FINAL DRAINAGE REPORT

PARKER POINTE SUBDIVISION, FILING NO. 1 - LOT 2A

MCDONALD'S

Parker, Colorado

Prepared for:

McDonald's USA, LLC

Kortney Pedigo, Area Construction Manager

(312) 599-2876

Prepared by:

Kimley-Horn and Associates, Inc.

2 North Nevada Avenue, Suite 900

Colorado Springs, CO 80903

Jessica McCallum, P.E.

(719) 453-0180

Kimley»Horn

Project #: 096806018
Prepared: August 28, 2023
Revised: May 15, 2024

PARKER POINTE SUBDIVISION, FILING NO. 1 LOT 2 A

MCDONALD'S

PARKER, COLORADO

DRAINAGE REPORT

MAY 15, 2024

Prepared by:

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ENGINEER’S STATEMENT

"This report for the drainage design of the Parker Pointe Subdivision Filing No. 1, Lot 2A McDonald’s Development was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.”

Jessica McCallum, P.E.

Registered Professional Engineer

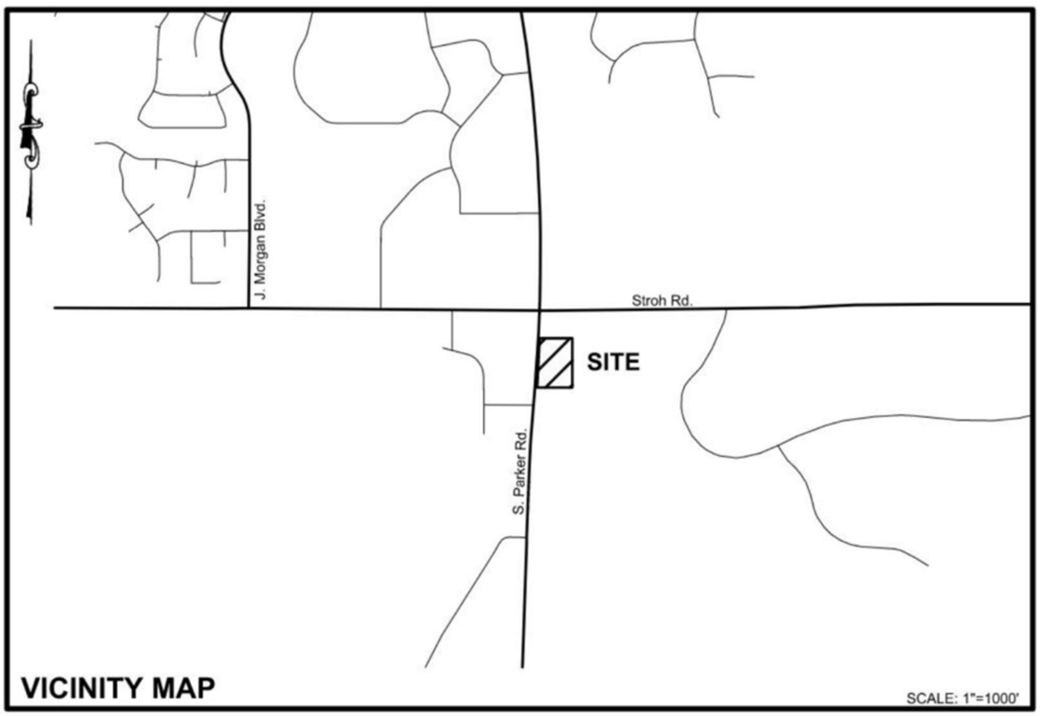
State of Colorado No. 59054

GENERAL LOCATION AND DESCRIPTION

The purpose of this report is to outline the drainage plan for the McDonald's Development near the southeast corner of South Parker Road and Stroh Road in the Town of Parker, County of Douglas, State of Colorado (herein the "Project").

LOCATION

The Site is located on Lot 2A of the Parker Pointe Subdivision Filing No. 1 development (the "Site"). More specifically, the Site is located in the Section 3, Township 7 South, Range 66 West of the Sixth Principal Meridian, Town of Parker, County of Douglas, State of Colorado. A vicinity map is provided below for reference.



DESCRIPTION OF PROPERTY

The overall site is approximately 1.48 acres of undeveloped land. The existing topography generally drains from northeast to southwest to South Parker Road. The Site is to be overlot graded with the Parker Pointe Subdivision master development. Overlot topography generally drains from north to the south to the proposed internal private drives to be routed to a regional detention pond for water quality and detention. The overall site varies in elevation from a low of approximately 5965 feet to a high of approximately 5978 feet. Respective runoff sheet flows across the property from north to south at slopes on average of 2%.

The existing vacant ground cover consists of sparse vegetation of native weeds and grasses. A review of the Natural Resource Conservation Service (NRCS) Web Soil Survey determined that the Site is made up of 21% Bresser-Truckton Sandy Loam (an NRCS Soil Type B) and 79% Sampson Loam (an NRCS Soil Type A). Soil Type B was utilized for calculations included within this report. The NRCS study is found in **Appendix A** of the report.

Groundwater was not encountered. It is assumed that the existing foundations and utilities serving the previous structures will be removed per the Parker Pointe Master Development and therefore, there will be no geological hazards on site during construction of the McDonald's.

DESCRIPTION OF PROJECT

The Project is anticipated to consist of a new single-story McDonald's fast-food restaurant with dual drive-thru lanes, drive aisles, parking on the north and east sides of the building, sidewalks, landscaping, and associated utility improvements. The proposed building will be oriented from north to south and roughly centered in the Site. Drive aisles are proposed to loop around the building to provide internal traffic circulation as well as emergency access throughout the Project. Runoff from the Project will be captured by proposed inlets and storm sewer infrastructure which will route the runoff to the regional detention pond.

Roadway infrastructure proposed within the overall development adjacent to the Project will provide access from the Project to the adjacent right-of-way and access roadways. Project access will be obtained through both the private north shared access road (Napa Avenue) and the private east shared access road (Declan Drive).

Water quality and detention for this property and the adjacent rights-of-way are provided off-site within the existing detention pond which is located east of the Parker Pointe development. Therefore, no additional water quality or detention is proposed with this project.

DRAINAGE BASINS AND SUB-BASINS

MAJOR DRAINAGE BASIN DESCRIPTION

This project falls within the limits and is tributary to both Kinney Creek and Stroh Gulch as outlined in the "*Final Drainage Report Parker Pointe*" prepared by Perception Design Group, Inc., dated November 28, 2018 (the "*Master Drainage Report*"). The Site falls within Sub-basins L11A, L12, IN2, U1, and U2 as outlined in the "*Final Drainage Report Amendment Parker Pointe*" prepared by Perception Design Group, Inc., dated December 14, 2023 (the "*Master Drainage Report Amendment*").

Per the Master Drainage Report, the assumed weighted imperviousness for the Site was 95.0%. The proposed Site has a weighted imperviousness of 76.9% which is less than the assumed 95.0%.

By scaled map location and graphical review of the Flood Insurance Rate Map (FIRM) Number 08035C0182G, dated March 16, 2016, the Site lies completely within as area classified as Zone X. Areas classified as Zone X are considered areas of minimal flood hazard, usually depicted by Flood Insurance Rate Maps as areas outside of the 500-year floodplain. The FIRM map is included in **Appendix A**.

Drainage infrastructure is provided per the Master Development to convey stormwater to the existing detention pond for water quality treatment and detention and then outfalls to Kinney Creek.

SUB-BASIN DESCRIPTION

The Site has been divided into sub-basins that are tributary to the existing storm sewer system which conveys flows downstream to the existing detention pond east of the Site. Further information regarding the basin characteristics, runoff, coefficients and drainage patterns can be found in **Appendix B.**

Existing Runoff Conditions

The Site falls within Sub-basins L11A, L12, IN2, U1 and U2 of the Master Drainage Report Amendment. Sub-basins L11A & L12 were assigned an imperviousness value of 95% with runoff generally flowing from northeast to southwest. Sub-basin IN2 was assigned an imperviousness value of 100% with runoff flowing from north to south. Sub-basin U1 was assigned an imperviousness value of 2.0% with runoff flowing from east to west. Sub-basin U2 was assigned an imperviousness value of 80.4% with runoff flowing from east to west. Flows from sub-basins L11A, L12, and IN2 are ultimately conveyed to the existing detention pond for water quality treatment and detention. Sub-basins U1 and U2 are conveyed to a grass swale for water quality treatment before discharge into S. Parker Road. The 5-year and 100-year runoff values are as follows:

Sub-Basin	5-yr [cfs]	100-yr [cfs]
L11A	1.90	3.89
L12	2.13	4.36
U1	0.58	2.22
U2	1.04	1.13
IN2	2.24	4.50

The existing drainage maps from the Master Drainage Report and Master Drainage Report Amendment are provided in **Appendix E.**

Proposed Runoff Conditions

Sub-basin A is 0.21 acres within the north portion of the Site and contains a concrete parking lot, sidewalk, northern drive access, drive-thru lanes and landscaping. Runoff from this basin will surface flow to a proposed inlet at Design Point A where it will be conveyed via proposed storm sewer to the existing storm sewer stub and outfall to the regional detention pond. If the inlet were to plug the runoff would pond until ultimately flowing over the proposed parking lot top back of curb and sheet flow through Napa Avenue to S. Parker Road.

Sub-basin B is 0.29 acres within the eastern half of the Site, consisting of a concrete parking lot, sidewalks, the trash enclosure, and landscaping. Runoff from this basin will surface flow to a proposed inlet at Design Point B where it will be conveyed via proposed storm sewer to the existing storm sewer stub and outfall to the regional detention pond. If the inlet were to plug the runoff would pond until ultimately flowing into Sub-basin A.

Sub-basin C is 0.15 acres within the southwest corner of the Site, consisting of drive-thru lane, drive aisle, sidewalk, and landscaping. Runoff from this basin will surface flow to a proposed inlet at Design Point C where it will be conveyed via proposed storm sewer to the existing storm sewer stub and outfall to the regional detention pond. If the inlet were to plug the runoff would pond until ultimately flowing over the top back of curb and through landscaping to S. Parker Road.

Sub-basin D is 0.22 acres within the southeastern corner of the Site, consisting of a concrete parking lot, eastern drive access, sidewalk, and landscaping. Runoff from this basin will surface flow to a proposed inlet at Design Point D where it will be conveyed via proposed storm sewer to the existing storm sewer stub and outfall to the regional detention pond. If the inlet were to plug the runoff would pond until ultimately flowing over the parking lot to Sub-Basin C.

Sub-basin R is 0.12 acres and consists of the roof area of the proposed building. Runoff from this basin will be routed to the roof drain at Design Point R which outfalls into the proposed storm sewer system at the proposed manhole in Sub-basin E and eventually to the existing storm sewer stub to outfall to the regional detention pond.

Sub-basin UD-1 is 0.16 acres along the northern boundary of the Site, consisting of the existing Napa Avenue 40' Right-of-Way asphalt drive, sidewalks, and landscaping. Runoff from this sub-basin will surface flow to the existing curb and gutter and be routed to S. Parker Road at Design Point U1. This sub-basin eventually enters existing curb inlets within S. Parker Road (within basin PR1 of the Master Drainage Report) before outfalling to the existing grass swale for treatment before entering Kinney Creek. Sub-basin UD-1 is included within a portion of basin U2 of the Master Drainage Report, and 0.02 acres of additional landscaping area to basin U2 than was previously accounted for in the Master Drainage Report. The additional area consists of landscaped area which does not require water quality capture volume. This acreage results in negligible additional flow to be conveyed by the existing grass swale.

Sub-basin UD-2 is 0.18 acres along the western boundary of the Site, consisting entirely of landscaping. Runoff from this basin will surface flow west into an existing grass swale east of S. Parker Road at Design Point U2, where it is treated before outfalling at Kinney Creek. It is not feasible to capture these flows due to the hillside along the western side of the Site. This sub-basin is within a portion of basin U1 of the Master Drainage Report, and 0.06 acres of additional landscaping area to basin U1 than was previously accounted for in the Master Drainage Report. The additional area consists of landscaped area which does not require water quality capture volume. This acreage results in negligible additional flow to be conveyed by the existing grass swale.

Sub-basin UD-3 is 0.14 acres at the east side of the Site, consisting of a portion of the existing Declan Drive, sidewalks, and landscaping. Runoff from this basin will surface flow to the existing curb and gutter and be routed south to Design Point U3. The entirety of this sub-basin is located within basin IN2 of the Master Drainage Report, and it eventually outfalls to an existing inlet at the southwest corner of basin IN2. Therefore, the entirety of this uncaptured sub-basin is accounted for in the Master Drainage Report.

DRAINAGE DESIGN CRITERIA

REGULATIONS

The *Town of Parker Storm Drainage and Environmental Criterial Manual* (the "CRITERIA") and the *Urban Storm Drainage Criteria Manual* (the "MANUAL") provided by Mile High Flood District (MHFD) were used for the drainage design and preparation of this letter.

There are no proposed deviations from the Town of Parker and MHFD floodplain regulations and ordinance.

COMPLIANCE WITH TOWN'S STREAM PRESERVATION STANDARDS

There are no existing stream buffers within the Project area.

DEVELOPMENT CRITERIA REFERENCE AND CONSTRAINTS

The FIRM panel cited in the Major Drainage Basin Description Section shows no portion of the Site to be located within the 100-year floodplain. The proposed storm facilities are in compliance with the CRITERIA and the MANUAL. Site drainage is not significantly impacted by such constraints as utilities or existing development.

The proposed approach included pipe flow into an existing storm sewer system. Additional detail regarding onsite drainage patterns is provided in the Drainage Facility Design Section.

The proposed Project is in general compliance with the Master Drainage Report.

HYDROLOGIC CRITERIA

The 5-year and 100-year design storm events were used in determining rainfall and runoff for the proposed drainage system per Table 2.3 of the CRITERIA. Table 5.1 of the CRITERIA is the source for rainfall data for the 5-year and 100-year design storm events. Design runoff was calculated using the Rational Method for developed conditions as established in the CRITERA and MANUAL. Runoff coefficients for the proposed development were determined using Table RO-5 of the MANUAL by calculating weighted impervious values for each specific site basin. No modifications are proposed to any off-site drainage structure.

The rainfall intensity values used for the 5-year event and 100-year event are 1.9 inches/hour and 2.6 inches/hour, respectively.

Hydrologic design criteria utilized to analyze runoff conditions consists of the Rational Method as approved by the Criteria. Also, for sub-basins less than 160 acres in size, the Rational Method can be utilized as approved by the Manual.

Hydrologic calculations are provided in **Appendix B.**

HYDRAULIC CRITERIA

STORM SEWER PIPE HYDRAULICS

StormCAD was utilized to analyze pipe flows and conveyance capacity to the existing swale based upon direct runoff and time of concentration calculations for respective design point tributary areas. StormCAD modeling software allows the designer to analyze the system with respect to system conveyance timing and corresponding hydraulic gradient and capacity calculations.

Storm sewer design and modeling consists of design intervals as outlined by the following design storm events:

- Minor Storm: 5-year Storm Event
- Major Storm: 100-year Storm Event

Compliant with the Town Criteria, the Hydraulic Grade Line (HGL) for the minor event shall be contained within the pipe and for the major event shall be at least 12-inches below the finished grade elevation for the length of the pipe.

The resulting hydraulic analysis is included in **Appendix C**.

GUTTER CAPACITY, INLET HYDRAULICS AND OUTFALL PROTECTION

Applicable design methods have been utilized to size proposed storm sewer inlets, which includes the use of UD-Inlet, v4.06 MHFD spreadsheets and nomographs.

The gutter capacity, inlet hydraulic and outfall protection analysis will consist of design intervals as outlined by the following design storm events:

- Minor Storm: 5-year Storm Event
- Major Storm: 100-year Storm Event

Analysis of the gutter capacity of internal access drives, curb cuts, riprap dissipation and Inlet Hydraulic Calculations have been included in **Appendix D**.

VARIANCE FROM CRITERIA

At this time, no variances from the Criteria are being requested.

DRAINAGE DESIGN

GENERAL CONCEPT

The Project consists of a proposed McDonald's fast-food restaurant with a dual drive-thru, drive aisles, parking, landscaping, and utility improvements.

Water quality and detention has been provided downstream of the Site within an existing detention pond east of the Site. Thus, no additional water quality or detention improvements are proposed with this Project.

FLOODPLAIN DEVELOPMENT PERMIT

This site does not fall within a FEMA floodplain and no floodplain modifications are required for this project therefore a floodplain development permit from the Town of Parker is not required.

ENVIRONMENTAL PROTECTION CRITERIA

GENERAL

No impacts to threatened or endangered species are anticipated as a result of the Project, and the Project is understood to comply with the State and Federal environmental permitting regulations. Additionally, no existing wetlands or Waters of the US are adjacent to the project site or are anticipated to be impacted by the proposed improvements.

CONSTRUCTION BMP PLAN

Construction BMPs will be used throughout the redevelopment of the Site in order to comply with Section 8.2 of the CRITERIA. Construction BMPs implemented onsite include silt fences and construction fence around the perimeter of the Site, vehicle tracking control, and a concrete washout area. The full list of construction BMPs to be implemented will be shown with the Project's Civil Construction Documents.

PERMANENT BMP PLAN

The existing detention pond acts as the Water Quality Enhancement BMP for the Project Site.

CONCLUSIONS

COMPLIANCE WITH STANDARDS

The drainage design presented within this report conforms to the Town of Parker Storm Drainage and Environmental Criteria Manual. The existing detention pond will not be adversely affected by the Project, and the Project meets Mile High Flood District requirements.

DRAINAGE CONCEPT

The drainage design discussed herein effectively controls the storm runoff from the Project by conveying developed runoff to the existing storm sewer system where it is then conveyed to the regional detention facility. The proposed developed imperviousness of 76.9% falls below the assumed imperviousness of 95.0% outlined in the Master Drainage Report.

SEDIMENT AND EROSION CONTROL CONCEPT

The Construction BMP plans are designed to prevent erosion within the Site during and after construction. BMPs are in place to prevent erosion during construction including silt fence around the perimeter of the Site, vehicle tracking control, and a concrete washout area.

REFERENCES

Final Drainage Report Parker Pointe, Perception Design Group, Inc.; November 28, 2018.

Final Drainage Report Amendment Parker Pointe, Perception Design Group, Inc.; December 14, 2023.

Town of Parker Storm Drainage and Environmental Criteria Manual, Town of Parker; February 1996, Revised and Adopted February 2014.

Urban Storm Drainage Criteria Manual, Volume 1-3, Urban Drainage and Flood Control District, Denver, CO.; latest editions. (Provided by Mile High Flood Control District)

APPENDIX

APPENDIX A – FIRM, SOILS AND DRAINAGE MAP
APPENDIX B – HYDROLOGIC COMPUTATIONS
APPENDIX C – HYDRAULIC COMPUTATIONS
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APPENDIX A – FIRM, SOILS AND DRAINAGE MAPS

FEMA FIRM Map

NRCS Soil Map

Proposed Drainage Maps

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

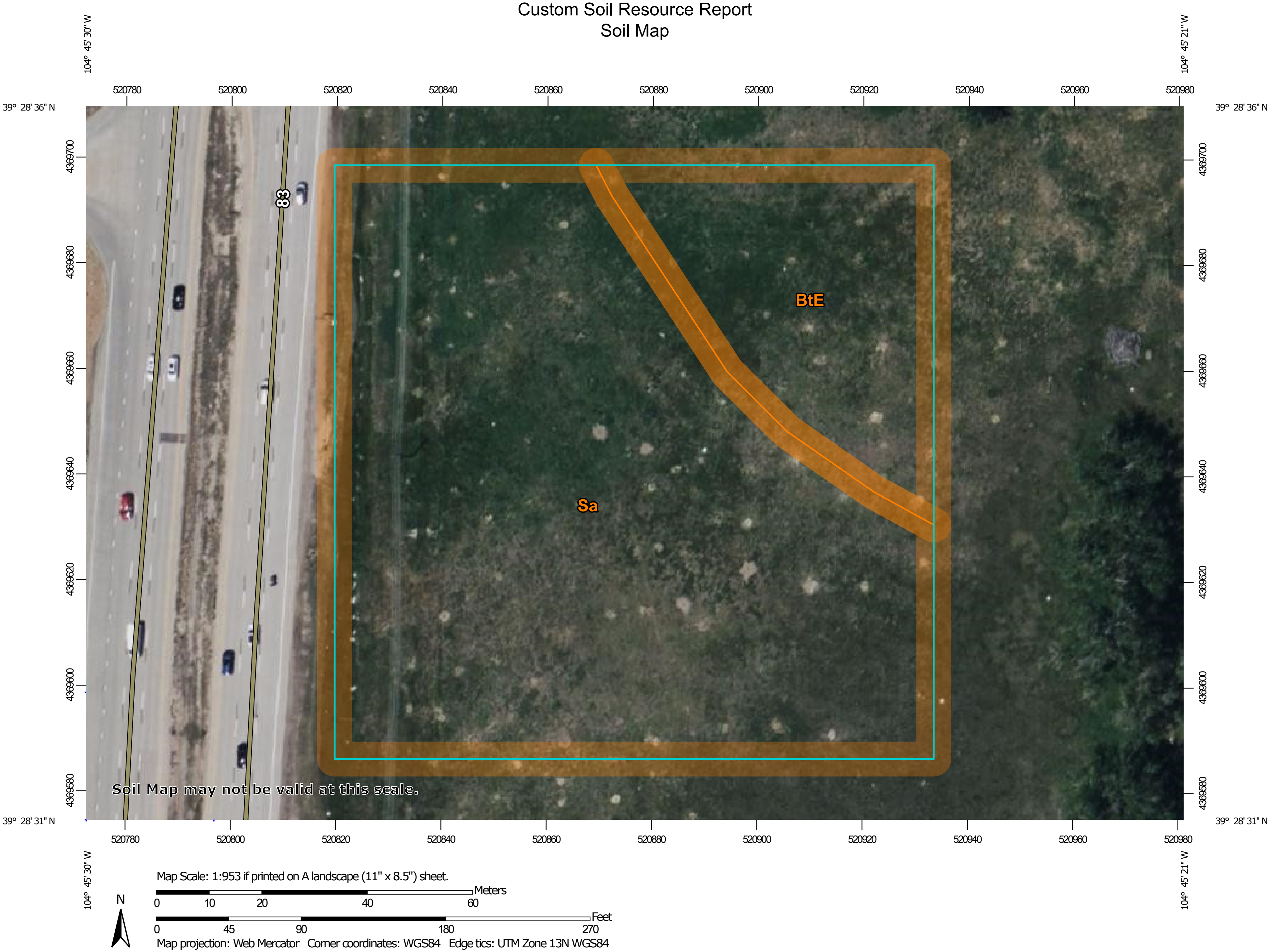
A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Castle Rock Area, Colorado

August 10, 2023

Soil Map



104° 45' 30" W
104° 45' 21" W
39° 28' 36" N
39° 28' 31" N
520780
520800
520820
520840
520860
520880
520900
520920
520940
520960
520980
4369700
4369680
4369660
4369640
4369620
4369600
4369580
83
BtE
Sa
Soil Map may not be valid at this scale.
Map Scale: 1:953 if printed on A landscape (11" x 8.5") sheet.
Meters
0 10 20 40 60
Feet
0 45 90 180 270
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 1:20,000.

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: Castle Rock Area, Colorado
Survey Area Data: Version 15, Sep 1, 2022

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

Date(s) aerial images were photographed: Jun 9, 2021—Jun 12, 2021

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
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	0.7	20.9%
Sa	Sampson loam	2.5	79.1%
Totals for Area of Interest		**3.2**	**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.

Castle Rock Area, Colorado

BtE—Bresser-Truckton sandy loams, 5 to 25 percent slopes

Map Unit Setting

National map unit symbol: jqy9
Elevation: 5,500 to 6,600 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 120 to 135 days
Farmland classification: Not prime farmland

Map Unit Composition

Bresser and similar soils: 50 percent
Truckton and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bresser

Setting

Landform: Terraces
Landform position (three-dimensional): Tread, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy eolian deposits

Typical profile

H1 - 0 to 8 inches: sandy loam
H2 - 8 to 30 inches: sandy clay loam
H3 - 30 to 60 inches: loamy sand

Properties and qualities

Slope: 5 to 15 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Description of Truckton

Setting

Landform: Terraces
Landform position (three-dimensional): Tread, riser

Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from arkosic sedimentary rock

Typical profile
H1 - 0 to 4 inches: sandy loam
H2 - 4 to 19 inches: sandy loam
H3 - 19 to 60 inches: sandy loam

Properties and qualities
Slope: 10 to 25 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 6.0 inches)

Interpretive groups
Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Newlin
Percent of map unit: 5 percent
Hydric soil rating: No

Blakeland
Percent of map unit: 5 percent
Hydric soil rating: No

Stapleton
Percent of map unit: 4 percent
Hydric soil rating: No

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

Sa—Sampson loam

Map Unit Setting
National map unit symbol: jr02

Elevation: 5,500 to 6,600 feet
Mean annual precipitation: 15 to 19 inches
Mean annual air temperature: 48 to 50 degrees F
Frost-free period: 120 to 135 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Sampson and similar soils: 80 percent
Minor components: 20 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sampson

Setting

Landform: Stream terraces on drainageways
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Weathered alluvium derived from arkose

Typical profile

H1 - 0 to 9 inches: loam
H2 - 9 to 28 inches: clay loam
H3 - 28 to 38 inches: loam
H4 - 38 to 60 inches: silt loam

Properties and qualities

Slope: 1 to 4 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R049XC202CO - Loamy Foothill 14-19 PZ
Hydric soil rating: No

Minor Components

Englewood

Percent of map unit: 8 percent
Hydric soil rating: No

Bresser

Percent of map unit: 7 percent
Hydric soil rating: No

Loamy alluvial land

Percent of map unit: 4 percent
Hydric soil rating: No

Aquic haplustolls

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

National Flood Hazard Layer FIRMette

FEMA

104°45'45"W 39°28'51"N

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

1:6,000

104°45'8"W 39°28'23"N

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

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

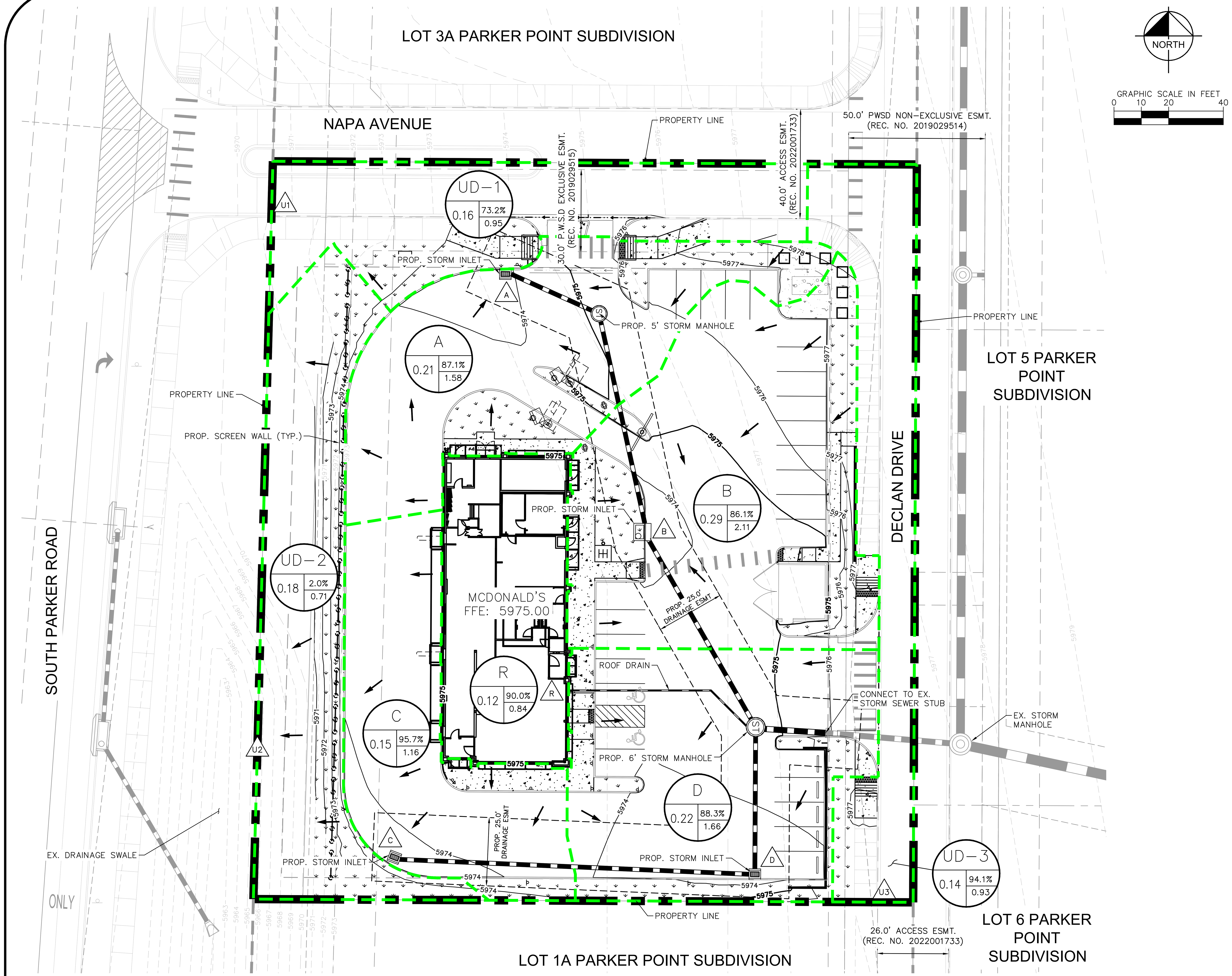
N

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

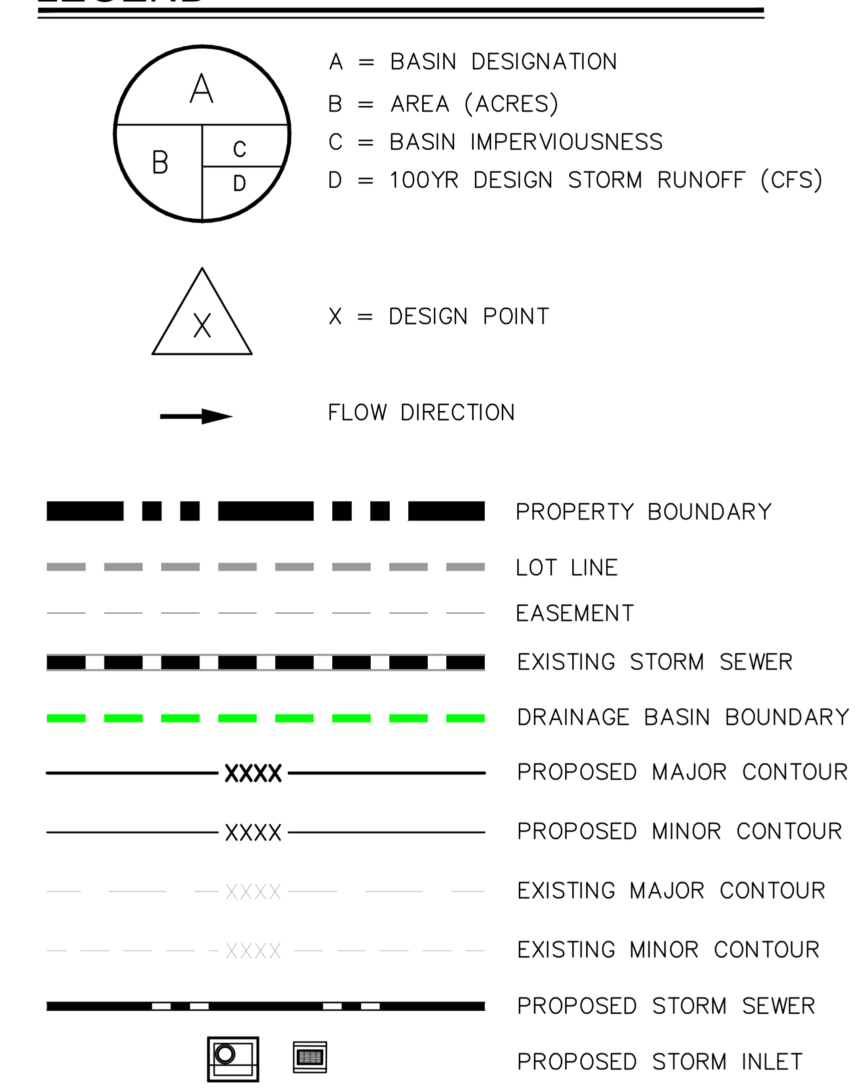
This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 11/18/2021 at 6:25 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.



LEGEND



SUMMARY - PROPOSED RUNOFF TABLE

DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
R	R	0.12	0.29	0.84
A	A	0.21	0.54	1.58
B	B	0.29	0.71	2.11
C	C	0.15	0.41	1.16
D	D	0.22	0.57	1.66
UD-1	UD-1	0.16	0.29	0.95
UD-2	UD-2	0.18	0.01	0.71
UD-3	UD-3	0.14	0.33	0.93
SITE TOTAL		1.48	3.15	9.94
	(CAPTURED)	1.00	2.52	7.35
	(UNDETAINED)	0.48	0.63	2.59

DRAINAGE EXHIBIT – PROPOSED CONDITIONS
MCDONALD'S SOUTH PARKER ROAD AND STROH ROAD, PARKER, CO

Kimley»Horn

2 N NEVADA AVE, SUITE 900, COLORADO SPRINGS, CO 80903
PHONE: 719-453-0180

APPENDIX B – HYDROLOGIC COMPUTATIONS

Sub-Basin Impervious Area Calculations

Sub-Basin Runoff Calculations

The one-hour point rainfall depths for different frequency events are shown in Table 5.1 herein. Rainfall intensity as a function of the one-hour point rainfall and the time of concentration can be approximated by the following equation which appears in the MANUAL as Equation RA-5.

$$I = (28.5P_1)/(10+t_c)^{0.786}$$

Where, I = rainfall intensity (in/hr)
P_1 = one-hour point rainfall depth (in)
t_c = time of concentration (min)

	2-yr	5-yr	10-yr	100-yr
P_1 =	0.99	1.39	1.64	2.6

Weighted Imperviousness Calculations

	AREA	AREA	ROOF	ROOF	ROOF				LANDSCAPE	LANDSCAPE	LANDSCAPE				PAVEMENT	PAVEMENT	PAVEMENT				WEIGHTED	WEIGHTED COEFFICIENTS			
SUB-BASIN	(SF)	(Acres)	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	AREA	IMPERVIOUSNESS	C2	C5	C10	C100	IMPERVIOUSNESS	C2	C5	C10	C100
R	5,253	0.12	5,253	90%	0.74	0.76	0.78	0.84	0	2%	0.01	0.01	0.07	0.44	0	100%	0.84	0.86	0.86	0.90	90.0%	0.74	0.76	0.78	0.84
A	9,314	0.21	0	90%	0.74	0.76	0.78	0.84	1,226	2%	0.01	0.01	0.07	0.44	8,088	100%	0.84	0.86	0.86	0.90	87.1%	0.73	0.75	0.76	0.84
B	12,498	0.29	0	90%	0.74	0.76	0.78	0.84	1,767	2%	0.01	0.01	0.07	0.44	10,731	100%	0.84	0.86	0.86	0.90	86.1%	0.72	0.74	0.75	0.83
C	6,696	0.15	0	90%	0.74	0.76	0.78	0.84	296	2%	0.01	0.01	0.07	0.44	6,400	100%	0.84	0.86	0.86	0.90	95.7%	0.80	0.82	0.83	0.88
D	9,671	0.22	0	90%	0.74	0.76	0.78	0.84	1,150	2%	0.01	0.01	0.07	0.44	8,521	100%	0.84	0.86	0.86	0.90	88.3%	0.74	0.76	0.77	0.85
UD-1	6,902	0.16	0	90%	0.74	0.76	0.78	0.84	1,888	2%	0.01	0.01	0.07	0.44	5,014	100%	0.84	0.86	0.86	0.90	73.2%	0.61	0.63	0.64	0.77
UD-2	7,944	0.18	0	90%	0.74	0.76	0.78	0.84	7,944	2%	0.01	0.01	0.07	0.44	0	100%	0.84	0.86	0.86	0.90	2.0%	0.01	0.01	0.07	0.44
UD-3	6,082	0.14	0	90%	0.74	0.76	0.78	0.84	367	2%	0.01	0.01	0.07	0.44	5,715	100%	0.84	0.86	0.86	0.90	94.1%	0.79	0.81	0.81	0.87
Onsite Total	64,360	1.48	5,253	90%	0.74	0.76	0.78	0.84	14,638	2%	0.01	0.01	0.07	0.44	44,469	100%	0.84	0.86	0.86	0.90	76.9%	0.64	0.66	0.67	0.79
(Captured)	43,432	1.00	5,253	90%	0.74	0.76	0.78	0.84	4,439	2%	0.01	0.01	0.07	0.44	33,740	100%	0.84	0.86	0.86	0.90	88.8%	0.74	0.76	0.77	0.85
(Undetained)	20,928	0.48	0	90%	0.74	0.76	0.78	0.84	10,199	2%	0.01	0.01	0.07	0.44	10,729	100%	0.84	0.86	0.86	0.90	52.2%	0.44	0.45	0.48	0.68

McDonald's - Drainage Report
Proposed Runoff Calculations
Time of Concentration

Watercourse Coefficient

Forest & Meadow	2.50	Short Grass Pasture & Lawns	7.00	Grassed Waterway	15.00
Fallow or Cultivation	5.00	Nearly Bare Ground	10.00	Paved Area & Shallow Gutter	20.00

DESIGN POINT	SUB-BASIN DATA: DRAIN BASIN	SUB-BASIN DATA: AREA sq. ft.	SUB-BASIN DATA: AREA ac.	SUB-BASIN DATA: C(5)	INITIAL / OVERLAND TIME: Length ft.	INITIAL / OVERLAND TIME: Slope %	INITIAL / OVERLAND TIME: T(i) min	TRAVEL TIME T(t): Length ft.	TRAVEL TIME T(t): Slope %	TRAVEL TIME T(t): Coeff.	TRAVEL TIME T(t): Velocity fps	T(t) min.	T(c) CHECK (URBANIZED BASINS): COMP. T(c)	T(c) CHECK (URBANIZED BASINS): TOTAL LENGTH	T(c) CHECK (URBANIZED BASINS): L/180+10	FINAL T(c) min.
R	R	5,253	0.12	0.76	100	1.0%	6.2				0.0	0.0	6.2	100	10.6	6.2
A	A	9,314	0.21	0.75	100	2.7%	4.6	76	2.1%	20.00	2.9	0.4	5.0	176	11.0	5.0
B	B	12,498	0.29	0.74	100	3.6%	4.3	34	2.5%	20.00	3.2	0.2	5.0	134	10.7	5.0
C	C	6,696	0.15	0.82	39	0.5%	4.0	125	0.5%	20.00	1.4	1.5	5.5	164	10.9	5.5
D	D	9,671	0.22	0.76	100	3.0%	4.3	18	1.0%	20.00	2.0	0.2	5.0	118	10.7	5.0
UD-1	UD-1	6,902	0.16	0.63	100	2.0%	6.9	120	2.0%	20.00	2.8	0.7	7.6	220	11.2	7.6
UD-2	UD-2	7,944	0.18	0.01	45	20.0%	4.9				0.0	0.0	5.0	45	10.3	5.0
UD-3	UD-3	6,082	0.14	0.81	100	0.6%	6.3	171	0.6%	20.00	1.6	1.8	8.1	271	11.5	8.1

McDonald's - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *5 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				NOTES
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	
R	R	0.12	0.76	6.2	0.09	3.16	0.29					
A	A	0.21	0.75	5.0	0.16	3.35	0.54					
B	B	0.29	0.74	5.0	0.21	3.36	0.71					
C	C	0.15	0.82	5.5	0.13	3.28	0.41					
D	D	0.22	0.76	5.0	0.17	3.36	0.57					
UD-1	UD-1	0.16	0.63	7.6	0.10	2.96	0.29					
UD-2	UD-2	0.18	0.01	5.0	0.00	3.36	0.01					
UD-3	UD-3	0.14	0.81	8.1	0.11	2.90	0.33					

McDonald's - Drainage Report
Proposed Runoff Calculations
(Rational Method Procedure)

Design Storm *100 Year*

BASIN INFORMATION				DIRECT RUNOFF				CUMMULATIVE RUNOFF				
DESIGN POINT	DRAIN BASIN	AREA ac.	RUNOFF COEFF	T(c) min	C x A	I in/hr	Q cfs	T(c) min	C x A	I in/hr	Q cfs	NOTES
R	R	0.12	0.84	6.2	0.10	8.30	0.84					
A	A	0.21	0.84	5.0	0.18	8.80	1.58					
B	B	0.29	0.83	5.0	0.24	8.82	2.11					
C	C	0.15	0.88	5.5	0.14	8.61	1.16					
D	D	0.22	0.85	5.0	0.19	8.82	1.66					
UD-1	UD-1	0.16	0.77	7.6	0.12	7.78	0.95					
UD-2	UD-2	0.18	0.44	5.0	0.08	8.82	0.71					
UD-3	UD-3	0.14	0.87	8.1	0.12	7.60	0.93					

SUMMARY - PROPOSED RUNOFF TABLE				
DESIGN POINT	BASIN DESIGNATION	BASIN AREA (ACRES)	DIRECT 5-YR RUNOFF (CFS)	DIRECT 100-YR RUNOFF (CFS)
R	R	0.12	0.29	0.84
A	A	0.21	0.54	1.58
B	B	0.29	0.71	2.11
C	C	0.15	0.41	1.16
D	D	0.22	0.57	1.66
UD-1	UD-1	0.16	0.29	0.95
UD-2	UD-2	0.18	0.01	0.71
UD-3	UD-3	0.14	0.33	0.93
SITE TOTAL		1.48	3.15	9.94
	(CAPTURED)	1.00	2.52	7.35
	(UNDETAINED)	0.48	0.63	2.59

ROOF				
NRCS Soil Group	Storm Return Period			
	2-Year	5-Year	10-Year	100-Year
A				
B	0.74	0.76	0.78	0.84
C/D	0.74	0.77	0.80	0.85

LANDSCAPE				
NRCS Soil Group	Storm Return Period			
	2-Year	5-Year	10-Year	100-Year
A				
B	0.01	0.01	0.07	0.44
C/D	0.01	0.05	0.15	0.49

PAVEMENT				
NRCS Soil Group	Storm Return Period			
	2-Year	5-Year	10-Year	100-Year
A				
B	0.84	0.86	0.86	0.90
C/D	0.83	0.86	0.87	0.89

I (%)	
ROOF	90.00%
LANDSCAPE	2.00%
PAVEMENT	100.00%

Soil Type
A
B
C/D

Table 6-4. Runoff coefficient equations based on NRCS soil group and storm return period

NRCS Soil Group	Storm Return Period						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
A	$C_A=$ $0.84i^{1.302}$	$C_A=$ $0.86i^{1.276}$	$C_A=$ $0.87i^{1.232}$	$C_A=$ $0.88i^{1.124}$	$C_A=$ $0.85i+0.025$	$C_A=$ $0.78i+0.110$	$C_A=$ $0.65i+0.254$
B	$C_B=$ $0.84i^{1.169}$	$C_B=$ $0.86i^{1.088}$	$C_B=$ $0.81i+0.057$	$C_B=$ $0.63i+0.249$	$C_B=$ $0.56i+0.328$	$C_B=$ $0.47i+0.426$	$C_B=$ $0.37i+0.536$
C/D	$C_{C/D}=$ $0.83i^{1.122}$	$C_{C/D}=$ $0.82i+0.035$	$C_{C/D}=$ $0.74i+0.132$	$C_{C/D}=$ $0.56i+0.319$	$C_{C/D}=$ $0.49i+0.393$	$C_{C/D}=$ $0.41i+0.484$	$C_{C/D}=$ $0.32i+0.588$

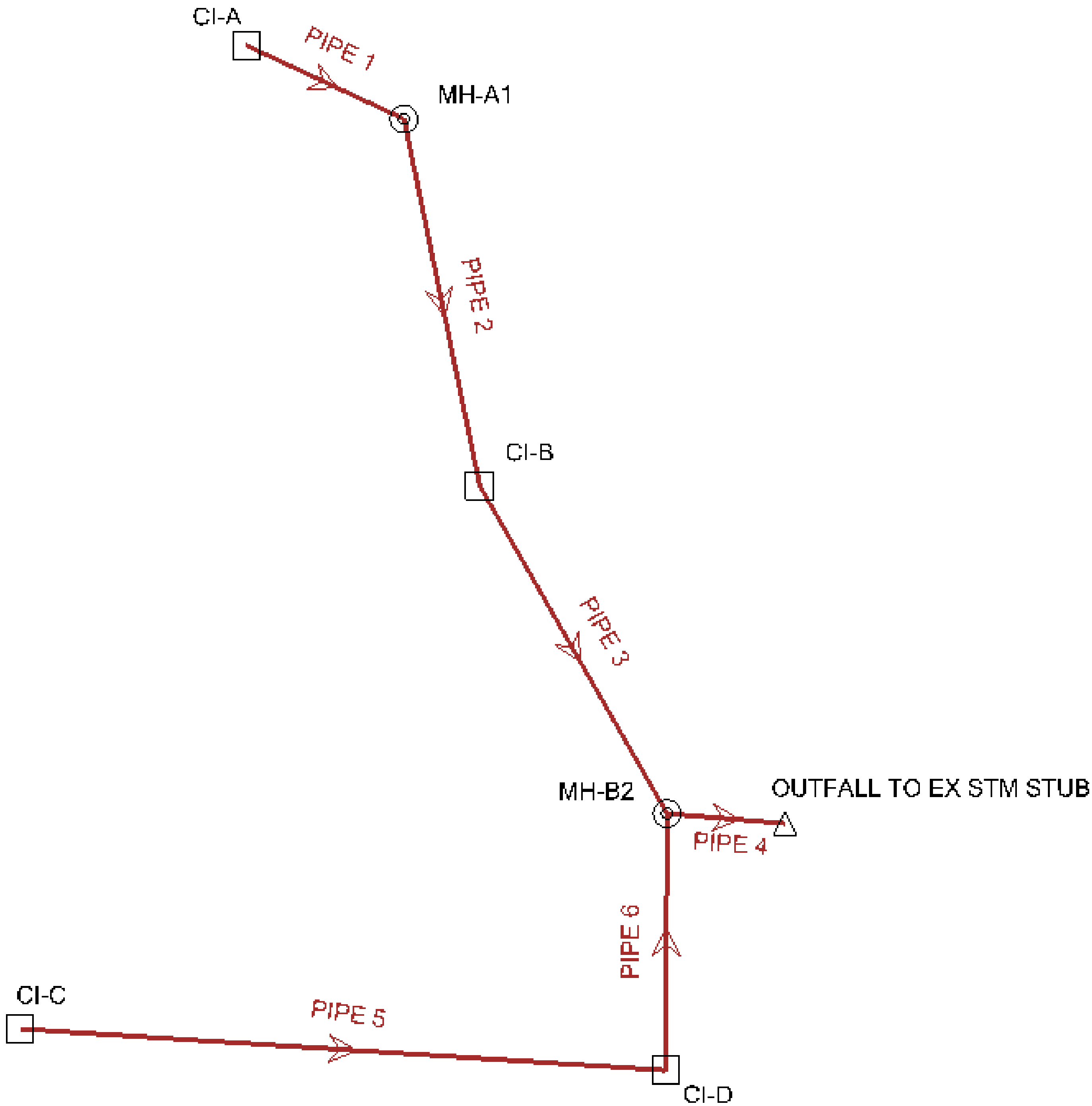
APPENDIX C – HYDRAULIC COMPUTATIONS

StormCAD Map

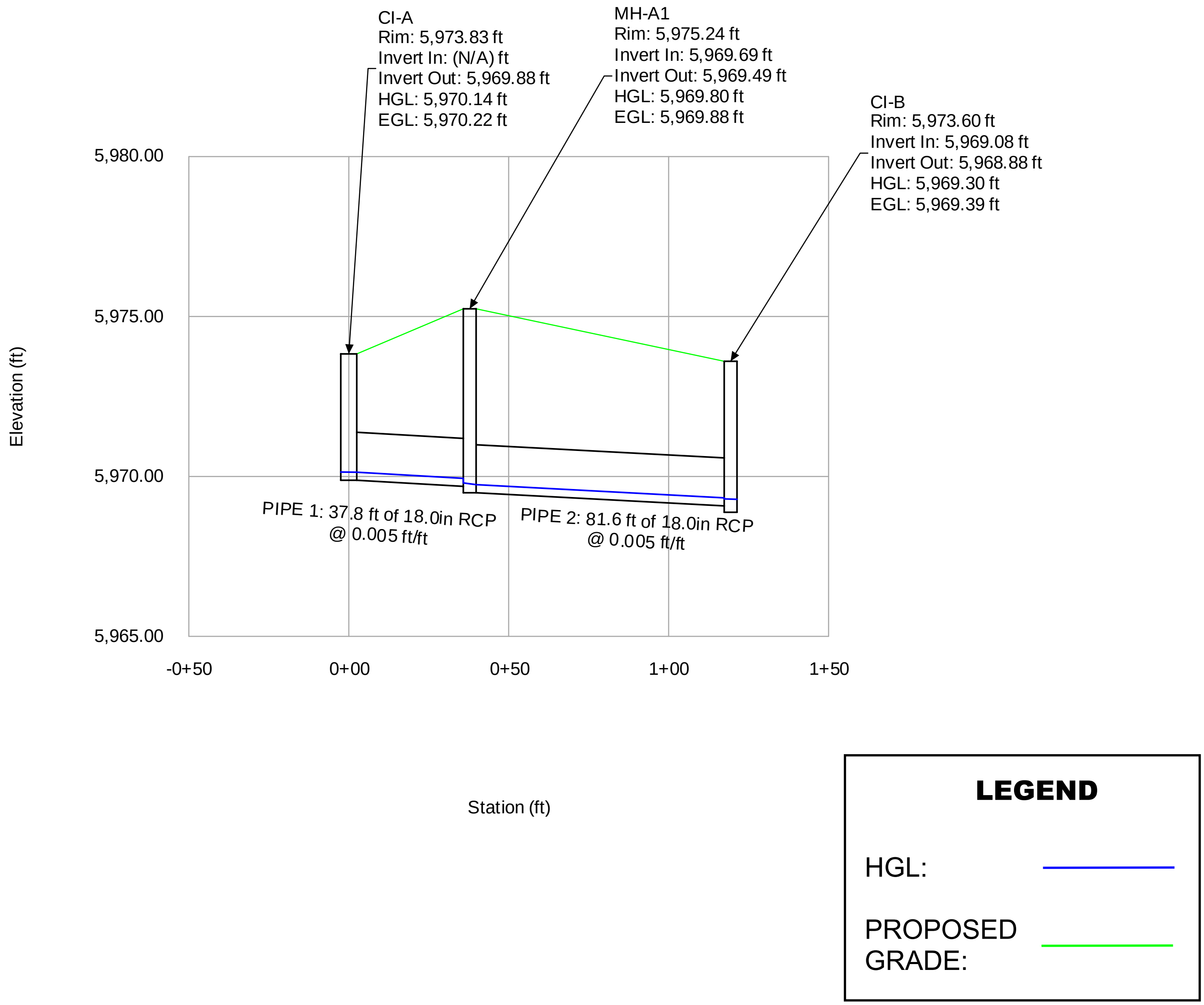
StormCAD Results Tables

StormCAD Result Profiles (100yr and 5yr)

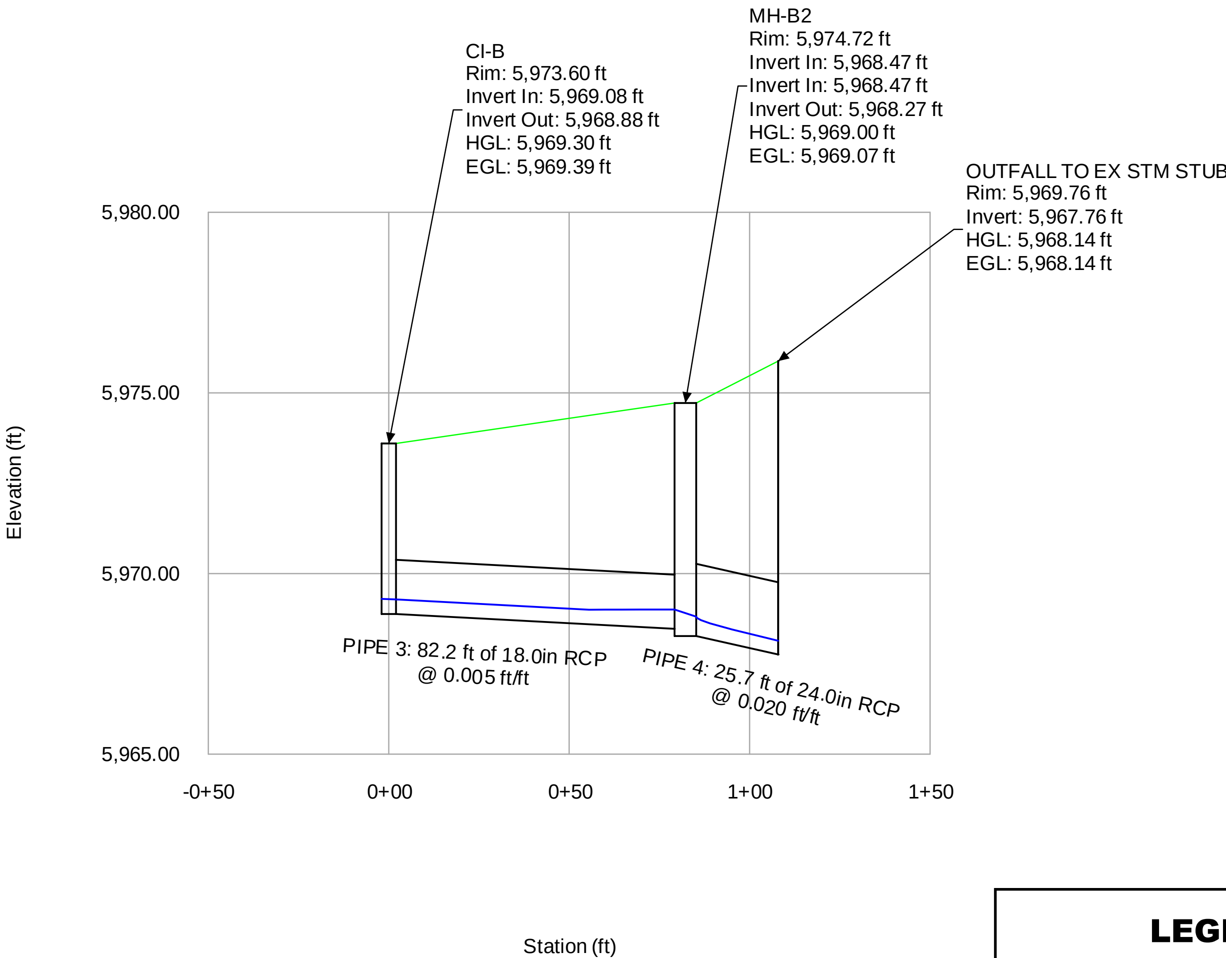
McDonald's Parker Stroh
StormCAD Layout

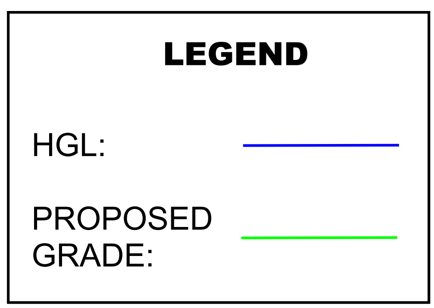


Profile Report
Engineering Profile - STRM A (McDonald's Parker Stroh_StormCAD.stsw)
5-YR

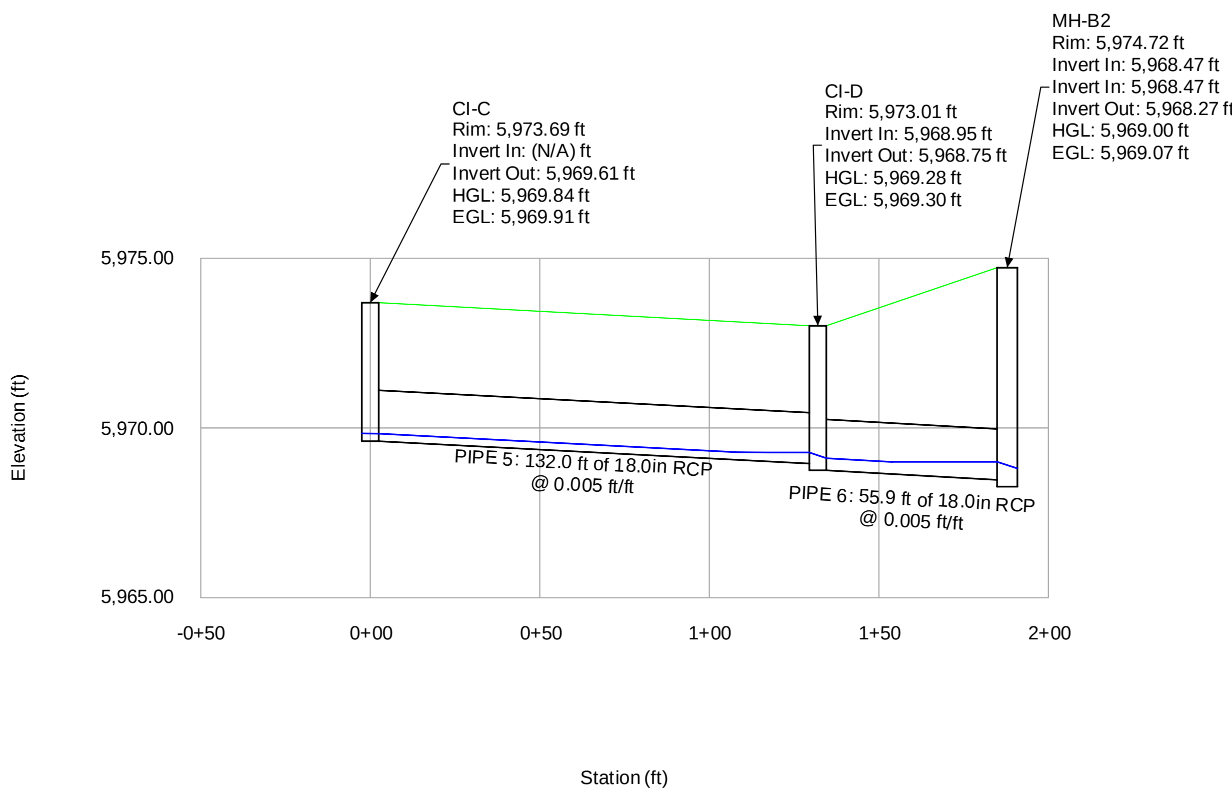


Profile Report
Engineering Profile - STRM B (McDonald's Parker Stroh_StormCAD.stsw)
5-YR



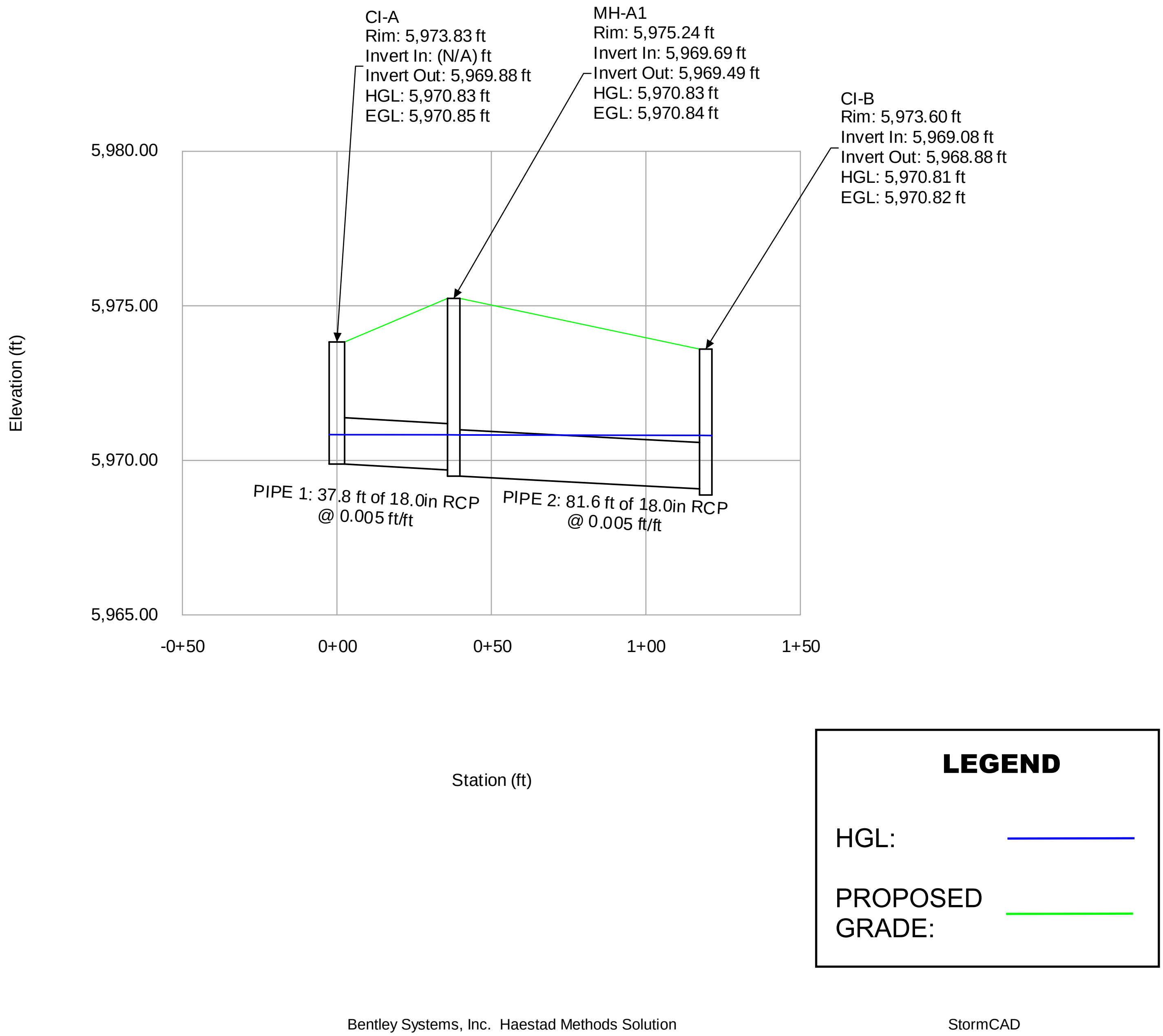


Profile Report
Engineering Profile - STRM C (McDonald's Parker Stroh_StormCAD.stsw)
5-YR

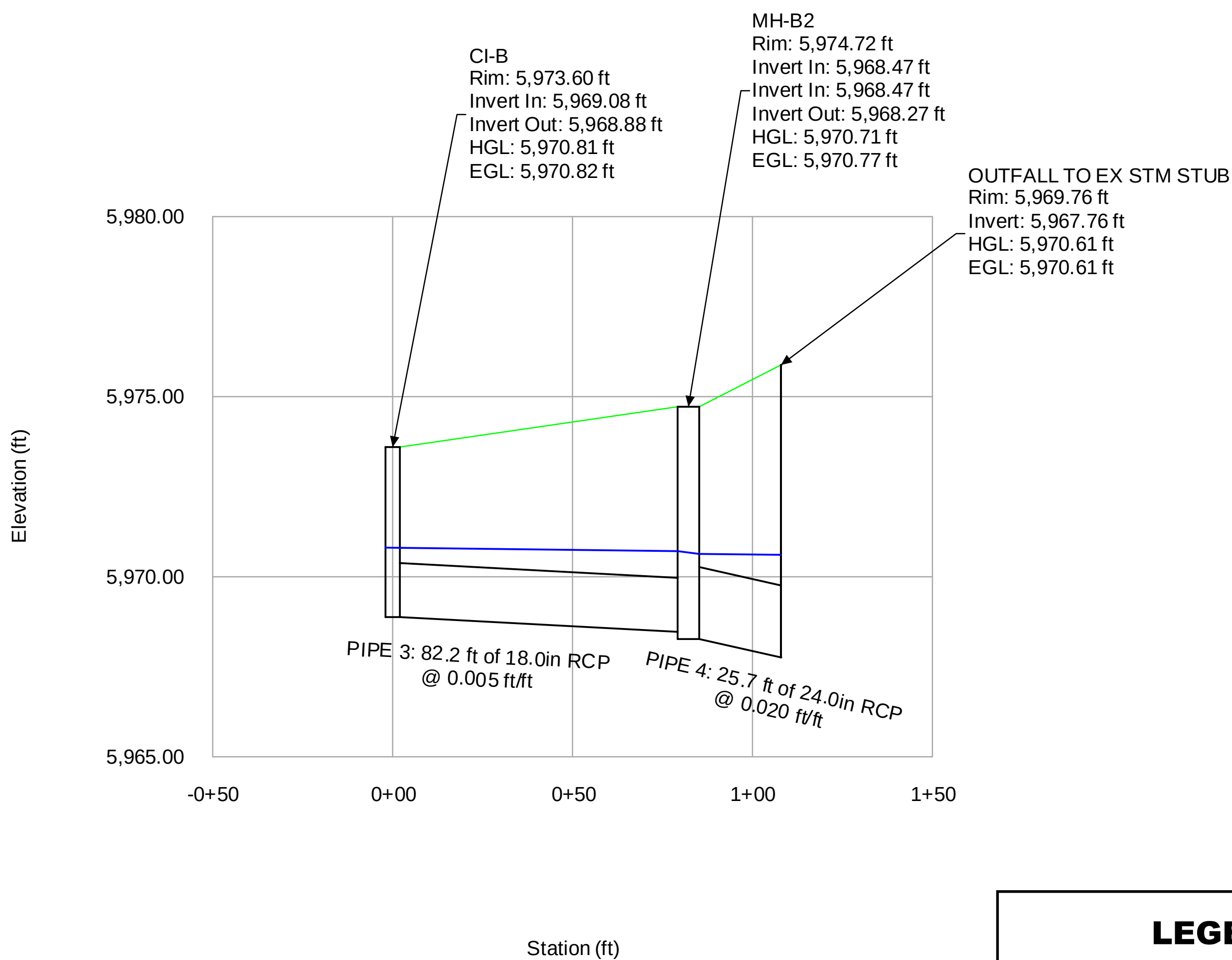


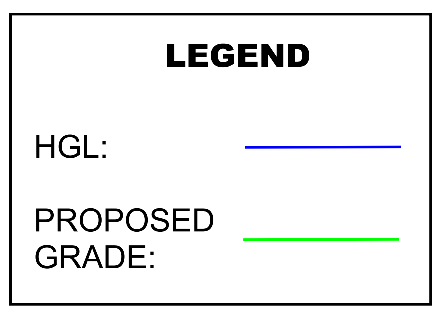
LEGEND	
HGL:	(blue line)
PROPOSED GRADE:	(green line)

Profile Report
Engineering Profile - STRM A (McDonald's Parker Stroh_StormCAD.stsw)
100-YR

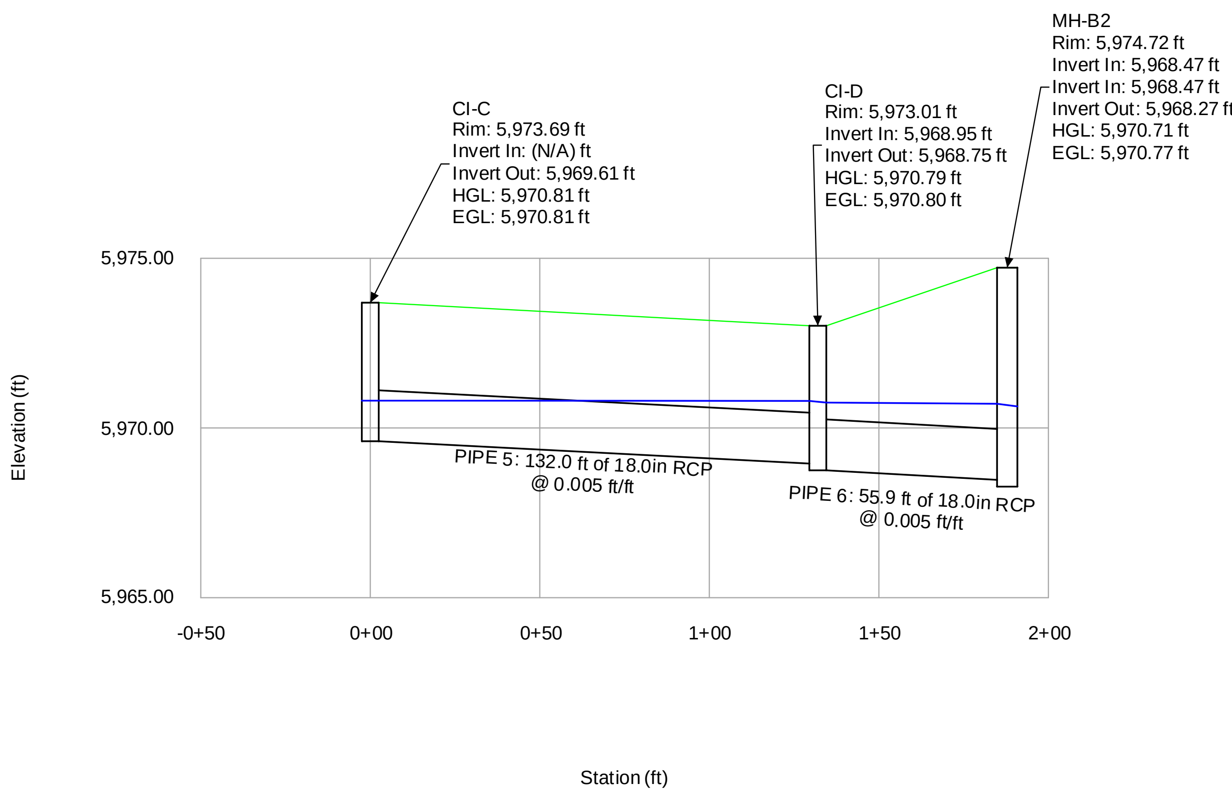


Profile Report
Engineering Profile - STRM B (McDonald's Parker Stroh_StormCAD.stsw)
100-YR





Profile Report
Engineering Profile - STRM C (McDonald's Parker Stroh_StormCAD.stsw)
100-YR



LEGEND

HGL:

PROPOSED GRADE:

5-YR

FlexTable: Catch Basin Table

Label	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
CI-A	0.46	5,970.14	5,970.13	5,970.22	5,970.22	0.050	0.00
CI-B	1.17	5,969.30	5,969.28	5,969.39	5,969.43	0.100	0.01
CI-D	0.93	5,969.28	5,969.11	5,969.30	5,969.24	1.320	0.17
CI-C	0.36	5,969.84	5,969.83	5,969.91	5,969.91	0.050	0.00

5-YR

FlexTable: Conduit Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
PIPE 2	MH-A1	CI-B	81.6	0.005	18.0	0.013	0.46	2.34	7.45	6.2
PIPE 1	CI-A	MH-A1	37.8	0.005	18.0	0.013	0.46	2.34	7.45	6.2
PIPE 4	MH-B2	OUTFALL TO EX STM STUB	25.7	0.020	24.0	0.013	2.39	5.96	31.86	7.5
PIPE 3	CI-B	MH-B2	82.2	0.005	18.0	0.013	1.17	3.06	7.42	15.8
PIPE 6	CI-D	MH-B2	55.9	0.005	18.0	0.013	0.93	2.87	7.44	12.5
PIPE 5	CI-C	CI-D	132.0	0.005	18.0	0.013	0.36	2.17	7.43	4.8

5-YR

FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
MH-A1	0.46	5,969.80	5,969.74	5,969.88	5,969.83	0.640	0.05
MH-B2	2.39	5,969.00	5,968.81	5,969.07	5,969.00	1.020	0.20

100-YR

FlexTable: Catch Basin Table

Label	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
CI-A	1.37	5,970.83	5,970.83	5,970.85	5,970.85	0.050	0.00
CI-B	3.48	5,970.81	5,970.80	5,970.82	5,970.86	0.100	0.01
CI-D	2.66	5,970.79	5,970.75	5,970.80	5,970.78	1.320	0.05
CI-C	1.00	5,970.81	5,970.81	5,970.81	5,970.81	0.050	0.00

100-YR

FlexTable: Conduit Table

Label	Start Node	Stop Node	Length (User Defined) (ft)	Slope (Calculated) (ft/ft)	Diameter (in)	Manning's n	Flow (cfs)	Velocity (ft/s)	Capacity (Full Flow) (cfs)	Flow / Capacity (Design) (%)
PIPE 2	MH-A1	CI-B	81.6	0.005	18.0	0.013	1.37	3.21	7.45	18.4
PIPE 1	CI-A	MH-A1	37.8	0.005	18.0	0.013	1.37	3.21	7.45	18.4
PIPE 4	MH-B2	OUTFALL TO EX STM STUB	25.7	0.020	24.0	0.013	6.98	2.22	31.86	21.9
PIPE 3	CI-B	MH-B2	82.2	0.005	18.0	0.013	3.48	1.97	7.42	46.9
PIPE 6	CI-D	MH-B2	55.9	0.005	18.0	0.013	2.66	1.51	7.44	35.8
PIPE 5	CI-C	CI-D	132.0	0.005	18.0	0.013	1.00	2.93	7.43	13.5

100-YR

FlexTable: Manhole Table

Label	Flow (Total Out) (cfs)	Hydraulic Grade Line (In) (ft)	Hydraulic Grade Line (Out) (ft)	Energy Grade Line (In) (ft)	Energy Grade Line (Out) (ft)	Headloss Coefficient (Standard)	Headloss (ft)
MH-A1	1.37	5,970.83	5,970.82	5,970.84	5,970.83	0.640	0.01
MH-B2	6.98	5,970.71	5,970.63	5,970.77	5,970.71	1.020	0.08

APPENDIX D – INLET COMPUTATIONS

UD-Inlet Sizing

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet A	Inlet B	Inlet C
Site Type (Urban or Rural)	URBAN	URBAN	URBAN
Inlet Application (Street or Area)	STREET	STREET	STREET
Hydraulic Condition	In Sump	In Sump	In Sump
Inlet Type	CDOT/Denver 13 Combination	CDOT Type R Curb Opening	CDOT/Denver 13 Valley Grate

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.5	0.7	0.4
Major Q_{Known} (cfs)	1.6	2.1	1.2

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received	No Bypass Flow Received	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0	0.0	0.0

Watershed Characteristics

Subcatchment Area (acres)			
Percent Impervious			
NRCS Soil Type			

Watershed Profile

Overland Slope (ft/ft)			
Overland Length (ft)			
Channel Slope (ft/ft)			
Channel Length (ft)			

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)			
One-Hour Precipitation, P_1 (inches)			

CALCULATED OUTPUT

Minor Total Design Peak Flow, Q (cfs)	0.5	0.7	0.4
Major Total Design Peak Flow, Q (cfs)	1.6	2.1	1.2
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A	N/A	N/A

MHFD-Inlet, Version 5.01 (April 2021)

INLET MANAGEMENT

Worksheet Protected

INLET NAME	Inlet D
Site Type (Urban or Rural)	URBAN
Inlet Application (Street or Area)	STREET
Hydraulic Condition	In Sump
Inlet Type	CDOT/Denver 13 Combination

USER-DEFINED INPUT

User-Defined Design Flows

Minor Q_{Known} (cfs)	0.6
Major Q_{Known} (cfs)	1.7

Bypass (Carry-Over) Flow from Upstream

Receive Bypass Flow from:	No Bypass Flow Received
Minor Bypass Flow Received, Q_b (cfs)	0.0
Major Bypass Flow Received, Q_b (cfs)	0.0

Watershed Characteristics

Subcatchment Area (acres)	
Percent Impervious	
NRCS Soil Type	

Watershed Profile

Overland Slope (ft/ft)	
Overland Length (ft)	
Channel Slope (ft/ft)	
Channel Length (ft)	

Minor Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

Major Storm Rainfall Input

Design Storm Return Period, T_r (years)	
One-Hour Precipitation, P_1 (inches)	

CALCULATED OUTPUT

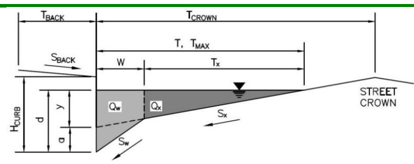
Minor Total Design Peak Flow, Q (cfs)	0.6
Major Total Design Peak Flow, Q (cfs)	1.7
Minor Flow Bypassed Downstream, Q_b (cfs)	N/A
Major Flow Bypassed Downstream, Q_b (cfs)	N/A

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

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

Project: McDonald's Stroh, Parker, CO

Inlet ID: Inlet A



Gutter Geometry:

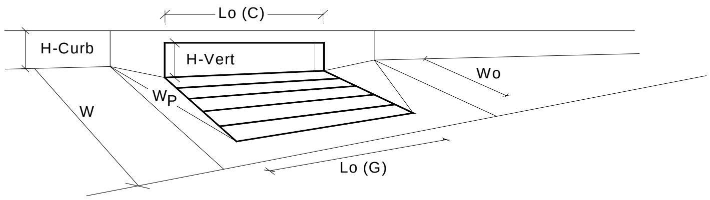
Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		ft/ft
Manning's Roughness Behind Curb (typically between 0.012 and 0.020)	n_{BACK} =	0.020	
Height of Curb at Gutter Flow Line	H_{CURB} =	6.00	inches
Distance from Curb Face to Street Crown	T_{CROWN} =	20.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.013	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} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	18.0	18.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	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

MHFD-Inlet, Version 5.01 (April 2021)



Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT/Denver 13 Combination)	Type =	CDOT/Denver 13 Combination		
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 =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.5	4.5	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) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	

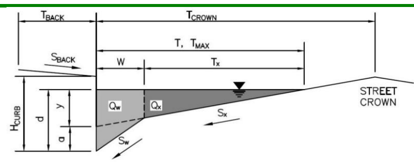
Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.395	0.395	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.21	0.21	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.70	0.70	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.70	0.70	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	1.6	1.6	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.5	1.6	cfs

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

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

Project: McDonald's Stroh, Parker, CO
Inlet ID: Inlet B



<u>Gutter Geometry:</u>

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		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} =	11.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.027	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} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	9.0	9.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	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

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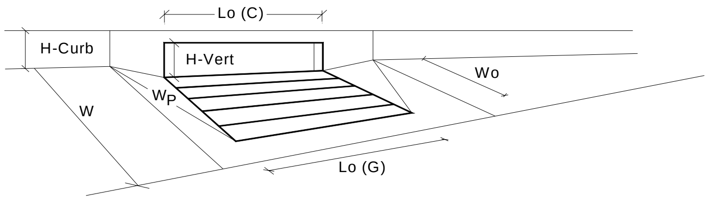


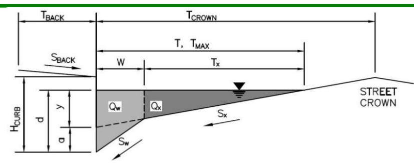
Design Information (Input)	CDOT Type R Curb Opening		MINOR	MAJOR	
Type of Inlet		Type =	CDOT Type R Curb Opening		
Local Depression (additional to continuous gutter depression 'a' from above)		a_{local} =	3.00	3.00	inches
Number of Unit Inlets (Grate or Curb Opening)		No =	1	1	
Water Depth at Flowline (outside of local depression)		Ponding Depth =	4.3	4.3	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} =	0.19	0.19	ft
Combination Inlet Performance Reduction Factor for Long Inlets		$RF_{Combination}$ =	0.55	0.55	
Curb Opening Performance Reduction Factor for Long Inlets		RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets		RF_{Grate} =	N/A	N/A	
			MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)		Q_a =	2.3	2.3	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)		$Q_{PEAK\ REQUIRED}$ =	0.7	2.1	cfs

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

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

Project: McDonald's Stroh, Parker, CO

Inlet ID: Inlet C



<u>Gutter Geometry:</u>

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		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} =	10.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.026	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} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	10.0	10.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	inches
Check boxes are not applicable in SUMP conditions		☐	☐	

MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

	Minor Storm	Major Storm	
Q_{allow} =	SUMP	SUMP	cfs

INLET IN A SUMP OR SAG LOCATION

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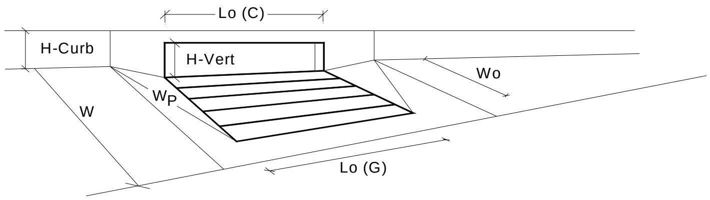


Design Information (Input)		MINOR	MAJOR	
Type of Inlet — CDOT/Denver 13 Valley Grate	Type =	CDOT/Denver 13 Valley Grate		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.5	4.5	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} =	0.398	0.398	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} =	0.70	0.70	

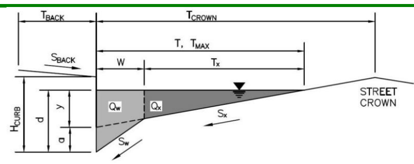
		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	1.3	1.3	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.4	1.2	cfs

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

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

Project: McDonald's Stroh, Parker, CO

Inlet ID: Inlet D



<u>Gutter Geometry:</u>

Maximum Allowable Width for Spread Behind Curb	T_{BACK} =	0.0	ft
Side Slope Behind Curb (leave blank for no conveyance credit behind curb)	S_{BACK} =		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} =	10.0	ft
Gutter Width	W =	2.00	ft
Street Transverse Slope	S_X =	0.043	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} =	0.013	

		Minor Storm	Major Storm	
Max. Allowable Spread for Minor & Major Storm	T_{MAX} =	7.0	7.0	ft
Max. Allowable Depth at Gutter Flowline for Minor & Major Storm	d_{MAX} =	6.0	6.0	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

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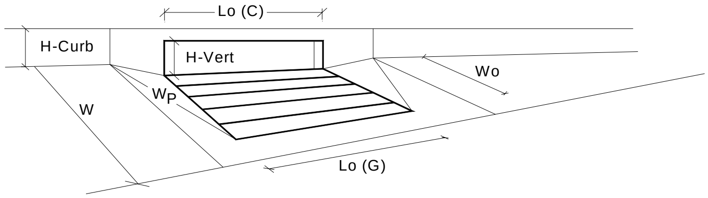


Design Information (Input)		MINOR	MAJOR	
Type of Inlet (CDOT/Denver 13 Combination)	Type =	CDOT/Denver 13 Combination		
Local Depression (additional to continuous gutter depression 'a' from above)	a_{local} =	2.00	2.00	inches
Number of Unit Inlets (Grate or Curb Opening)	No =	1	1	
Water Depth at Flowline (outside of local depression)	Ponding Depth =	4.6	4.6	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) =	3.00	3.00	feet
Height of Vertical Curb Opening in Inches	H_{vert} =	6.50	6.50	inches
Height of Curb Orifice Throat in Inches	H_{throat} =	5.25	5.25	inches
Angle of Throat (see USDCM Figure ST-5)	Theta =	0.00	0.00	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) =	3.70	3.70	
Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)	C_o (C) =	0.66	0.66	

Low Head Performance Reduction (Calculated)		MINOR	MAJOR	
Depth for Grate Midwidth	d_{Grate} =	0.405	0.405	ft
Depth for Curb Opening Weir Equation	d_{Curb} =	0.22	0.22	ft
Combination Inlet Performance Reduction Factor for Long Inlets	$RF_{Combination}$ =	0.72	0.72	
Curb Opening Performance Reduction Factor for Long Inlets	RF_{Curb} =	1.00	1.00	
Grated Inlet Performance Reduction Factor for Long Inlets	RF_{Grate} =	0.72	0.72	

		MINOR	MAJOR	
Total Inlet Interception Capacity (assumes clogged condition)	Q_a =	1.7	1.7	cfs
Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)	$Q_{PEAK\ REQUIRED}$ =	0.6	1.7	cfs

INLET PICTURES

CDOT Type R Curb Opening

Denver No. 14 Curb Opening

Colorado Springs D-10-R

CDOT/Denver 13 Valley Grate

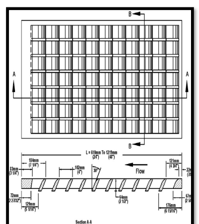
CDOT/Denver 13 Combination

Denver No. 16 Combination

Wheat Ridge Combination Inlet

Denver No. 16 Valley Grate

Directional Cast Vane Grate

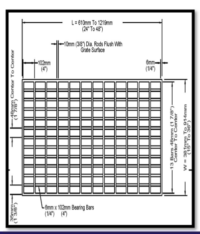


Directional 30-Degree Bar Grate (courtesy HEC-22)

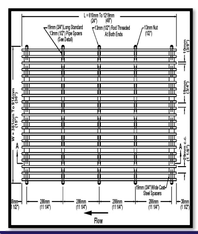
Directional 45-Degree Bar Grate

Reticuline Riveted Grate

1-7/8" Bar Grate, Crossbars @ 8"



1-7/8" Bar Grate, Crossbars @ 4" (courtesy HEC-22)



1-1/8 in. Bar Grate, Crossbars @ 8 in. (courtesy HEC-22)

Slotted Inlet Parallel to Flow

CDOT Type C Grate (Close Mesh)

CDOT Type C Grate

CDOT Type C Inlet

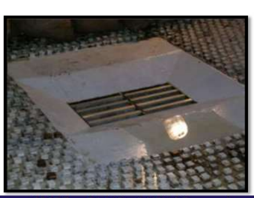
CDOT Type C Inlet in Depression

CDOT Type D Inlet In Series (Flat & Depressed)

CDOT Type D Inlet In Series (10° Incline & Depressed)

CDOT Type D Inlet In Series (20° Incline & Depressed)

CDOT Type D Inlet In Series (30° Incline & Depressed)



CDOT Type D Inlet Parallel (Flat & Depressed)

CDOT Type D Inlet Parallel (10° Incline & Depressed)

CDOT Type D Inlet Parallel (20° Incline & Depressed)

CDOT Type D Inlet Parallel (30° Incline & Depressed)

APPENDIX E – REFERENCE REPORT EXCERPTS

Final Drainage Report for Parker Pointe

FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO

PREPARED FOR:
PARKER & STROH, LLC
975 LINCOLN STREET, SUITE 204
DENVER, CO 80203

CONTACT: DAN YACOVETTA
303-699-3368

Perception design group, inc.

6901 SOUTH PIERCE STREET, SUITE 315
LITTLETON, CO 80128
CONTACT: JERRY DAVIDSON, P.E.
(303) 232-5255

JOB #2015-015

NOVEMBER 28, 2018

FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO

I. CERTIFICATION PAGE

This report for the final design of (Name of Development) was prepared by me or under my direct supervision in accordance with the provisions of the Town of Parker Storm Drainage and Environmental Criteria Manual. I understand that the Town of Parker and its designated town authority do not and will not assume liability for drainage facilities designed by others.

____

Jerry W. Davidson, P.E.
Colorado P.E. License No. 30226
For and on Behalf of
Perception Design Group, Inc.

____

Seal and Date

FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO

II GENERAL LOCATION AND DESCRIPTION

A. Site Location:

This Final Drainage Report is prepared by Perception Design Group, Inc. as part of the Construction Plan / Final Plat submittal process for the Parker Pointe project proposed in Parker, Colorado. Parker Pointe, (Project / Site) is located on an unplatted parcel of land situated at the southeast corner of South Parker Road and Stroh Road. See appendix for vicinity map. The Site lies within the southwest quarter of Section 3, Township 7 South, Range 66 West of the 6th Prime Meridian, Douglas County, State of Colorado. The site is bounded by South Parker Road to the west, and Stroh Road to the north. Adjacent developments include the Colorado Golf club in Douglas County to the east, new commercial and residential development in the Town of Parker on the north side of Stroh Road, Commercial development in Parker on the west side of Parker Road, and undeveloped open space in Douglas County south of the property.

B. Site Location:

The Site occupies approximately 14.7 acres. Ground cover consists of pasture grasses. Site topography generally slopes from a tall mound in the northerly portion of the site down to the southwest towards Kinney Creek. Runoff north of the mound flows northwesterly towards the intersection of Stroh Road and Parker Road. Slopes vary widely from 3:1 on the mound to 6% over flatter portions of the site.

Site soils as shown by the USDA Web Soil Survey indicate that primarily Sampson Loam and Bresser Truckton Sandy Loam soil is present. This soil is sandy clay loam in nature. It is a type B hydrologic soil. Additionally Loamy Alluvial Land soils are present to a lesser extent. This soil is also clay loam in nature. It is a type C hydrologic soil.

The site falls within the Cherry Creek basin. The Kinney Creek tributary lies along the southern border of the site. This tributary has a delineated floodplain which encroaches on the extreme southwest corner of the site.

There are no irrigation canals or ditches on site. Additionally, there are no significant geologic features on site.

The site is presently partially developed with a house and barns. These structures are to be removed as a part of the proposed development. As a part of this application, the site will be developed with graded pad sites for commercial and retail businesses, drives, and utilities.

III DRAINAGE BASINS AND SUB-BASINS

A. Major Drainage Basins:

The site falls within two major drainage basins. The southerly portion of the site is tributary to Kinney Creek. Areas from the peak of the aforementioned mound and to the north are tributary to Stroh Gulch. The southerly line of basin H1 defines the historic break between the two basins. Per the Town of Parker, the majority of this runoff to Stroh Gulch is captured and conveyed via storm sewer to the new detention pond and ultimately to Kinney Creek. A final drainage report was prepared for Stroh Crossing Filing No. 1 by Calibre Engineering. This is the development on the north side of Stroh Road. This report anticipated runoff from the Parker Pointe property and made allowance to handle the flow. Basin ST-2b from the Calibre report quantifies 18.9 cfs for the basin. Basin SR2 in this report indicates 4.1 cfs tributary to Stroh Road downstream of the newly placed inlet on Stroh Road for Basin SR1plus carryover from Inlet SR1 of 3.2 cfs for a total tributary to Stroh Gulch of 7.3 cfs.

Kinney Creek was studied by WRC Engineering Inc. in a report entitled "Flood Hazard Area Delineation for Kinney Creek Fonder Draw and Tributaries" date April 2004. Floodplain was determined along the southwest corner of the site. Minor grading is proposed in the floodplain along Parker Road. Roadway widening encroaches upon and places fill in the floodplain. To mitigate this the shoulder borrow ditch is shifted east in similar size to replace filled floodplain with like volume and shape.

B. Minor Drainage Basins:

To facilitate design, the site is divided into multiple sub-basins described as follows:

Basins L1 thru L15 are used to represent each of the proposed lots. As development conditions are not yet determined, an assumed 95% imperviousness is established for each basin. A storm sewer stub is provided for each lot to convey developed runoff to the extended detention basin at the southeast corner of the site providing both detention and water quality facilities. While Basins L10 thur L15 drain towards Parker road in the overlot condition, it is required that these lots convey site runoff to the mainline storm sewer down the center access drive. Due to the presence of the Magellan gas pipeline and it's limited cover requirements as well as site visibility lines to the easterly lots, The west side of lots 10 thru 15 will remain below the center access drive. The storm sewer has been placed at maximum depth to accommodate these lots "bucking" grade with the storm sewer system.

Basins L1A thru L5A represents the easterly portion of Lots 1 thru 5. Runoff from these basins flow overland to the east to the drainage swale along the east property line thence into the extended detention facility. As development conditions are not yet determined, an assumed 95% imperviousness is established for each basin.

Basins IN1 thru IN3 are established to quantify runoff collected in a series of inlets along the central north-south access drive. This runoff is piped to the extended detention basin at the southeast corner of the site providing both detention and water quality facilities.

Basin SR1 is used to quantify runoff to Stroh Road from the road itself as well as offsite areas to the east. Detention and water quality are provided for this basin. See additional discussion under Major Basins above.

Basin SR2 (along with basin U4) is used to quantify runoff to the new inlet at the intersection of Stroh Road and Parker Road. Detention and water quality are not provided for this basin.

Basin PR1 combines with Basins U2 and PR2 to define runoff to the new pair of inlets located at the low point of Parker Road. Basin PR1 is separated to quantify new paved area requiring water quality treatment. Treatment for Basin PR1 combined with Basin U2 is provided in a grass swale in the ROW of Parker Road leading down to Kinney Creek.

Basin PR2 is used to quantify runoff from existing Parker Road improvements to the new pair of inlets located at the low point of Parker Road. Water quality is not provided for this basin. Total flow to the inlets is a combination of Basins PR1, PR2, and U2.

Basin PR3 is not illustrated on the plan. This basin is used to quantify new paved areas in Parker Road north of Stroh Road. This basin encompasses the new left turn bay on Prker Road to Stroh Road. Runoff from this basin is treated for water quality in the existing grass buffer along the west side of Parker Road.

Basin U1 is on-site area that is not tributary to the detention / water quality facility. This basin encompasses Tracts A and B which are floodplain and mouse habitat areas. Detention and water quality are not provided for this basin.

Basin U2 is on-site area that is not tributary to the detention / water quality facility. This basin quantifies runoff escaping the site down the access road to Parker Road. Detention is not provided for this basin, however, water quality is provided in the grass swale referenced above in the PR1 basin description.

Basin U3 is on-site area that is not tributary to the detention / water quality facility. Runoff from this basin adjacent to Parker Road flows overland into Parker Road.

Detention and water quality are not provided for this basin.

Basin U4 is on-site area that is not tributary to the detention / water quality facility. Runoff from this basin enters Stroh Road and is collected in inlet SR2.

Basin H1 is a historic basin quantifying historic runoff to Stroh Road. It is used as a check for Calibre basin ST-2b. Basin H1 indicates runoff of 17.0 cfs while basin ST2-b indicates 18.9 cfs. Variance is due to more accurate topography available for the Parker Pointe site and better defined drainage basin as well as differences in time of concentration.

Basin OS1 quantifies flows entering the extended detention pond from offsite flows from the Colorado Golf Club property east of the Parker Pointe property. Detention and water quality are provided for this offsite flow area in its present condition.

IV DRAINAGE DESIGN CRITERIA

A. Regulations:

Design calculations and methodologies are based upon the Town of Parker Storm Drainage and Environmental Criteria Manual. Additionally, the Urban Drainage Storm Drainage Criteria Manual Volumes 1 thru 3 are utilized.

B. Drainage Studies, Outfall System Plans:

The Final Drainage Report for Stroh Crossing Filing No. 1 by Calibre Engineering is used to identify allowable site discharge to Stroh Gulch. The WRC Engineering Inc. report entitled “Flood Hazard Area Delineation for Kinney Creek Fonder Draw and Tributaries” date April 2004 was utilized to map the floodplain elevations along the south property line. This study has negligible impact on the design presented.

C. Hydrology:

Runoff is calculated for both the 5 year and 100 year storms using the rational method. On-site basins utilize a 5 minute time of concentration with 5 year intensity of 4.7 in/hr and 100 year at 8.85 in/hr. Detention storage volumes are calculated using the UDFCD ver 3.07 UD-Detention spreadsheet. This spreadsheet is also utilized to calculate allowable release rates.

D. Hydraulics:

Storm sewer capacities are calculated using Hydraflow Storm Sewers extension for AutoCAD Civil 3D ver 2017. The system is designed such to provide minimal surcharge for the 100 year event, and no surcharge for the 5 year event. The Hydraflow software is also used to calculate hydraulic grade lines for the storm sewer.

E. Water Quality Enhancement:

Water quality is achieved in an extended detention facility designed to EURV specifications using UDFCD ver 3.07 UD-Detention spreadsheet.

V STORMWATER MANAGEMENT FACILITY DESIGN

A. Stormwater Conveyance Facilities:

Developed stormwater is generally conveyed towards the central north south driveway where stubs are provided that connect to a storm sewer mainline. The storm main runs in a southerly then easterly direction to the proposed EDB detention facility. Total developed site runoff tributary to the EDB is 146.51 cfs. Storm sewer outfall into the EDB occurs at a concrete forebay. Outfall from the EDB is controlled to code levels and discharged via storm sewer pipe to Kinney Creek where riprap is provided to control erosion. Storm sewer is placed in an easement for perpetual maintenance. Do to the depth of the pond and invert of the adjacent Kinney Creek, outfall is piped westerly to discharge near the box culvert under Parker Road where more favorable elevations exist.

B. Stormwater Storage Facilities:

Stormwater storage on site is accomplished in an extended detention basin located offsite near the southeast corner of the site. Required pond design elements are summarized below:

Volume Element	Volume	Elevation	Release Rate
WQCV	0.566 Ac-Ft	5966.12	41 hours
EURV + WQCV	1.472 Ac-Ft	5968.03	70 hours
100 year	2.753 Ac-Ft	5970.05	36.7 cfs
Storage Provided	2.753 Ac-Ft	5970.05	

Outflow metering is accomplished in a concrete outlet structure. 2 orifices are used. One for WQ and EURV while a second is used covering the outfall pipe to limit the 100 year flow. A double type D inlet is proposed to provide sufficient weir flow to accommodate the 100 year release rate. Micropool and trash racks are provided. Emergency overflow occurs directly into Kinney Creek via overflow weir and riprap embankment.

Allowable 100 year discharge must be reduced to allow for uncaptured basin U1 thru U4. The combined 100 year un-detained flow from basins U1 thru U4 is 4.4 cfs. Allowable detention discharge as shown on the UDFCD spreadsheet is 44.5 cfs. The outlet structure design limits discharge to 36.7 cfs. This provides adequate compensation for the uncaptured flows.

A maintenance access is provided entering at the northwest corner of the pond. Roadbase surfacing is provided and slopes not exceeding 10% are employed to enhance access for maintenance. An easement is provided over the pond should Town access, inspection, or repairs be required.

C. Water quality Enhancement Best Management Practices:

The EDB pond design includes water quality capture volume. Developed flows are conveyed via underground storm sewer to a single discharge point into the pond. At this point, a concrete forebay is provided to capture heavier particulate material.

Water quality treatment is also provided for the new paved areas of Parker Road. Basin PR1 is treated in a grass swale with discharge to Kinney Creek. Basin PR3 is treated in the existing grass buffer along the west side of Parker Road north of Stroh Road. UDFCD spreadsheets are provided for each treatment facility in the appendix.

D. Floodplain Modification:

Minor grading is proposed in the floodplain along Parker Road. Roadway widening encroaches upon and places fill in the floodplain. To mitigate this the shoulder borrow ditch is shifted east in similar size to replace filled floodplain with like volume and shape. A floodplain development permit will be required for this work as well as disturbances due to outfall construction. A no rise analysis has been performed and the results indicating compliance are included in the appendix.

E. Additional Permitting Requirements:

State stormwater permit for discharges during construction.
Town of Parker permits.
Douglas County permits.

V CONCLUSIONS

A. Compliance with Standards:

The plans and calculations presented are in compliance with Town of Parker, Douglas County, and Urban Drainage requirements.

B. Variances:

No variances are requested.

V REFERNCES

Urban Drainage and Flood Control District Drainage Criteria Manual, Current addition.
Town of Parker Storm Drainage Criteria Manual
Town of Parker Construction Best Management Practices
Douglas County Storm Drainage Design and Technical Criteria Manual
USDA Web Soil Survey

FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO

APPENDICES

APPENDIX A **HYDROLOGIC CALCULATIONS**
APPENDIX B **DETENTION AND WATER QUALITY CALCULATIONS**
APPENDIX C **HYDRAULIC CALCULATIONS**
APPENDIX D **KEYMAP, FIRM, SOILS**
APPENDIX E **DRAINAGE MAP**
APPENDIX F **FLOODPLAIN NO RISE REPORT**

FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO

APPENDIX A HYDROLOGIC CALCULATIONS

Perception Design Group, Inc.
6901 South Pierce Street, Suite 315
Littleton, Colorado 80128
(303) 232-8088 Fax (303) 232-5255

Designed by: JWD
Checked by: JWD
Date: 18-Sep-17
Job Number: 2015-015

Project: Parker Pointe

COMPOSITE RUNOFF COEFFICIENTS

TYPE B SOILS

	FUTURE COMMERCIAL		DRIVES/WALKS/ROOF		LANDSCAPING				
Catchment	Area (Ac.)	C	Area (Ac.)	C	Area (Ac.)	C	Composite C	Catchment Area (Ac.)	Imperviousness
	Imperviousness = 95%		Imperviousness = 100%		Imperviousness = 2%				
L5 (5 YR)	0.63	0.81	0.00	0.90	0.00	0.09	**0.81**	0.63	95.0%
L5 (100 YR)	0.63	0.88	0.00	0.96	0.00	0.36	**0.88**	0.63	
L5A (5 YR)	0.24	0.81	0.00	0.90	0.00	0.09	**0.81**	0.24	95.0%
L5A (100 YR)	0.24	0.88	0.00	0.96	0.00	0.36	**0.88**	0.24	
L6 (5 YR)	0.78	0.81	0.00	0.90	0.00	0.09	**0.81**	0.78	95.0%
L6 (100 YR)	0.78	0.88	0.00	0.96	0.00	0.36	**0.88**	0.78	
L7 (5 YR)	0.68	0.81	0.00	0.90	0.00	0.09	**0.81**	0.68	95.0%
L7 (100 YR)	0.68	0.88	0.00	0.96	0.00	0.36	**0.88**	0.68	
L8 (5 YR)	0.87	0.81	0.00	0.90	0.00	0.09	**0.81**	0.87	95.0%
L8 (100 YR)	0.87	0.88	0.00	0.96	0.00	0.36	**0.88**	0.87	
L9 (5 YR)	0.71	0.81	0.00	0.90	0.00	0.09	**0.81**	0.71	95.0%
L9 (100 YR)	0.71	0.88	0.00	0.96	0.00	0.36	**0.88**	0.71	
L10 (5 YR)	0.88	0.81	0.00	0.90	0.00	0.09	**0.81**	0.88	95.0%
L10 (100 YR)	0.88	0.88	0.00	0.96	0.00	0.36	**0.88**	0.88	
L11 (5 YR)	0.92	0.81	0.00	0.90	0.00	0.09	**0.81**	0.92	95.0%
L11 (100 YR)	0.92	0.88	0.00	0.96	0.00	0.36	**0.88**	0.92	

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COMPOSITE RUNOFF COEFFICIENTS

TYPE B SOILS

	FUTURE COMMERCIAL		DRIVES/WALKS/ROOF		LANDSCAPING				
Catchment	Area (Ac.)	C	Area (Ac.)	C	Area (Ac.)	C	Composite C	Catchment Area (Ac.)	Imperviousness
	Imperviousness = 95%		Imperviousness = 100%		Imperviousness = 2%				
L12 (5 YR)	0.56	0.81	0.00	0.90	0.00	0.09	**0.81**	0.56	95.0%
L12 (100 YR)	0.56	0.88	0.00	0.96	0.00	0.36	**0.88**	0.56	
L13 (5 YR)	0.73	0.81	0.00	0.90	0.00	0.09	**0.81**	0.73	95.0%
L13 (100 YR)	0.73	0.88	0.00	0.96	0.00	0.36	**0.88**	0.73	
L14 (5 YR)	0.73	0.81	0.00	0.90	0.00	0.09	**0.81**	0.73	95.0%
L14 (100 YR)	0.73	0.88	0.00	0.96	0.00	0.36	**0.88**	0.73	
L15 (5 YR)	0.72	0.81	0.00	0.90	0.00	0.09	**0.81**	0.72	95.0%
L15 (100 YR)	0.72	0.88	0.00	0.96	0.00	0.36	**0.88**	0.72	
IN1 (5 YR)	0.00	0.81	0.26	0.90	0.00	0.09	**0.90**	0.26	100.0%
IN1 (100 YR)	0.00	0.88	0.26	0.96	0.00	0.36	**0.96**	0.26	
IN2 (5 YR)	0.00	0.81	0.53	0.90	0.00	0.09	**0.90**	0.53	100.0%
IN2 (100 YR)	0.00	0.88	0.53	0.96	0.00	0.36	**0.96**	0.53	
IN3 (5 YR)	0.00	0.81	0.11	0.90	0.00	0.09	**0.90**	0.11	100.0%
IN3 (100 YR)	0.00	0.88	0.11	0.96	0.00	0.36	**0.96**	0.11	
OS1 (5 YR)	0.00	0.81	1.21	0.90	22.13	0.09	**0.13**	23.34	7.1%
OS1 (100 YR)	0.00	0.88	1.21	0.96	22.13	0.36	**0.39**	23.34	
SR1 (5 YR)	0.00	0.81	0.40	0.90	3.35	0.09	**0.18**	3.75	12.5%

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COMPOSITE RUNOFF COEFFICIENTS

TYPE B SOILS

	FUTURE COMMERCIAL		**DRIVES/WALKS/ROOF**		**LANDSCAPING**				
Catchment	Area (Ac.)	C	Area (Ac.)	C	Area (Ac.)	C	Composite C	Catchment Area (Ac.)	Imperviousness
	Imperviousness = 95%		Imperviousness = 100%		Imperviousness = 2%				
SR1 (100 YR)	0.00	0.88	0.40	0.96	3.35	0.36	**0.42**	3.75	
AREA TO POND	11.31	0.88	2.51	0.96	25.48	0.36	0.55	**39.30**	**35.0%**
U1 (5 YR)	0.00	0.81	0.00	0.90	1.37	0.09	**0.09**	1.37	2.0%
U1 (100 YR)	0.00	0.88	0.00	0.96	1.37	0.36	**0.36**	1.37	
U2 (2 YR)	0.00	0.79	0.24	0.89	0.06	0.02	**0.72**	0.30	
U2 (5 YR)	0.00	0.81	0.24	0.90	0.06	0.09	**0.74**	0.30	80.4%
U2 (100 YR)	0.00	0.88	0.24	0.96	0.06	0.36	**0.84**	0.30	
U3 (5 YR)	0.00	0.81	0.00	0.90	0.17	0.09	**0.09**	0.17	2.0%
U3 (100 YR)	0.00	0.88	0.00	0.96	0.17	0.36	**0.36**	0.17	
U4 (5 YR)	0.00	0.81	0.14	0.90	0.09	0.09	**0.58**	0.23	61.7%
U4 (100 YR)	0.00	0.88	0.14	0.96	0.09	0.36	**0.73**	0.23	
POND DESIGN NUMBERS	11.31	0.88	2.89	0.96	27.17	0.36	0.54	**41.37**	**34.3%**
SR2 (5 YR)	0.00	0.81	0.31	0.90	0.01	0.09	**0.87**	0.32	96.9%
SR2 (100 YR)	0.00	0.88	0.31	0.96	0.01	0.36	**0.94**	0.32	
PR1 (2 YR)	0.00	0.79	0.35	0.89	0.07	0.02	**0.75**	0.42	
PR1 (5 YR)	0.00	0.81	0.35	0.90	0.07	0.09	**0.77**	0.42	83.7%
PR1 (100 YR)	0.00	0.88	0.35	0.96	0.07	0.36	**0.86**	0.42	

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Designed by: JWD
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Job Number: 2015-015

Project: Parker Pointe

RUNOFF CALCULATIONS

(RATIONAL METHOD)

Design Storm: 5-Yr.

		Direct Runoff						
	Design	Basin	Area	Runoff	CA	Tc	I	Q
	Point	Desig.	(Acres)	Coefficient		(min)	(in/hr)	(cfs)
		H1	10.52	0.09	0.95	26.0	2.30	2.18
		L1	0.71	0.81	0.58	5.0	4.70	2.70
		L2	0.50	0.81	0.41	5.0	4.70	1.90
		L2A	0.19	0.81	0.15	5.0	4.70	0.72
		L3	0.43	0.81	0.35	5.0	4.70	1.64
		L3A	0.16	0.81	0.13	5.0	4.70	0.61
		L4	0.63	0.81	0.51	5.0	4.70	2.40
		L4A	0.24	0.81	0.19	5.0	4.70	0.91
		L5	0.63	0.81	0.51	5.0	4.70	2.40
		L5A	0.24	0.81	0.19	5.0	4.70	0.91
		L6	0.78	0.81	0.63	5.0	4.70	2.97
		L7	0.68	0.81	0.55	5.0	4.70	2.59
		L8	0.87	0.81	0.70	5.0	4.70	3.31
		L9	0.71	0.81	0.58	5.0	4.70	2.70
		L10	0.88	0.81	0.71	5.0	4.70	3.35
		L11	0.92	0.81	0.75	5.0	4.70	3.50
		L12	0.56	0.81	0.45	5.0	4.70	2.13
		L13	0.73	0.81	0.59	5.0	4.70	2.78
		L14	0.73	0.81	0.59	5.0	4.70	2.78
		L15	0.72	0.81	0.58	5.0	4.70	2.74
		IN1	0.26	0.90	0.23	5.0	4.70	1.10
		IN2	0.53	0.90	0.48	5.0	4.70	2.24
		IN3	0.11	0.9	0.10	5.0	4.70	0.47
		SR1	3.75	0.18	0.68	22.4	2.60	1.76
		SR2	0.32	0.87	0.28	5.0	4.70	1.31
		PR1	0.42	0.77	0.32	5.0	4.70	1.52
		PR2	0.91	0.96	0.87	5.0	4.70	4.11
		U1	1.37	0.09	0.12	5.0	4.70	0.58
		U2	0.3	0.74	0.22	5.0	4.70	1.04
		U3	0.17	0.09	0.02	5.0	4.70	0.07
		U4	0.23	0.58	0.13	5.0	4.70	0.63
		OS1	23.34	0.13	3.03	25.5	2.50	7.59

Perception Design Group, Inc.
6901 South Pierce Street, Suite 315
Littleton, Colorado 80128
(303) 232-8088 Fax (303) 232-5255

Designed by: JWD
Checked by: JWD
Date: 18-Sep-17
Job Number: 2015-015

Project: Parker Pointe

RUNOFF CALCULATIONS

(RATIONAL METHOD)

Design Storm: 100-Yr.

		Direct Runoff						
	Design Point	Basin Desig.	Area (Acres)	Runoff Coefficient	CA	Tc (min)	I (in/hr)	Q (cfs)
		H1	10.52	0.36	3.79	26.0	4.50	17.04
		L1	0.71	0.88	0.62	5.0	8.85	5.53
		L2	0.50	0.88	0.44	5.0	8.85	3.89
		L2A	0.19	0.88	0.17	5.0	8.85	1.48
		L3	0.43	0.88	0.38	5.0	8.85	3.35
		L3A	0.16	0.88	0.14	5.0	8.85	1.25
		L4	0.63	0.88	0.55	5.0	8.85	4.91
		L4A	0.24	0.88	0.21	5.0	8.85	1.87
		L5	0.63	0.88	0.55	5.0	8.85	4.91
		L5A	0.24	0.88	0.21	5.0	8.85	1.87
		L6	0.78	0.88	0.69	5.0	8.85	6.07
		L7	0.68	0.88	0.60	5.0	8.85	5.30
		L8	0.87	0.88	0.77	5.0	8.85	6.78
		L9	0.71	0.88	0.62	5.0	8.85	5.53
		L10	0.88	0.88	0.77	5.0	8.85	6.85
		L11	0.92	0.88	0.81	5.0	8.85	7.16
		L12	0.56	0.88	0.49	5.0	8.85	4.36
		L13	0.73	0.88	0.64	5.0	8.85	5.69
		L14	0.73	0.88	0.64	5.0	8.85	5.69
		L15	0.72	0.88	0.63	5.0	8.85	5.61
		IN1	0.26	0.96	0.25	5.0	8.85	2.21
		IN2	0.53	0.96	0.51	5.0	8.85	4.50
		IN3	0.11	0.96	0.11	5.0	8.85	0.93
		SR1	3.75	0.42	1.58	22.4	4.90	7.72
TOTAL FLOW TO FOREBAY								103.45
		OS1	23.34	0.39	9.10	25.5	4.50	40.96
TOTAL TO POND			39.30					144.41
		U1	1.37	0.36	0.49	25.5	4.50	2.22
		U2	0.3	0.84	0.25	25.5	4.50	1.13
		U3	0.17	0.36	0.06	25.5	4.50	0.28
		U4	0.23	0.73	0.17	25.5	4.50	0.76
UN-CAPTURED SITE RUNOFF								4.38
		SR2	0.32	0.94	0.30	5.0	8.85	2.66
		PR1	0.42	0.86	0.36	5.0	8.85	3.20
		PR2	0.91	0.96	0.87	5.0	8.85	7.73

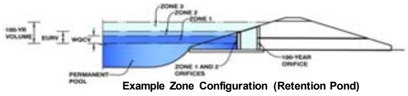
APPENDIX B DETENTION AND WATER QUALITY CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

Project:

Basin ID:



Example Zone Configuration (Retention Pond)

Depth Increment = 1 ft

Required Volume Calculation

			Optional User Override 1-hr Precipitation	
Selected BMP Type =	EDB			
Watershed Area =	41.37	acres		
Watershed Length =	1,500	ft		
Watershed Slope =	0.005	ft/ft		
Watershed Imperviousness =	34.30%	percent		
Percentage Hydrologic Soil Group A =	0.0%	percent		
Percentage Hydrologic Soil Group B =	100.0%	percent		
Percentage Hydrologic Soil Groups C/D =	0.0%	percent		
Desired WQCV Drain Time =	40.0	hours		
Location for 1-hr Rainfall Depths =	Parker - The Pinery Country Club			
Water Quality Capture Volume (WQCV) =	0.566	acre-feet		
Excess Urban Runoff Volume (EURV) =	1.472	acre-feet		
2-yr Runoff Volume (P1 = 0.83 in.) =	0.799	acre-feet		inches
5-yr Runoff Volume (P1 = 1.11 in.) =	1.191	acre-feet		inches
10-yr Runoff Volume (P1 = 1.36 in.) =	1.844	acre-feet		inches
25-yr Runoff Volume (P1 = 1.72 in.) =	3.245	acre-feet		inches
50-yr Runoff Volume (P1 = 2.01 in.) =	4.201	acre-feet		inches
100-yr Runoff Volume (P1 = 2.32 in.) =	5.449	acre-feet		inches
500-yr Runoff Volume (P1 = 3.1 in.) =	8.252	acre-feet		inches
Approximate 2-yr Detention Volume =	0.747	acre-feet		
Approximate 5-yr Detention Volume =	1.118	acre-feet		
Approximate 10-yr Detention Volume =	1.664	acre-feet		
Approximate 25-yr Detention Volume =	2.098	acre-feet		
Approximate 50-yr Detention Volume =	2.292	acre-feet		
Approximate 100-yr Detention Volume =	2.753	acre-feet		

Stage-Storage Calculation

Zone 1 Volume (WQCV) =	0.566	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.906	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	1.281	acre-feet
Total Detention Basin Volume =	2.753	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	

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

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
Plan Elev=63.0	--	0.68	--	--	--	1,372	0.031	453	0.010
Plan Elev=64.0	--	2.33	--	--	--	5,730	0.132	6,326	0.145
Plan Elev=65.0	--	3.33	--	--	--	15,643	0.359	17,012	0.391
Plan Elev=66.0	--	4.33	--	--	--	19,238	0.442	34,453	0.791
Plan Elev=67.0	--	5.33	--	--	--	22,614	0.519	55,378	1.271
Plan Elev=68.0	--	6.33	--	--	--	26,217	0.602	79,794	1.832
Plan Elev=69.0	--	7.33	--	--	--	30,010	0.689	107,907	2.477
Plan Elev=70.00	--	8.33	--	--	--	33,993	0.780	139,909	3.212
Plan Elev=71.00	--	9.33	--	--	--	40,439	0.928	177,125	4.066
Plan Elev=72.00	--	10.33	--	--	--	43,595	1.001	219,142	5.031
Plan Elev=73.00	--	11.33	--	--	--	43,595	1.001	262,737	6.032
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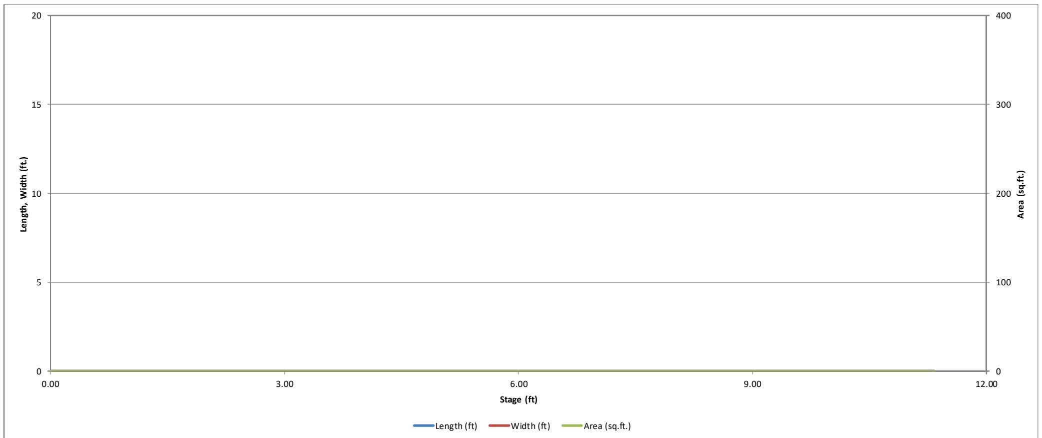
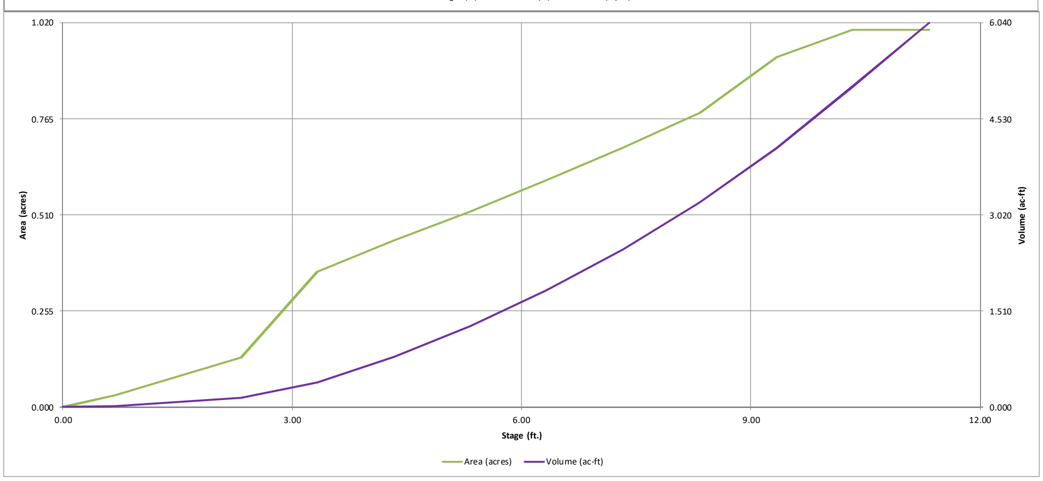
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)

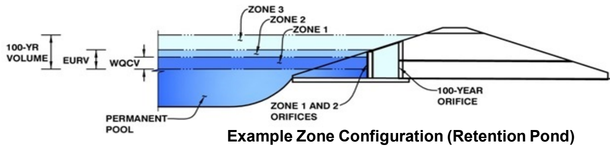




Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Project:
Basin ID:



Example Zone Configuration (Retention Pond)

	Stage (ft)	Zone Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.80	0.566	Orifice Plate
Zone 2 (EURV)	5.71	0.906	Orifice Plate
Zone 3 (100-year)	7.73	1.281	Weir&Pipe (Circular)
		2.753	Total

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

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

Calculated Parameters for Underdrain

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

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Orifice Plate =	5.27	ft (relative to basin bottom at Stage = 0 ft)
Orifice Plate: Orifice Vertical Spacing =	12.00	inches
Orifice Plate: Orifice Area per Row =	N/A	inches

Calculated Parameters for Plate

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

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

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	1.00	2.00	3.00				
Orifice Area (sq. inches)	1.50	1.50	1.50	1.50				

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

User Input: Vertical Orifice (Circular or Rectangular)

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

Calculated Parameters for Vertical Orifice

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

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

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.71	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	6.00	N/A	feet
Overflow Weir Slope =	0.00	N/A	H:V (enter zero for flat grate)
Horiz. Length of Weir Sides =	6.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	5.71	N/A	feet
Over Flow Weir Slope Length =	6.00	N/A	feet
Grate Open Area / 100-yr Orifice Area =	8.73	N/A	should be ≥ 4
Overflow Grate Open Area w/o Debris =	25.20	N/A	ft^2
Overflow Grate Open Area w/ Debris =	12.60	N/A	ft^2

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

	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	23.00	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected	
Outlet Orifice Area =	2.89	N/A	ft^2
Outlet Orifice Centroid =	0.96	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	72.00	ft (relative to basin bottom at Stage = 0 ft)
Spillway Crest Length =	50.00	feet
Spillway End Slopes =	3.00	H:V
Freeboard above Max Water Surface =	2.00	feet

Calculated Parameters for Spillway

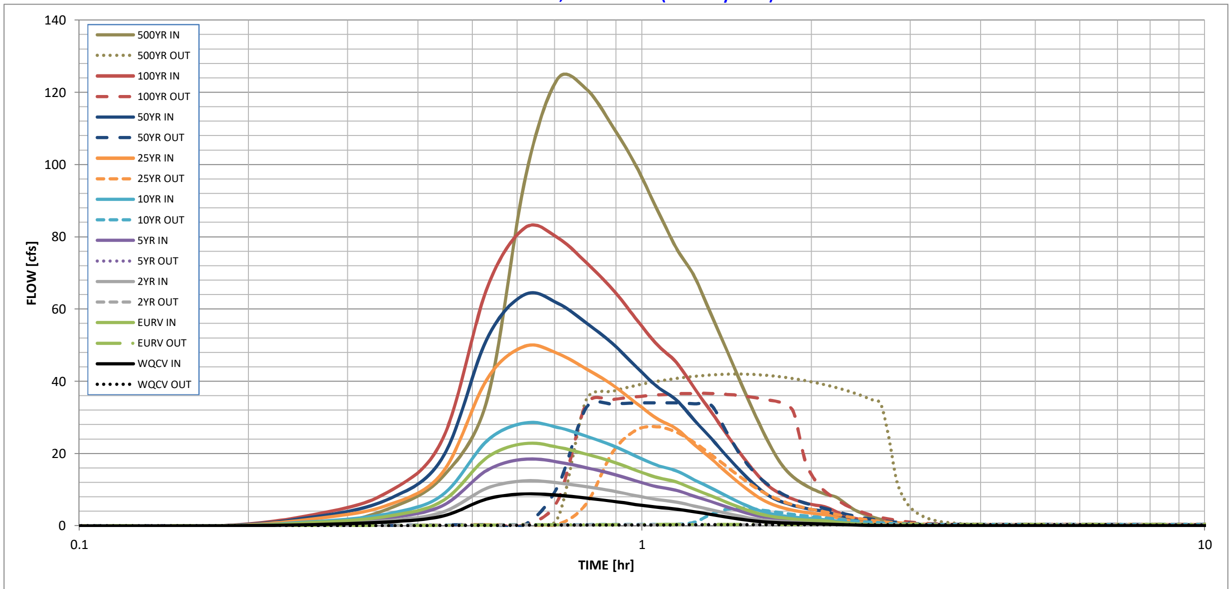
Spillway Design Flow Depth=	0.65	feet
Stage at Top of Freeboard =	74.65	feet
Basin Area at Top of Freeboard =	1.00	acres

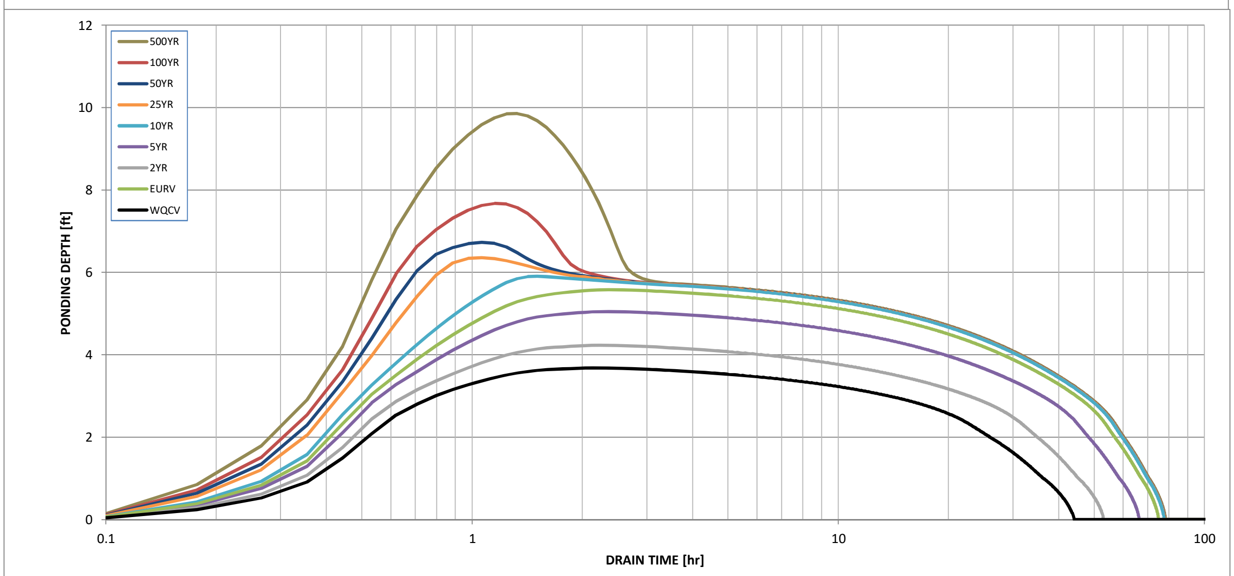
Routed Hydrograph Results

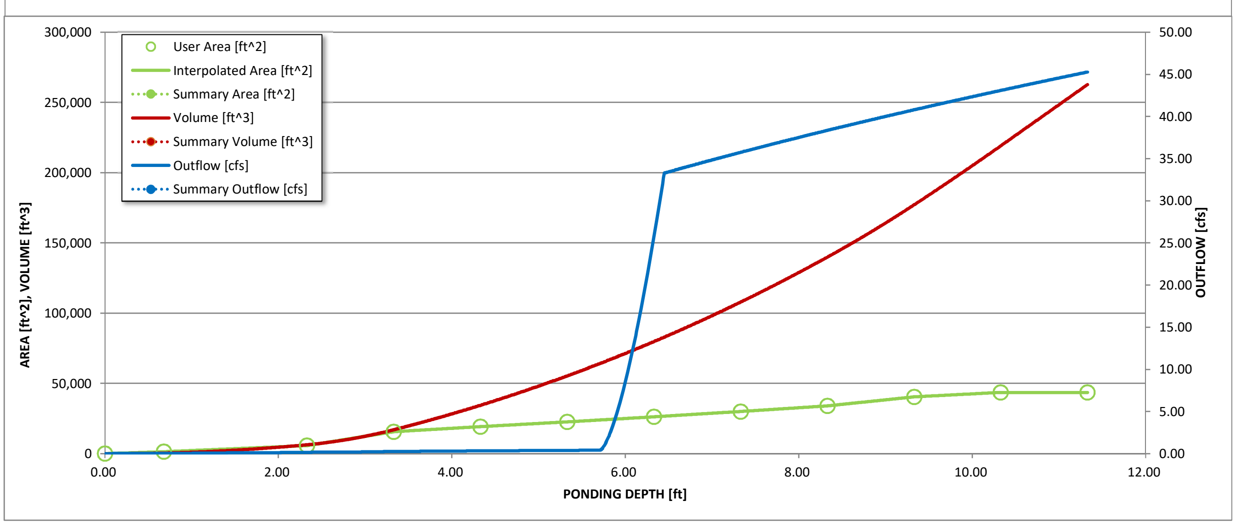
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	0.53	1.07	0.83	1.11	1.36	1.72	2.01	2.32	3.10
Calculated Runoff Volume (acre-ft) =	0.566	1.472	0.799	1.191	1.844	3.245	4.201	5.449	8.252
OPTIONAL Override Runoff Volume (acre-ft) =									
Inflow Hydrograph Volume (acre-ft) =	0.566	1.471	0.799	1.191	1.844	3.246	4.201	5.442	8.249
Predevelopment Unit Peak Flow, q (cfs/acre) =	0.00	0.00	0.01	0.02	0.17	0.60	0.87	1.20	1.90
Predevelopment Peak Q (cfs) =	0.0	0.0	0.4	0.7	6.9	24.9	35.8	49.5	78.5
Peak Inflow Q (cfs) =	8.9	22.8	12.5	18.5	28.5	49.7	64.1	82.5	123.8
Peak Outflow Q (cfs) =	0.3	0.4	0.3	0.4	4.9	27.5	34.1	36.7	42.0
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.6	0.7	1.1	1.0	0.7	0.5
Structure Controlling Flow =	Plate	Plate	Plate	Plate	Overflow Grate 1	Overflow Grate 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.2	1.1	1.3	1.4	1.6
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	38	64	45	57	65	61	58	55	50
Time to Drain 99% of Inflow Volume (hours) =	**41**	70	50	62	71	69	67	66	63
Maximum Ponding Depth (ft) =	3.68	5.58	4.23	5.05	5.91	6.36	6.73	7.68	9.86
Area at Maximum Ponding Depth (acres) =	0.39	0.54	0.43	0.50	0.57	0.60	0.64	0.72	0.97
Maximum Volume Stored (acre-ft) =	0.521	1.398	0.747	1.124	1.581	1.844	2.073	2.717	4.559

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	SOURCE TIME	WORKBOOK WQCV [cfs]	WORKBOOK EURV [cfs]	WORKBOOK 2 Year [cfs]	WORKBOOK 5 Year [cfs]	WORKBOOK 10 Year [cfs]	WORKBOOK 25 Year [cfs]	WORKBOOK 50 Year [cfs]	WORKBOOK 100 Year [cfs]	WORKBOOK 500 Year [cfs]
5.31 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Hydrograph	0:10:37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Constant	0:15:56	0.39	0.99	0.55	0.81	1.23	2.10	2.66	3.34	4.71
0.942	0:21:14	1.06	2.69	1.48	2.19	3.35	5.79	7.39	9.39	13.65
	0:26:33	2.72	6.91	3.81	5.62	8.60	14.85	18.96	24.10	35.06
	0:31:52	7.48	18.96	10.47	15.43	23.61	40.75	51.99	66.03	95.90
	0:37:10	8.86	22.78	12.46	18.48	28.49	49.73	64.08	82.55	123.78
	0:42:29	8.45	21.80	11.90	17.67	27.27	47.72	61.66	79.80	120.93
	0:47:47	7.69	19.84	10.83	16.09	24.82	43.43	56.17	72.83	110.82
	0:53:06	6.87	17.79	9.69	14.41	22.28	39.09	50.60	65.65	99.97
	0:58:25	5.92	15.44	8.37	12.49	19.36	34.13	44.27	57.54	87.90
	1:03:43	5.16	13.42	7.29	10.86	16.81	29.75	38.65	50.29	76.94
	1:09:02	4.68	12.17	6.61	9.85	15.25	26.90	34.88	45.30	69.06
	1:14:20	3.85	10.12	5.46	8.17	12.71	22.50	29.24	38.09	58.42
	1:19:39	3.14	8.32	4.47	6.71	10.47	18.61	24.23	31.61	48.57
	1:24:58	2.42	6.50	3.46	5.22	8.20	14.70	19.20	25.15	38.90
	1:30:16	1.80	4.92	2.58	3.93	6.24	11.31	14.83	19.50	30.31
	1:35:35	1.30	3.59	1.87	2.86	4.58	8.40	11.08	14.63	22.90
	1:40:53	1.01	2.74	1.44	2.19	3.48	6.33	8.31	10.93	16.98
	1:46:12	0.83	2.24	1.19	1.80	2.84	5.11	6.68	8.75	13.51
	1:51:31	0.71	1.90	1.01	1.52	2.40	4.30	5.62	7.35	11.33
	1:56:49	0.62	1.66	0.88	1.33	2.09	3.75	4.89	6.39	9.81
	2:02:08	0.56	1.49	0.79	1.20	1.88	3.36	4.37	5.70	8.74
	2:07:26	0.52	1.37	0.73	1.10	1.73	3.08	4.01	5.22	7.98
	2:12:45	0.38	1.01	0.54	0.81	1.27	2.28	2.99	3.92	6.09
	2:18:04	0.28	0.74	0.39	0.59	0.93	1.66	2.16	2.83	4.39
	2:23:22	0.20	0.54	0.29	0.44	0.68	1.22	1.60	2.10	3.26
	2:28:41	0.15	0.40	0.21	0.32	0.51	0.91	1.19	1.56	2.42
	2:33:59	0.11	0.29	0.15	0.23	0.37	0.66	0.87	1.15	1.78
	2:39:18	0.08	0.21	0.11	0.16	0.26	0.48	0.63	0.83	1.29
	2:44:37	0.05	0.15	0.08	0.12	0.19	0.35	0.45	0.60	0.93
	2:49:55	0.04	0.10	0.05	0.08	0.13	0.24	0.32	0.42	0.66
	2:55:14	0.02	0.06	0.03	0.05	0.08	0.15	0.20	0.27	0.44
	3:00:32	0.01	0.03	0.02	0.03	0.04	0.09	0.12	0.16	0.26
	3:05:51	0.00	0.01	0.00	0.01	0.02	0.04	0.05	0.07	0.13
	3:11:10	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.04
	3:16:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:21:47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:27:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:32:24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:37:43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:43:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:48:20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:53:38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:58:57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:04:16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:09:34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:14:53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:36:07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:41:26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:46:44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:52:03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:57:22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:02:40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:07:59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:13:17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:18:36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:23:55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:29:13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:34:32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:39:50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:01:05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:06:23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:11:42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:17:01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:22:19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)

Summary Stage-Area-Volume-Discharge Relationships

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

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

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

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

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

Perception Design Group, Inc.
6901 South Pierce Street, Suite 315
Littleton, Colorado 80128
(303) 232-8088 Fax (303) 232-5255

Designed by: JWD
Checked by: JWD
Date: 18-Sep-17
Job Number: 2015-015

Project: Parker Pointe

Forebay Design

Required Forebay Volume = 3% of WQCV

WQCV =	0.551	ac-ft
	24,002	cubit feet
Required Forebay Volume =	720	cubit feet
Provided Area=	750.00	square feet
Provided Depth =	0.96	feet

Required Release = 2% of 100 year peak discharge

100 year discharge =	103.5	cfs
Required Release Rate =	2.07	cfs

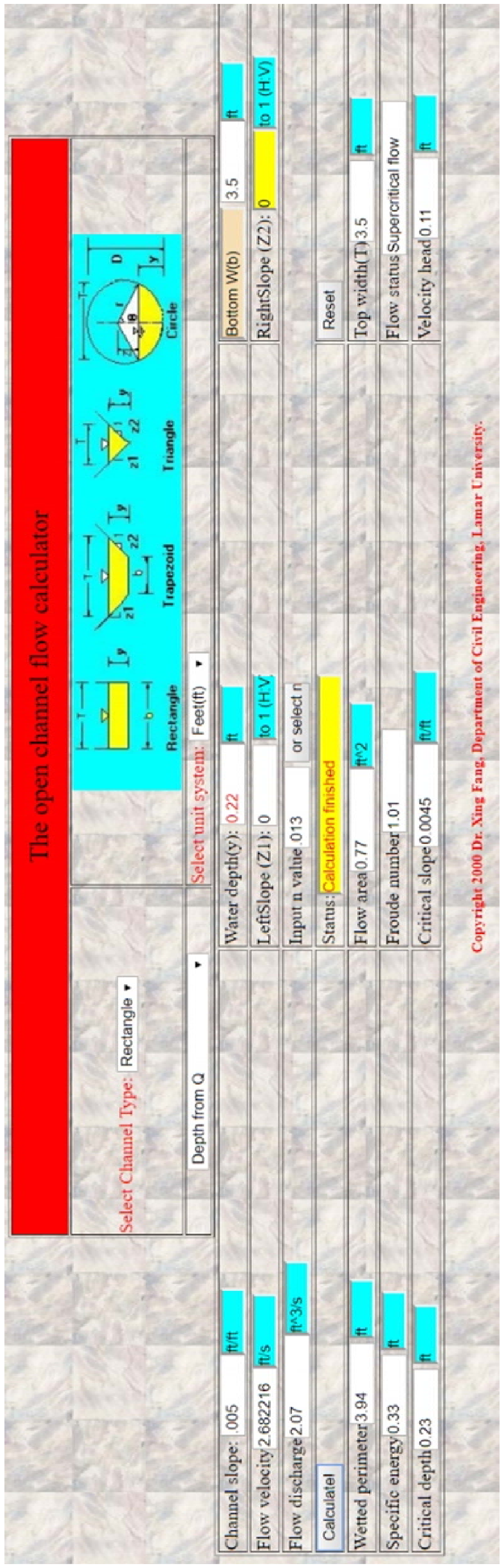
Use Weir Equation to Size Slot in Concrete

100 YEAR

Invert Elevation	62.32
Ponding Elevation	63.32
Required Discharge	1.77
Coefficient of Discharge	3.40
Length L	0.6042

Q=Cd x L x H^0.5

Cd	Length	Head (ft)	Discharge (cfs)
3.40	0.6042	1.00	2.05
	7.25"		



<u>POND TRICKLE PAN DESIGN</u>

Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Designer: Jerry Davidson
Company: Perception Design Group, Inc.
Date: June 25, 2018
Project: Parker Pointe
Location: BASINS PR1 AND U2

1. Design Discharge for 2-Year Return Period	Q_2 = 1.80 cfs
2. Hydraulic Residence Time	
A) : Length of Grass Swale	L_S = 375.0 ft
B) Calculated Residence Time (based on design velocity below)	T_{HR}= 6.7 minutes
3. Longitudinal Slope (vertical distance per unit horizontal)	
A) Available Slope (based on site constraints)	S_{avail} = 0.005 ft / ft
B) Design Slope	S_D = 0.005 ft / ft
4. Swale Geometry	
A) Channel Side Slopes (Z = 4 min., horiz. distance per unit vertical)	Z = 4.00 ft / ft
B) Bottom Width of Swale (enter 0 for triangular section)	W_B = 1.00 ft
5. Vegetation	Choose One
A) Type of Planting (seed vs. sod, affects vegetal retardance factor)	◉ Grass From Seed ○ Grass From Sod
6. Design Velocity (1 ft / s maximum)	V_2 = 0.93 ft / s
7. Design Flow Depth (1 foot maximum)	D_2 = 0.58 ft
A) Flow Area	A_2 = 1.9 sq ft
B) Top Width of Swale	W_T = 5.6 ft
C) Froude Number (0.50 maximum)	F = 0.28
D) Hydraulic Radius	R_H = 0.33
E) Velocity-Hydraulic Radius Product for Vegetal Retardance	VR = 0.31
F) Manning's n (based on SCS vegetal retardance curve E for seeded grass)	n = 0.054
G) Cumulative Height of Grade Control Structures Required	H_D = 0.00 ft
8. Underdrain (Is an underdrain necessary?)	Choose One ◉ YES ○ NO — **AN UNDERDRAIN IS REQUIRED IF THE DESIGN SLOPE < 2.0%**
9. Soil Preparation (Describe soil amendment)	
10. Irrigation	Choose One ○ Temporary ○ Permanent

Notes:

Design Procedure Form: Grass Buffer (GB)

UD-BMP (Version 3.07, March 2018)

Designer:	**Jerry Davidson**
Company:	**Perception Design Group, Inc.**
Date:	**June 25, 2018**
Project:	**Parker Pointe**
Location:	**New Left Turn Lane on Parker Road - Basin P3**

1. Design Discharge A) 2-Year Peak Flow Rate of the Area Draining to the Grass Buffer	Q_2 = 0.7 cfs
2. Minimum Width of Grass Buffer	W_G = 13 ft
3. Length of Grass Buffer (14' or greater recommended)	L_G = 800 ft
4. Buffer Slope (in the direction of flow, not to exceed 0.1 ft / ft)	S_G = 0.020 ft / ft
5. Flow Characteristics (sheet or concentrated) A) Does runoff flow into the grass buffer across the entire width of the buffer?	Choose One: (●) Yes ( ) No
B) Watershed Flow Length	F_L= 800 ft
C) Interface Slope (normal to flow)	S_I= 0.001 ft / ft
D) Type of Flow Sheet Flow: $F_L * S_I \leq 1$ Concentrated Flow: $F_L * S_I > 1$	SHEET FLOW
6. Flow Distribution for Concentrated Flows	Choose One: ( ) None (sheet flow) ( ) Slotted Curbing ( ) Level Spreader ( ) Other (Explain):
7 Soil Preparation (Describe soil amendment)	Existing Buffer
8 Vegetation (Check the type used or describe "Other")	Choose One: ( ) Existing Xeric Turf Grass (●) Irrigated Turf Grass ( ) Other (Explain):
9. Irrigation (*Select None if existing buffer area has 80% vegetation AND will not be disturbed during construction.)	Choose One: ( ) Temporary (●) Permanent ( ) None*
10. Outflow Collection (Check the type used or describe "Other")	Choose One: ( ) Grass Swale ( ) Street Gutter ( ) Storm Sewer Inlet ( ) Other (Explain):

Notes:

FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO

APPENDIX E DRAINAGE MAP

SEE SHEET DP3

100 YEAR RUNOFF SUMMARY

	Design Point	Basin Desig.	Area (Acres)	Runoff Coefficient	CA	Tc (min)	I (in/hr)	Q (cfs)
		H1	10.52	0.36	3.79	26.0	4.50	17.04
		L1	0.71	0.88	0.62	5.0	8.85	5.53
		L2	0.50	0.88	0.44	5.0	8.85	3.89
		L2A	0.19	0.88	0.17	5.0	8.85	1.48
		L3	0.43	0.88	0.38	5.0	8.85	3.35
		L3A	0.16	0.88	0.14	5.0	8.85	1.25
		L4	0.63	0.88	0.55	5.0	8.85	4.91
		L4A	0.24	0.88	0.21	5.0	8.85	1.87
		L5	0.63	0.88	0.55	5.0	8.85	4.91
		L5A	0.24	0.88	0.21	5.0	8.85	1.87
		L6	0.78	0.88	0.69	5.0	8.85	6.07
		L7	0.68	0.88	0.60	5.0	8.85	5.30
		L8	0.87	0.88	0.77	5.0	8.85	6.78
		L9	0.71	0.88	0.62	5.0	8.85	5.53
		L10	0.88	0.88	0.77	5.0	8.85	6.85
		L11	0.92	0.88	0.81	5.0	8.85	7.16
		L12	0.56	0.88	0.49	5.0	8.85	4.36
		L13	0.73	0.88	0.64	5.0	8.85	5.69
		L14	0.73	0.88	0.64	5.0	8.85	5.69
		L15	0.72	0.88	0.63	5.0	8.85	5.61
		IN1	0.26	0.96	0.25	5.0	8.85	2.21
		IN2	0.53	0.96	0.51	5.0	8.85	4.50
		IN3	0.11	0.96	0.11	5.0	8.85	0.93
		SR1	3.75	0.42	1.58	22.4	4.90	7.72
TOTAL FLOW TO FOREBAY								103.45
		OS1	23.34	0.39	9.10	25.5	4.50	40.96
TOTAL TO POND			39.30					144.41
		U1	1.37	0.36	0.49	25.5	4.50	2.22
		U2	0.3	0.84	0.25	25.5	4.50	1.13
		U3	0.17	0.36	0.06	25.5	4.50	0.28
		U4	0.23	0.73	0.17	25.5	4.50	0.76
UN-CAPTURED SITE RUNOFF								4.38
		SR2	0.32	0.94	0.30	5.0	8.85	2.66
		PR1	0.42	0.86	0.36	5.0	8.85	3.20
		PR2	0.91	0.96	0.87	5.0	8.85	7.73

DETENTION SUMMARY

ZONE	VOLUME	ELEVATION	RELEASE RATE
WQCV	0.566 AC-FT		41 HOURS
EURV+WQCV	1.472 AC-FT	5968.03	70 HOURS
100 YEAR	2.753 AC-FT	5970.05	36.7 CFS

LEGEND

5340 — EXISTING CONTOUR

42 — PROPOSED CONTOUR

R1 — BASIN DESIGNATION
0.75 — 5 YR RUNOFF COEFFICIENT
0.83 — 100 YR RUNOFF COEFFICIENT
0.20 — BASIN AREA

BASIN BOUNDARY LINE

1 — DESIGN POINT

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40ft.

BENCHMARK

BENCHMARK: DOUGLAS COUNTY SURVEY CONTROL MONUMENT TT15A – 3" DIAMETER DOUGLAS COUNTY GIS ALUMINUM CAP AT THE NE CORNER OF STROH ROAD AND SOUTH PARKER ROAD (US HIGHWAY 83)
ELEVATION: 5970.79 FEET (NAVD 1988 DATUM)

THE TOWN OF PARKER REVIEW CONSTITUTES GENERAL COMPLIANCE WITH THE TOWN'S STANDARDS AND APPROVED VARIANCES, SUBJECT TO THESE PLANS BEING STAMPED, SIGNED, AND DATED BY THE PROFESSIONAL ENGINEER OF RECORD. REVIEW BY THE TOWN DOES NOT CONSTITUTE APPROVAL OF THE PLAN DESIGN OR ACCURACY AND CORRECTNESS OF ENGINEERING CALCULATIONS. ERRORS IN THE DESIGN OR CALCULATIONS REMAIN THE RESPONSIBILITY OF THE REGISTERED PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE ARE AFFIXED TO THIS DOCUMENT.

THIS REVIEW DOES NOT CONSTITUTE APPROVAL OF ANY PRIVATE ON-SITE IMPROVEMENTS WHICH MAY BE SHOWN. CONSTRUCTION CANNOT COMMERCE UNTIL ALL REQUIRED DRAINAGE/ TRAFFIC REPORT(S), FINAL DEVELOPMENT PLAN(S), SPECIAL REVIEW(S), GRADING PERMIT, AND/OR OTHER PERMITS ARE COMPLETE, APPROVED AND ON THE FILE WITH THE TOWN OF PARKER.

TOWN OF PARKER, DIRECTOR OF ENGINEERING   DATE

PERCEPTION
DESIGN GROUP, INC.
6901 SOUTH PIERCE STREET, SUITE 315, LITTLETON, CO 80128 303-232-8088
WWW.PERCEPTIONDESIGNGROUP.COM

PREPARED UNDER THE DIRECT SUPERVISION OF
JERRY W. DAVIDSON, P.E.
COLORADO REG # 30226
FOR AND ON BEHALF OF
PERCEPTION DESIGN GROUP, INC.

△	DATE	DESCRIPTION
	11/01/18	SIXTH SUBMITTAL
	08/31/18	FOURTH SUBMITTAL
	05/25/18	THIRD SUBMITTAL
	03/19/18	PWSD SUBMITTAL
	02/28/18	SECOND SUBMITTAL
	10/24/17	INITIAL SUBMITTAL

REVISIONS

DRAINAGE PLAN WEST

PARKER POINTE
LOTS 1 THRU 15 AND TRACTS A AND B, PARKER POINTE FILING NO. 1
SOUTHEAST CORNER PARKER ROAD AND STROH ROAD
PARKER, COLORADO

design by: JWD
approved by: JWD
project no.: 2015-015
date: 10/01/17

SHEET
DP2

FINAL DRAINAGE REPORT AMENDMENT
PARKER POINTE
PARKER, COLORADO

PREPARED FOR:

PARKER & STROH, LLC
PO BOX 867
CRESTED BUTTE, CO 81224

CONTACT: BRAD WILLETT
970-366-1271

6901 SOUTH PIERCE STREET, SUITE 315
LITTLETON, CO 80128
CONTACT: JERRY DAVIDSON, P.E.
(303) 232-5255

JOB #2015-015

DECEMBER 14, 2023

FINAL DRAINAGE REPORT AMENDMENT
PARKER POINTE
PARKER, COLORADO

II GENERAL LOCATION AND DESCRIPTION

Site Location and Purpose:

This Final Drainage Report Amendment is prepared by Perception Design Group, Inc. as part of the Re-Plat submittal process for the Parker Pointe project proposed in Parker, Colorado. The re-plat area encompasses Lots 7 thru 15 of Parker Pointe Subdivision Filing No. 1.

The Re-Plat occupies approximately 8.5 acres. Its purpose is to reconfigure / combine the original 9 lots into 6 new lots.

III DRAINAGE BASINS

Drainage Basins:

Basins L7 thru L15 represent lots 7 thru 15 in the original study. In this amendment basins L7 thru L10, IN2 and IN3, and a portion of basin L11 defined as new basin L11B are now combined to a single collection point at design point 25. Previous upstream collection piping is eliminated from this amendment. Basin L11B represents additional flow to design point 25 not accommodated in the original report. New calculations are attached indicating the provided stub to design point 25 is adequate to carry this additional flow.

The balance of original basin L11, now defined as L11A continues to flow to the original collection stub at design point 14. Since flow is reduced by basin L11B, the system downstream is adequate to accommodate this revision.

While basins L13 thru L15 experience minor changes to lot line locations, runoff to the main line system remains un-changed.

IV CONCLUSIONS

The existing storm sewer system is adequate to carry amended flows as illustrated by the attached calculations. No additional analysis is needed for the detention and water quality facility as overall runoff and imperviousness is unchanged.

Perception Design Group, Inc.
6901 South Pierce Street, Suite 315
Littleton, Colorado 80128
(303) 232-8088 Fax (303) 232-5255

Designed by: JWD
Checked by: JWD
Date: 18-Sep-17
Job Number: 2015-015

Project: Parker Pointe

RUNOFF CALCULATIONS

(RATIONAL METHOD)

Design Storm: 5-Yr.

		Direct Runoff						
	Design	Basin	Area	Runoff	CA	Tc	I	Q
	Point	Desig.	(Acres)	Coefficient		(min)	(in/hr)	(cfs)
		H1	10.52	0.09	0.95	26.0	2.30	2.18
		L1	0.71	0.81	0.58	5.0	4.70	2.70
		L2	0.50	0.81	0.41	5.0	4.70	1.90
		L2A	0.19	0.81	0.15	5.0	4.70	0.72
		L3	0.43	0.81	0.35	5.0	4.70	1.64
		L3A	0.16	0.81	0.13	5.0	4.70	0.61
		L4	0.63	0.81	0.51	5.0	4.70	2.40
		L4A	0.24	0.81	0.19	5.0	4.70	0.91
		L5	0.63	0.81	0.51	5.0	4.70	2.40
		L5A	0.24	0.81	0.19	5.0	4.70	0.91
		L6	0.78	0.81	0.63	5.0	4.70	2.97
		L7	0.68	0.81	0.55	5.0	4.70	2.59
		L8	0.87	0.81	0.70	5.0	4.70	3.31
		L9	0.71	0.81	0.58	5.0	4.70	2.70
		L10	0.88	0.81	0.71	5.0	4.70	3.35
		L11A	0.50	0.81	0.41	5.0	4.70	1.90
		L11B	0.42	0.81	0.34	5.0	4.70	1.60
		L12	0.56	0.81	0.45	5.0	4.70	2.13
		L13	0.73	0.81	0.59	5.0	4.70	2.78
		L14	0.73	0.81	0.59	5.0	4.70	2.78
		L15	0.72	0.81	0.58	5.0	4.70	2.74
		IN1	0.26	0.90	0.23	5.0	4.70	1.10
		IN2	0.53	0.90	0.48	5.0	4.70	2.24
		IN3	0.11	0.9	0.10	5.0	4.70	0.47
		SR1	3.75	0.18	0.68	22.4	2.60	1.76
		SR2	0.32	0.87	0.28	5.0	4.70	1.31
		PR1	0.42	0.77	0.32	5.0	4.70	1.52
		PR2	0.91	0.96	0.87	5.0	4.70	4.11
		U1	1.37	0.09	0.12	5.0	4.70	0.58
		U2	0.3	0.74	0.22	5.0	4.70	1.04
		U3	0.17	0.09	0.02	5.0	4.70	0.07
		U4	0.23	0.58	0.13	5.0	4.70	0.63
		OS1	23.34	0.13	3.03	25.5	2.50	7.59

Perception Design Group, Inc.
6901 South Pierce Street, Suite 315
Littleton, Colorado 80128
(303) 232-8088 Fax (303) 232-5255

Designed by: JWD
Checked by: JWD
Date: 18-Sep-17
Job Number: 2015-015

Project: Parker Pointe

RUNOFF CALCULATIONS

(RATIONAL METHOD)

Design Storm: 100-Yr.

		Direct Runoff						
	Design Point	Basin Desig.	Area (Acres)	Runoff Coefficient	CA	Tc (min)	I (in/hr)	Q (cfs)
		H1	10.52	0.36	3.79	26.0	4.50	17.04
		L1	0.71	0.88	0.62	5.0	8.85	5.53
		L2	0.50	0.88	0.44	5.0	8.85	3.89
		L2A	0.19	0.88	0.17	5.0	8.85	1.48
		L3	0.43	0.88	0.38	5.0	8.85	3.35
		L3A	0.16	0.88	0.14	5.0	8.85	1.25
		L4	0.63	0.88	0.55	5.0	8.85	4.91
		L4A	0.24	0.88	0.21	5.0	8.85	1.87
		L5	0.63	0.88	0.55	5.0	8.85	4.91
		L5A	0.24	0.88	0.21	5.0	8.85	1.87
		L6	0.78	0.88	0.69	5.0	8.85	6.07
		L7	0.68	0.88	0.60	5.0	8.85	5.30
		L8	0.87	0.88	0.77	5.0	8.85	6.78
		L9	0.71	0.88	0.62	5.0	8.85	5.53
		L10	0.88	0.88	0.77	5.0	8.85	6.85
		L11A	0.50	0.88	0.44	5.0	8.85	3.89
		L11B	0.42	0.88	0.37	5.0	8.85	3.27
		L12	0.56	0.88	0.49	5.0	8.85	4.36
		L13	0.73	0.88	0.64	5.0	8.85	5.69
		L14	0.73	0.88	0.64	5.0	8.85	5.69
		L15	0.72	0.88	0.63	5.0	8.85	5.61
		IN1	0.26	0.96	0.25	5.0	8.85	2.21
		IN2	0.53	0.96	0.51	5.0	8.85	4.50
		IN3	0.11	0.96	0.11	5.0	8.85	0.93
		SR1	3.75	0.42	1.58	22.4	4.90	7.72
TOTAL FLOW TO FOREBAY								103.45
		OS1	23.34	0.39	9.10	25.5	4.50	40.96
TOTAL TO POND			39.30					144.41
		U1	1.37	0.36	0.49	25.5	4.50	2.22
		U2	0.3	0.84	0.25	25.5	4.50	1.13
		U3	0.17	0.36	0.06	25.5	4.50	0.28
		U4	0.23	0.73	0.17	25.5	4.50	0.76
UN-CAPTURED SITE RUNOFF								4.38
		SR2	0.32	0.94	0.30	5.0	8.85	2.66
		PR1	0.42	0.86	0.36	5.0	8.85	3.20
		PR2	0.91	0.96	0.87	5.0	8.85	7.73

100 YEAR RUNOFF SUMMARY

	Design Point	Basin Desig.	Area (Acres)	Runoff Coefficient	CA	Tc (min)	I (in/hr)	Q (cfs)
		H1	10.52	0.36	3.79	26.0	4.50	17.04
		L1	0.71	0.88	0.62	5.0	8.85	5.53
		L2	0.50	0.88	0.44	5.0	8.85	3.89
		L2A	0.19	0.88	0.17	5.0	8.85	1.48
		L3	0.43	0.88	0.38	5.0	8.85	3.35
		L3A	0.16	0.88	0.14	5.0	8.85	1.25
		L4	0.63	0.88	0.55	5.0	8.85	4.91
		L4A	0.24	0.88	0.21	5.0	8.85	1.87
		L5	0.63	0.88	0.55	5.0	8.85	4.91
		L5A	0.24	0.88	0.21	5.0	8.85	1.87
		L6	0.78	0.88	0.69	5.0	8.85	6.07
		L7	0.68	0.88	0.60	5.0	8.85	5.30
		L8	0.87	0.88	0.77	5.0	8.85	6.78
		L9	0.71	0.88	0.62	5.0	8.85	5.53
		L10	0.88	0.88	0.77	5.0	8.85	6.85
		L11A	0.50	0.88	0.44	5.0	8.85	3.89
		L11B	0.42	0.88	0.37	5.0	8.85	3.27
		L12	0.56	0.88	0.49	5.0	8.85	4.36
		L13	0.73	0.88	0.64	5.0	8.85	5.69
		L14	0.73	0.88	0.64	5.0	8.85	5.69
		L15	0.72	0.88	0.63	5.0	8.85	5.61
		IN1	0.26	0.96	0.25	5.0	8.85	2.21
		IN2	0.53	0.96	0.51	5.0	8.85	4.50
		IN3	0.11	0.96	0.11	5.0	8.85	0.93
		SR1	3.75	0.42	1.58	22.4	4.90	7.72
TOTAL FLOW TO FOREBAY								103.45
		OS1	23.34	0.39	9.10	25.5	4.50	40.96
TOTAL TO POND			39.30					144.41
		U1	1.37	0.36	0.49	25.5	4.50	2.22
		U2	0.3	0.84	0.25	25.5	4.50	1.13
		U3	0.17	0.36	0.06	25.5	4.50	0.28
		U4	0.23	0.73	0.17	25.5	4.50	0.76
UN-CAPTURED SITE RUNOFF								4.38
		SR2	0.32	0.94	0.30	5.0	8.85	2.66
		PR1	0.42	0.86	0.36	5.0	8.85	3.20
		PR2	0.91	0.96	0.87	5.0	8.85	7.73

DETENTION SUMMARY

ZONE	VOLUME	ELEVATION	RELEASE RATE
WQCV	0.566 AC-FT		41 HOURS
EURV+WQCV	1.472 AC-FT	5968.03	70 HOURS
100 YEAR	2.753 AC-FT	5970.05	36.7 CFS

LEGEND

5340 — EXISTING CONTOUR

42 — PROPOSED CONTOUR

R1 / 0.20 / 0.75 / 0.83:
- BASIN DESIGNATION
- 5 YR RUNOFF COEFFICIENT
- 100 YR RUNOFF COEFFICIENT
- BASIN AREA

BASIN BOUNDARY LINE

1 — DESIGN POINT

GRAPHIC SCALE

40 0 20 40 80

(IN FEET)
1 inch = 40ft.

BENCHMARK

BENCHMARK: DOUGLAS COUNTY SURVEY CONTROL MONUMENT TT15A – 3" DIAMETER DOUGLAS COUNTY GIS ALUMINUM CAP AT THE NE CORNER OF STROH ROAD AND SOUTH PARKER ROAD (US HIGHWAY 83)
ELEVATION: 5970.79 FEET (NAVD 1988 DATUM)

THE TOWN OF PARKER REVIEW CONSTITUTES GENERAL COMPLIANCE WITH THE TOWN'S STANDARDS AND APPROVED VARIANCES, SUBJECT TO THESE PLANS BEING STAMPED, SIGNED, AND DATED BY THE PROFESSIONAL ENGINEER OF RECORD. REVIEW BY THE TOWN DOES NOT CONSTITUTE APPROVAL OF THE PLAN DESIGN OR ACCURACY AND CORRECTNESS OF ENGINEERING CALCULATIONS. ERRORS IN THE DESIGN OR CALCULATIONS REMAIN THE RESPONSIBILITY OF THE REGISTERED PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE ARE AFFIXED TO THIS DOCUMENT.

THIS REVIEW DOES NOT CONSTITUTE APPROVAL OF ANY PRIVATE ON-SITE IMPROVEMENTS WHICH MAY BE SHOWN. CONSTRUCTION CANNOT COMMENCE UNTIL ALL REQUIRED DRAINAGE/ TRAFFIC REPORT(S), FINAL DEVELOPMENT PLAN(S), SPECIAL REVIEW(S), GRADING PERMIT, AND/OR OTHER PERMITS ARE COMPLETE, APPROVED AND ON THE FILE WITH THE TOWN OF PARKER.

TOWN OF PARKER, DIRECTOR OF ENGINEERING   DATE

PERCEPTION DESIGN GROUP, INC.
6901 SOUTH PIERCE STREET, SUITE 315, LITTLETON, CO 80128 303-232-8088
WWW.PERCEPTIONDESIGNGROUP.COM

PREPARED UNDER THE DIRECT SUPERVISION OF
JERRY W. DAVIDSON, P.E.
COLORADO REG # 30226
FOR AND ON BEHALF OF
PERCEPTION DESIGN GROUP, INC.

DATE	DESCRIPTION
12/14/23	2ND REPLAT SUBMITTAL
08/01/23	SECOND CDOT NTP SUBMITTAL
04/21/23	CDOT NTP SUBMITTAL / RE-PLAT SUBMITTAL
04/15/22	RESUBMITTAL
11/01/18	SIXTH SUBMITTAL
08/31/18	FOURTH SUBMITTAL
05/25/18	THIRD SUBMITTAL
10/24/17	INITIAL SUBMITTAL

REVISIONS

DRAINAGE PLAN WEST

PARKER POINTE
LOTS 1 THRU 15 AND TRACTS A AND B, PARKER POINTE FILING NO. 1
SOUTHEAST CORNER PARKER ROAD AND STROH ROAD
PARKER, COLORADO

design by: JWD
approved by: JWD
project no.: 2015-015

date: 10/01/17

SHEET
DP2