FINAL DRAINAGE REPORT

for

DEYOUNG SUBDIVISION
BENT GRASS MEADOWS DRIVE

Prepared for:

Randall DeYoung
2790 N. Academy Blvd., Suite #150
Colorado Springs, CO 80917

December 18, 2019
Revised April 20, 2020

Prepared by:

JPS ENGINEERING

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JPS Project No. 031901
PCD Project No. MS-20-001

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FINAL DRAINAGE REPORT
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DRAINAGE 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 master plan of the drainage basin. I accept responsibility for liability caused by negligent acts, errors or omissions on my part in preparing this report.

____

John P. Schwab, P.E. #29891

Developer's Statement:

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

By:

____

Randall DeYoung Date
2790 N. Academy Blvd. #150
Colorado Springs, CO 80917

El Paso County's Statement

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

____

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

Conditions:

I. INTRODUCTION

A. Property Location and Description

Mr. Randall DeYoung (Owner) is planning to construct a new “Mancave” storage complex on a vacant 17.2-acre property (El Paso County Assessor’s Parcel No. 53010-00-016) located on the east side of Bent Grass Meadows Drive, north of Woodmen Road, in the Falcon area of El Paso County, Colorado. The site is zoned Industrial (I-2), and the proposed storage facility is a permitted use in this zone. The property is currently an unplatted tract described as a portion of the Southwest Quarter of Section 1, Township 13S, Range 65W of the 6^{th} P.M., El Paso County, Colorado. The project will include platting the property as DeYoung Subdivision.

The west boundary of the property adjoins Bent Grass Meadows Drive, which is an improved public collector street, with the exception of the need for paving a final lift of asphalt, and extension of approximately 140 feet at the north end of the property. An existing storage facility platted as Lot 1, Latigo Business Center Filing No. 1 is located on the west side of Bent Grass Meadows Drive.

The north boundary of the property adjoins a 14.3-acre undeveloped tract (EPC Parcel No. 53010-00-023) and a 16.1-acre undeveloped tract (EPC Parcel No. 53010-00-036). We understand these parcels are planned for residential development as part of the Bent Grass PUD.

The east boundary of the property adjoins an unplatted 40-acre parcel (EPC Parcel No. 53000-00-202) which has been developed as the existing Mountain View Electric Association headquarters facility (zoned I-2). The south boundary of the property adjoins an undeveloped 8.1-acre tract (EPC Parcel No. 53010-00-017) zoned Industrial (I-2).

The proposed Site Development Plan consists of 10 new storage buildings and canopy structures, providing a mixture of enclosed, covered, and open storage spaces, along with associated access drives, parking and site improvements. Access will be provided by two private access drive connections to Bent Grass Meadows Drive along the western site boundary.

B. Scope

In support of the Subdivision Plat and Site Development Plan submittals to El Paso County, this report is intended to meet the requirements of a Final Drainage Report in accordance with El Paso County drainage criteria. This report will provide a summary of site drainage issues impacting the proposed development. The report will analyze impacts from upstream drainage patterns, site-specific developed drainage patterns, and impacts on downstream facilities. This report is based on the guidelines and criteria presented in the El Paso County “Drainage Criteria Manual.”

C. References

City of Colorado Springs "Drainage Criteria Manual, Volumes 1 and 2," revised May, 2014.

Classic Consulting Engineers & Surveyors, LLC, "Preliminary Drainage Report for Bent Grass Residential (Filing No. 1), revised June, 2014.

El Paso County "Drainage Criteria Manual," revised November, 1991.

El Paso County Resolution No. 15-042, "Resolution for Adoption of Portions of the City of Colorado Springs Drainage Criteria Manual Volume 1 dated May 2014," January 27, 2015.

El Paso County "Engineering Criteria Manual," revised June 20, 2019.

FEMA, Flood Insurance Rate Map (FIRM) Number 08041C0553G, December 7, 2018.

Galloway & Company, Inc., "Final Drainage Report, Bent Grass Residential Subdivision Filing No. 2," revised January 2020.

Kiowa Engineering Corporation, "Final Drainage Report and Erosion Control Plan, Latigo Business Center Filing No. 1," revised November 30, 2004.

Kiowa Engineering Corporation, "Master Development Drainage Plan and Preliminary Drainage Plan, Bent Grass Subdivision," revised December 18, 2006.

Matrix Design Group, "Falcon Drainage Basin Planning Study," September, 2015.

USDA/NRCS, "Custom Soil Resource Report for El Paso County Area, Colorado," October 27, 2019.

II. EXISTING DRAINAGE CONDITIONS

The existing site topography generally slopes downward to the southeast with grades in the range of 1-4 percent. According to the Soil Survey of El Paso County prepared by the Soil Conservation Service (SCS), on-site soils are comprised primarily of Columbine gravelly sandy loam soils, with a small area in the southeast corner of the site comprised of Blakeland-Fluvaquentic Haplaquolls. These well-drained soils are classified as hydrologic soils group "A" (see Appendix A).

As shown on the enclosed Historic Drainage Plan (Sheet EX1, Appendix D), the site has been delineated as one on-site drainage basin. The on-site area has been delineated as Basin A, which sheet flows towards the southeast corner of the property. Existing on-site flows from Basin A drain to Design Point #1, with historic peak flows calculated as Q_5 = 2.9 cfs and Q_{100} = 21.3 cfs. Hydrologic calculations are enclosed in Appendix A.

A major drainage channel identified as the Falcon Basin West Tributary Channel flows south across the east side of this property. According to the 2015 "Falcon Drainage Basin Planning Study" (DBPS) by Matrix Design Group, this channel conveys off-site drainage from an upstream area of approximately 3.1 square miles. The DBPS identifies future peak flows of Q_2 = 120 cfs and Q_{100} = 1,300 cfs at Design Point #JWT 210 (Woodmen Road) downstream of this site.

III. PROPOSED DRAINAGE CONDITIONS

On-Site Development

As shown on the enclosed Drainage Plan (Figure D1, Appendix E), the site has been delineated as two on-site drainage basins. Developed flows have been calculated based on the impervious areas associated with the proposed building and parking areas.

The proposed storage complex on the west side of the property has been delineated as Basin A, which will drain southeasterly across the site to a private storm sewer system, discharging to the Falcon Basin West Tributary Channel flowing south across the east side of the property. The proposed building pads will be graded with protective slopes to provide positive drainage away from the buildings. Surface drainage swales and a private storm sewer system will convey developed flows to an on-site water quality pond discharging to the existing drainage channel on the east side of the property. Site grades will slope to storm inlets at selected locations, collecting surface drainage and conveying stormwater to the on-site water quality pond.

Concrete crosspans and curb and gutter will convey surface drainage across the Phase 1 Storage Complex area to Private Storm Inlets A1-A3 (Triple Type 13) located in the access drive near the east end of the Phase 1 development area. Private Storm Sewer A1 (15") will flow south to Private Storm Inlet A2 (Triple Type 13), and Storm Sewer A2 (24") will continue southeasterly to Storm Inlet A3 (Triple Type 13).

Storm Sewer A3 (24") will extend easterly from the southeast corner of the Phase 1 development area to Private Storm Inlet A6 (Triple Type 13) in the southeast corner of the Phase 2 site. Developed peak flows discharged from Storm Sewer A3 (Design Point #A3.1) are calculated as Q_5 = 12.1 cfs and Q_{100} = 23.1 cfs.

Phase 2 development will include a similar layout of concrete crosspan and drainage swales conveying surface drainage to private storm inlet at selected locations. Private Storm Inlets A4 and A5 (Triple Type 13) will intercept surface drainage in the northeasterly part of the Phase 2 storage area, and Storm Sewer A5 (24") will flow south to a junction at Inlet A6 (Triple Type 13).

Storm Sewer A6 (30") will extend southeasterly into Water Quality Detention Basin A in the southeast corner of the Phase 2 storage area, and the Pond A Discharge Pipe (12") will extend southeasterly to a riprap energy dissipator entering the West Tributary Channel.

Flows from Storm Inlets A1-A6 combine at Design Point #A6.1, with total developed peak flows calculated as $Q_5 = 24.2$ cfs and $Q_{100} = 46.2$ cfs.

The developed area on the south end of the storage site will flow easterly in a paved swale, flowing directly into Water Quality Pond A. The total developed peak flows entering Pond A at Design Point #1 are calculated as $Q_5 = 36.6$ cfs and $Q_{100} = 70.0$ cfs. The increase in developed flow from this site will be mitigated by the downstream regional Detention Pond WU, and the on-site Water Quality Pond A will provide water quality mitigation for the site. Documentation from the downstream property owners between this site and Pond WU will be provided acknowledging acceptance of the developed flows from this property.

The undeveloped area on the east side of the property has been delineated as Basin B, which will sheet flow into the West Tributary Channel. The on-site developed peak flows at Design Point #2 are calculated as $Q_5 = 1.0$ cfs and $Q_{100} = 7.1$ cfs.

Hydrologic calculations for the site are detailed in the attached spreadsheets (Appendix A), and peak flows are identified on Figures EX1, D1, and D1.1 (Appendix E).

The contractor will be required to implement standard best management practices for erosion control during construction.

West Tributary Channel

As previously noted, the West Tributary Channel of the Falcon Drainage Basin flows southerly across the east side of this property. In comparison to the flow in the main channel (DBPS future peak flow of $Q_{100} = 1{,}300$ cfs at Design Point #JWT 210), the total on-site flow contribution amounts to approximately 6 percent of the flow in the West Tributary Channel downstream of this site. As such, on-site flows from the proposed DeYoung Subdivision are relatively small in comparison to the total flows in the West Tributary Channel.

According to the Falcon DBPS, proposed regional channel improvements include re-establishing a natural cross section and implementing a series of Rock Cross Vanes for grade control (see Matrix Sheet 6-11, Appendix D). In conjunction with subdivision platting, this site will pay drainage basin fees towards the recommended regional drainage channel improvements.

Based on the "Final Drainage Report, Bent Grass Meadows Residential Subdivision Filing No. 2" by Galloway & Company dated January, 2020, we understand that no main channel improvements are currently proposed. The east side of this property will be platted as a tract to provide access for channel maintenance and future channel improvements. Future channel improvements are anticipated to be constructed by the Bent Grass Metropolitan District.

IV. DRAINAGE PLANNING FOUR STEP PROCESS

El Paso County Drainage Criteria require drainage planning to include a Four Step Process for receiving water protection that focuses on reducing runoff volumes, treating the water quality capture volume (WQCV), stabilizing drainageways, and implementing long-term source controls.

As stated in DCM Volume 2, the Four Step Process is applicable to all new and re-development projects with construction activities that disturb 1 acre or greater or that disturb less than 1 acre but are part of a larger common plan of development. The Four Step Process has been implemented as follows in the planning of this project:

<u>Step 1: Employ Runoff Reduction Practices</u>

- Minimize Impacts: The existing drainage channel area crossing the east side of the property will be preserved as a drainage easement. No development is proposed in the easterly part of the property, which will minimize developed drainage impacts.

<u>Step 2: Stabilize Drainageways</u>

- The Falcon Basin West Tributary Channel flows in a southerly direction across the east side of this property. This site will pay Drainage Basin Fees as the applicable cost share towards the regional drainage channel improvements recommended in the Falcon Drainage Basin Planning Study. The east side of the property will be platted as a tract allowing for maintenance access to the channel.

<u>Step 3: Provide Water Quality Capture Volume (WQCV)</u>

- An on-site Water Quality Pond will be constructed to mitigate water quality impacts within the site. The on-site water quality pond will capture and slowly release the WQCV over a 40-hour design release period.

<u>Step 4: Consider Need for Industrial and Commercial BMPs</u>

- The proposed commercial development project will implement a Stormwater Management Plan including proper housekeeping practices and spill containment procedures.

V. FLOODPLAIN IMPACTS

Floodplain limits in vicinity of this site are delineated in the applicable Flood Insurance Rate Map, FIRM Panel No. 08041C0553G dated December 7, 2018. As depicted in the FIRM exhibit enclosed in Appendix D, this site is impacted by the delineated 100-year FEMA floodplain of the Falcon West Tributary Channel, which flows southerly across the east side of this property. The existing 100-year floodplain limits are shown on the enclosed Drainage Plans (Appendix D).

On the enclosed Developed Drainage Plan (Sh. D1, Appendix D), the FEMA 100-year flood elevations based on the Flood Insurance Study (FIS) datum (NAVD 88) have been converted to the NGVD 1929 datum used in the topographic survey for this site. The proposed Northeast Storage Building Finished Floor Elevation is 6925.0, which is over one foot above the corresponding base flood elevation of 6923.5 (converted to NGVD 29), and the proposed Southeast Building Finished Floor Elevation is 6921.6, which is also well above the adjoining base flood elevation of 6915.0 (converted to NGVD 29).

The existing drainage channel appears to be a stable grass-lined channel flowing through this site. Phase 1 development of the storage complex will result in no significant disturbance to the existing channel or floodplain.

Future Phase 2 development of the storage complex assumes that the channel will be diverted to the east of the Phase 2 development limits, consistent with the effective floodplain delineation.

VI. STORMWATER DETENTION AND WATER QUALITY

The proposed drainage and grading plan for the site conveys developed drainage southeasterly across the site to an on-site Water Quality Pond before discharging into the existing Falcon Basin West Tributary Drainage Channel. The channel flows south to the existing Regional Detention Pond WU located at the northwest corner of Meridian Road and US Highway 24.

Regional Detention Pond WU

According to the 2015 "Falcon Drainage Basin Planning Study" (DBPS) by Matrix Design Group, the existing regional detention pond has a capacity of 39.5 acre-feet and provides the required stormwater detention for this site.

As detailed in the "Final Drainage Report, Bent Grass Residential Subdivision Filing No. 2" by Galloway & Company, Inc., the existing regional detention pond is currently not functioning properly, and the pond requires a number of improvements. The proposed detention pond improvements to be completed by Bent Grass Residential include upgrade of the pond outlet structure, repair of the washed-out inlet and embankment, and installation of a new cutoff wall along the pond embankment.

On-Site Water Quality Pond A

The proposed drainage and grading plan for this site includes a private Extended Detention Basin (EDB) at the southeast corner of the developed site to provide the required stormwater quality mitigation in accordance with current El Paso County drainage criteria.

According to the calculations in Appendix D, the required Water Quality Capture Volume (WQCV) is 0.37 acre-feet, and the proposed Extended Detention Basin A provides a volume of 0.39 acre-feet.

The Water Quality Pond will discharge through an outlet structure and 12-inch outlet pipe draining into a riprap apron entering the existing channel.

The proposed stormwater quality facilities will be privately owned and maintained by the property owner, and maintenance access will be readily available from the adjoining parking area.

VII. DRAINAGE BASIN FEES

Development of this commercial storage site will include construction of a private storm sewer system and water quality pond within the site. No public drainage improvements are proposed as part of this project.

The site lies entirely within the Falcon Drainage Basin, which is tributary to Black Squirrel Creek. The Falcon Drainage Basin is subject to an El Paso County 2020 drainage basin fee of $30,807 per impervious acre, and a bridge fee of $4,232 per impervious acre. The required drainage and bridge fees are due at the time of recording the subdivision plat.

According to El Paso County Engineering Criteria Manual Section 3.13a, the required drainage basin fees for subdivision plats are assessed based upon the new impervious area if no such fee has been previously paid. As such, the required basin fees are calculated based on the developed impervious area calculation for this site.

The required drainage and bridge fees are calculated as follows:

Platted Area:		17.173 acres
Lot 1 Area (excluding drainage tract):		13.066 acres
Lot 1 Developed Impervious Area:		**10.7 acres**
Drainage Fee:	(10.7 ac.) @ ($30,807/ac.) =	**$329,634.90**
Bridge Fee:	(10.7 ac.) @ ($4,232/ac.) =	**$ 45,282.40**

VIII. SUMMARY

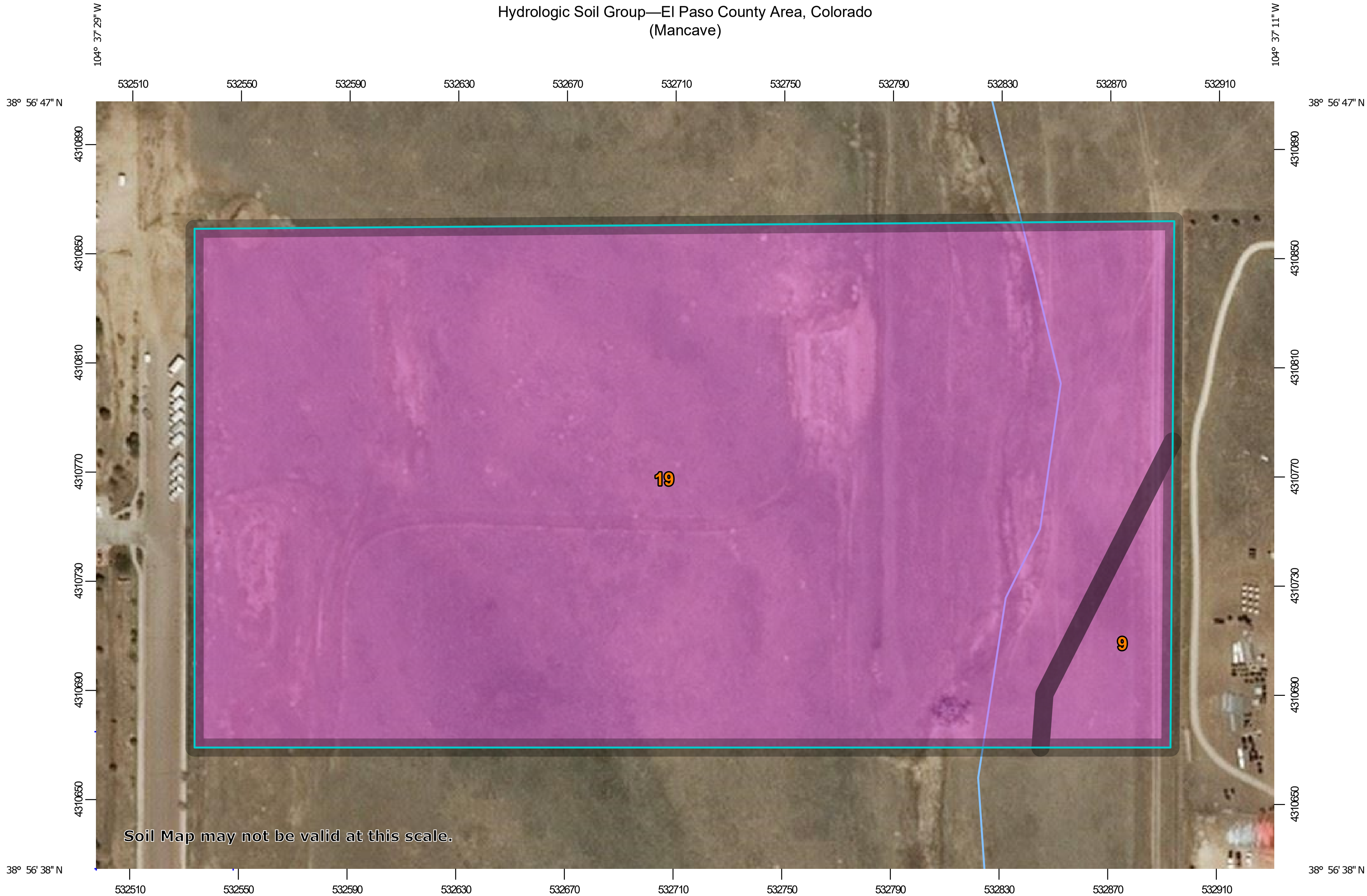
The developed drainage patterns associated with the proposed “Mancave” storage complex on Lot 1, DeYoung Subdivision will remain consistent with existing conditions and the overall drainage basin master plan for area. Developed flows from the site will drain southeasterly across the property through a private storm sewer system and on-site water quality pond, discharging to the existing Falcon Basin West Tributary Channel. The existing downstream regional stormwater detention pond and the proposed on-site water quality facilities have been designed to mitigate developed flow impacts and meet the County’s stormwater detention and water quality requirements.

Construction and proper maintenance of the proposed private drainage facilities and existing downstream public drainage facilities, in conjunction with proper on-site erosion control practices, will ensure that this site development has no significant adverse drainage impact on downstream or surrounding areas.

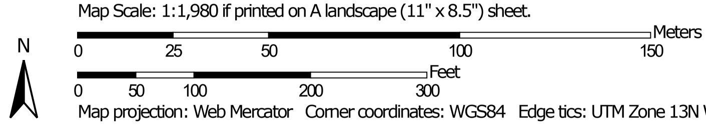
APPENDIX A

SOILS INFORMATION

Hydrologic Soil Group—El Paso County Area, Colorado
(Mancave)



Map Scale: 1:1,980 if printed on A landscape (11" x 8.5") sheet.



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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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: Sep 8, 2018—May 26, 2019

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
9	Blakeland-Fluvaquentic Haplaquolls	A	0.8	4.5%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	A	16.3	95.5%
Totals for Area of Interest			**17.1**	**100.0%**

Description

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

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

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

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

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

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

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

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

USDA United States Department of Agriculture

NRCS Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

El Paso County Area, Colorado

October 27, 2019

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map

Map Scale: 1:1,980 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 25, 50, 100, 150

Feet: 0, 50, 100, 200, 300

N

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 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: Sep 8, 2018—May 26, 2019

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
9	Blakeland-Fluvaquentic Haplaquolls	0.8	4.5%
19	Columbine gravelly sandy loam, 0 to 3 percent slopes	16.3	95.5%
Totals for Area of Interest		**17.1**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

El Paso County Area, Colorado

9—Blakeland-Fluvaquentic Haplaquolls

Map Unit Setting

National map unit symbol: 36b6
Elevation: 3,500 to 5,800 feet
Mean annual precipitation: 13 to 17 inches
Mean annual air temperature: 46 to 55 degrees F
Frost-free period: 110 to 165 days
Farmland classification: Not prime farmland

Map Unit Composition

Blakeland and similar soils: 60 percent
Fluvaquentic haplaquolls and similar soils: 38 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting

Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium derived from arkose and/or eolian deposits derived from arkose

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: 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
Calcium carbonate, maximum in profile: 5 percent
Available water storage in profile: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Description of Fluvaquentic Haplaquolls

Setting

Landform: Swales
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 12 inches: variable

Properties and qualities

Slope: 1 to 2 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 0 to 24 inches
Frequency of flooding: Occasional
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Interpretive groups

Land capability classification (irrigated): 6w
Land capability classification (nonirrigated): 6w
Hydrologic Soil Group: D
Hydric soil rating: Yes

Minor Components

Other soils

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

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

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: Flood plains, fan terraces, fans
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
Natural 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 storage in profile: Very low (about 2.5 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: Gravelly Foothill (R049BY214CO)
Hydric soil rating: No

Minor Components

Fluvaquentic haplaquolls

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

Other soils

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

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

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APPENDIX B

HYDROLOGIC CALCULATIONS

Table 6-6. Runoff Coefficients for Rational Method

(Source: UDFCD 2001)

Land Use or Surface Characteristics	Percent Impervious	Runoff Coefficients											
		2-year		5-year		10-year		25-year		50-year		100-year	
		HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D	HSG A&B	HSG C&D
Business													
Commercial Areas	95	0.79	0.80	0.81	0.82	0.83	0.84	0.85	0.87	0.87	0.88	0.88	0.89
Neighborhood Areas	70	0.45	0.49	0.49	0.53	0.53	0.57	0.58	0.62	0.60	0.65	0.62	0.68
Residential													
1/8 Acre or less	65	0.41	0.45	0.45	0.49	0.49	0.54	0.54	0.59	0.57	0.62	0.59	0.65
1/4 Acre	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
1/3 Acre	30	0.18	0.22	0.25	0.30	0.32	0.38	0.39	0.47	0.43	0.52	0.47	0.57
1/2 Acre	25	0.15	0.20	0.22	0.28	0.30	0.36	0.37	0.46	0.41	0.51	0.46	0.56
1 Acre	20	0.12	0.17	0.20	0.26	0.27	0.34	0.35	0.44	0.40	0.50	0.44	0.55
Industrial													
Light Areas	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Heavy Areas	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Parks and Cemeteries	7	0.05	0.09	0.12	0.19	0.20	0.29	0.30	0.40	0.34	0.46	0.39	0.52
Playgrounds	13	0.07	0.13	0.16	0.23	0.24	0.31	0.32	0.42	0.37	0.48	0.41	0.54
Railroad Yard Areas	40	0.23	0.28	0.30	0.35	0.36	0.42	0.42	0.50	0.46	0.54	0.50	0.58
Undeveloped Areas													
Historic Flow Analysis-- Greenbelts, Agriculture	2	0.03	0.05	0.09	0.16	0.17	0.26	0.26	0.38	0.31	0.45	0.36	0.51
Pasture/Meadow	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Forest	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50
Exposed Rock	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Offsite Flow Analysis (when landuse is undefined)	45	0.26	0.31	0.32	0.37	0.38	0.44	0.44	0.51	0.48	0.55	0.51	0.59
Streets													
Paved	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Gravel	80	0.57	0.60	0.59	0.63	0.63	0.66	0.66	0.70	0.68	0.72	0.70	0.74
Drive and Walks	100	0.89	0.89	0.90	0.90	0.92	0.92	0.94	0.94	0.95	0.95	0.96	0.96
Roofs	90	0.71	0.73	0.73	0.75	0.75	0.77	0.78	0.80	0.80	0.82	0.81	0.83
Lawns	0	0.02	0.04	0.08	0.15	0.15	0.25	0.25	0.37	0.30	0.44	0.35	0.50

3.2 Time of Concentration

One of the basic assumptions underlying the Rational Method is that runoff is a function of the average rainfall rate during the time required for water to flow from the hydraulically most remote part of the drainage area under consideration to the design point. However, in practice, the time of concentration can be an empirical value that results in reasonable and acceptable peak flow calculations.

For urban areas, the time of concentration (t_c) consists of an initial time or overland flow time (t_i) plus the travel time (t_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel. For non-urban areas, the time of concentration consists of an overland flow time (t_i) plus the time of travel in a concentrated form, such as a swale or drainageway. The travel portion (t_t) of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainageway. Initial time, on the other hand, will vary with surface slope, depression storage, surface cover, antecedent rainfall, and infiltration capacity of the soil, as well as distance of surface flow. The time of concentration is represented by Equation 6-7 for both urban and non-urban areas.

$$t_c = t_i + t_t \qquad \text{(Eq. 6-7)}$$

Where:

t_c = time of concentration (min)

t_i = overland (initial) flow time (min)

t_t = travel time in the ditch, channel, gutter, storm sewer, etc. (min)

3.2.1 Overland (Initial) Flow Time

The overland flow time, t_i, may be calculated using Equation 6-8.

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S^{0.33}} \qquad \text{(Eq. 6-8)}$$

Where:

t_i = overland (initial) flow time (min)
C_5 = runoff coefficient for 5-year frequency (see Table 6-6)
L = length of overland flow (300 ft maximum for non-urban land uses, 100 ft maximum for urban land uses)
S = average basin slope (ft/ft)

Note that in some urban watersheds, the overland flow time may be very small because flows quickly concentrate and channelize.

3.2.2 Travel Time

For catchments with overland and channelized flow, the time of concentration needs to be considered in combination with the travel time, t_t, which is calculated using the hydraulic properties of the swale, ditch, or channel. For preliminary work, the overland travel time, t_t, can be estimated with the help of Figure 6-25 or Equation 6-9 (Guo 1999).

$$V = C_v S_w^{0.5} \qquad \text{(Eq. 6-9)}$$

Where:

V = velocity (ft/s)

C_v = conveyance coefficient (from Table 6-7)

S_w = watercourse slope (ft/ft)

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

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

The travel time is calculated by dividing the flow distance (in feet) by the velocity calculated using Equation 6-9 and converting units to minutes.

The time of concentration (t_c) is then the sum of the overland flow time (t_i) and the travel time (t_t) per Equation 6-7.

3.2.3 First Design Point Time of Concentration in Urban Catchments

Using this procedure, the time of concentration at the first design point (typically the first inlet in the system) in an urbanized catchment should not exceed the time of concentration calculated using Equation 6-10. The first design point is defined as the point where runoff first enters the storm sewer system.

$$t_c = \frac{L}{180} + 10 \qquad \text{(Eq. 6-10)}$$

Where:

t_c = maximum time of concentration at the first design point in an urban watershed (min)

L = waterway length (ft)

Equation 6-10 was developed using the rainfall-runoff data collected in the Denver region and, in essence, represents regional “calibration” of the Rational Method. Normally, Equation 6-10 will result in a lesser time of concentration at the first design point and will govern in an urbanized watershed. For subsequent design points, the time of concentration is calculated by accumulating the travel times in downstream drainageway reaches.

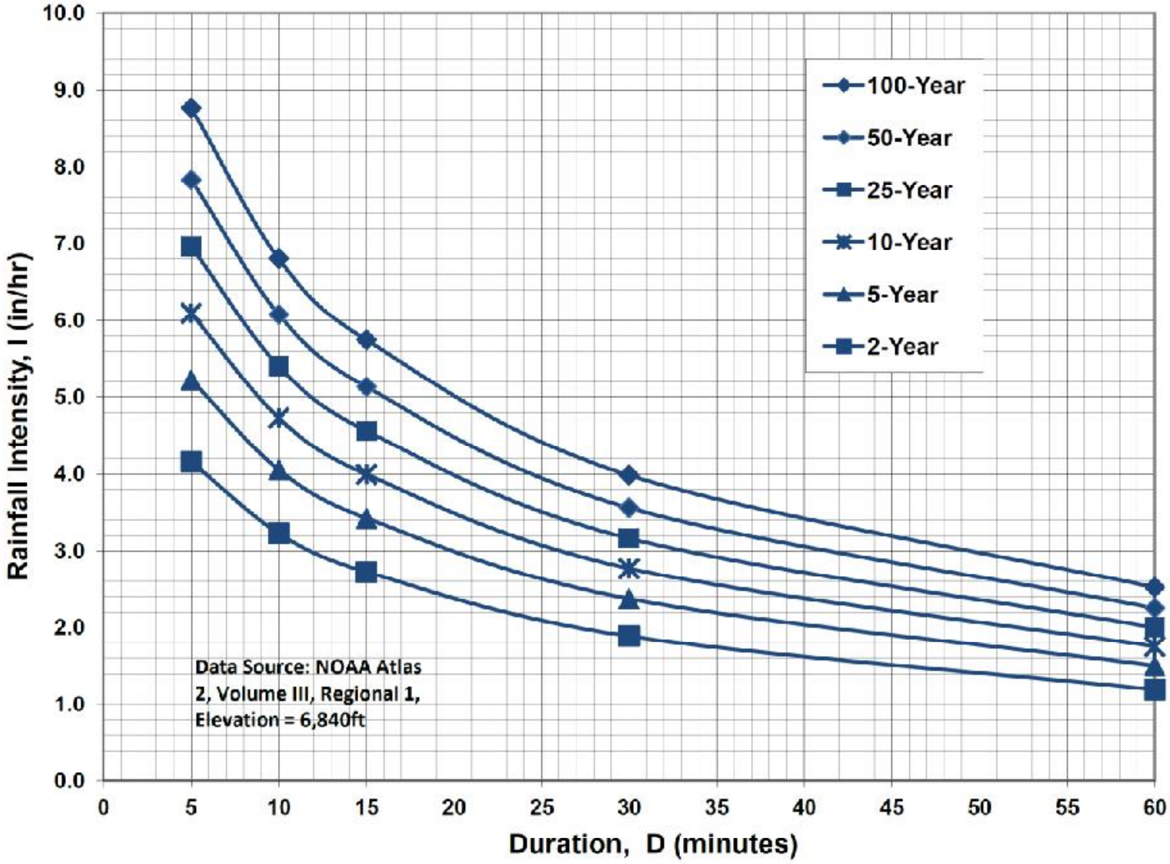
3.2.4 Minimum Time of Concentration

If the calculations result in a t_c of less than 10 minutes for undeveloped conditions, it is recommended that a minimum value of 10 minutes be used. The minimum t_c for urbanized areas is 5 minutes.

3.2.5 Post-Development Time of Concentration

As Equation 6-8 indicates, the time of concentration is a function of the 5-year runoff coefficient for a drainage basin. Typically, higher levels of imperviousness (higher 5-year runoff coefficients) correspond to shorter times of concentration, and lower levels of imperviousness correspond to longer times of

Figure 6-5. Colorado Springs Rainfall Intensity Duration Frequency



IDF Equations

$$I_{100} = -2.52 \ln(D) + 12.735$$

$$I_{50} = -2.25 \ln(D) + 11.375$$

$$I_{25} = -2.00 \ln(D) + 10.111$$

$$I_{10} = -1.75 \ln(D) + 8.847$$

$$I_{5} = -1.50 \ln(D) + 7.583$$

$$I_{2} = -1.19 \ln(D) + 6.035$$

Note: Values calculated by equations may not precisely duplicate values read from figure.

DEYOUNG SUBDIVISION
COMPOSITE RUNOFF COEFFICIENTS

DEVELOPED CONDITIONS

5-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
A	13.38	10.70	BUILDINGS/IMPERVIOUS	0.9	2.68	LANDSCAPED	0.08				0.736
B	3.79	3.79	MEADOW	0.08							0.080

100-YEAR C VALUES

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	C	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	C	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	C	WEIGHTED C VALUE
A	13.38	10.70	BUILDINGS/IMPERVIOUS	0.96	2.68	LANDSCAPED	0.35				0.838
B	3.79	3.79	MEADOW	0.35							0.350

IMPERVIOUS AREAS

BASIN	TOTAL AREA (AC)	(AC)	SUB-AREA 1 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	AREA (AC)	SUB-AREA 2 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	(AC)	SUB-AREA 3 DEVELOPMENT/ COVER	PERCENT IMPERVIOUS	WEIGHTED % IMP
A	13.38	10.70	BUILDINGS/IMPERVIOUS	100	2.68	LANDSCAPED	0				79.970
B	3.79	3.79	MEADOW	0.00							0.000
A,B	17.17	11.14	BUILDINGS/IMPERVIOUS	100	6.03	LANDSCAPED	0				64.881

DEYOUNG SUBDIVISION
RATIONAL METHOD

HISTORIC FLOWS

			C		Overland Flow			Channel flow							INTENSITY (5)		PEAK FLOW	
BASIN	DESIGN POINT	AREA (AC)	5-YEAR	100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	Tco (1) (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS (2) VELOCITY (FT/S)	Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	5-YR (IN/HR)	100-YR (IN/HR)	Q5 (6) (CFS)	Q100 (6) (CFS)
A	1	17.17	0.080	0.350	620	0.027	33.4	330	7	0.024	1.08	5.1	38.5	38.5	2.11	3.54	2.90	21.26

DEVELOPED FLOWS

			C		Overland Flow			Channel flow							INTENSITY (5)		PEAK FLOW	
BASIN	DESIGN POINT	AREA (AC)	5-YEAR	100-YEAR	LENGTH (FT)	SLOPE (FT/FT)	Tco (1) (MIN)	CHANNEL LENGTH (FT)	CONVEYANCE COEFFICIENT C	SLOPE (FT/FT)	SCS (2) VELOCITY (FT/S)	Tt (3) (MIN)	TOTAL Tc (4) (MIN)	TOTAL Tc (4) (MIN)	5-YR (IN/HR)	100-YR (IN/HR)	Q5 (6) (CFS)	Q100 (6) (CFS)
A	1	13.38	0.736	0.838	100	0.075	3.4	1410	20	0.0145	2.41	9.8	13.2	13.2	3.72	6.24	36.60	69.96
B	2	3.79	0.080	0.350	100	0.020	14.8	580	15	0.026	2.42	4.0	18.8	18.8	3.18	5.34	0.96	7.08

1) OVERLAND FLOW Tco = (0.395*(1.1-RUNOFF COEFFICIENT)*(OVERLAND FLOW LENGTH^(0.5)/(SLOPE^(0.333))
2) SCS VELOCITY = C * ((SLOPE(FT/FT)^0.5)
C = 2.5 FOR HEAVY MEADOW
C = 5 FOR TILLAGE/FIELD
C = 7 FOR SHORT PASTURE AND LAWNS
C = 10 FOR NEARLY BARE GROUND
C = 15 FOR GRASSED WATERWAY
C = 20 FOR PAVED AREAS AND SHALLOW PAVED SWALES

3) MANNING'S CHANNEL TRAVEL TIME = L/V (WHEN CHANNEL VELOCITY IS KNOWN)
4) Tc = Tco + Tt
*** IF TOTAL TIME OF CONCENTRATION IS LESS THAN 5 MINUTES, THEN 5 MINUTES IS USED
5) INTENSITY BASED ON I-D-F EQUATIONS IN CITY OF COLORADO SPRINGS DRAINAGE CRITERIA MANUAL
$I_5 = -1.5 * \ln(Tc) + 7.583$
$I_{100} = -2.52 * \ln(Tc) + 12.735$
6) Q = CiA

APPENDIX C

HYDRAULIC CALCULATIONS

DEYOUNG SUBDIVISION
STORM INLET SIZING SUMMARY

	BASIN FLOW			INLET FLOW					
INLET	DP	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET FLOW % OF BASIN	Q5 FLOW (CFS)	Q100 FLOW (CFS)	INLET CONDITION / TYPE	INLET SIZE	INLET CAPACITY (CFS)
A1	1	36.6	70.0	11	4.0	7.7	SUMP TYPE 13	TRIPLE	8.8
A2	1	36.6	70.0	11	4.0	7.7	SUMP TYPE 13	TRIPLE	8.8
A3	1	36.6	70.0	11	4.0	7.7	SUMP TYPE 13	TRIPLE	8.8
A4	1	36.6	70.0	11	4.0	7.7	SUMP TYPE 13	TRIPLE	8.8
A5	1	36.6	70.0	11	4.0	7.7	SUMP TYPE 13	TRIPLE	8.8
A6	1	36.6	70.0	11	4.0	7.7	SUMP TYPE 13	TRIPLE	8.8

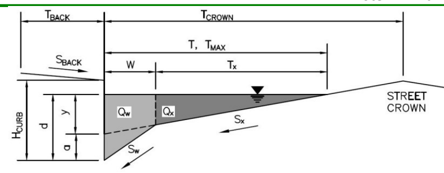
Version 4.05 Released March 2017

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

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

Project: Deyoung Subdivision - Inlets A1-A6 (Sump Condition)

Inlet ID: Inlets A1-A6



Gutter Geometry (Enter data in the blue cells)

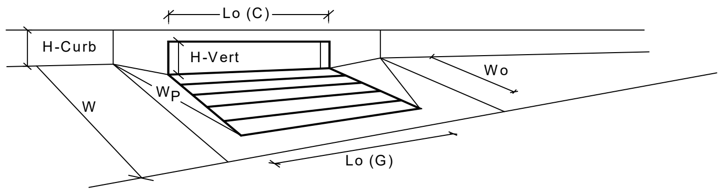
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	25.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.016	
Height of Curb at Gutter Flow Line	H_{CURB} =	0.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	25.0	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} =	25.0	25.0	ft
Warning 02 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



		MINOR	MAJOR	
Design Information (Input) CDOT/Denver 13 Valley Grate		MINOR	MAJOR	
Type of Inlet	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	8.0	inches
Grate Information		MINOR	MAJOR	☑ Override Depths
Length of a Unit Grate	L_o (G) =	3.00	3.00	feet
Width of a Unit Grate	W_o =	1.73	1.73	feet
Area Opening Ratio for a Grate (typical values 0.15-0.90)	A_{ratio} =	0.43	0.43	
Clogging Factor for a Single Grate (typical value 0.50 - 0.70)	C_f (G) =	0.50	0.50	
Grate Weir Coefficient (typical value 2.15 - 3.60)	C_w (G) =	3.30	3.30	
Grate Orifice Coefficient (typical value 0.60 - 0.80)	C_o (G) =	0.60	0.60	
Curb Opening Information		MINOR	MAJOR	
Length of a Unit Curb Opening	L_o (C) =	N/A	N/A	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	N/A	N/A	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	N/A	N/A	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	N/A	N/A	degrees
Side Width for Depression Pan (typically the gutter width of 2 feet)	W_p =	N/A	N/A	feet
Clogging Factor for a Single Curb Opening (typical value 0.10)	C_f (C) =	N/A	N/A	
Curb Opening Weir Coefficient (typical value 2.3-3.7)	C_w (C) =	N/A	N/A	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	N/A	N/A	
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.523	0.689	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	N/A	N/A	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	N/A	N/A	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	N/A	N/A	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.57	0.75	
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	**4.4**	**8.8**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	4.2	7.9	cfs

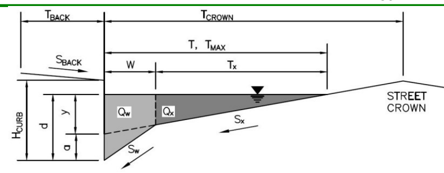
Version 4.05 Released March 2017

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

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

Project: Deyoung Subdivision - Inlet A7 (Sump Condition)

Inlet ID: Inlet A7



Gutter Geometry (Enter data in the blue cells)

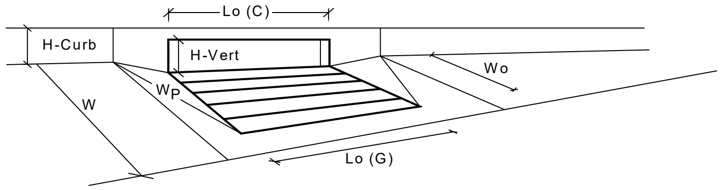
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	4.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =	0.020	ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	40.0	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} =	40.0	40.0	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



		MINOR	MAJOR	
Design Information (Input)				
Type of Inlet — CDOT Type R Curb Opening	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 =	3	3	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	6.0	11.1	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	0.76	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.57	1.00	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	0.79	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 =	**13.5**	**37.6**	**cfs**
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	13.0	24.5	cfs

DEYOUNG SUBDIVISION
STORM SEWER SIZING SUMMARY

	PIPE FLOW			PIPE CAPACITY		
PIPE	BASINS	Q5 FLOW (CFS)	Q100 FLOW (CFS)	SELECTED PIPE SIZE (IN)	MIN. PIPE SLOPE	FULL PIPE CAPACITY (CFS)
A1	A1	4.0	7.7	**15**	1.5%	7.9
A2	A1,A2	8.1	15.4	**24**	1.0%	22.6
A3	A1-A3	12.1	23.1	**24**	1.2%	24.8
A4	A4	4.0	7.7	**15**	1.5%	7.9
A5	A4-A5	8.1	15.4	**24**	1.0%	22.6
A6	A1-A6	24.2	46.2	**30**	1.4%	48.5

ASSUMPTIONS:
1. STORM DRAIN PIPE ASSUMED TO BE RCP OR HDPE

Hydraulic Analysis Report

Project Data

Project Title: Project - DeYoung Subdivision

Designer: JPS

Project Date: Tuesday, December 17, 2019

Project Units: U.S. Customary Units

Notes:

Channel Analysis: SD-A1

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.2500 ft

Longitudinal Slope: 0.0150 ft/ft

Manning's n: 0.0130

Depth: 1.2500 ft

Result Parameters

Flow: 7.9116 cfs

Area of Flow: 1.2272 ft^2

Wetted Perimeter: 3.9270 ft

Hydraulic Radius: 0.3125 ft

Average Velocity: 6.4470 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.1108 ft

Critical Velocity: 6.8651 ft/s

Critical Slope: 0.0134 ft/ft

Critical Top Width: 0.79 ft

Calculated Max Shear Stress: 1.1700 lb/ft^2

Calculated Avg Shear Stress: 0.2925 lb/ft^2

Channel Analysis: SD-A2

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 22.6224 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.2009 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.6953 ft

Critical Velocity: 7.9674 ft/s

Critical Slope: 0.0095 ft/ft

Critical Top Width: 1.44 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-A3

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0120 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 24.7816 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.8882 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.7559 ft

Critical Velocity: 8.4792 ft/s

Critical Slope: 0.0108 ft/ft

Critical Top Width: 1.31 ft

Calculated Max Shear Stress: 1.4976 lb/ft^2

Calculated Avg Shear Stress: 0.3744 lb/ft^2

Channel Analysis: SD-A4

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 1.2500 ft

Longitudinal Slope: 0.0150 ft/ft

Manning's n: 0.0130

Depth: 1.2500 ft

Result Parameters

Flow: 7.9116 cfs

Area of Flow: 1.2272 ft^2

Wetted Perimeter: 3.9270 ft

Hydraulic Radius: 0.3125 ft

Average Velocity: 6.4470 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.1108 ft

Critical Velocity: 6.8651 ft/s

Critical Slope: 0.0134 ft/ft

Critical Top Width: 0.79 ft

Calculated Max Shear Stress: 1.1700 lb/ft^2

Calculated Avg Shear Stress: 0.2925 lb/ft^2

Channel Analysis: SD-A5

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.0100 ft/ft

Manning's n: 0.0130

Depth: 2.0000 ft

Result Parameters

Flow: 22.6224 cfs

Area of Flow: 3.1416 ft^2

Wetted Perimeter: 6.2832 ft

Hydraulic Radius: 0.5000 ft

Average Velocity: 7.2009 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 1.6953 ft

Critical Velocity: 7.9674 ft/s

Critical Slope: 0.0095 ft/ft

Critical Top Width: 1.44 ft

Calculated Max Shear Stress: 1.2480 lb/ft^2

Calculated Avg Shear Stress: 0.3120 lb/ft^2

Channel Analysis: SD-A6

Notes:

Input Parameters

Channel Type: Circular

Pipe Diameter: 2.5000 ft

Longitudinal Slope: 0.0140 ft/ft

Manning's n: 0.0130

Depth: 2.5000 ft

Result Parameters

Flow: 48.5321 cfs

Area of Flow: 4.9087 ft^2

Wetted Perimeter: 7.8540 ft

Hydraulic Radius: 0.6250 ft

Average Velocity: 9.8869 ft/s

Top Width: 0.0000 ft

Froude Number: 0.0000

Critical Depth: 2.2803 ft

Critical Velocity: 10.3317 ft/s

Critical Slope: 0.0122 ft/ft

Critical Top Width: 1.42 ft

Calculated Max Shear Stress: 2.1840 lb/ft^2

Calculated Avg Shear Stress: 0.5460 lb/ft^2

Deyoung - SΔ-A7

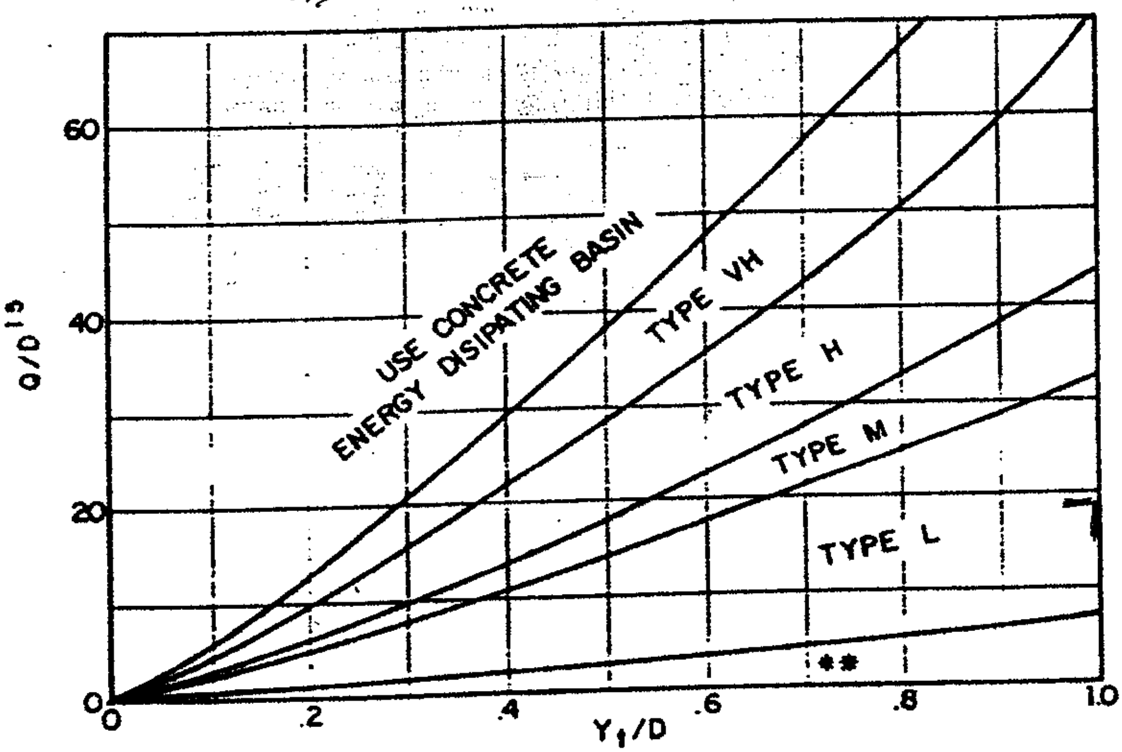
$Q_{100} = 72.2$ cfs

$\Delta = 30'' = 2.5'$

$$\frac{Q}{\Delta^{1.5}} = \frac{72.2}{(2.5)^{1.5}} = 18.3$$

$Y_t = 4.7'$ (per Matrix HEC-RAS, West Trib-Future)

$$\frac{Y_t}{\Delta} = \frac{4.7}{2.5} = 1.9$$



Use D_a instead of D whenever flow is supercritical in the barrel.
** Use Type L for a distance of 3D downstream.

→ Use Type M (minimum)

FIGURE 5-7. RIPRAP EROSION PROTECTION AT CIRCULAR CONDUIT OUTLET.

APPENDIX D

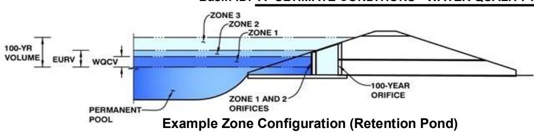
WATER QUALITY POND CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project: DEYOUNG SUBDIVISION

Basin ID: A- ULTIMATE CONDITIONS - WATER QUALITY POND



Example Zone Configuration (Retention Pond)

Required Volume Calculation

Selected BMP Type =	**EDB**			
Watershed Area =	13.38	acres		
Watershed Length =	1,500	ft		
Watershed Slope =	0.020	ft/ft		
Watershed Imperviousness =	80.00%	percent		
Percentage Hydrologic Soil Group A =	100.0%	percent		
Percentage Hydrologic Soil Group B =	0.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	User Input			
Water Quality Capture Volume (WQCV) =	0.366	acre-feet	Optional User Override 1-hr Precipitation	
Excess Urban Runoff Volume (EURV) =	1.408	acre-feet		
2-yr Runoff Volume (P1 = 1.19 in.) =	0.974	acre-feet	1.19	inches
5-yr Runoff Volume (P1 = 1.5 in.) =	1.266	acre-feet	1.50	inches
10-yr Runoff Volume (P1 = 1.75 in.) =	1.527	acre-feet	1.75	inches
25-yr Runoff Volume (P1 = 2 in.) =	1.808	acre-feet	2.00	inches
50-yr Runoff Volume (P1 = 2.25 in.) =	2.083	acre-feet	2.25	inches
100-yr Runoff Volume (P1 = 2.52 in.) =	2.414	acre-feet	2.52	inches
500-yr Runoff Volume (P1 = 3.14 in.) =	3.159	acre-feet	3.14	inches
Approximate 2-yr Detention Volume =	0.924	acre-feet		
Approximate 5-yr Detention Volume =	1.202	acre-feet		
Approximate 10-yr Detention Volume =	1.435	acre-feet		
Approximate 25-yr Detention Volume =	1.704	acre-feet		
Approximate 50-yr Detention Volume =	1.862	acre-feet		
Approximate 100-yr Detention Volume =	2.007	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.366	acre-feet
Zone 2 Volume (User Defined - Zone 1) =	0.024	acre-feet
Select Zone 3 Storage Volume (Optional) =		acre-feet
Total Detention Basin Volume =	0.390	acre-feet

Total detention volume is less than 100-year volume.

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	10	0.000		
Bot EL=6912.0	--	1.00	--	--	--	720	0.017	358	0.008
	--	3.00	--	--	--	1,887	0.043	2,972	0.068
	--	5.00	--	--	--	3,453	0.079	8,312	0.191
Spillway=6918.0	--	7.00	--	--	--	5,245	0.120	17,010	0.390
Top EL=6920.0	--	9.00	--	--	--	7,040	0.162	29,295	0.673
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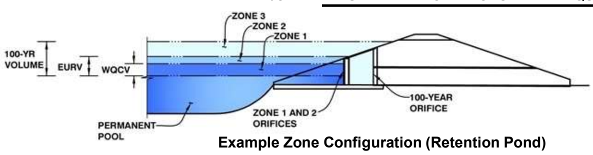
Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project: DeYOUNG SUBDIVISION

Basin ID: A - ULTIMATE CONDITIONS - WATER QUALITY POND ONLY



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	6.80	0.366	Orifice Plate
Zone 2 (User)	7.00	0.024	Weir&Pipe (Restrict)
Zone 3			
		0.390	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	6.80	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	27.20	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	2.27	4.53					
Orifice Area (sq. inches)	1.02	1.02	0.79					

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

	Not Selected	Not Selected	
Vertical Orifice Area =			ft^2
Vertical Orifice Centroid =			feet

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

	Zone 2 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	6.80		ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.00		feet
Overflow Weir Slope =	0.00		H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	2.50		feet
Overflow Grate Open Area % =	70%		%, grate open area/total area
Debris Clogging % =	50%		%

Calculated Parameters for Overflow Weir

	Zone 2 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	6.80		feet
Over Flow Weir Slope Length =	2.50		feet
Grate Open Area / 100-yr Orifice Area =	22.28		should be ≥ 4
Overflow Grate Open Area w/o Debris =	8.75		ft^2
Overflow Grate Open Area w/ Debris =	4.38		ft^2

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

	Zone 2 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.00		ft (distance below basin bottom at Stage = 0 ft)
Outlet Pipe Diameter =	12.00		inches
Restrictor Plate Height Above Pipe Invert =	6.00		inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 2 Restrictor	Not Selected	
Outlet Orifice Area =	0.39		ft^2
Outlet Orifice Centroid =	0.29		feet
Half-Central Angle of Restrictor Plate on Pipe =	1.57	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	7.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	8.00	feet
Spillway End Slopes =	4.00	H:V
Freeboard above Max Water Surface =	1.00	feet

Calculated Parameters for Spillway

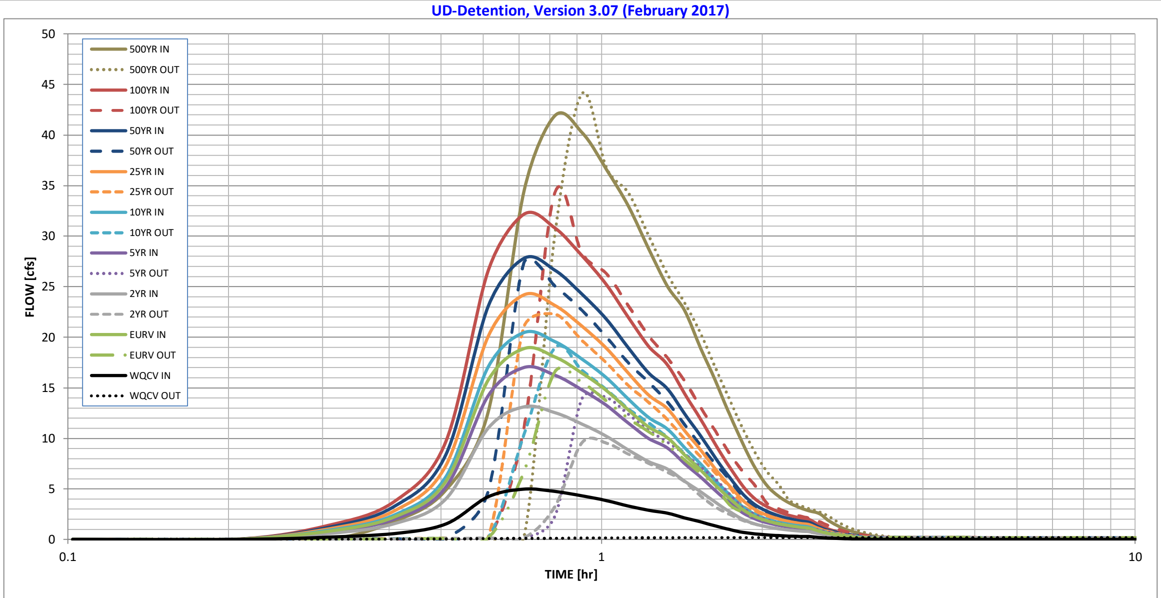
Spillway Design Flow Depth=	0.97	feet
Stage at Top of Freeboard =	8.97	feet
Basin Area at Top of Freeboard =	0.16	acres

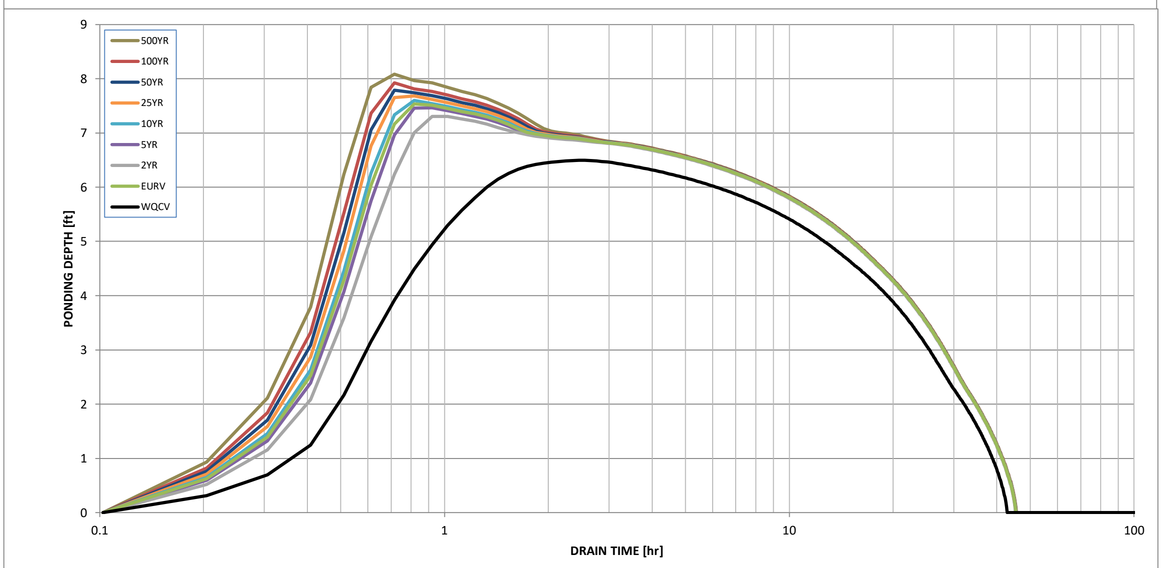
Routed Hydrograph Results

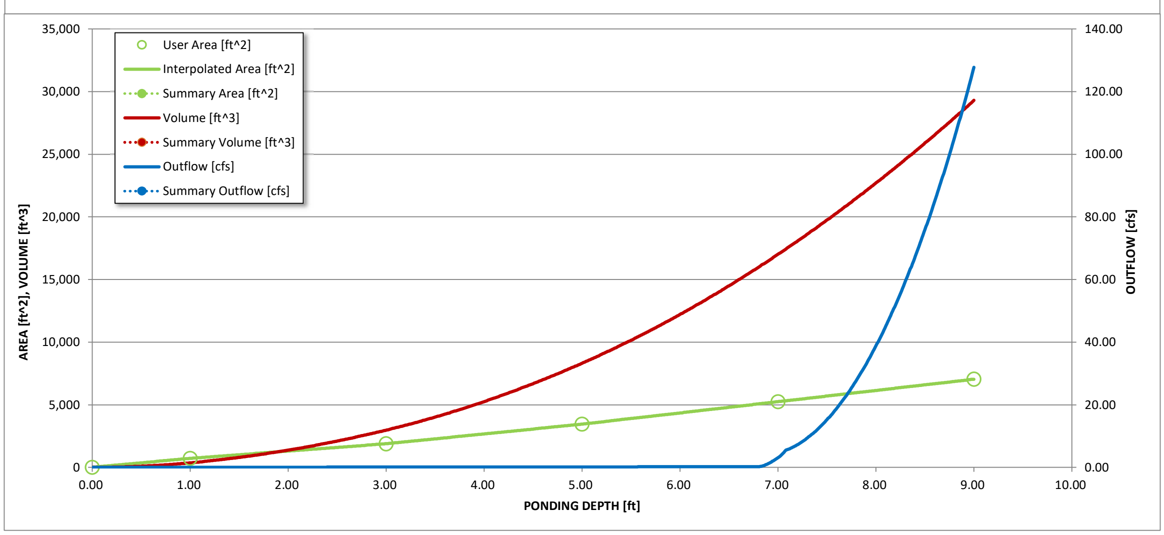
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	1.19	1.50	1.75	2.00	2.25	2.52	3.14
Calculated Runoff Volume (acre-ft) =	0.366	1.408	0.974	1.266	1.526	1.808	2.082	2.413	3.157
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.366	1.407	0.974	1.265	1.527	1.808	2.083	2.412	3.157
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.00	0.00	0.01	0.02	0.15	0.36	0.83
Predevelopment Peak Q (cfs) =	0.0	0.0	0.0	0.1	0.1	0.3	2.0	4.8	11.1
Peak Inflow Q (cfs) =	5.0	18.9	13.1	17.0	20.5	24.2	27.8	32.2	41.9
Peak Outflow Q (cfs) =	0.2	16.6	9.6	14.0	19.0	22.3	27.3	34.3	44.1
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	274.9	159.9	83.9	13.9	7.1	4.0
Structure Controlling Flow =	Plate	Spillway	Spillway	Spillway	Spillway	Spillway	Spillway	Spillway	Spillway
Max Velocity through Grate 1 (fps) =	N/A	0.56	0.55	0.6	0.6	0.6	0.6	0.6	0.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	32	35	33	32	30	29	28	25
Time to Drain 99% of Inflow Volume (hours) =	**41**	40	41	40	39	38	38	37	35
Maximum Ponding Depth (ft) =	6.50	7.54	7.31	7.46	7.60	7.68	7.79	7.92	8.08
Area at Maximum Ponding Depth (acres) =	0.11	0.13	0.13	0.13	0.13	0.13	0.14	0.14	0.14
Maximum Volume Stored (acre-ft) =	0.332	0.457	0.428	0.448	0.466	0.477	0.491	0.510	0.533

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)







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

Detention Basin Outlet Structure Design

Outflow Hydrograph Workbook Filename:

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

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

Time Interval: 6.13 min

Hydrograph Constant: 0.816

SOURCE	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK	WORKBOOK
TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:06:08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:12:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0:18:23	0.22	0.82	0.58	0.74	0.89	1.04	1.19	1.37	1.77
0:24:31	0.60	2.23	1.56	2.01	2.41	2.85	3.26	3.76	4.88
0:30:39	1.54	5.73	4.00	5.17	6.20	7.31	8.38	9.66	12.53
0:36:47	4.23	15.73	11.00	14.19	17.02	20.06	23.01	26.52	34.38
0:42:55	4.99	18.89	13.13	17.00	20.47	24.19	27.81	32.15	41.92
0:49:02	4.75	18.07	12.54	16.26	19.58	23.16	26.64	30.81	40.23
0:55:10	4.32	16.45	11.42	14.80	17.83	21.08	24.25	28.04	36.61
1:01:18	3.85	14.74	10.22	13.26	15.99	18.92	21.77	25.20	32.94
1:07:26	3.31	12.79	8.85	11.50	13.88	16.43	18.94	21.95	28.75
1:13:34	2.89	11.12	7.70	10.00	12.06	14.27	16.46	19.10	25.06
1:19:41	2.62	10.08	6.98	9.07	10.94	12.95	14.92	17.30	22.66
1:25:49	2.15	8.38	5.78	7.53	9.10	10.79	12.44	14.44	18.95
1:31:57	1.74	6.89	4.74	6.19	7.49	8.89	10.27	11.92	15.68
1:38:05	1.33	5.37	3.67	4.82	5.85	6.96	8.05	9.37	12.37
1:44:13	0.98	4.07	2.76	3.63	4.43	5.29	6.14	7.17	9.51
1:50:20	0.72	2.97	1.99	2.65	3.24	3.88	4.52	5.30	7.07
1:56:28	0.56	2.27	1.54	2.03	2.47	2.95	3.43	4.01	5.32
2:02:36	0.46	1.85	1.26	1.66	2.02	2.41	2.79	3.25	4.30
2:08:44	0.39	1.57	1.07	1.40	1.71	2.03	2.35	2.74	3.62
2:14:52	0.34	1.37	0.94	1.23	1.49	1.78	2.06	2.39	3.16
2:20:59	0.31	1.23	0.84	1.10	1.34	1.59	1.84	2.14	2.83
2:27:07	0.29	1.13	0.78	1.02	1.23	1.46	1.69	1.97	2.59
2:33:15	0.21	0.83	0.57	0.75	0.91	1.08	1.25	1.46	1.92
2:39:23	0.15	0.61	0.42	0.55	0.66	0.79	0.91	1.06	1.39
2:45:31	0.11	0.45	0.31	0.40	0.49	0.58	0.67	0.78	1.03
2:51:38	0.08	0.33	0.23	0.30	0.36	0.43	0.50	0.58	0.77
2:57:46	0.06	0.24	0.16	0.21	0.26	0.31	0.36	0.42	0.56
3:03:54	0.04	0.17	0.12	0.15	0.19	0.22	0.26	0.30	0.40
3:10:02	0.03	0.12	0.08	0.11	0.13	0.16	0.19	0.22	0.29
3:16:10	0.02	0.08	0.06	0.07	0.09	0.11	0.13	0.15	0.20
3:22:17	0.01	0.05	0.03	0.05	0.06	0.07	0.08	0.09	0.13
3:28:25	0.01	0.03	0.02	0.02	0.03	0.04	0.04	0.05	0.07
3:34:33	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03
3:40:41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
3:46:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:52:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3:59:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:05:12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:11:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:17:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:23:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:29:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:35:51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:41:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:48:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4:54:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:00:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:06:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:12:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:18:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:24:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:31:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:37:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:43:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:49:25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5:55:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:01:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:07:48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:13:56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:20:04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:26:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:32:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:38:27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:44:35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:50:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6:56:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:02:58	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:09:06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:15:14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7:21:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Design Procedure Form: Extended Detention Basin (EDB)

UD-BMP (Version 3.06, November 2016)

Designer: JPS
Company: JPS
Date: April 17, 2020
Project: DeYOUNG SUBDIVISION
Location: WATER QUALITY POND A

1. Basin Storage Volume	
A) Effective Imperviousness of Tributary Area, I_a	I_a = 80.0 %
B) Tributary Area's Imperviousness Ratio ($i = I_a / 100$)	i = 0.800
C) Contributing Watershed Area	Area = 13.380 ac
D) For Watersheds Outside of the Denver Region, Depth of Average Runoff Producing Storm	d_6 = ______ in
E) Design Concept (Select EURV when also designing for flood control)	Choose One ◉ Water Quality Capture Volume (WQCV) ○ Excess Urban Runoff Volume (EURV)
F) Design Volume (WQCV) Based on 40-hour Drain Time ($V_{DESIGN} = (1.0 * (0.91 * i^3 - 1.19 * i^2 + 0.78 * i) / 12 * Area)$)	V_{DESIGN}= 0.366 ac-ft
G) For Watersheds Outside of the Denver Region, Water Quality Capture Volume (WQCV) Design Volume ($V_{WQCV\ OTHER} = (d_6 * (V_{DESIGN}/0.43))$)	$V_{DESIGN\ OTHER}$= ______ ac-ft
H) User Input of Water Quality Capture Volume (WQCV) Design Volume (Only if a different WQCV Design Volume is desired)	$V_{DESIGN\ USER}$= ______ ac-ft
I) Predominant Watershed NRCS Soil Group	Choose One ○ A ○ B ○ C / D **WQCV selected. Soil group not required.**
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 = ______ 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 = 3.0 : 1
3. Basin Side Slopes A) Basin Maximum Side Slopes (Horizontal distance per unit vertical, 4:1 or flatter preferred)	Z = 3.00 ft / ft **DIFFICULT TO MAINTAIN, INCREASE WHERE POSSIBLE**
4. Inlet A) Describe means of providing energy dissipation at concentrated inflow locations:	Concrete Forebay

Design Procedure Form: Extended Detention Basin (EDB)

Designer: JPS
Company: JPS
Date: April 17, 2020
Project: DeYOUNG SUBDIVISION
Location: WATER QUALITY POND A

5. Forebay

A) Minimum Forebay Volume (V_{FMIN} = 3% of the WQCV) — V_{FMIN} = 0.011 ac-ft

B) Actual Forebay Volume — V_F = 0.011 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} = 70.00 cfs

ii) Forebay Discharge Design Flow ($Q_F = 0.02 * Q_{100}$) — Q_F = 1.40 cfs

E) Forebay Discharge Design

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

(flow too small for berm w/ pipe)

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

G) Rectangular Notch Width — Calculated W_N = 6.3 in

6. Trickle Channel

A) Type of Trickle Channel

Choose One
- ◉ Concrete
- ○ Soft Bottom

F) Slope of Trickle Channel — S = 0.0050 ft / ft

7. Micropool and Outlet Structure

A) Depth of Micropool (2.5-feet minimum) — D_M = 2.5 ft

B) Surface Area of Micropool (10 ft^2 minimum) — A_M = 10 sq ft

C) Outlet Type

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

D) Smallest Dimension of Orifice Opening Based on Hydrograph Routing (Use UD-Detention) — $D_{orifice}$ = 1.00 inches

E) Total Outlet Area — A_{ot} = 2.83 square inches

Design Procedure Form: Extended Detention Basin (EDB)

Designer: JPS
Company: JPS
Date: April 17, 2020
Project: DeYOUNG SUBDIVISION
Location: WATER QUALITY POND A

8. Initial Surcharge Volume	
A) Depth of Initial Surcharge Volume (Minimum recommended depth is 4 inches)	D_{IS} = 6 in
B) Minimum Initial Surcharge Volume (Minimum volume of 0.3% of the WQCV)	V_{IS} = 47.8 cu ft
C) Initial Surcharge Provided Above Micropool	V_s= 5.0 cu ft
9. Trash Rack	
A) Water Quality Screen Open Area: $A_t = A_{ot} * 38.5*(e^{-0.095D})$	A_t = 99 square inches
B) Type of Screen (If specifying an alternative to the materials recommended in the USDCM, indicate "other" and enter the ratio of the total open are to the total screen are for the material specified.)	*S.S. Well Screen with 60% Open Area*
Other (Y/N): N	
C) Ratio of Total Open Area to Total Area (only for type 'Other')	User Ratio =
D) Total Water Quality Screen Area (based on screen type)	A_{total} = 165 sq. in.
E) Depth of Design Volume (EURV or WQCV) (Based on design concept chosen under 1E)	H= 6.8 feet
F) Height of Water Quality Screen (H_{TR})	H_{TR}= 109.6 inches
G) Width of Water Quality Screen Opening ($W_{opening}$) (Minimum of 12 inches is recommended)	$W_{opening}$ = 12.0 inches

Design Procedure Form: Extended Detention Basin (EDB)

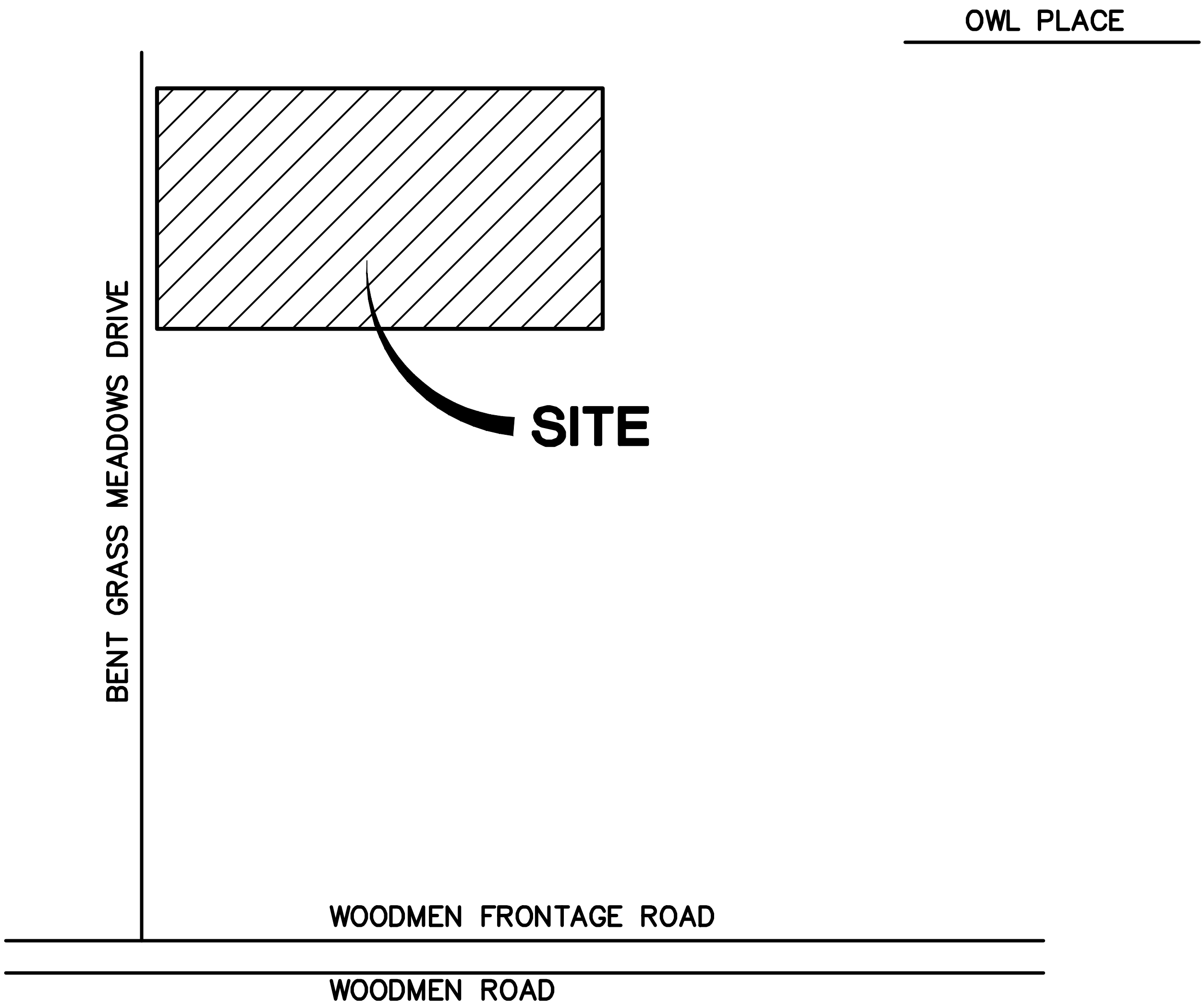
Designer: JPS
Company: JPS
Date: April 17, 2020
Project: DeYOUNG SUBDIVISION
Location: WATER QUALITY POND A

10. Overflow Embankment	
A) Describe embankment protection for 100-year and greater overtopping:	Buried Riprap Spillway
B) Slope of Overflow Embankment (Horizontal distance per unit vertical, 4:1 or flatter preferred)	
11. Vegetation	Choose One ○ Irrigated ◉ Not Irrigated
12. Access	
A) Describe Sediment Removal Procedures	Periodic inspection and maintenance by property owner as required Ramp provided for skid-loader access to pond bottom

Notes:

APPENDIX E

FIGURES



VICINITY MAP

JPS ENGINEERING

DEYOUNG SUBDIVISION

FIGURE A1

JPS PROJ NO. 031901

National Flood Hazard Layer FIRMette

FEMA

38°56'58.71"N

104°37'41.03"W

104°37'3.58"W

38°56'30.73"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

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

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

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

OTHER FEATURES
- B 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 — Coastal Transect
- 513 — 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

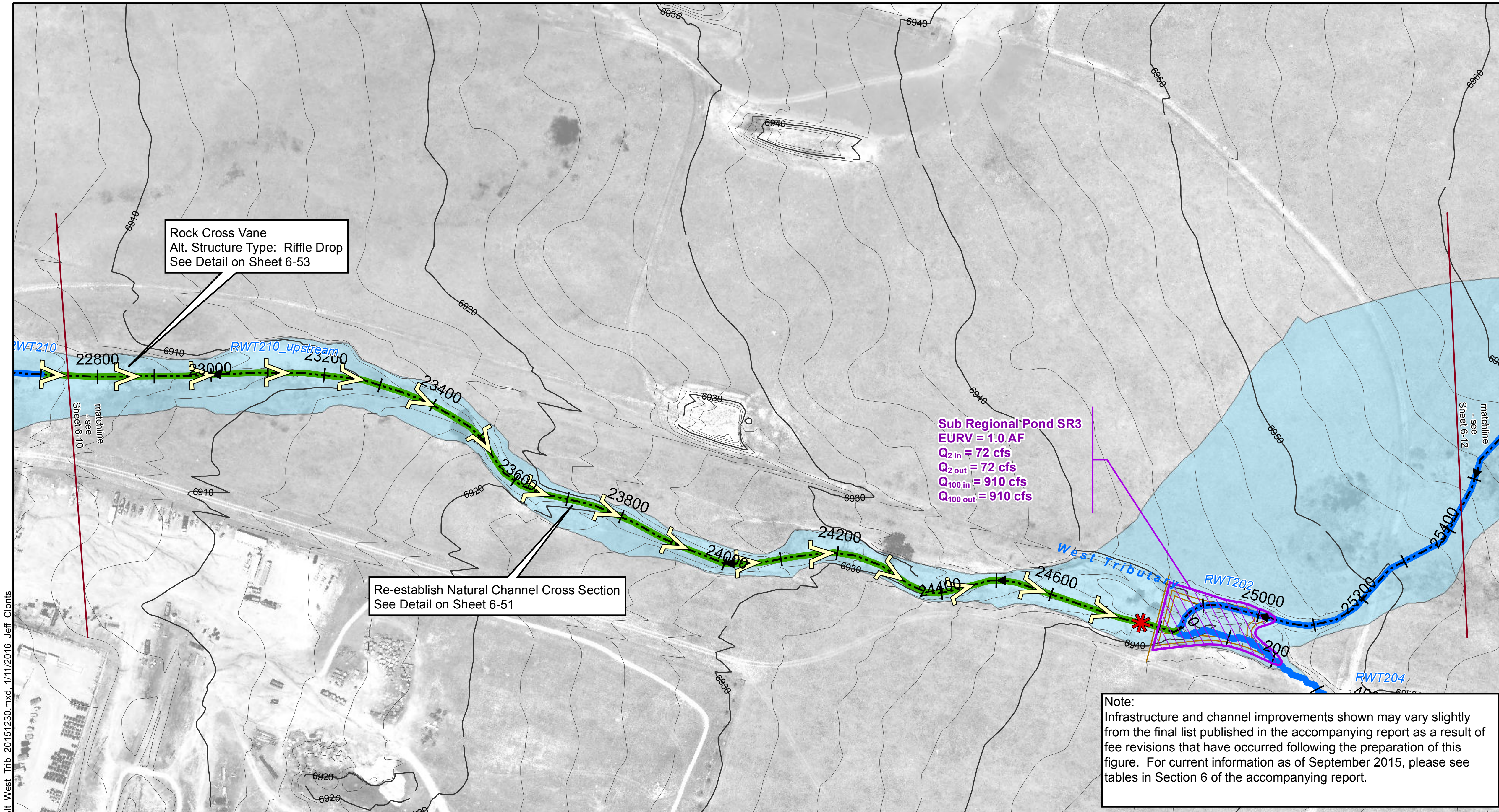
N

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 12/16/2019 at 3:00:55 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.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.



Note:
Infrastructure and channel improvements shown may vary slightly from the final list published in the accompanying report as a result of fee revisions that have occurred following the preparation of this figure. For current information as of September 2015, please see tables in Section 6 of the accompanying report.

Sheet 6-11
Falcon DBPS
Conceptual Plan
West Tributary
El Paso County, CO

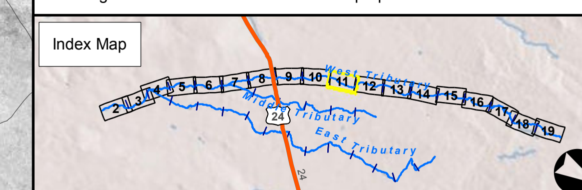
Drainageway Crossing
Stream Centerline
Existing Approximate 100-yr Floodplain*
Floodplain Study Limit

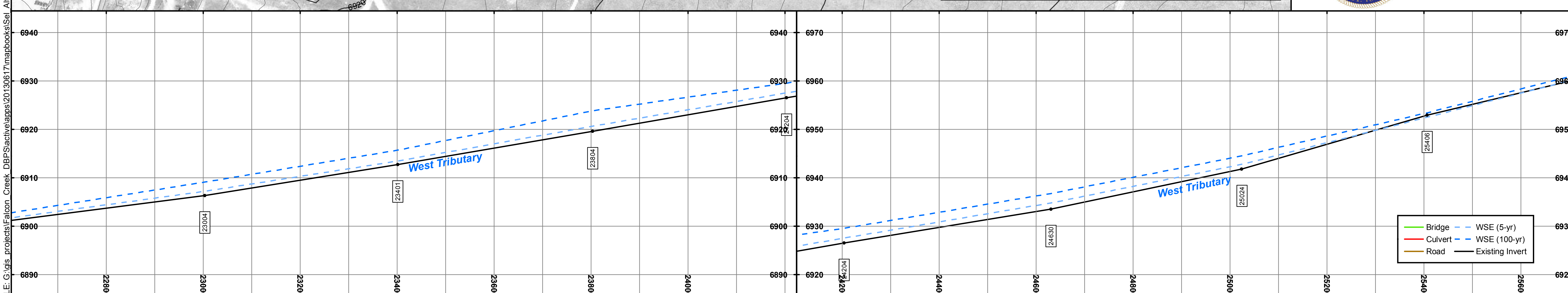
Storm Sewer
Inlet
Manhole
Pipe

Reach Improvements
Natural Channel Design
Protect In Place
Roadside Ditch Improvement
Small Drop Structures w/ Toe Protection
Existing Detention
Proposed Detention
Proposed Detention Grading
Small Drop Structure
Cross Vane
Immediate Action Required to Preserve Existing Condition

0 100 200 Feet

* These approximate 100-yr floodplain boundaries are for planning purposes only. This information is not intended to replace the information provided on the FEMA Flood Insurance Rate Maps for this area.
** These are conceptual design drawings and are subject to change. These drawings are not intended for construction purposes.





FILE: G:\gis_projects\Falcon Creek_DBPS\active\apps\20130617\mapbooks\Sel_Alt_West_Trib_20151230.mxd, 1/11/2016, Jeff_Clonts

SUMMARY HYDROLOGY TABLE

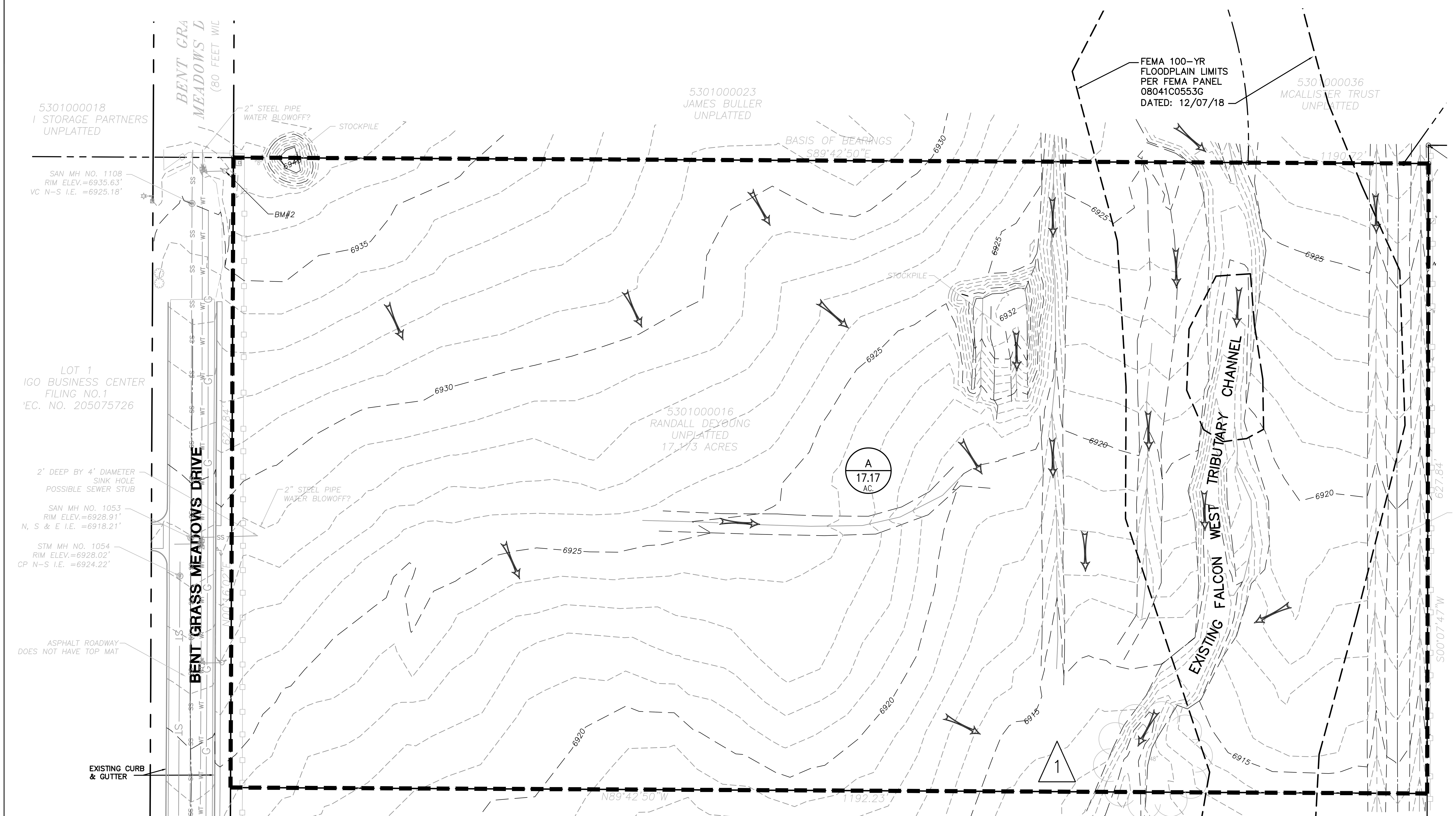
DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	2.9	21.3

50' 0 50' 100'
ORIGINAL SCALE: 1"=50' (24"x36" SHEET)
CONTOUR INTERVAL=1'

DRAINAGE LEGEND

- RIPRAP
- FLOW DIRECTION ARROW
- FLOWLINE
- MAJOR DRAINAGE BASIN BOUNDARY

- 5 — DESIGN POINT
- C14 — DEVELOPED BASIN DESIGNATION
- 23.21 AC — DEVELOPED BASIN AREA (ACRES)



BENCHMARKS:

BM#1
FIMS MONUMENT BLT169
ELEV.=6884.81' (NGVD1929)

BM#2
FLANGE BOLT ON HYDRANT "MUELLER BOLT", LOCATED ON THE EAST SIDE OF BENT GRASS MEADOWS DRIVE 1900 FEET NORTH OF WOODMEN FRONTAGE ROAD
ELEV.=6938.84' (NGVD1929)

FEMA DATUM CONVERSION NOTE:
NAVD88 IS 3.89' ABOVE NGVD29 BASED ON A FIMS BENCHMARK BL74 NEAR WOODMEN AND BENT GRASS

JPS ENGINEERING
19 E. Willamette Ave.
Colorado Springs, CO 80903
PH: 719-477-9429
FAX: 719-471-0766
www.jpsengr.com

CALL UTILITY NOTIFICATION CENTER OF COLORADO
1-800-922-1987
CALL 2-BUSINESS DAYS IN ADVANCE BEFORE YOU DIG, GRADE, OR EXCAVATE FOR THE MARKING OF UNDERGROUND MEMBER UTILITIES.

NO.	REVISION	BY	DATE

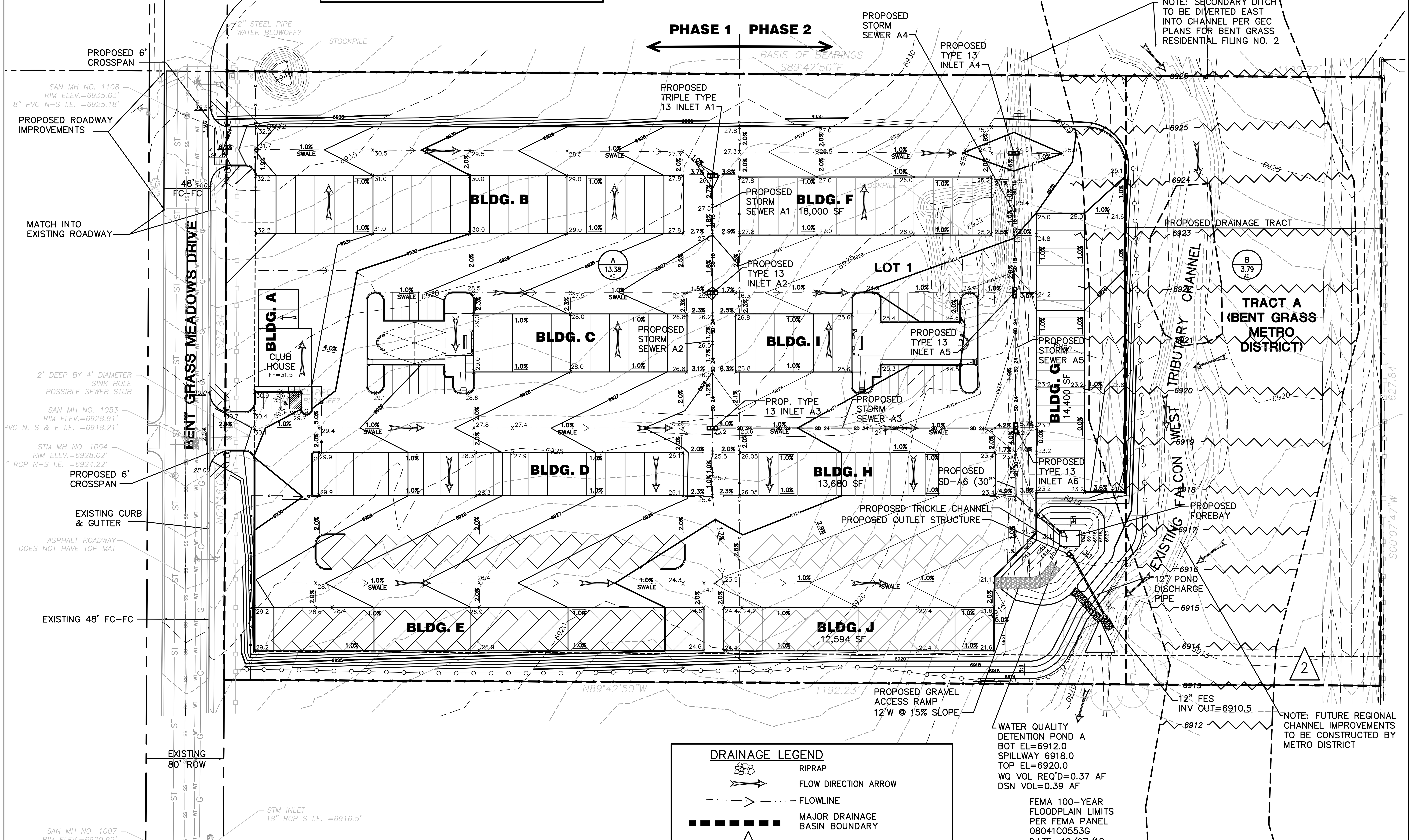
DEYOUNG SUBDIVSION

HISTORIC DRAINAGE PLAN

HORZ. SCALE: 1"=50'	DRAWN: BJJ
VERT. SCALE: N/A	DESIGNED: JPS
SURVEYED: RIDGELINE	CHECKED: JPS
CREATED: 10/11/19	LAST MODIFIED: 12/18/19
PROJECT NO: 031901	MODIFIED BY: BJJ
SHEET:	EX1

DRAINAGE NOTES:

1. ALL ON-SITE STORM SEWER IMPROVEMENTS ARE PRIVATE
2. INLETS A1-A6 ARE EACH TRIPLE TYPE 13
3. WEST TRIBUTARY DRAINAGE CHANNEL IS PUBLIC



DRAINAGE LEGEND

- RIPRAP
- FLOW DIRECTION ARROW
- FLOWLINE
- MAJOR DRAINAGE BASIN BOUNDARY
- DESIGN POINT
- DEVELOPED BASIN DESIGNATION
- DEVELOPED BASIN AREA (ACRES)
- FEMA 100-YR WATER SURFACE ELEVATION (CONVERTED TO NGVD 29 DATUM)

FEMA DATUM CONVERSION NOTE: NAVD88 IS 3.89' ABOVE NGVD29 BASED ON A FIMS BENCHMARK BL74 NEAR WOODMEN AND BENT GRASS

ORIGINAL SCALE: 1"=50' (24"x36" SHEET)
CONTOUR INTERVAL=1'

BENCHMARKS:

BM#1
FIMS MONUMENT BLT169
ELEV.=6884.81' (NGVD1929)

BM#2
FLANGE BOLT ON HYDRANT "MUELLER BOLT", LOCATED ON THE EAST SIDE OF BENT GRASS MEADOWS DRIVE 1900 FEET NORTH OF WOODMEN FRONTAGE ROAD
ELEV.=6938.84' (NGVD1929)

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q5 (CFS)	Q100 (CFS)
1	38.2	72.2
2	1.0	7.1

BASIN A AREA = 13.38 AC.

IMPERVIOUS AREAS (PH 1 & PH 2):

SURFACE TYPE	AREA
BUILDING & PAVEMENT	466,453 SF
TOTAL	466,453 SF

= 10.7 AC
= 80% IMPERVIOUS

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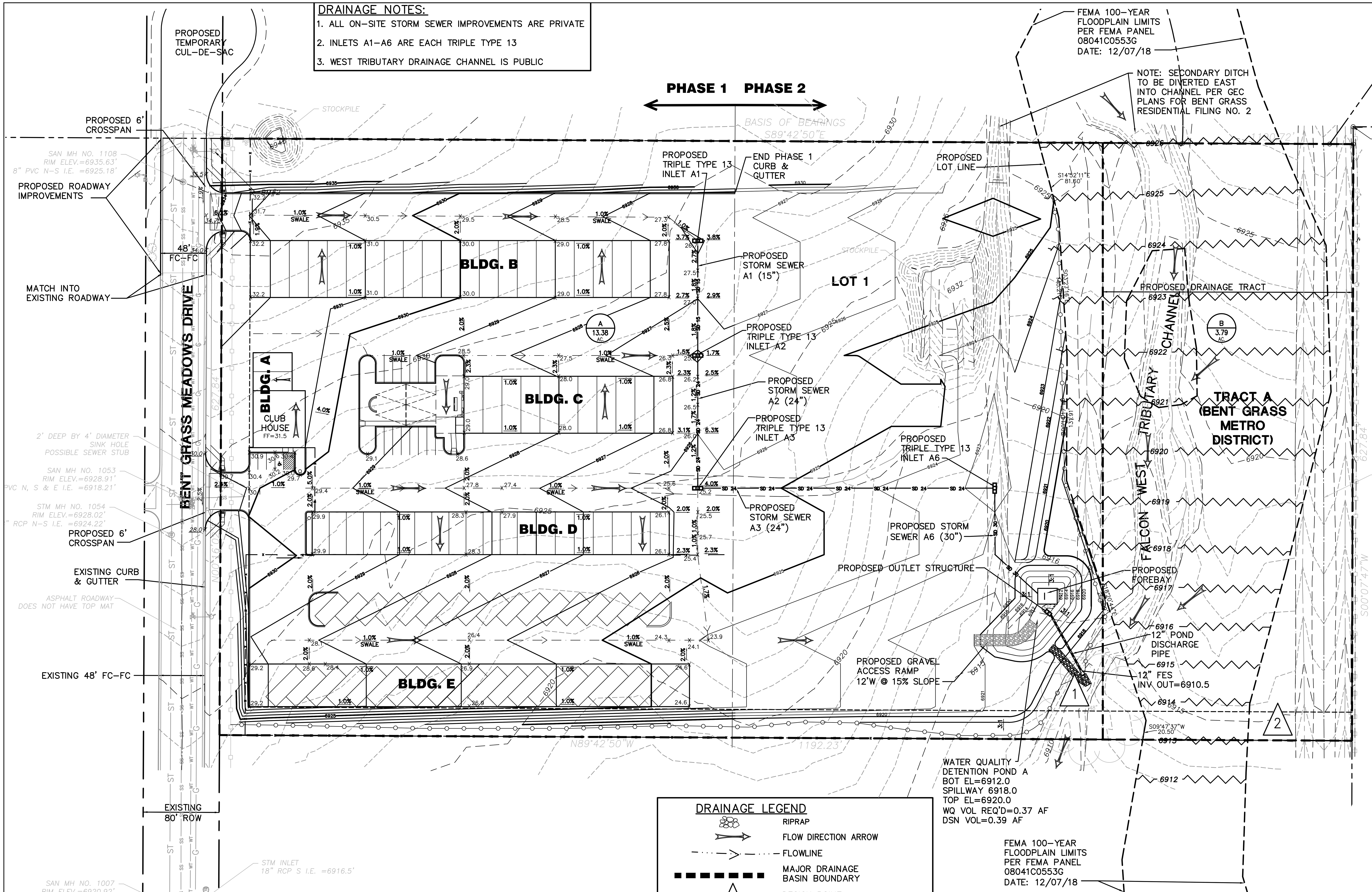
No.	REVISION	BY	DATE

DEYOUNG SUBDIVSION

DEVELOPED DRAINAGE PLAN (ULTIMATE - FOR INFORMATION ONLY)

HORZ. SCALE:	1"=50'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RIDGELINE	CHECKED:	JPS
CREATED:	10/11/19	LAST MODIFIED:	4/22/20
PROJECT NO:	031901	MODIFIED BY:	BJJ
SHEET:	D1		

DRAINAGE NOTES:
1. ALL ON-SITE STORM SEWER IMPROVEMENTS ARE PRIVATE
2. INLETS A1-A6 ARE EACH TRIPLE TYPE 13
3. WEST TRIBUTARY DRAINAGE CHANNEL IS PUBLIC



DRAINAGE LEGEND

(symbol)	RIPRAP
(symbol)	FLOW DIRECTION ARROW
(symbol)	FLOWLINE
(symbol)	MAJOR DRAINAGE BASIN BOUNDARY
5	DESIGN POINT
C14	DEVELOPED BASIN DESIGNATION
23.21 AC.	DEVELOPED BASIN AREA (ACRES)
6910	FEMA 100-YR WATER SURFACE ELEVATION (CONVERTED TO NGVD 29 DATUM)

FEMA DATUM CONVERSION NOTE:
NAVD88 IS 3.89' ABOVE NGVD29 BASED ON A FIMS BENCHMARK BL74 NEAR WOODMEN AND BENT GRASS

ORIGINAL SCALE: 1"=50' (24"x36" SHEET)
CONTOUR INTERVAL=1'

BENCHMARKS:

BM#1
FIMS MONUMENT BLT169
ELEV.=6884.81' (NGVD1929)

BM#2
FLANGE BOLT ON HYDRANT "MUELLER BOLT", LOCATED ON THE EAST SIDE OF BENT GRASS MEADOWS DRIVE 1900 FEET NORTH OF WOODMEN FRONTAGE ROAD
ELEV.=6938.84' (NGVD1929)

SUMMARY HYDROLOGY TABLE

DESIGN POINT	Q_5 (CFS)	Q_{100} (CFS)
1	36.6	70.0
2	1.0	7.1

BASIN A AREA = 13.38 AC.

IMPERVIOUS AREAS (PH 1 & PH 2):

SURFACE TYPE	AREA
BUILDING & PAVEMENT	466,453 SF
TOTAL	466,453 SF

= 10.7 AC
= 80% IMPERVIOUS

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No.	REVISION	BY	DATE

DEYOUNG SUBDIVSION

PHASE 1 DEVELOPED DRAINAGE PLAN

HORZ. SCALE:	1"=50'	DRAWN:	BJJ
VERT. SCALE:	N/A	DESIGNED:	JPS
SURVEYED:	RIDGELINE	CHECKED:	JPS
CREATED:	12/18/19	LAST MODIFIED:	4/22/20
PROJECT NO:	031901	MODIFIED BY:	BJJ
SHEET:	D1.1		