q_5 = 46$ cfs, $Q_{100} = 88$ cfs within the stormwater quality pond to downstream facilities. Overflow routing for the stormwater quality facility will be provided in an overflow weir, directed toward proposed Design Point 5. This facility will be privately owned and maintained.

Design Point 5 ($Q_5 = 51$ cfs, $Q_{100} = 112$ cfs) is the cumulative total of offsite MDDP Basins 1, 2, 3, and 5, as well as Basin E (1.15 acres). Stormwater at this location will be intercepted by a proposed public 48" RCP @ 1% minimum storm pipe (Pipe 6) with a CDOT standard headwall. Stormwater from Pipe 6 will combine with upstream Pipe 5 and will be conveyed in Integrity Center Point in a proposed 54" RCP (Pipe 7) at 1% minimum grade.

Design Point 6 ($Q_5 = 17$ cfs, $Q_{100} = 31$ cfs) is the total developed runoff from Basin F, a future 4.08-acre commercial site. This area will be overlot graded, but no development is currently proposed with this Plat/Development Plan application. Stormwater from Basin F will be conveyed as sheet flow to the south, where a temporary diversion swale will direct runoff to a proposed temporary sediment basin. A 30" private RCP pipe stub (Pipe 8) will be provided to collect the developed flows and convey the stormwater across Integrity Center Point. The stormwater will then be conveyed overland across Basin I in a protected diversion swale to a temporary 0.5327 ac-ft Extended Detention Basin stormwater quality facility. Upon final development, a private storm sewer will be extended through Basin I to provide for a permanent outfall for Basin F. See Design Point 10 for further description of the SWQ facility.

Design Point 7 ($Q_5 = 3$ cfs, $Q_{100} = 6$ cfs) is the total developed runoff from Basin G1, a future 0.73-acre private roadway extension (Integrity Center Point). Stormwater from Basin G1 will be conveyed along the westerly curb and gutter flowline to a proposed private 3'x7' grated D-9 inlet. Intercepted flows will combine in with Pipe 8, and a proposed 30" private storm pipe (Pipe 9) will convey flows overland across Basin I in a protected diversion swale to a temporary 0.537 ac-ft Extended Detention Basin stormwater quality facility. Upon final development, a private storm sewer will be extended through Basin I to provide for a permanent outfall for Basin G1. See Design Point 10 for further description of the SWQ facility.



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Design Point 8 ($Q_5 = 15$ cfs, $Q_{100} = 28$ cfs) is the total developed runoff from Basin H, a future 3.65-acre commercial site. This area will be overlot graded, but no development is currently proposed with this Plat/Development Plan application. Stormwater from Basin H will be conveyed as sheet flow to the south, where a temporary diversion swale will direct runoff to a proposed temporary sediment basin. A 30" private RCP pipe stub (Pipe 10) will be provided to collect the developed flows and convey the stormwater across Integrity Center Point. The stormwater will then be conveyed to a temporary 0.537 ac-ft Extended Detention Basin stormwater quality facility. See Design Point 10 for further description of this facility.

Design Point 9 ($Q_5 = 3$ cfs, $Q_{100} = 6$ cfs) is the total developed runoff from Basin G2, a future 0.71-acre private roadway extension (Integrity Center Point). Stormwater from Basin G2 will be conveyed along the westerly curb and gutter flowline to a proposed private 8' D-10-R at-grade inlet. Intercepted flows will combine with upstream Pipe 10 and will be conveyed in Pipe 11. Flow by of $Q_5 = 1$ cfs, $Q_{100} = 2$ cfs within the private street will be allowed to continue to the south and will be intercepted by downstream facilities. A proposed 30" private storm pipe conveys stormwater at the inlet to the proposed temporary Extended Detention Basin stormwater quality facility. See Design Point 10 for further description of this facility.

Design Point 10 ($Q_5 = 52$ cfs, $Q_{100} = 97$ cfs) consists of flows from the Basin I (2.42 acres), Pipe 8 and Pipe 11. Stormwater at this location will be treated in a proposed 0.537 ac-ft Extended Detention Basin. This stormwater quality facility meets the required size using UDFCD spreadsheets, attached in the Appendix of this report. At this time, this facility has been sized to treat commercial development from Basin I, H, F, G1, and G2. Based upon the unknown timing and layout of the development of the commercial parcels, this pond will be constructed in a temporary state (for the current roadway improvements only) until final development of these upstream stormwater Basins take place. Final sizing for detention combined with stormwater quality, outlet structure sizing and all final design including forebays, micropools, and energy dissipation details will be reviewed and approved with final construction drawings for Integrity Center Point roadway and Barnes Apartments Filing No. 1 and will conform to the current requirements of UDFCD and City of Colorado Springs DCM Volume 2, dated January 2014. Pipe 12 is a proposed public 48" RCP that will convey the total $Q_5 = 52$ cfs, $Q_{100} = 97$ cfs within the stormwater quality pond to the existing 54" public storm extension. Overflow routing for the stormwater quality facility (temporary and permanent) will be provided in an overflow weir, directed toward the historic stormwater overland swale along the west side of Integrity Center Point. This facility will be privately owned and maintained. In the interim condition, an easement has been identified on the Development plan to reserve the property required for the ultimate sizing of this facility within Basin I.



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Developed drainage patterns conform to the intent of the approved High Chaparral MDDP, and total flows match those anticipated in the approved MDDP.

This location is the proposed Full Spectrum Detention and Water Quality Facility – Pond A. The developed runoff consists of Pipe 2, DP-7, and Basin E, 0.12 acres of the pond area itself. The UDFCD spreadsheet UD-BMP v3.06 was used to determine the overall impervious percentage (IRF form) and also provide the pond sizing, specifically the EURV (extended urban runoff volume). There is a total of 1.83 acres tributary to this facility at a 53.51% imperviousness, resulting in a required EURV of 0.078 acre-feet, and WQCV of 0.027 acre-feet.

EROSION CONTROL PLAN AND STORMWATER QUALITY

The City of Colorado Springs has required 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 to achieve stormwater permit requirements. The site adheres to this Four Step Process as follows:

1. This site is located in a previously studied basin. As no downstream detention exists for this area, Full Spectrum on-site Detention will be provided. Off-site basins are routed through and around the site. Reference IRF spreadsheet in Appendix of this report.
2. The proposed permanent private Full Spectrum Detention extended detention Basin will provide all water quality capture volume required for this development.
3. The ultimate recipient of the drainage flows from the site is Sand Creek after traveling in and extensive public storm pipe system.
4. A site-specific stormwater quality and erosion control plan and narrative has been approved by City Engineering for the project area.



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DETENTION AND STORMWATER QUALITY

The City of Colorado Springs Drainage Criteria Manual specifies that this site is required to provide full spectrum detention. The proposed private Full Spectrum Detention Sand Filter facility will be designed and fully constructed to provide for WQCV, EURV and full spectrum detention requirements.

Full Spectrum Detention Requirement: The UD-Detention spreadsheet has been provided in the Appendix of this report to provide sizing based upon UDFCD requirements for EURV, with a minimum drain time of 72 hours.

Detention Summary:

The proposed extended detention Basin is a 0.078 ac-ft Private Full Spectrum Detention facility. A 12" private storm pipe will outlet the stormwater from the pond and will convey flows to the adjacent drainage corridor. Total inflow to this facility is $Q_5 = 2.1$ cfs, $Q_{100} = 4.9$ cfs. Total tributary acreage is 1.83 acres with 53.5% imperviousness, as calculated by the attached IRF form in the Appendix of the report. This pond will store and treat developed stormwater from this site as described in this report. Appropriate energy dissipation measures will be included in the construction drawings at the outlet pipe connection to provide for permanent erosion protection (2' x 3' Rip Rap Pad). The proposed outlet structure is a 4'x4' inlet riser with the UDFCD required single hole 0.41' orifice plate. Reference worksheets in Appendix for details. Overflow weir routing for this facility is shown on the Drainage Map and sized in the attached UD-Detention worksheet. A 30" overflow weir will be installed to route the stormwater flows in an emergency event. Overflow routing is directed to the existing on-site drainage swale.

Final pond design details will be included with final construction drawings for review and approval by City Engineering prior to construction approval.

Detention Maintenance, Ownership and Access: The proposed FSD will be owned and maintained by the owner of Lot 1 as a private facility. Access to the pond will be provided per the current City Engineer Criteria and UDFCD criteria as shown on the Drainage Map. A City of Colorado Springs Inspection and Maintenance (IM) plan will be required indicating this facility will be ultimately owned and maintained by the Lot 1 owner.

EURV and Stormwater Quality Capture Volume: The standard UD- Detention spreadsheet has been provided in the Appendix of this report to provide sizing based upon UDFCD requirements for EURV, with a minimum drain time of 72 hours.



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Erosion Control: 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.

DRAINAGE CRITERIA

Hydrologic calculations were performed using the City of Colorado Springs/El Paso County Drainage Criteria Manual, as revised in May 2014. Stormwater quality analysis and calculations were performed using the Drainage Criteria Manual, Volume 2 and Urban Drainage Flood Control District. The Rational Method was used to estimate stormwater runoff anticipated from design storms for the 2-year, 5 year, and 100-year recurrence interval.

Hydraulic grade line calculations have been provided for the proposed private storm system in the appendix of this report.

FLOODPLAIN STATEMENT

No portion of this site is located within a floodplain as determined by the Flood Insurance Rate Map (F.I.R.M.) Map Number 08041C 0538G and effective date, December 7, 2018 (See Appendix).

DRAINAGE AND BRIDGE FEES (2020)

This area lies within the Sand Creek Drainage Basin boundaries.

2020 drainage and bridge fees as follows:

Drainage Fees:

Filing No. 1

Drainage

\$13,309/acre x 6.664 acres \$ 88,691.18

Bridge

\$791/acre x 6.664 acres \$ 5,271.22

Pond Land Fee

\$1070/acre x 6.664 acres \$ 7,130.48

Pond Facility Fee

\$3,823/acre x 6.664 acres \$ 25,476.72

TOTAL FEES

\$ 126,569.60



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Fees are due prior to plat recordation. Prior to issuance of building permits a plat will need to be submitted and appropriate drainage facility and erosion control assurances will need to be posted.

CONSTRUCTION COST OPINION

Private Drainage Facilities

1.	Type 1 Storm Manhole	1 EACH	\$4,000/EA	\$ 4,000.00
2.	42" Storm RCP	700 LF	\$95/LF	\$66,500.00
3.	48" Storm RCP	210 LF	\$120/LF	\$ 25,200.00
SUB-TOTAL				\$ 95,700.00
15% ENGINEERING & CONTINGENCIES				<u>\$ 14,355.00</u>
TOTAL				<u>\$ 110,055.00</u>

SUMMARY

Developed runoff from the Barnes Center Apartments Filing No. 2 development will be conveyed into proposed on-site private storm sewer systems as shown on the enclosed proposed conditions Drainage Map, and will outfall to the west into an existing public storm system. The onsite private storm sewer systems will be treated for water quality within a proposed private extended detention Basin facility in accordance with City and UDFCD criteria prior to being discharged into the existing public system in Integrity Center Point. Detention will be required for the Barnes Center Filing No. 2 apartment site. All stormwater from the Barnes Center Filing No. 2 apartment site and surrounding areas conform to previously the approved report flowrates and outfall location. All overflow routing for the stormwater system is described in the report and will be defined by final construction drawings for the facilities proposed. The stormwater quality facility will be privately owned and maintained.

PREPARED BY:

Classic Consulting Engineers & Surveyors, LLC

Kyle R. Campbell, P.E.
Project Engineer

db/245141/Reports/FDR.doc



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REFERENCES

1. City of Colorado Springs/County of El Paso Drainage Criteria Manual dated October 1991.
2. "High Chaparral and Surrounding Parcels Preliminary Drainage Plan & Report," prepared by Rockwell Consulting, Inc., dated February 2014.
3. "Final Drainage Report Barnes Center Apartments Filing No. 2" prepared by Classic Consulting Engineers & Surveyors, LLC, dated March 18, 2015
4. "Final Drainage Report for Lot 1 and 2 at Integrity Center Point" by Forsgren and Associates, dated August 23, 2017

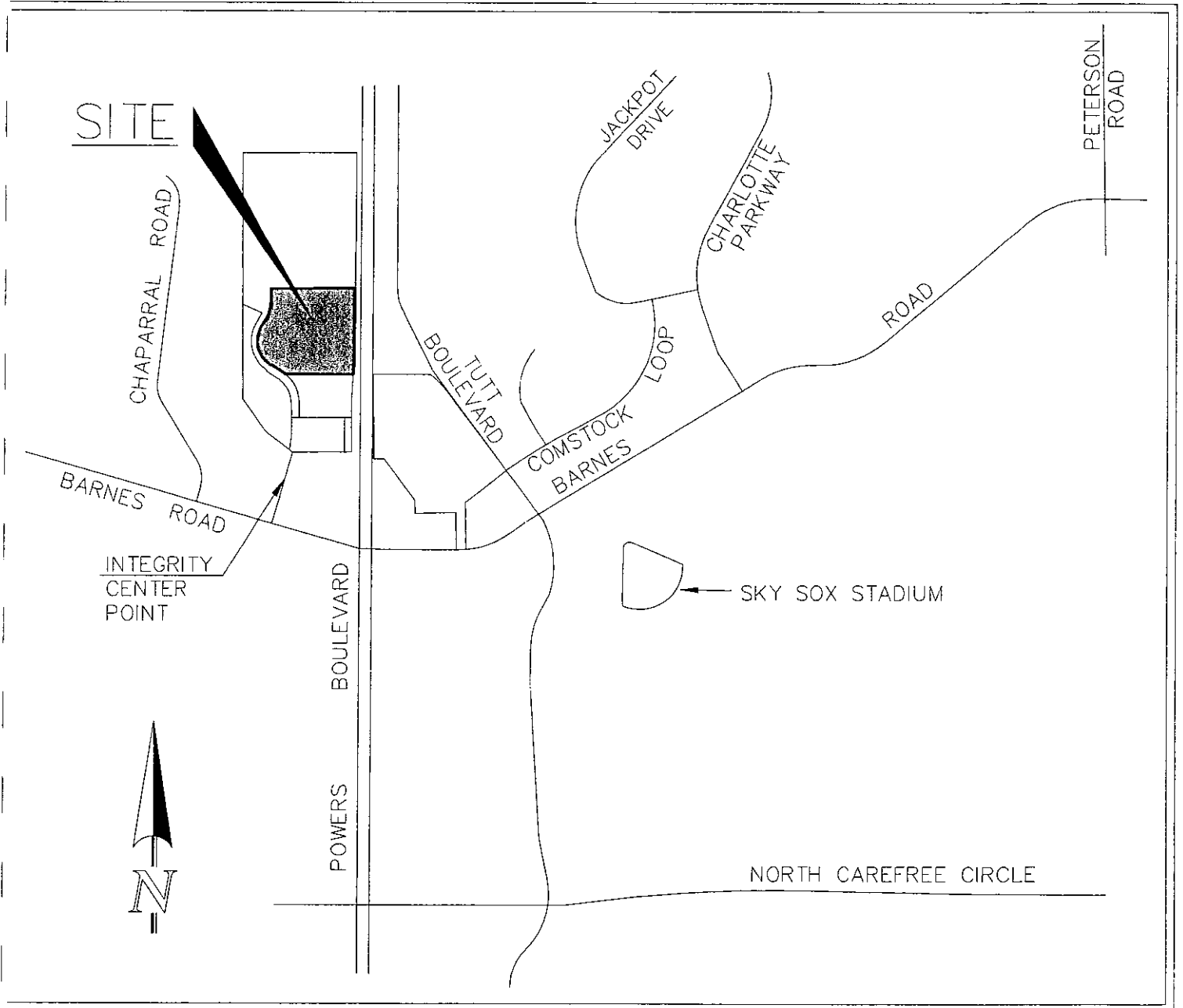


APPENDIX



VICINITY MAP





VICINITY MAP

N.T.S.

SOILS MAP (Web Soil Survey)

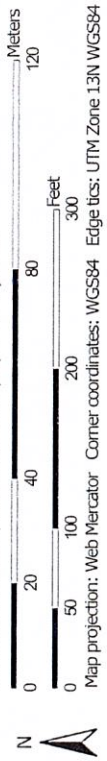


Soil Map—El Paso County Area, Colorado
(Barnes Center Apartments Fil. No. 2)



















Soil Map may not be valid at this scale.

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



MAP LEGEND

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

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 17, Sep 13, 2019

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

Date(s) aerial images were photographed: Aug 19, 2018—Sep 23, 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
85	Stapleton-Bernal sandy loams, 3 to 20 percent slopes	6.5	100.0%
Totals for Area of Interest		6.5	100.0%

El Paso County Area, Colorado

85—Stapleton-Bernal sandy loams, 3 to 20 percent slopes

Map Unit Setting

National map unit symbol: 36b1
Elevation: 6,500 to 6,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Stapleton and similar soils: 55 percent
Bernal and similar soils: 44 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Stapleton

Setting

Landform: Hills
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose

Typical profile

A - 0 to 11 inches: sandy loam
Bw - 11 to 17 inches: gravelly sandy loam
C - 17 to 60 inches: gravelly loamy sand

Properties and qualities

Slope: 3 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: Gravelly Foothill (R049BY214CO)
Hydric soil rating: No

Description of Bernal

Setting

Landform: Hills
Landform position (three-dimensional): Crest, side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone

Typical profile

A - 0 to 4 inches: sandy loam
Bt - 4 to 11 inches: sandy clay loam
C - 11 to 13 inches: sandy loam
R - 13 to 17 inches: unweathered bedrock

Properties and qualities

Slope: 3 to 20 percent
Depth to restrictive feature: 8 to 20 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat):
Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: D
Ecological site: Shallow Foothill (R049BY204CO)
Hydric soil rating: No

Minor Components

Other soils

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

Data Source Information

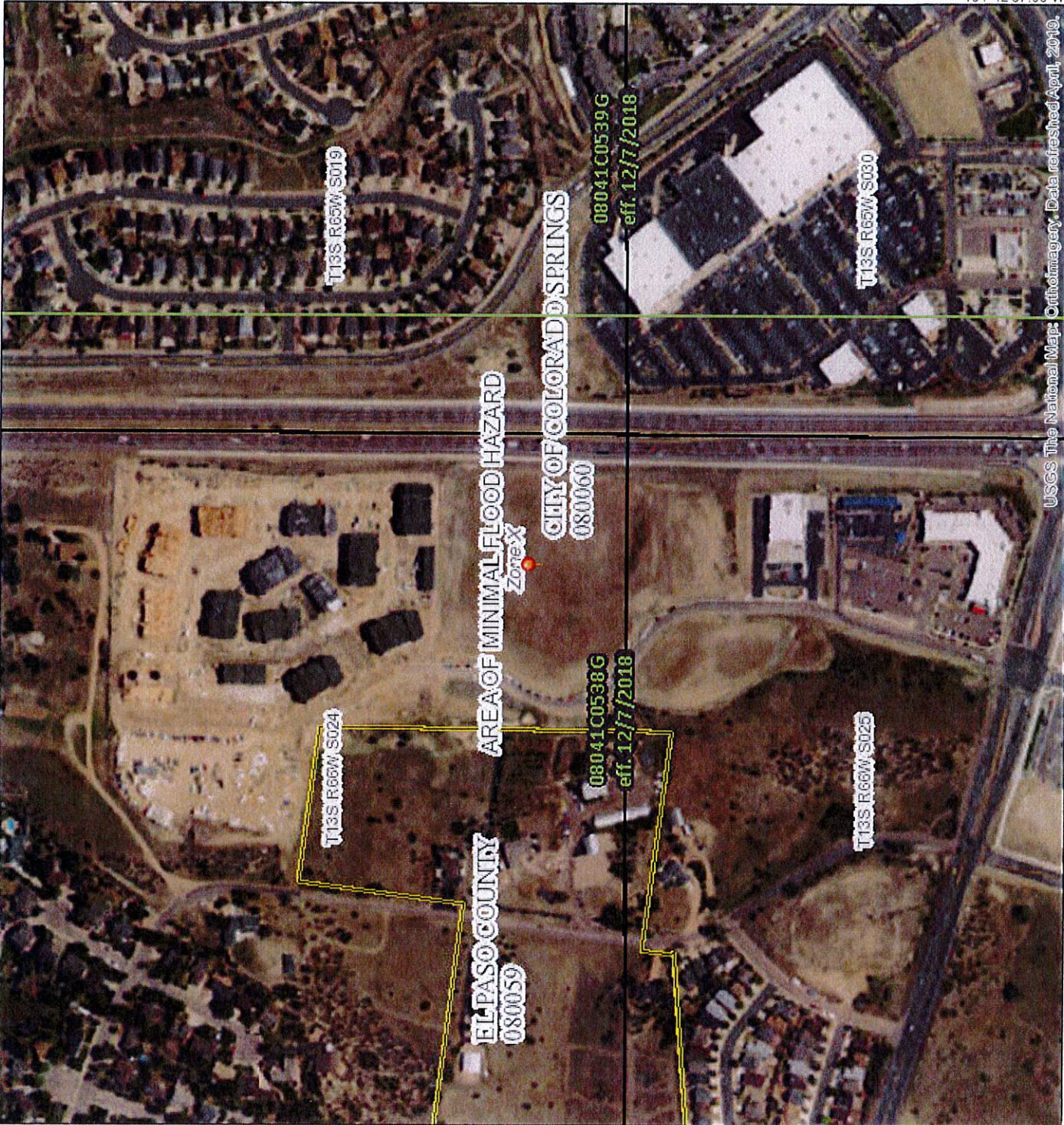
Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 17, Sep 13, 2019

F.E.M.A. MAP





38°54'5.40"N



USGS The National Map: Orthoimagery. Data refreshed April, 2019. 1:6,000 Feet 0 250 500 1,000 1,500 2,000

104°42'57.00"W 38°53'37.40"N

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS

- Without Base Flood Elevation (BFE) Zone A, V, A99
- With BFE or Depth Zone AE, AO, AH, VE, AR
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD

- 0.2% Annual Chance Flood Hazard. Area of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile
- Future Conditions 1% Annual Chance Flood Hazard
- Area with Reduced Flood Risk due to Levee. See Notes.
- Area with Flood Risk due to Levee

OTHER AREAS

- Area of Minimal Flood Hazard
- Effective LOMRS
- Area of Undetermined Flood Hazard

GENERAL STRUCTURES

- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

CROSS SECTIONS WITH 1% ANNUAL CHANCE WATER SURFACE ELEVATION

- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS

- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards.

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 3/12/2020 at 12:26:48 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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HYDROLOGIC/HYDRAULIC CALCULATIONS



JOB NAME: BARNES CENTER APARTMENTS FIL. NO. 1
 JOB NUMBER: 2451.17
 DATE: 03/7/15
 CALCULATED BY: CMT

FINAL DRAINAGE REPORT ~ 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	5.81	5.81	0.80	0.85	0.00	0.25	0.35	0.80	0.85	4.65	4.94
B	0.28	0.28	0.90	0.95	0.00	0.25	0.35	0.90	0.95	0.25	0.27
B2	0.17	0.17	0.90	0.95	0.00	0.25	0.35	0.90	0.95	0.15	0.16
C	6.00	6.00	0.80	0.85	0.00	0.25	0.35	0.80	0.85	4.80	5.10
D	0.42	0.00	0.90	0.95	0.42	0.35	0.45	0.35	0.45	0.15	0.19
E	1.15	0.00	0.90	0.95	1.15	0.35	0.45	0.35	0.45	0.40	0.52
F	4.08	4.08	0.90	0.95	0.00	0.25	0.35	0.90	0.95	3.67	3.88
G1	0.73	0.73	0.90	0.95	0.00	0.25	0.35	0.90	0.95	0.66	0.69
G2	0.71	0.71	0.90	0.95	0.00	0.25	0.35	0.90	0.95	0.64	0.67
H	3.65	3.65	0.90	0.95	0.00	0.25	0.35	0.90	0.95	3.29	3.47
I	2.42	1.94	0.90	0.95	0.48	0.25	0.35	0.77	0.83	1.86	2.01

JOB NAME: BARNES CENTER APARTMENTS P.L. NO. 1
 JOB NUMBER: 245117

DATE: 03/17/15
 CALC'D BY: CMT

FINAL DRAINAGE REPORT ~ BASIN RUNOFF SUMMARY

BASIN	WEIGHTED		C(5)	OVERLAND			STREET / CHANNEL FLOW				TOTAL Tc (min)	INTENSITY			TOTAL FLOWS		
	CA(5)	CA(100)		Length (#)	Height (#)	Tc (min)	Length (#)	Slope (%)	Velocity (fps)	Tc (min)		I(2) (in/hr)	I(5) (in/hr)	I(100) (in/hr)	Q(2) (cfs)	Q(5) (cfs)	Q(100) (cfs)
A	465	494	0.25	35	3	4.6	1000	4.0%	7.0	2.4	7.0	3.37	4.64	8.25	16	22	41
B	0.25	0.27	0.25	15	5	1.9	400	4.0%	7.0	1.0	5.0	3.71	5.10	9.07	0.9	1.3	2.4
B2	0.15	0.16	0.25	35	4	4.2	700	3.0%	6.1	1.9	6.1	3.51	4.83	8.59	0.5	0.7	1.4
C	4.80	5.10	0.25	50	2	7.1	600	3.0%	6.1	1.6	8.8	3.13	4.31	7.66	15	21	39
D	0.15	0.19	0.25	112	13	7.5	0	0.0%	0.0	0.0	7.5	3.30	4.54	8.07	0.5	0.7	1.5
E	0.40	0.52	0.25	118	20	6.8	0	0.0%	0.0	0.0	6.8	3.41	4.69	8.33	1	2	4
F	3.67	3.88	0.25	50	2	7.1	200	5.0%	7.8	0.4	7.5	3.29	4.53	8.06	12	17	31
G1	0.66	0.69	0.25	27	9	2.6	500	4.0%	7.0	1.2	5.0	3.71	5.10	9.07	2	3	6
G2	0.64	0.67	0.25	24	8	2.4	500	4.0%	7.0	1.2	5.0	3.71	5.10	9.07	2	3	6
H	3.29	3.47	0.25	50	2	7.1	200	5.0%	7.8	0.4	7.5	3.29	4.53	8.06	11	15	28
I	1.86	2.01	0.25	20	2	3.3	300	4.0%	7.0	0.7	5.0	3.71	5.10	9.07	7	10	18

JOB NAME: BARNES CENTER APARTMENTS FIL NO. 1
 JOB NUMBER: 245117
 DATE: 03/17/15
 CALCULATED BY: CMT

FINAL DRAINAGE REPORT ~ SURFACE ROUTING SUMMARY

Design Point(s)	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Inlet Size
					I(5)	I(100)	Q(5)	Q(100)	
1	BASIN A	4.65	4.94	7.0	4.64	8.25	22	41	ONSITE STORM SYSTEM INLETS
2	BASIN B + B2	0.41	0.43	5.0	5.10	9.07	2	4	4x5' D-9 INLET FOR STREET FLOW
3	BASIN C	4.80	5.10	8.8	4.31	7.66	21	39	ONSITE STORM SYSTEM INLETS
4	BASIN D + PIPE 3 + PIPE 4	10.00	10.66	7.0	4.64	8.25	46	88	TOTAL POND INFLOW
5	OFFSITE MDDP BASIN 1+2+3+5 + BASIN E	FROM ROCKWELL MDDP		0.0	6.95	12.35	51	112	TO 42" RCP HEADWALL
6	BASIN F	3.67	3.88	7.5	4.53	8.06	17	31	PIPE TO EDB/SWQ FACILITY
7	BASIN G1	0.66	0.69	5.0	5.10	9.07	3	6	3x7' GRATED D-9 INLET FOR STREET FLOW
8	BASIN H	3.29	3.47	7.5	4.53	8.06	15	28	PIPE TO EDB/SWQ FACILITY
9	BASIN G2	0.64	0.67	5.0	5.10	9.07	3	6	8' D-10-R INLET
10	BASIN I + PIPE 8 + PIPE 11+ PIPE 9	13.79	14.50	12.5	3.75	6.67	52	97	TOTAL POND INFLOW

JOB NAME: BARNES CENTER APARTMENTS FIL. NO. 1
 JOB NUMBER: 2451.17
 DATE: 03/17/15
 CALCULATED BY: CMT

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

FINAL DRAINAGE REPORT ~ PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Equivalent CA(5)	Equivalent CA(100)	Maximum Tc	Intensity		Flow		Pipe Size*
					I(5)	I(100)	Q(5)	Q(100)	
1	DP 1	4.65	4.94	7.01	4.64	8.25	22	41	30" RCP
2	DP 2	0.41	0.43	5.00	5.10	9.07	2	4	18" RCP
3	PIPE 1 + 2	5.05	5.37	7.0	4.64	8.25	23	44	30" RCP
4	DP 3	4.80	5.10	8.76	4.31	7.66	21	39	30" RCP
5	DP 4	10.00	10.66	7.01	4.64	8.25	46	88	48" RCP
6	DP 5			0.0	6.95	12.35	51	112	48" RCP
7	PIPE 5 + 6			0.0	6.95	12.35	97	200	54" RCP
8	DP 6	3.67	3.88	7.54	4.53	8.06	17	31	30" RCP
9	DP 7 + PIPE 8	4.33	4.57	7.5	4.53	8.06	20	37	30" RCP
10	DP 8	3.29	3.47	7.54	4.53	8.06	15	28	30" RCP
11	PIPE 10 + DP 9	3.92	4.14	7.5	4.53	8.06	18	33	30" RCP
12	DP 10	13.79	14.60	12.50	3.75	6.67	52	97	48" RCP
13	PIPE 7 + PIPE 12			12.5	3.75	6.67	149	297	EX. 54" RCP

JOB NAME: BARNES CENTER APARTMENTS FIL. NO. 1

JOB NUMBER: 2451.17

DATE: 3/17/2015

CALCULATED BY: CMT

DESIGN POINT 2

Total Flow: Q(5) = 2.07 cfs
 Q(100) = 3.88 cfs

Maximum allowable ponding depth at sump:

D(5) = 0.50 (d)
D(100) = 0.67 (dmax)

$Q_i = [(3.0)(P)(d^{1.5})]/F$ (Weir Conditions)

Clogging Factor (F) = 2.0

5-Year Event: 3.9 foot perimeter required

100-Year Event: 4.7 foot perimeter required

INSTALL A 4'x5' FT D-9 INLET TO ACCEPT BOTH 5YR &
100 YR DEVELOPED FLOWS AT THIS DESIGN POINT.
(INLET OVERSIZED FOR ADDITIONAL CLOGGING CAPACITY)

JOB NAME: BARNES CENTER APARTMENTS FIL. NO. 1
 JOB NUMBER: 2451.17
 DATE: 03/17/15
 CALCULATED BY: CMT

DESIGN POINT 9 100 YEAR FLOW

Q(100)	6	I(100)	3.8		
DEPTH	0.30	Fr	2.02	Inlet size ? L(i) =	8
SPREAD	8.5	L(1)	13.2	If Li < L(2) then Qi =	4
CROSS SLOPE	2.0%	L(2)	7.9	If Li > L(2) then Qi =	4
STREET SLOPE	3.0%	L(3)	28.3	FB =	2
				CA(eqv.) =	0.53

5 YEAR FLOW

Q(5)	3	I(5)	5.1		
DEPTH	0.28	Fr	1.98	Inlet size ? L(i) =	8
SPREAD	7.8	L(1)	11.8	If Li < L(2) then Qi =	2
CROSS SLOPE	2.0%	L(2)	7.1	If Li > L(2) then Qi =	2
STREET SLOPE	3.0%	L(3)	25.3	FB =	1
				CA(eqv.) =	0.20

DPS Headwall

tmp#4.txt
Culvert calculator

All calculator output should be verified prior to design use

Entered Data:

Shape Circular
 Number of Barrels 1
 Solving for Headwater
 Chart Number 1
 Scale Number 1
 Chart Description CONCRETE PIPE CULVERT; NO BEVELED RING

ENTRANCE

Scale Description SQUARE EDGE ENTRANCE WITH HEADWALL
 Overtopping Off
 Flowrate 112.0000 cfs
 Manning's n 0.0130
 Roadway Elevation 6675.0000 ft
 Inlet Elevation 6666.0000 ft
 Outlet Elevation 6665.3200 ft
 Diameter 48.0000 in
 Length 67.7787 ft
 Entrance Loss 0.0000
 Tailwater 0.5000 ft

Computed Results:

Headwater 6671.8215 ft Inlet Control
 Slope 0.0100 ft/ft
 Velocity 12.6464 fps

Messages:

Inlet head > Outlet head.
 Computing Inlet Control headwater.
 Solving Inlet Equation 26.
 Solving Inlet Equation 28.
 → Headwater: 6671.8215 ft

DIS-CHARGE	HEAD-WATER	INLET CONTROL	OUTLET CONTROL	FLOW TYPE	NORMAL DEPTH	CRITICAL DEPTH	OUTLET VEL.	OUTLET DEPTH	TAILWATER VEL.	TAILWATER DEPTH
Flow	ELEV.	DEPTH	DEPTH		in	in	fps	ft	fps	ft
cfs	ft	ft	ft							
22.40	6667.92	1.92	1.47	NA	12.81	16.75	8.32	1.07	0.00	
0.50										
44.80	6668.89	2.89	2.37	NA	18.40	24.04	10.10	1.53	0.00	
0.50										
67.20	6669.79	3.79	3.15	NA	23.08	29.71	11.25	1.92	0.00	
0.50										
89.60	6670.74	4.74	3.88	NA	27.45	34.44	12.06	2.29	0.00	
0.50										
112.00	6671.82	5.82	4.63	NA	31.86	38.37	12.65	2.66	0.00	
0.50										
134.40	6673.21	7.21	5.43	NA	36.80	41.48	13.00	3.07	0.00	
0.50										
156.80	6674.86	8.86	6.67	NA	48.00	48.00	12.48	4.00	0.00	
0.50										
179.20	6673.54	0.00	7.54	M2	48.00	48.00	14.26	4.00	0.00	
0.50										
201.60	6674.58	0.00	8.58	M2	48.00	48.00	16.04	4.00	0.00	
0.50										

STORMWATER QUALITY CAPTURE VOLUME



Design Procedure Form: Extended Detention Basin (EDB)

Sheet 1 of 4

Designer: CTESSIN
Company: CCES
Date: March 17, 2015
Project: BARNES CENTER APARTMENTS - APARTMENTS POND
Location: POWERS AND BARNES

1. Basin Storage Volume

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

$I_a = 80.0$ %

$i = 0.800$

Area = 12,680 ac

$d_s = 0.42$ in

Choose One

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

$V_{DESIGN} = 0.416$ ac-ft

$V_{DESIGN\ OTHER} = 0.407$ ac-ft

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

Choose One

- CA
- CB
- CC / D

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

L : W = 2.0 : 1

3. Basin Side Slopes

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

Z = 4.00 ft / ft

4. Inlet

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

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 2 of 4

Designer: CTESSIN
Company: CCES
Date: March 17, 2015
Project: BARNES CENTER APARTMENTS - APARTMENTS POND
Location: POWERS AND BARNES

5. Forebay

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

$V_{FMIN} = 0.010$ ac-ft

B) Actual Forebay Volume

$V_F = 0.050$ ac-ft

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

$D_F = 18.0$ in

D) Forebay Discharge

i) Undetained 100-year Peak Discharge

$Q_{100} = 88.00$ cfs

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

$Q_F = 1.76$ cfs

E) Forebay Discharge Design

Choose One
 Berm With Pipe (flow too small for berm w/ pipe)
 Wall with Rect. Notch
 Wall with V-Notch Weir

G) Rectangular Notch Width

Calculated $W_W = 7.1$ in

6. Trickle Channel

A) Type of Trickle Channel

Choose One
 Concrete
 Soft Bottom

F) Slope of Trickle Channel

$S = 0.0100$ ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-foot minimum)

$D_M = 2.5$ ft

B) Surface Area of Micropool (10 ft² minimum)

$A_M = 180$ sq ft

C) Outlet Type

Choose One
 Orifice Plate
 Other (Describe):

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

$H = 4.00$ feet

E) Volume to Drain Over Prescribed Time

WQCV = 0.339 ac-ft

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

$T_D = 40$ hours

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

$A_o = 0.54$ square inches

H) Orifice Dimensions:
i) Circular Orifice Diameter or

$D_{orifice} = 13/16$ inches

I) Number of Columns

$n_c = 1$ number

J) Actual Design Outlet Area per Row (A_{oA})

$A_{oA} = 0.52$ square inches

K) Number of Rows (n_r)

$n_r = 12$ number

L) Total Outlet Area (A_{oT})

$A_{oT} = 5.2$ square inches

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 4

Designer: CTESSIN
Company: CCES
Date: March 17, 2015
Project: BARNES CENTER APARTMENTS - APARTMENTS POND
Location: POWERS AND BARNES

<p>8. Initial Surcharge Volume</p> <p>A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)</p> <p>B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WCCV)</p> <p>C) Initial Surcharge Provided Above Micropool</p>	<p>$D_{IS} = 4.0$ in</p> <p>$V_{IS} = 44.3$ cu ft</p> <p>$V_s = 60.0$ cu ft</p>
<p>9. Trash Rack</p> <p>A) Type of Water Quality Orifice Used</p> <p>B) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5 * (e^{-0.065D})$</p> <p>C) For 1-1/4", or Smaller, Circular Opening (See Fact Sheet T-12):</p> <p>i) Width of Water Quality Screen and Concrete Opening ($W_{opening}$)</p> <p>ii) Height of Water Quality Screen (H_{TR})</p> <p>iii) Type of Screen, Describe if "Other"</p>	<p>Choose One</p> <p><input checked="" type="radio"/> Circular (up to 1-1/4" diameter)</p> <p><input type="radio"/> Circular (greater than 1-1/4" diameter) OR Rectangular (2" high)</p> <p>$A_t = 222$ square inches</p> <p>$W_{opening} = 12.0$ inches</p> <p>$H_{TR} = 76.0$ inches</p> <p>Choose One</p> <p><input checked="" type="radio"/> S.S. Well Screen with 60% Open Area*</p> <p><input type="radio"/> Other (Describe):</p> <hr/> <hr/> <p>$W_{TR} = 12.0$ inches</p> <p>$H_{TR} = 76.0$ inches</p> <p>Choose One</p> <p><input type="radio"/> Aluminum Amico-Klomp SR Series (or equal)</p> <p><input type="radio"/> Other (Describe):</p> <hr/> <hr/> <p>$W_{TR} = 12.0$ inches</p> <p>$H_{TR} = 76.0$ inches</p>

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 4 of 4

Designer: CTESSIN
Company: CCES
Date: March 17, 2015
Project: BARNES CENTER APARTMENTS - APARTMENTS POND
Location: POWERS AND BARNES

10. Overflow Embankment

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

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

$Z_E =$ 4.00 ft / ft

11. Vegetation

Choose One

Irrigated

Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

Notes:

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 1 of 4

Designer: CTESSIN
 Company: CCES
 Date: March 17, 2015
 Project: BARNES APARTMENTS OFFSITE COMMERCIAL
 Location: POWERS & BARNES

1. Basin Storage Volume

- A) Effective Imperviousness of Tributary Area, I_a
- B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)
- C) Contributing Watershed Area
- D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm
- E) Design Concept
(Select EURV when also designing for flood control)
- F) Design Volume (1.2 WQCV) Based on 40-hour Drain Time
($V_{DESIGN} = (1.0 * (0.91 * I_a^3 - 1.19 * I_a^2 + 0.78 * I_a)) / 12 * Area * 1.2$)
- G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume
($V_{WQCV OTHER} = (d_s * (V_{DESIGN} / 0.43))$)
- H) User Input of Water Quality Capture Volume (WQCV) Design Volume
(Only if a different WQCV Design Volume is desired)
- I) Predominant Watershed NRCS Soil Group

$I_a =$ 95.0 %

$i =$ 0.950

Area = 12.300 ac

$d_s =$ 0.42 in

Choose One

Water Quality Capture Volume (WQCV)

Excess Urban Runoff Volume (EURV)

$V_{DESIGN} =$ 0.550 ac-ft

$V_{DESIGN OTHER} =$ 0.537 ac-ft

$V_{DESIGN USER} =$ _____ ac-ft

Choose One

A

B

C / D

$S =$ 0.005

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

L : W = 2.0 : 1

3. Basin Side Slopes

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

Z = 4.00 ft / ft

4. Inlet

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

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 2 of 4

Designer: CTESSIN
 Company: CCES
 Date: March 17, 2015
 Project: BARNES APARTMENTS OFFSITE COMMERCIAL
 Location: POWERS & BARNES

<p>5. Forebay</p> <p>A) Minimum Forebay Volume ($V_{FMIN} = 3\%$ of the WQCV)</p> <p>B) Actual Forebay Volume</p> <p>C) Forebay Depth ($D_F = 18$ inch maximum)</p> <p>D) Forebay Discharge</p> <p>i) Undetained 100-year Peak Discharge</p> <p>ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$)</p> <p>E) Forebay Discharge Design</p> <p>G) Rectangular Notch Width</p>	<p>$V_{FMIN} = 0.013$ ac-ft</p> <p>$V_F = 0.015$ ac-ft</p> <p>$D_F = 18.0$ in</p> <p>$Q_{100} = 97.00$ cfs</p> <p>$Q_F = 1.94$ cfs</p> <p>Choose One</p> <p><input type="radio"/> Berm With Pipe (flow too small for berm w/ pipe)</p> <p><input checked="" type="radio"/> Wall with Rect. Notch</p> <p><input type="radio"/> Wall with V-Notch Weir</p> <p>Calculated $W_N = 7.4$ in</p>
<p>6. Trickle Channel</p> <p>A) Type of Trickle Channel</p> <p>F) Slope of Trickle Channel</p>	<p>Choose One</p> <p><input checked="" type="radio"/> Concrete</p> <p><input type="radio"/> Soft Bottom</p> <p>$S = 0.0100$ ft / ft</p>
<p>7. Micropool and Outlet Structure</p> <p>A) Depth of Micropool (2.5-foot minimum)</p> <p>B) Surface Area of Micropool (10 ft² minimum)</p> <p>C) Outlet Type</p> <p>D) Depth of Design Volume (EURV or 1.2 WQCV) Based on the Design Concept Chosen Under 1.E.</p> <p>E) Volume to Drain Over Prescribed Time</p> <p>F) Drain Time (Min T_D for WQCV= 40 hours; Max T_D for EURV= 72 hours)</p> <p>G) Recommended Maximum Outlet Area per Row, (A_o)</p> <p>H) Orifice Dimensions: i) Circular Orifice Diameter or</p> <p>I) Number of Columns</p> <p>J) Actual Design Outlet Area per Row (A_{oA})</p> <p>K) Number of Rows (n_r)</p> <p>L) Total Outlet Area (A_{oT})</p>	<p>$D_M = 2.5$ ft</p> <p>$A_M = 150$ sq ft</p> <p>Choose One</p> <p><input checked="" type="radio"/> Orifice Plate</p> <p><input type="radio"/> Other (Describe):</p> <hr/> <p>$H = 4.00$ feet</p> <p>WQCV = 0.448 ac-ft</p> <p>$T_D = 40$ hours</p> <p>$A_o = 0.68$ square inches</p> <p>$D_{orifice} = 7.18$ inches</p> <p>$n_c = 1$ number</p> <p>$A_{oA} = 0.60$ square inches</p> <p>$n_r = 12$ number</p> <p>$A_{oT} = 7.2$ square inches</p>

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 3 of 4

Designer: CTESSIN
Company: CCES
Date: March 17, 2015
Project: BARNES APARTMENTS OFFSITE COMMERCIAL
Location: POWERS & BARNES

8. Initial Surcharge Volume

- A) Depth of Initial Surcharge Volume
(Minimum recommended depth is 4 inches)
- B) Minimum Initial Surcharge Volume
(Minimum volume of 0.3% of the WQCV)
- C) Initial Surcharge Provided Above Micropool

$D_{IS} = 6.0$ in

$V_{IS} = 59.5$ cu ft

$V_s = 75.0$ cu ft

9. Trash Rack

- A) Type of Water Quality Orifices Used
- B) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5 * (e^{-0.095D})$
- C) For 1-1/4", or Smaller, Circular Opening (See Fact Sheet T-12):
 - i) Width of Water Quality Screen and Concrete Opening ($W_{opening}$)
 - ii) Height of Water Quality Screen (H_{TR})
 - iii) Type of Screen, Describe if "Other"

Choose One
 Circular (up to 1-1/4" diameter)
 Circular (greater than 1-1/4" diameter) OR Rectangular (2" high)

$A_t = 256$ square inches

$W_{opening} = 12.0$ inches

$H_{TR} = 76.0$ inches

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

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

Design Procedure Form: Extended Detention Basin (EDB)

Sheet 4 of 4

Designer: CTESSIN
Company: CCES
Date: March 17, 2015
Project: BARNES APARTMENTS OFFSITE COMMERCIAL
Location: POWERS & BARNES

10. Overflow Embankment

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

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

$Z_e =$ _____ ft / ft

11. Vegetation

Choose One

- Irrigated
 Not Irrigated

12. Access

A) Describe Sediment Removal Procedures

Notes:

EXISTING FILING NO. 1

DRAINAGE MAP



8720 N. SCOTTSDALE ROAD, #109
 SCOTTSDALE, AZ 85253
 (480) 922-9200 P
 (480) 922-9201 F



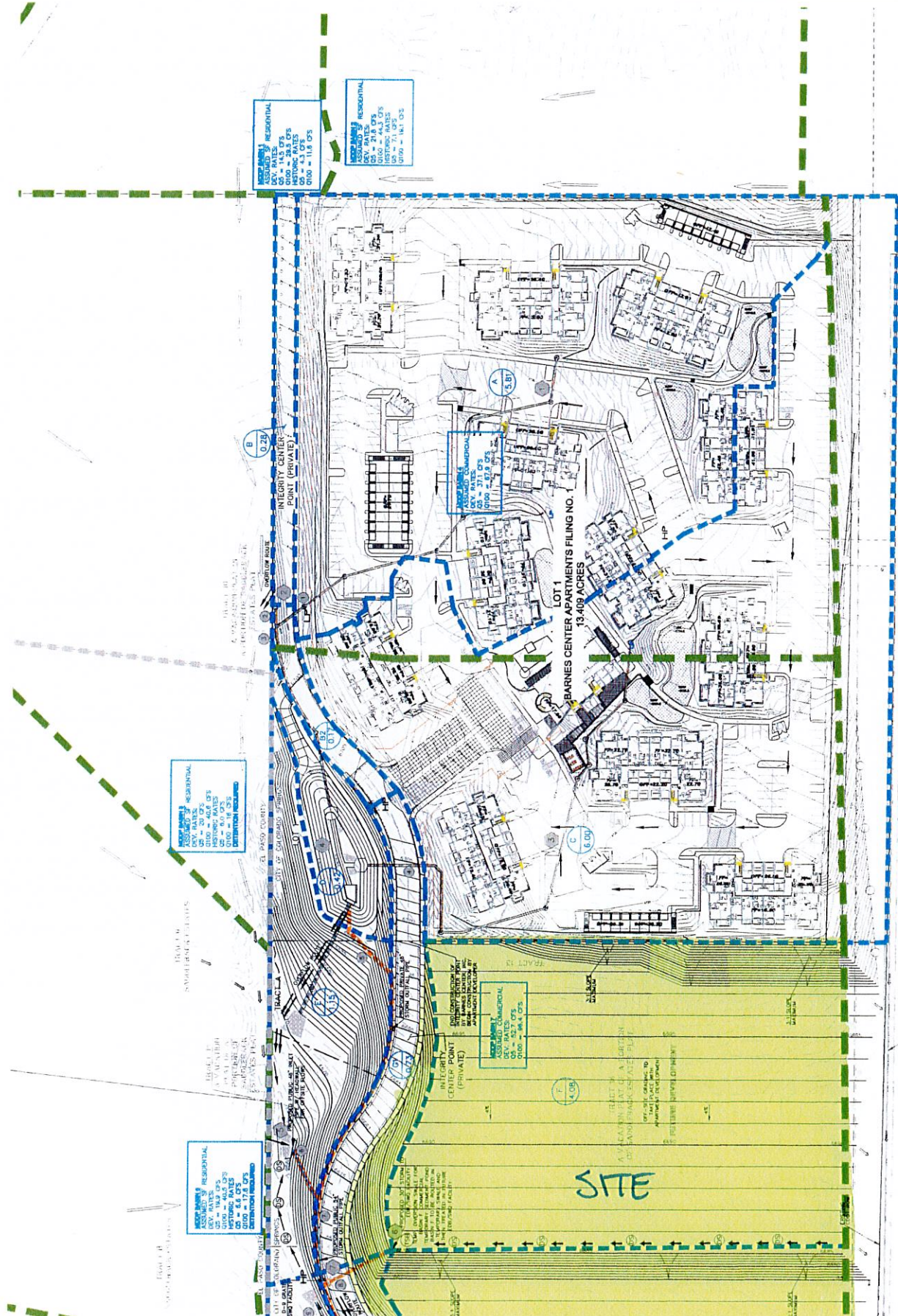
TODD & ASSOCIATES, INC.
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12/15/14



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CONTACT

DATA

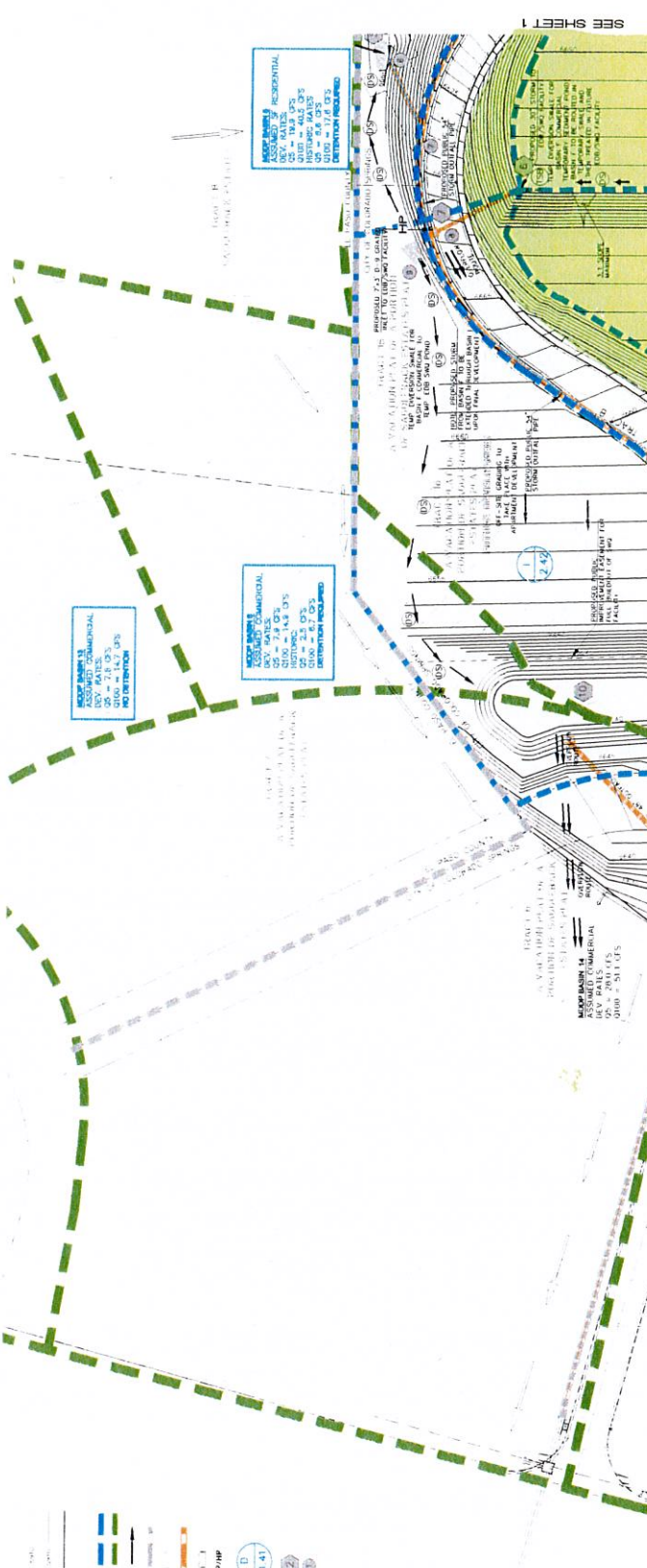
Map Scale: 1" = 100' (1" = 30.48m)

North Arrow

SEE SHEET 2

LEGEND

8.00' (2.44m) TO 10.00' (3.05m)	10.00' (3.05m) TO 12.00' (3.66m)	12.00' (3.66m) TO 14.00' (4.27m)	14.00' (4.27m) TO 16.00' (4.88m)	16.00' (4.88m) TO 18.00' (5.49m)	18.00' (5.49m) TO 20.00' (6.10m)	20.00' (6.10m) TO 22.00' (6.71m)	22.00' (6.71m) TO 24.00' (7.32m)	24.00' (7.32m) TO 26.00' (7.93m)	26.00' (7.93m) TO 28.00' (8.54m)	28.00' (8.54m) TO 30.00' (9.15m)	30.00' (9.15m) TO 32.00' (9.76m)	32.00' (9.76m) TO 34.00' (10.37m)	34.00' (10.37m) TO 36.00' (10.98m)	36.00' (10.98m) TO 38.00' (11.59m)	38.00' (11.59m) TO 40.00' (12.20m)	40.00' (12.20m) TO 42.00' (12.81m)	42.00' (12.81m) TO 44.00' (13.42m)	44.00' (13.42m) TO 46.00' (14.03m)	46.00' (14.03m) TO 48.00' (14.64m)	48.00' (14.64m) TO 50.00' (15.25m)	50.00' (15.25m) TO 52.00' (15.86m)	52.00' (15.86m) TO 54.00' (16.47m)	54.00' (16.47m) TO 56.00' (17.08m)	56.00' (17.08m) TO 58.00' (17.69m)	58.00' (17.69m) TO 60.00' (18.30m)	60.00' (18.30m) TO 62.00' (18.91m)	62.00' (18.91m) TO 64.00' (19.52m)	64.00' (19.52m) TO 66.00' (20.13m)	66.00' (20.13m) TO 68.00' (20.74m)	68.00' (20.74m) TO 70.00' (21.35m)	70.00' (21.35m) TO 72.00' (21.96m)	72.00' (21.96m) TO 74.00' (22.57m)	74.00' (22.57m) TO 76.00' (23.18m)	76.00' (23.18m) TO 78.00' (23.79m)	78.00' (23.79m) TO 80.00' (24.40m)	80.00' (24.40m) TO 82.00' (25.01m)	82.00' (25.01m) TO 84.00' (25.62m)	84.00' (25.62m) TO 86.00' (26.23m)	86.00' (26.23m) TO 88.00' (26.84m)	88.00' (26.84m) TO 90.00' (27.45m)	90.00' (27.45m) TO 92.00' (28.06m)	92.00' (28.06m) TO 94.00' (28.67m)	94.00' (28.67m) TO 96.00' (29.28m)	96.00' (29.28m) TO 98.00' (29.89m)	98.00' (29.89m) TO 100.00' (30.50m)
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FINAL DRAINAGE REPORT - SURFACE ROUTING SUMMARY

Design Point	Contributing Basin	Estimated Excessed CA (10)	Maximum CA (10)	Intensity	I (10)	H (10)	Q (10)	Q (10)	Q (10)	Q (10)	Q (10)	Inlet Size
1	Basin 1	100	100	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	18" (457mm)
2	Basin 2	200	200	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	24" (609mm)
3	Basin 3	300	300	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	30" (762mm)
4	Basin 4	400	400	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	36" (914mm)
5	Basin 5	500	500	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	42" (1067mm)
6	Basin 6	600	600	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	48" (1219mm)
7	Basin 7	700	700	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	54" (1372mm)
8	Basin 8	800	800	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	60" (1524mm)
9	Basin 9	900	900	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	66" (1676mm)
10	Basin 10	1000	1000	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	72" (1829mm)

FINAL DRAINAGE REPORT - PIPE ROUTING SUMMARY

Pipe Run	Contributing Basins	Estimated Excessed CA (10)	Maximum CA (10)	Intensity	I (10)	H (10)	Q (10)	Q (10)	Q (10)	Q (10)	Q (10)	Pipe Size
1	Basin 1	100	100	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	18" (457mm)
2	Basin 2	200	200	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	24" (609mm)
3	Basin 3	300	300	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	30" (762mm)
4	Basin 4	400	400	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	36" (914mm)
5	Basin 5	500	500	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	42" (1067mm)
6	Basin 6	600	600	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	48" (1219mm)
7	Basin 7	700	700	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	54" (1372mm)
8	Basin 8	800	800	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	60" (1524mm)
9	Basin 9	900	900	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	66" (1676mm)
10	Basin 10	1000	1000	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	72" (1829mm)

PROJECT NO. 14-2026-00
Barnes Center Apartments
 Filing No. 1
 Colorado Springs, CO

CLIENT
 6720 N. SCOTTSDALE ROAD, #109
 SCOTTSDALE, AZ 85253
 (480) 922 9200 P
 (480) 922 9201 F

SEAL

CONTACT
TODD & ASSOCIATES, INC.
 4019 North 44th Street
 Phoenix, AZ 85018
 602-952-8280p 602-952-8995f
 www.toddsoc.com



DATE
 12/15/14

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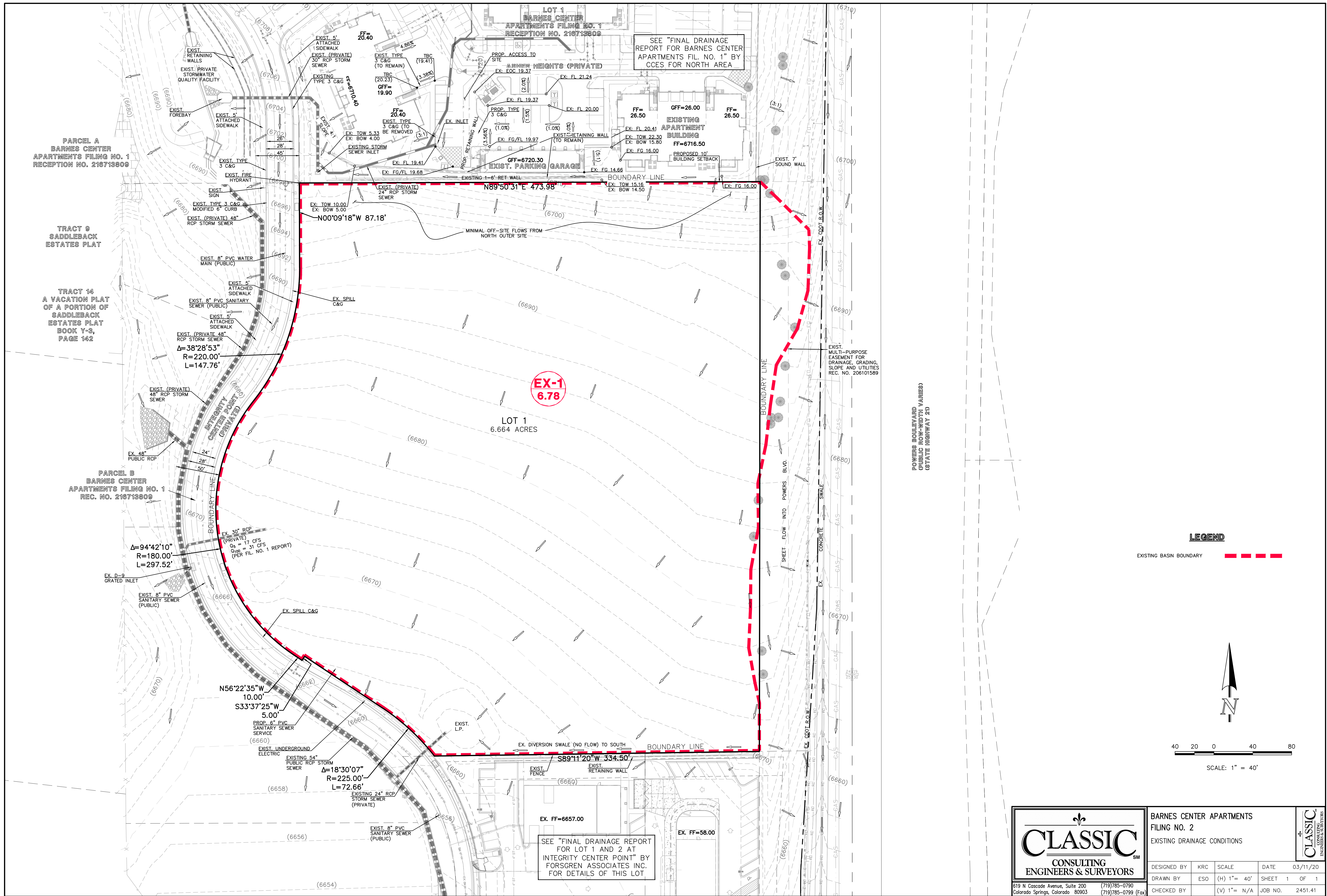
FINAL DRAINAGE REPORT DEVELOPED CONDITIONS
 2 of 2
 CPC DP 14-00XXX

DRAINAGE MAP EXISTING CONDITIONS



DRAINAGE MAP
DEVELOPED CONDITIONS





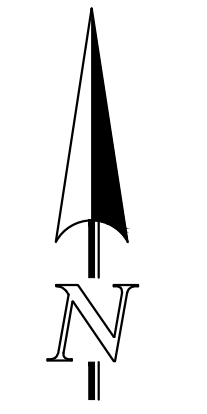
SEE "FINAL DRAINAGE REPORT FOR BARNES CENTER APARTMENTS FIL. NO. 1" BY CCES FOR NORTH AREA

EX-1
6.78

SEE "FINAL DRAINAGE REPORT FOR LOT 1 AND 2 AT INTEGRITY CENTER POINT" BY FORSGREN ASSOCIATES INC. FOR DETAILS OF THIS LOT

LEGEND

EXISTING BASIN BOUNDARY - - - - -



40 20 0 40 80

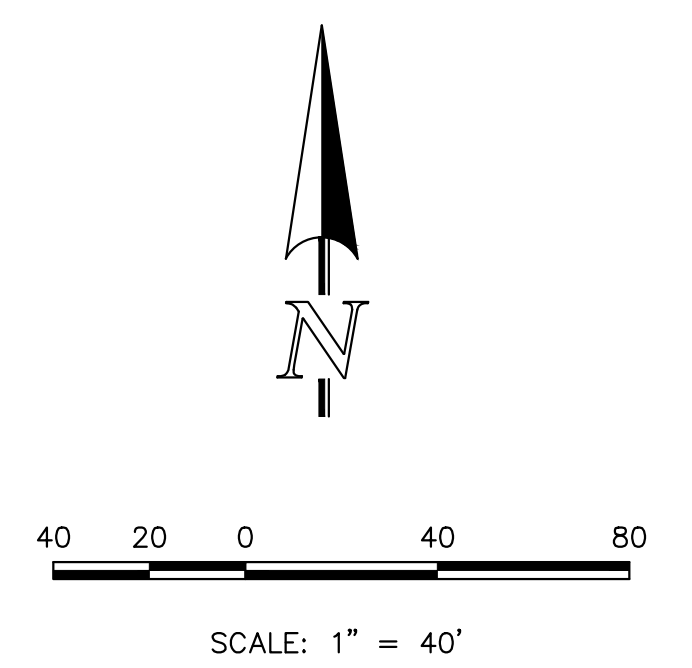
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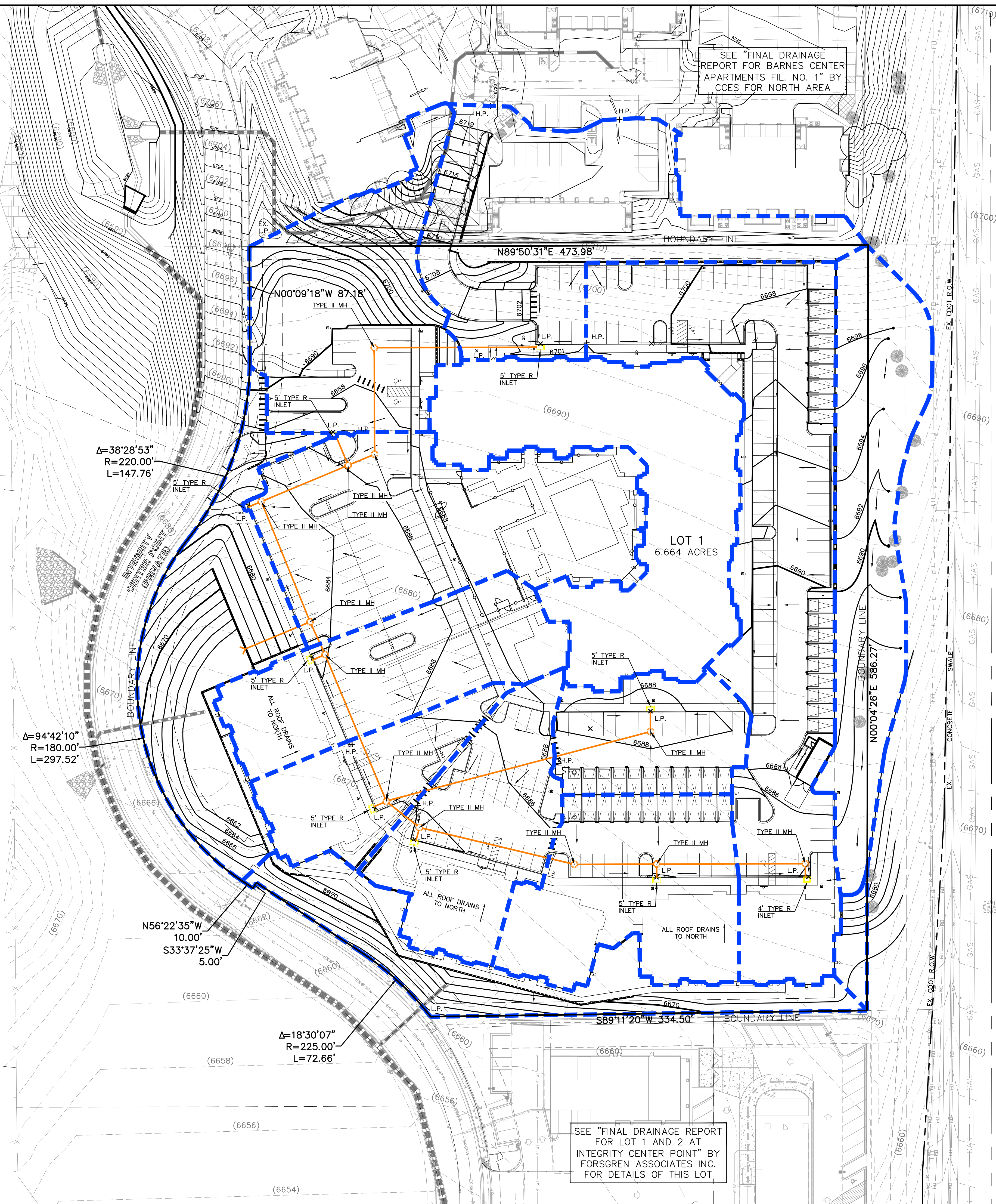
BARNES CENTER APARTMENTS FILING NO. 2 EXISTING DRAINAGE CONDITIONS			
DESIGNED BY	KRC	SCALE	DATE
DRAWN BY	ESO	(H) 1" = 40'	SHEET 1 OF 1
CHECKED BY	(V) 1" = N/A	JOB NO.	2451.41

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

N:\245141\DRAININGS\DEVELOPMENT\245141-EXISTING DRAINAGE CONDITIONS.dwg, 3/17/2020, 1:35:36 PM, 1:1



SEE "FINAL DRAINAGE REPORT FOR BARNES CENTER APARTMENTS FIL. NO. 1" BY CCES FOR NORTH AREA



$\Delta=38^{\circ}28'53''$
 $R=220.00'$
 $L=147.76'$

$\Delta=94^{\circ}42'10''$
 $R=180.00'$
 $L=297.52'$

$N56^{\circ}22'35''W$
 $10.00'$
 $S33^{\circ}37'25''W$
 $5.00'$

$\Delta=18^{\circ}30'07''$
 $R=225.00'$
 $L=72.66'$

SEE "FINAL DRAINAGE REPORT FOR LOT 1 AND 2 AT INTEGRITY CENTER POINT" BY FORSGREN ASSOCIATES INC. FOR DETAILS OF THIS LOT

POWERS BOULEVARD
(PUBLIC ROW-WIDTH VARIES)
(STATE HIGHWAY 20)

LEGEND

- EXISTING GROUND CONTOUR (5820)
- PROPOSED FINISHED CONTOUR 5820
- SITE BOUNDARY
- PROPOSED BASIN BOUNDARY
- PROP. DIRECTION OF DRAINAGE
- EXISTING STORM SEWER
- EXISTING STORM INLET
- PROPOSED STORM SEWER
- PROPOSED STORM INLET
- BASIN IDENTIFIER D
- AREA IN ACRES 1.41
- PIPE RUN 1
- DESIGN POINT 1
- LOW POINT L.P.
- HIGH POINT H.P.

NOTE: ALL PROPOSED STORM FACILITIES ARE PRIVATE

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BARNES CENTER APARTMENTS
FILING NO. 2
PROPOSED DRAINAGE CONDITIONS

DESIGNED BY	KRC	SCALE	DATE	03/11/20
DRAWN BY	LDB	(H) 1" = 40'	SHEET	1 OF 1
CHECKED BY	(V) 1" = N/A	JOB NO.	2451.41	

619 N Cascade Avenue, Suite 200
Colorado Springs, Colorado 80903

(719) 785-0790
(719) 785-0799 (Fax)



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