

**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**



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

JOB #2015-015

AUGUST 31, 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.

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

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 SR1 plus 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 thru 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

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

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 Parker 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.

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

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:

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

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:

| <u>Volume Element</u> | <u>Volume</u> | <u>Elevation</u> | <u>Release Rate</u> |
|-----------------------|---------------|------------------|---------------------|
| WQCV | 0.551 Ac-Ft | 5965.84 | 45 hours |
| EURV + WQCV | 1.427 Ac-Ft | 5967.59 | 81 hours |
| 100 year | 2.680 Ac-Ft | 5969.57 | 36.0 cfs |
| Storage Provided | 2.680 Ac-Ft | 5969.57 | |

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

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

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 52.5 cfs. The outlet structure design limits discharge to 36.0 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.

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

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

Table RO-3—Recommended Percentage Imperviousness Values

| Land Use or Surface Characteristics | Percentage Imperviousness |
|---|---------------------------|
| Business: | |
| Commercial areas | 95 |
| Neighborhood areas | 85 |
| Residential: | |
| Single-family | * |
| Multi-unit (detached) | 60 |
| Multi-unit (attached) | 75 |
| Half-acre lot or larger | * |
| Apartments | 80 |
| Industrial: | |
| Light areas | 80 |
| Heavy areas | 90 |
| Parks, cemeteries | 5 |
| Playgrounds | 10 |
| Schools | 50 |
| Railroad yard areas | 15 |
| Undeveloped Areas: | |
| Historic flow analysis | 2 |
| Greenbelts, agricultural | 2 |
| Off-site flow analysis (when land use not defined) | 45 |
| Streets: | |
| Paved | 100 |
| Gravel (packed) | 40 |
| Drive and walks | 90 |
| Roofs | 90 |
| Lawns, sandy soil | 0 |
| Lawns, clayey soil | 0 |

* See [Figures RO-3](#) through [RO-5](#) for percentage imperviousness.

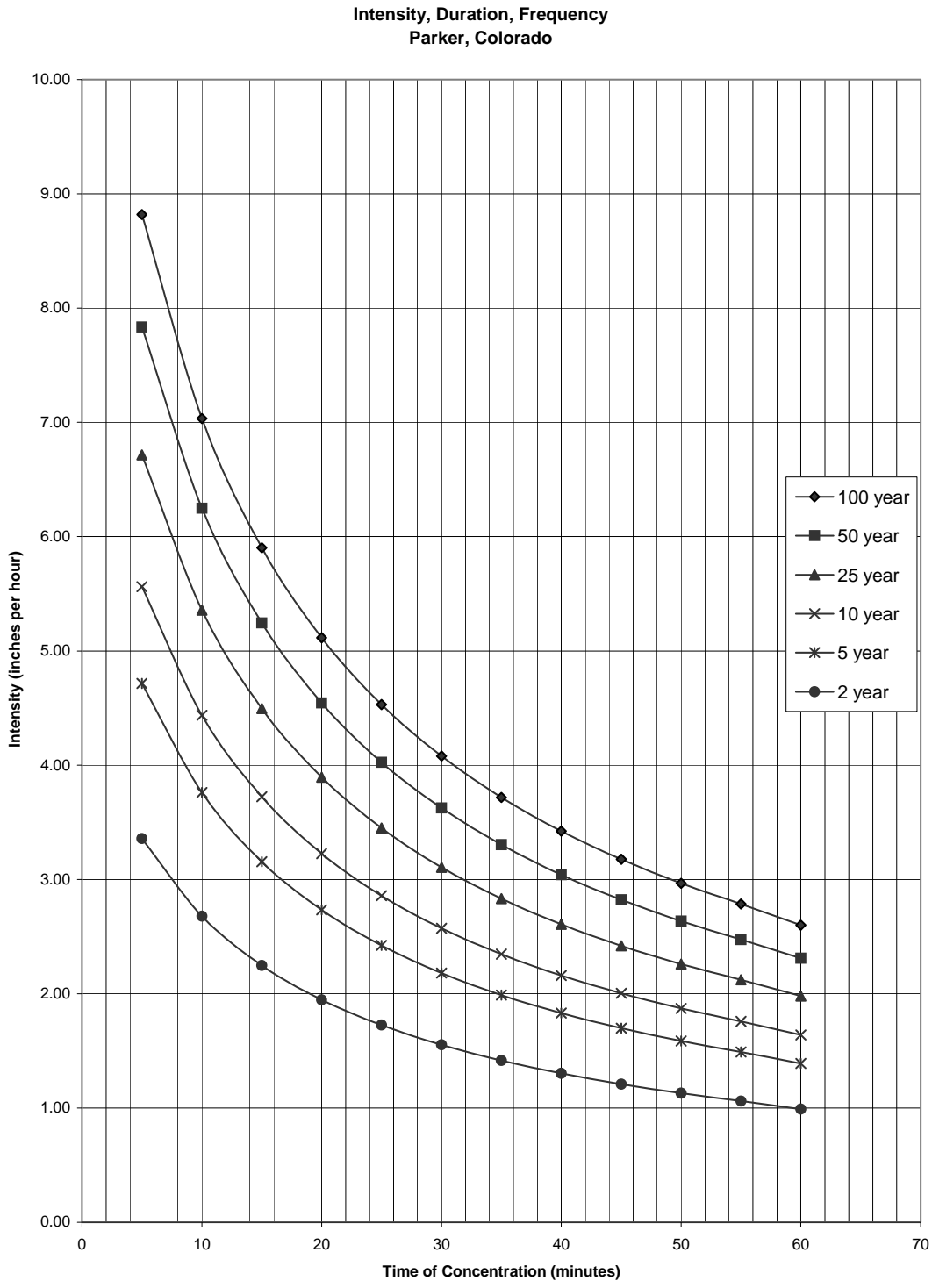
$$C_A = K_A + (1.31i^3 - 1.44i^2 + 1.135i - 0.12) \text{ for } C_A \geq 0, \text{ otherwise } C_A = 0 \quad (\text{RO-6})$$

$$C_{CD} = K_{CD} + (0.858i^3 - 0.786i^2 + 0.774i + 0.04) \quad (\text{RO-7})$$

$$C_B = (C_A + C_{CD})/2$$

Table RO-5— Runoff Coefficients, C

| Percentage Imperviousness | Type C and D NRCS Hydrologic Soil Groups | | | | | |
|---------------------------|---|------|-------|-------|-------|--------|
| | 2-yr | 5-yr | 10-yr | 25-yr | 50-yr | 100-yr |
| 0% | 0.04 | 0.15 | 0.25 | 0.37 | 0.44 | 0.50 |
| 5% | 0.08 | 0.18 | 0.28 | 0.39 | 0.46 | 0.52 |
| 10% | 0.11 | 0.21 | 0.30 | 0.41 | 0.47 | 0.53 |
| 15% | 0.14 | 0.24 | 0.32 | 0.43 | 0.49 | 0.54 |
| 20% | 0.17 | 0.26 | 0.34 | 0.44 | 0.50 | 0.55 |
| 25% | 0.20 | 0.28 | 0.36 | 0.46 | 0.51 | 0.56 |
| 30% | 0.22 | 0.30 | 0.38 | 0.47 | 0.52 | 0.57 |
| 35% | 0.25 | 0.33 | 0.40 | 0.48 | 0.53 | 0.57 |
| 40% | 0.28 | 0.35 | 0.42 | 0.50 | 0.54 | 0.58 |
| 45% | 0.31 | 0.37 | 0.44 | 0.51 | 0.55 | 0.59 |
| 50% | 0.34 | 0.40 | 0.46 | 0.53 | 0.57 | 0.60 |
| 55% | 0.37 | 0.43 | 0.48 | 0.55 | 0.58 | 0.62 |
| 60% | 0.41 | 0.46 | 0.51 | 0.57 | 0.60 | 0.63 |
| 65% | 0.45 | 0.49 | 0.54 | 0.59 | 0.62 | 0.65 |
| 70% | 0.49 | 0.53 | 0.57 | 0.62 | 0.65 | 0.68 |
| 75% | 0.54 | 0.58 | 0.62 | 0.66 | 0.68 | 0.71 |
| 80% | 0.60 | 0.63 | 0.66 | 0.70 | 0.72 | 0.74 |
| 85% | 0.66 | 0.68 | 0.71 | 0.75 | 0.77 | 0.79 |
| 90% | 0.73 | 0.75 | 0.77 | 0.80 | 0.82 | 0.83 |
| 95% | 0.80 | 0.82 | 0.84 | 0.87 | 0.88 | 0.89 |
| 100% | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 |
| | TYPE B NRCS HYDROLOGIC SOILS GROUP | | | | | |
| 0% | 0.02 | 0.08 | 0.15 | 0.25 | 0.30 | 0.35 |
| 5% | 0.04 | 0.10 | 0.19 | 0.28 | 0.33 | 0.38 |
| 10% | 0.06 | 0.14 | 0.22 | 0.31 | 0.36 | 0.40 |
| 15% | 0.08 | 0.17 | 0.25 | 0.33 | 0.38 | 0.42 |
| 20% | 0.12 | 0.20 | 0.27 | 0.35 | 0.40 | 0.44 |
| 25% | 0.15 | 0.22 | 0.30 | 0.37 | 0.41 | 0.46 |
| 30% | 0.18 | 0.25 | 0.32 | 0.39 | 0.43 | 0.47 |
| 35% | 0.20 | 0.27 | 0.34 | 0.41 | 0.44 | 0.48 |
| 40% | 0.23 | 0.30 | 0.36 | 0.42 | 0.46 | 0.50 |
| 45% | 0.26 | 0.32 | 0.38 | 0.44 | 0.48 | 0.51 |
| 50% | 0.29 | 0.35 | 0.40 | 0.46 | 0.49 | 0.52 |
| 55% | 0.33 | 0.38 | 0.43 | 0.48 | 0.51 | 0.54 |
| 60% | 0.37 | 0.41 | 0.46 | 0.51 | 0.54 | 0.56 |
| 65% | 0.41 | 0.45 | 0.49 | 0.54 | 0.57 | 0.59 |
| 70% | 0.45 | 0.49 | 0.53 | 0.58 | 0.60 | 0.62 |
| 75% | 0.51 | 0.54 | 0.58 | 0.62 | 0.64 | 0.66 |
| 80% | 0.57 | 0.59 | 0.63 | 0.66 | 0.68 | 0.70 |
| 85% | 0.63 | 0.66 | 0.69 | 0.72 | 0.73 | 0.75 |
| 90% | 0.71 | 0.73 | 0.75 | 0.78 | 0.80 | 0.81 |
| 95% | 0.79 | 0.81 | 0.83 | 0.85 | 0.87 | 0.88 |
| 100% | 0.89 | 0.90 | 0.92 | 0.94 | 0.95 | 0.96 |



**FIGURE 5.1
RAINFALL INTENSITY VERSUS DURATION CURVES FOR PARKER, COLORADO**

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

| Catchment | <u>FUTURE COMMERCIAL</u> | | <u>DRIVES/WALKS/ROOF</u> | | <u>LANDSCAPING</u> | | Composite C | Catchment Area (Ac.) | Imperviousness |
|--------------|--------------------------|------|--------------------------|------|---------------------|------|-------------|----------------------|----------------|
| | Area (Ac.) | C | Area (Ac.) | C | Area (Ac.) | C | | | |
| | Imperviousness = 95% | | Imperviousness = 100% | | Imperviousness = 2% | | | | |
| H1 (5 YR) | 0.00 | 0.81 | 0.00 | 0.90 | 10.52 | 0.09 | 0.09 | 10.52 | 2.0% |
| H1 (100 YR) | 0.00 | 0.88 | 0.00 | 0.96 | 10.52 | 0.36 | 0.36 | 10.52 | |
| L1 (5 YR) | 0.71 | 0.81 | 0.00 | 0.90 | 0.00 | 0.09 | 0.81 | 0.71 | 95.0% |
| L1 (100 YR) | 0.71 | 0.88 | 0.00 | 0.96 | 0.00 | 0.36 | 0.88 | 0.71 | |
| L2 (5 YR) | 0.50 | 0.81 | 0.00 | 0.90 | 0.00 | 0.09 | 0.81 | 0.50 | 95.0% |
| L2 (100 YR) | 0.50 | 0.88 | 0.00 | 0.96 | 0.00 | 0.36 | 0.88 | 0.50 | |
| L2A (5 YR) | 0.19 | 0.81 | 0.00 | 0.90 | 0.00 | 0.09 | 0.81 | 0.19 | 95.0% |
| L2A (100 YR) | 0.19 | 0.88 | 0.00 | 0.96 | 0.00 | 0.36 | 0.88 | 0.19 | |
| L3 (5 YR) | 0.43 | 0.81 | 0.00 | 0.90 | 0.00 | 0.09 | 0.81 | 0.43 | 95.0% |
| L3 (100 YR) | 0.43 | 0.88 | 0.00 | 0.96 | 0.00 | 0.36 | 0.88 | 0.43 | |
| L3A (5 YR) | 0.16 | 0.81 | 0.00 | 0.90 | 0.00 | 0.09 | 0.81 | 0.16 | 95.0% |
| L3A (100 YR) | 0.16 | 0.88 | 0.00 | 0.96 | 0.00 | 0.36 | 0.88 | 0.16 | |
| L4 (5 YR) | 0.63 | 0.81 | 0.00 | 0.90 | 0.00 | 0.09 | 0.81 | 0.63 | 95.0% |
| L4 (100 YR) | 0.63 | 0.88 | 0.00 | 0.96 | 0.00 | 0.36 | 0.88 | 0.63 | |
| L4A (5 YR) | 0.24 | 0.81 | 0.00 | 0.90 | 0.00 | 0.09 | 0.81 | 0.24 | 95.0% |
| L4A (100 YR) | 0.24 | 0.88 | 0.00 | 0.96 | 0.00 | 0.36 | 0.88 | 0.24 | |

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

| Catchment | <u>FUTURE COMMERCIAL</u> | | <u>DRIVES/WALKS/ROOF</u> | | <u>LANDSCAPING</u> | | Composite C | Catchment Area (Ac.) | Imperviousness |
|--------------|--------------------------|------|--------------------------|------|---------------------|------|-------------|----------------------|----------------|
| | Area (Ac.) | C | Area (Ac.) | C | Area (Ac.) | C | | | |
| | 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 | |

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

| Catchment | FUTURE COMMERCIAL | | DRIVES/WALKS/ROOF | | LANDSCAPING | | Composite C | Catchment Area (Ac.) | Imperviousness |
|--------------|----------------------|------|-----------------------|------|---------------------|------|-------------|----------------------|----------------|
| | Area (Ac.) | C | Area (Ac.) | C | Area (Ac.) | C | | | |
| | 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 | 23.33 | 0.09 | 0.13 | 24.54 | 6.8% |
| OS1 (100 YR) | 0.00 | 0.88 | 1.21 | 0.96 | 23.33 | 0.36 | 0.39 | 24.54 | |
| SR1 (5 YR) | 0.00 | 0.81 | 0.40 | 0.90 | 3.35 | 0.09 | 0.18 | 3.75 | 12.5% |

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

| Catchment | FUTURE COMMERCIAL | | DRIVES/WALKS/ROOF | | LANDSCAPING | | Composite C | Catchment Area (Ac.) | Imperviousness |
|----------------------------|----------------------|-------------|-----------------------|-------------|---------------------|-------------|-------------|----------------------|----------------|
| | Area (Ac.) | C | Area (Ac.) | C | Area (Ac.) | C | | | |
| | 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 | 26.68 | 0.36 | 0.54 | 40.50 | 34.0% |
| 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 | 28.37 | 0.36 | 0.54 | 42.57 | 33.4% |
| 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 | |

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

| Catchment | <u>FUTURE COMMERCIAL</u> | | <u>DRIVES/WALKS/ROOF</u> | | <u>LANDSCAPING</u> | | Composite C | Catchment Area (Ac.) | Imperviousness |
|--------------|--------------------------|------|--------------------------|------|---------------------|------|-------------|----------------------|----------------|
| | Area (Ac.) | C | Area (Ac.) | C | Area (Ac.) | C | | | |
| | Imperviousness = 95% | | Imperviousness = 100% | | Imperviousness = 2% | | | | |
| PR2 (5 YR) | 0.00 | 0.81 | 0.91 | 0.90 | 0.00 | 0.09 | 0.90 | 0.91 | 100.0% |
| PR2 (100 YR) | 0.00 | 0.88 | 0.91 | 0.96 | 0.00 | 0.36 | 0.96 | 0.91 | |
| PR3 (2 YR) | 0.00 | 0.79 | 0.22 | 0.89 | 0.00 | 0.02 | 0.89 | 0.22 | |

STANDARD FORM SF-2
TIME OF CONCENTRATION

PROJECT Parker Pointe
 JN ASP-2015-015
 CALCULATED BY JWD
 DATE 18-Sep-17

| SUB -BASIN | | DATA | INITIAL/OVERLAND TIME (Ti) | | | TRAVEL TIME (Tt) | | | | | Tc CHECK | | | FINAL (Tc) | REMARKS |
|------------|-----------|------|----------------------------|---------------|----------|------------------|---------|---------------------|-----------|----------|-----------|----------------------|-------------------------|------------|---------|
| DESIGN | Area (ac) | C5 | LENGTH Li (ft) | SLOPE (ft/ft) | Ti (min) | LENGTH - Lt (ft) | SLOPE % | K Conveyance Factor | VEL (fps) | Tt (min) | COMP (TC) | Basin Imp. (decimal) | Tc=(UDFCD Eq 6-5) (min) | MIN | |
| SR1 | 3.23 | 0.27 | 375.0 | 0.030 | 20.4 | 540.0 | 2.50 | 20 | 3.16 | 2.8 | 23.3 | 0.241 | 22.4 | 22.4 | 22.4 |
| H1 | 10.52 | 0.09 | 530.0 | 0.050 | 24.9 | 550.0 | 2.75 | 10 | 1.66 | 5.5 | 30.5 | 0.020 | 26.3 | 26.3 | 26.3 |
| OS1 | 24.54 | 0.13 | 290.0 | 0.070 | 15.8 | 1425.0 | 6.00 | 10 | 2.45 | 9.7 | 25.5 | 0.020 | 26.7 | 25.5 | 25.5 |

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 | |
| | 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 | 24.54 | 0.13 | 3.19 | 25.5 | 2.50 | 7.98 | |

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.

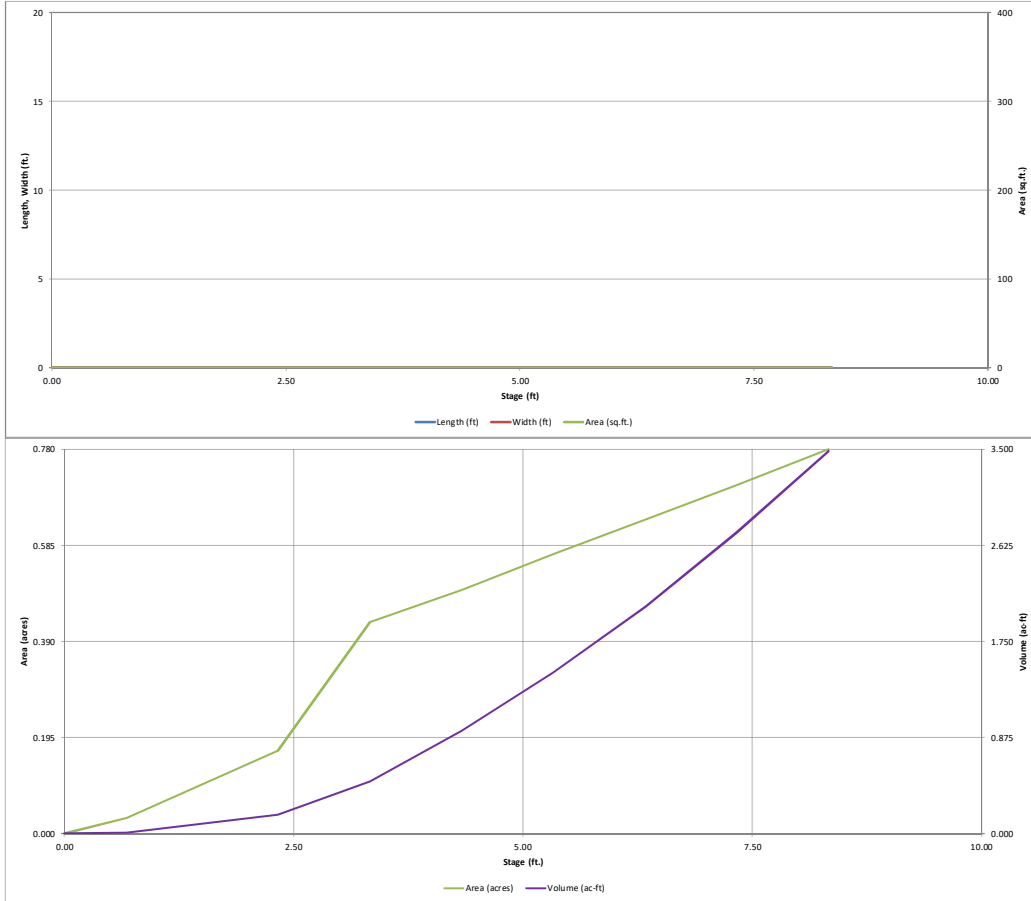
| | | Direct Runoff | | | | | | |
|-------------------------|--------|---------------|-------------|------|-------|---------|--------|--|
| Design | Basin | Area | Runoff | CA | Tc | I | Q | |
| Point | Desig. | (Acres) | Coefficient | | (min) | (in/hr) | (cfs) | |
| | H1 | 10.52 | 0.36 | 3.79 | 26.0 | 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 | 24.54 | 0.39 | 9.57 | 25.5 | 4.50 | 43.07 | |
| TOTAL TO POND | | 40.50 | | | | | 146.51 | |
| | 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 | |

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

APPENDIX B DETENTION AND WATER QUALITY CALCULATIONS

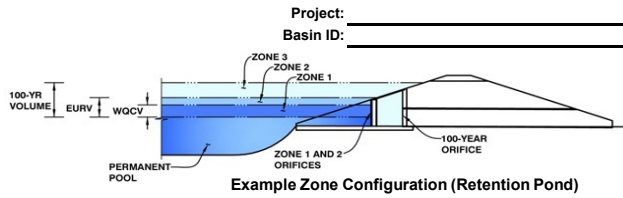
DETENTION BASIN STAGE-STORAGE TABLE BUILDER

UD-Detention, Version 3.07 (February 2017)



Detention Basin Outlet Structure Design

UD-Detention, Version 3.07 (February 2017)



| | Stage (ft) | Zone Volume (ac-ft) | Outlet Type |
|-------------------|------------|---------------------|----------------------|
| Zone 1 (WQCV) | 3.57 | 0.574 | Orifice Plate |
| Zone 2 (EURV) | 5.35 | 0.898 | Orifice Plate |
| Zone 3 (100-year) | 7.40 | 1.313 | Weir&Pipe (Circular) |
| | | 2.785 | Total |

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

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

Calculated Parameters for Underdrain

Underdrain Orifice Area = ft²
 Underdrain Orifice Centroid = 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 = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Orifice Plate = ft (relative to basin bottom at Stage = 0 ft)
 Orifice Plate: Orifice Vertical Spacing = inches
 Orifice Plate: Orifice Area per Row = inches

Calculated Parameters for Plate

WQ Orifice Area per Row = ft²
 Elliptical Half-Width = feet
 Elliptical Slot Centroid = feet
 Elliptical Slot Area = ft²

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 | | | | | |

| | 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)

Invert of Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Depth at top of Zone using Vertical Orifice = ft (relative to basin bottom at Stage = 0 ft)
 Vertical Orifice Diameter = inches

Calculated Parameters for Vertical Orifice

Vertical Orifice Area = ft²
 Vertical Orifice Centroid = feet

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

| | Zone 3 Weir | Not Selected | |
|---|-------------|--------------|---|
| Overflow Weir Front Edge Height, H _o = | 5.27 | N/A | ft (relative to basin bottom at Stage = 0 ft) |
| Overflow Weir Front Edge Length = | 11.00 | N/A | feet |
| Overflow Weir Slope = | 0.00 | N/A | H:V (enter zero for flat grate) |
| Horiz. Length of Weir Sides = | 3.00 | 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 _g = | 5.27 | N/A | feet |
| Overflow Weir Slope Length = | 3.00 | N/A | feet |
| Grate Open Area / 100-yr Orifice Area = | 8.01 | N/A | should be ≥ 4 |
| Overflow Grate Open Area w/o Debris = | 23.10 | N/A | ft ² |
| Overflow Grate Open Area w/ Debris = | 11.55 | 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 = ft (relative to basin bottom at Stage = 0 ft)
 Spillway Crest Length = feet
 Spillway End Slopes = H:V
 Freeboard above Max Water Surface = feet

Calculated Parameters for Spillway

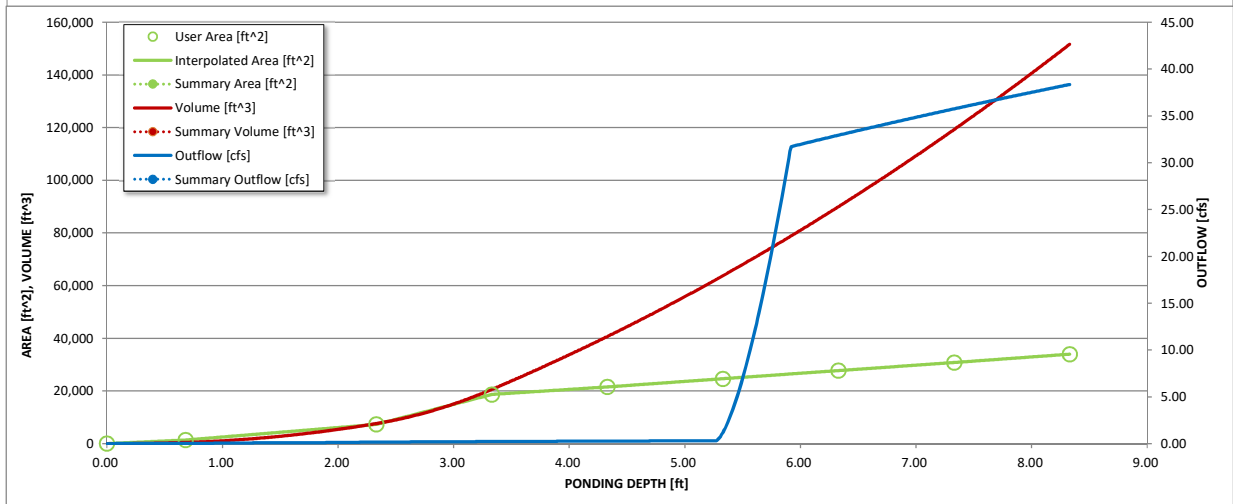
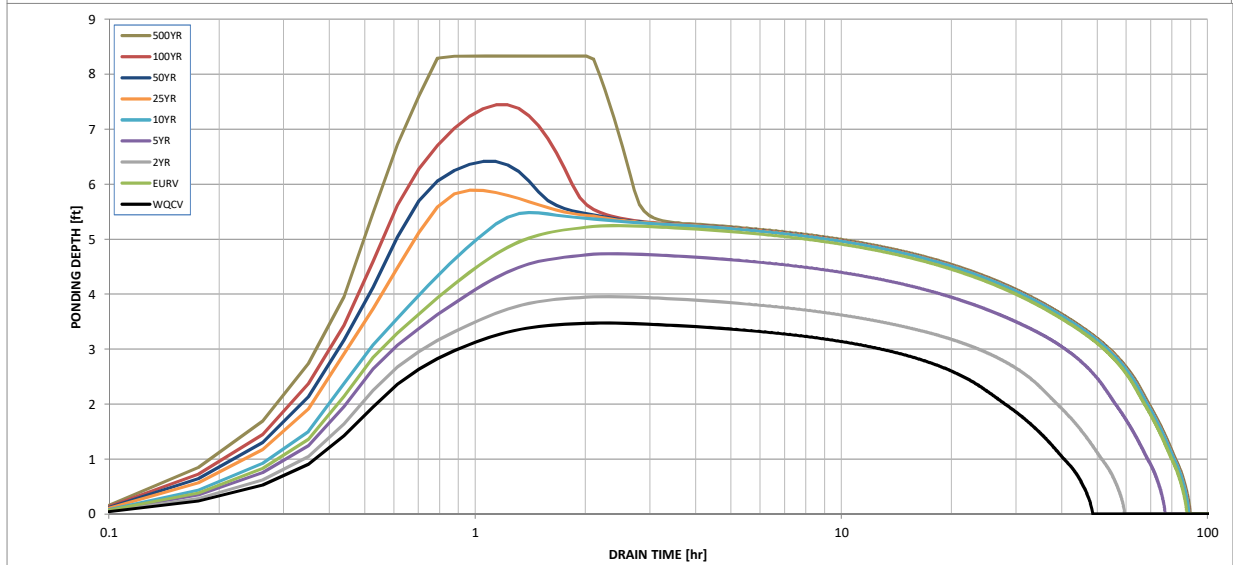
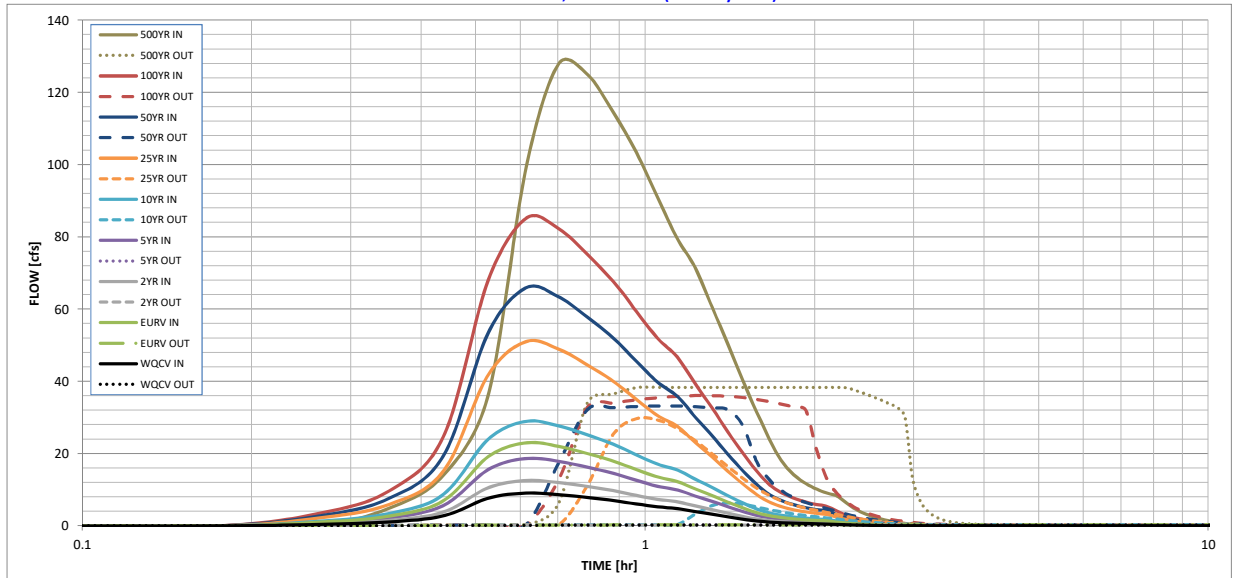
Spillway Design Flow Depth = feet
 Stage at Top of Freeboard = feet
 Basin Area at Top of Freeboard = acres

Routed Hydrograph Results

| | WQCV | EURV | 2 Year | 5 Year | 10 Year | 25 Year | 50 Year | 100 Year | 500 Year |
|---|-------|-------|--------|--------|------------------|------------------|----------------|----------------|----------|
| Design Storm Return Period = | 0.53 | 1.07 | 0.83 | 1.11 | 1.36 | 1.72 | 2.01 | 2.32 | 3.10 |
| 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) | 0.574 | 1.472 | 0.797 | 1.191 | 1.856 | 3.298 | 4.281 | 5.567 | 8.449 |
| OPTIONAL Override Runoff Volume (acre-ft) | | | | | | | | | |
| Inflow Hydrograph Volume (acre-ft) | 0.573 | 1.471 | 0.797 | 1.190 | 1.855 | 3.298 | 4.281 | 5.562 | 8.447 |
| Predevelopment Unit Peak Flow, q (cfs/acre) | 0.00 | 0.00 | 0.01 | 0.02 | 0.17 | 0.61 | 0.88 | 1.21 | 1.92 |
| Predevelopment Peak Q (cfs) | 0.0 | 0.0 | 0.4 | 0.7 | 7.2 | 25.9 | 37.3 | 51.5 | 81.5 |
| Peak Inflow Q (cfs) | 9.1 | 23.0 | 12.5 | 18.7 | 28.9 | 51.0 | 65.9 | 85.1 | 127.9 |
| Peak Outflow Q (cfs) | 0.2 | 0.3 | 0.3 | 0.3 | 6.3 | 29.7 | 33.2 | 36.1 | 38.4 |
| Ratio Peak Outflow to Predevelopment Q | N/A | N/A | N/A | 0.4 | 0.9 | 1.1 | 0.9 | 0.7 | 0.5 |
| Structure Controlling Flow | Plate | Plate | Plate | Plate | Overflow Grate 1 | Overflow Grate 1 | Outlet Plate 1 | Outlet Plate 1 | N/A |
| Max Velocity through Grate 1 (fps) | N/A | N/A | N/A | N/A | 0.3 | 1.3 | 1.4 | 1.5 | 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) | 43 | 77 | 52 | 67 | 76 | 71 | 68 | 65 | 60 |
| Time to Drain 99% of Inflow Volume (hours) | 46 | 83 | 56 | 72 | 83 | 80 | 78 | 77 | 74 |
| Maximum Ponding Depth (ft) | 3.47 | 5.24 | 3.96 | 4.73 | 5.48 | 5.89 | 6.42 | 7.45 | 8.33 |
| Area at Maximum Ponding Depth (acres) | 0.44 | 0.56 | 0.47 | 0.52 | 0.58 | 0.60 | 0.64 | 0.71 | 0.78 |
| Maximum Volume Stored (acre-ft) | 0.534 | 1.414 | 0.752 | 1.138 | 1.551 | 1.787 | 2.118 | 2.817 | 3.482 |

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 | | | |

POND TRICKLE PAN DESIGN

The open channel flow calculator

Select Channel Type: Rectangle

Depth from Q

Select unit system: Feet(ft)

| | | |
|-------------------|---|--------------------|
| Channel slope: | 0.05 | ft/ft |
| Flow velocity: | 2.682216 | ft/s |
| Flow discharge: | 2.07 | ft ³ /s |
| Calculator | Status: Calculation finished | |
| Wetted perimeter: | 3.94 | ft |
| Specific energy: | 0.33 | ft |
| Critical depth: | 0.23 | ft |

| | | |
|------------------|--------|-----------------|
| Water depth(y): | 0.22 | ft |
| Left Slope (Z1): | 0 | to 1 (HV) |
| Input n value: | 0.13 | or select n |
| Reset | | |
| Flow area: | 0.77 | ft ² |
| Froude number: | 1.01 | |
| Critical slope: | 0.0045 | ft/ft |

| | | |
|-------------------|--------------------|-----------|
| Bottom W(b): | 3.5 | ft |
| Right Slope (Z2): | 0 | to 1 (HV) |
| Top width(T): | 3.5 | ft |
| Flow status: | Supercritical flow | |
| Velocity head: | 0.11 | ft |

Copyright 2000 Dr. Xing Fang, Department of Civil Engineering, Lamar University.

Design Procedure Form: Grass Swale (GS)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

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 = $ <input style="width: 50px;" type="text" value="1.80"/> cfs |
| 2. Hydraulic Residence Time A) : Length of Grass Swale B) Calculated Residence Time (based on design velocity below) | $L_S = $ <input style="width: 50px;" type="text" value="375.0"/> ft $T_{HR} = $ <input style="width: 50px;" type="text" value="6.7"/> minutes |
| 3. Longitudinal Slope (vertical distance per unit horizontal) A) Available Slope (based on site constraints) B) Design Slope | $S_{avail} = $ <input style="width: 50px;" type="text" value="0.005"/> ft / ft $S_D = $ <input style="width: 50px;" type="text" value="0.005"/> ft / ft |
| 4. Swale Geometry A) Channel Side Slopes ($Z = 4$ min., horiz. distance per unit vertical) B) Bottom Width of Swale (enter 0 for triangular section) | $Z = $ <input style="width: 50px;" type="text" value="4.00"/> ft / ft $W_B = $ <input style="width: 50px;" type="text" value="1.00"/> ft |
| 5. Vegetation A) Type of Planting (seed vs. sod, affects vegetal retardance factor) | Choose One <input style="width: 100px;" type="text"/> <input checked="" type="radio"/> Grass From Seed <input type="radio"/> Grass From Sod |
| 6. Design Velocity (1 ft / s maximum) | $V_2 = $ <input style="width: 50px;" type="text" value="0.93"/> ft / s |
| 7. Design Flow Depth (1 foot maximum) A) Flow Area B) Top Width of Swale C) Froude Number (0.50 maximum) D) Hydraulic Radius E) Velocity-Hydraulic Radius Product for Vegetal Retardance F) Manning's n (based on SCS vegetal retardance curve E for seeded grass) G) Cumulative Height of Grade Control Structures Required | $D_2 = $ <input style="width: 50px;" type="text" value="0.58"/> ft $A_2 = $ <input style="width: 50px;" type="text" value="1.9"/> sq ft $W_T = $ <input style="width: 50px;" type="text" value="5.6"/> ft $F = $ <input style="width: 50px;" type="text" value="0.28"/> $R_H = $ <input style="width: 50px;" type="text" value="0.33"/> $VR = $ <input style="width: 50px;" type="text" value="0.31"/> $n = $ <input style="width: 50px;" type="text" value="0.054"/> $H_D = $ <input style="width: 50px;" type="text" value="0.00"/> ft |
| 8. Underdrain (Is an underdrain necessary?) | Choose One <input style="width: 100px;" type="text"/> <input checked="" type="radio"/> YES <input type="radio"/> NO AN UNDERDRAIN IS REQUIRED IF THE DESIGN SLOPE < 2.0% |
| 9. Soil Preparation (Describe soil amendment) | _____ _____ _____ |
| 10. Irrigation | Choose One <input style="width: 100px;" type="text"/> <input type="radio"/> Temporary <input type="radio"/> Permanent |

Notes: _____

Design Procedure Form: Grass Buffer (GB)

UD-BMP (Version 3.07, March 2018)

Sheet 1 of 1

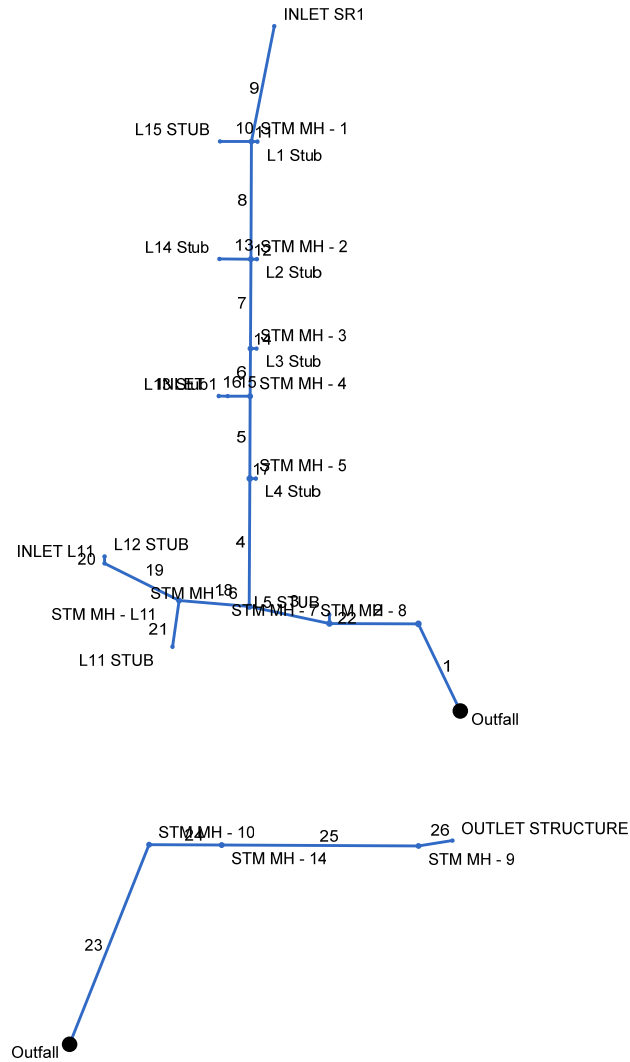
Designer: Jerry Davidson
Company: Perception Design Group, Inc.
Date: June 25, 2018
Project: Parker Pointe
Location: New Left Turn Lane on Parker Road - Basin P3

| | |
|---|--|
| 1. Design Discharge A) 2-Year Peak Flow Rate of the Area Draining to the Grass Buffer | $Q_2 = $ <input style="width: 50px;" type="text" value="0.7"/> cfs |
| 2. Minimum Width of Grass Buffer | $W_G = $ <input style="width: 50px;" type="text" value="13"/> ft |
| 3. Length of Grass Buffer (14' or greater recommended) | $L_G = $ <input style="width: 50px;" type="text" value="800"/> ft |
| 4. Buffer Slope (in the direction of flow, not to exceed 0.1 ft / ft) | $S_G = $ <input style="width: 50px;" type="text" value="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? B) Watershed Flow Length C) Interface Slope (normal to flow) D) Type of Flow Sheet Flow: $F_L * S_i \leq 1$ Concentrated Flow: $F_L * S_i > 1$ | Choose One <input type="checkbox"/> Yes <input checked="" type="radio"/> No $F_L = $ <input style="width: 50px;" type="text" value="800"/> ft $S_i = $ <input style="width: 50px;" type="text" value="0.001"/> ft / ft SHEET FLOW |
| 6. Flow Distribution for Concentrated Flows | Choose One <input type="radio"/> None (sheet flow) <input type="radio"/> Slotted Curbing <input type="radio"/> Level Spreader <input type="radio"/> Other (Explain): <hr/> <hr/> |
| 7 Soil Preparation (Describe soil amendment) | Existing Buffer <hr/> <hr/> |
| 8 Vegetation (Check the type used or describe "Other") | Choose One <input type="radio"/> Existing Xeric Turf Grass <input checked="" type="radio"/> Irrigated Turf Grass <input type="radio"/> Other (Explain): <hr/> <hr/> |
| 9. Irrigation (*Select None if existing buffer area has 80% vegetation AND will not be disturbed during construction.) | Choose One <input type="radio"/> Temporary <input checked="" type="radio"/> Permanent <input type="radio"/> None* |
| 10. Outflow Collection (Check the type used or describe "Other") | Choose One <input type="radio"/> Grass Swale <input type="radio"/> Street Gutter <input type="radio"/> Storm Sewer Inlet <input type="radio"/> Other (Explain): <hr/> <hr/> |
| Notes: <hr/> <hr/> <hr/> | |

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

APPENDIX C HYDRAULIC CALCULATIONS

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



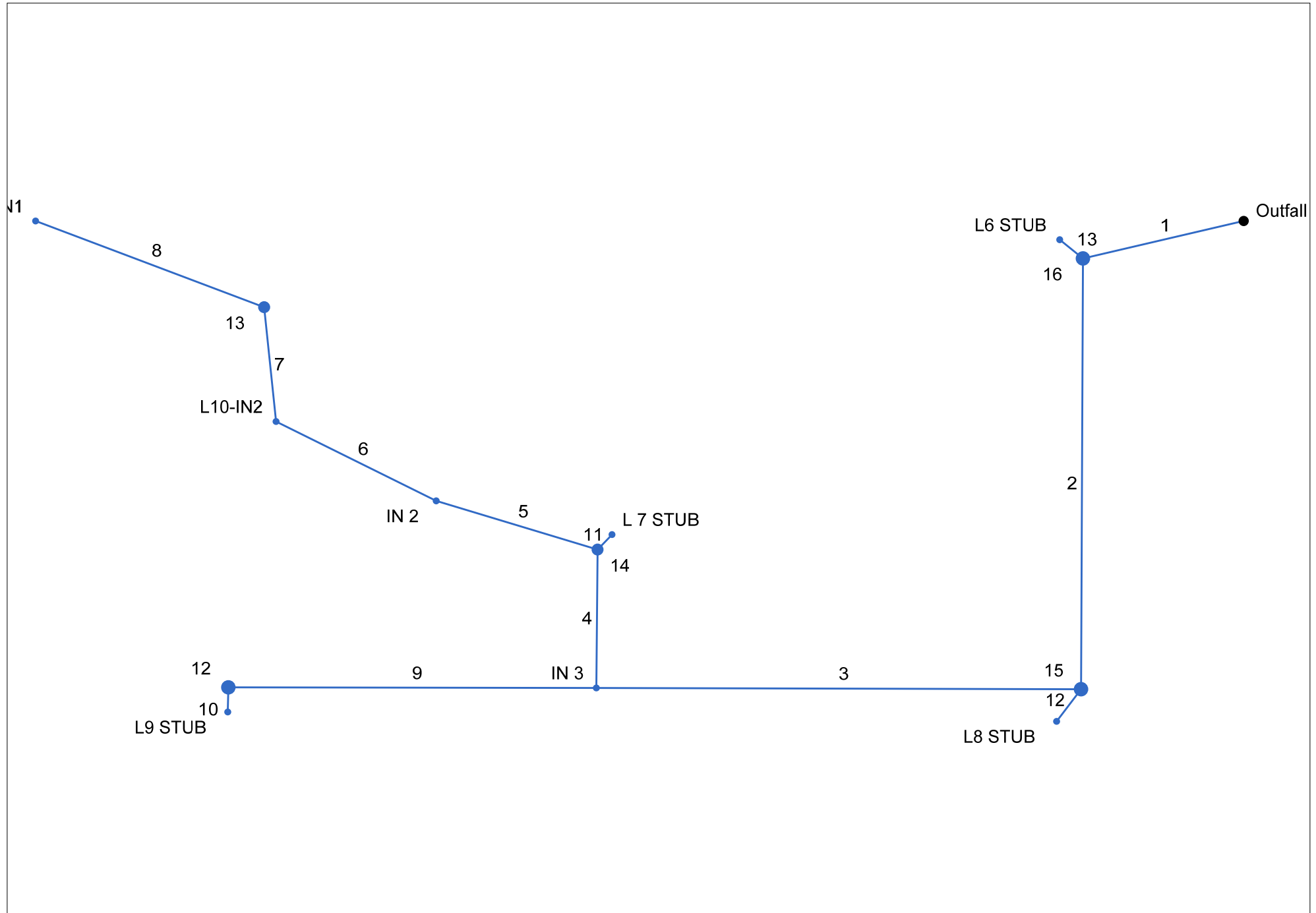
Project File: Storm Line A 100 yr.stm

Number of lines: 26

Date: 3/1/2018

| Line No. | Line Size | Flow Rate | Vel Ave | Depth Up | Depth Dn | HGL Up | HGL Dn | Line ID |
|----------|-----------|-----------|---------|----------|----------|-----------|---------|---------------|
| | (in) | (cfs) | (ft/s) | (ft) | (ft) | (ft) | (ft) | |
| 1 | 42 | 61.03 | 8.31 | 2.49 | 2.50 | 5967.48 | 5966.84 | P-22 |
| 2 | 42 | 61.03 | 6.74 | 2.99 | 3.28 | 5968.77 | 5968.47 | P-21 |
| 3 | 42 | 56.12 | 5.91 | 3.29 | 3.50 | 5969.82 | 5969.53 | P-19 |
| 4 | 42 | 44.60 | 4.83 | 3.04 | 3.50 | 5970.63 | 5970.36 | P-14 |
| 5 | 42 | 39.69 | 5.72 | 1.96** | 3.23 | 5970.30 | 5971.02 | P-12 |
| 6 | 36 | 31.79 | 7.11 | 1.83** | 1.80 | 5970.99 | 5970.64 | P-9 |
| 7 | 30 | 28.44 | 6.73 | 2.01 | 2.01 | 5972.27 | 5971.67 | P-7 |
| 8 | 30 | 18.86 | 4.18 | 1.98 | 2.50 | 5973.23 | 5972.97 | P-4 |
| 9 | 21 | 7.72 | 4.34 | 1.03** | 1.55 | 5974.21 j | 5973.55 | P-1 |
| 10 | 18 | 5.61 | 3.17 | 1.50 | 1.50 | 5973.67 | 5973.55 | P-2 |
| 11 | 18 | 5.53 | 3.13 | 1.50 | 1.50 | 5973.57 | 5973.55 | P-3 |
| 12 | 18 | 3.89 | 2.20 | 1.50 | 1.50 | 5972.98 | 5972.97 | P-6 |
| 13 | 18 | 5.69 | 3.22 | 1.50 | 1.50 | 5973.10 | 5972.97 | P-5 |
| 14 | 18 | 3.35 | 3.40 | 0.70** | 1.02 | 5970.83 | 5970.99 | P-8 |
| 15 | 18 | 7.90 | 4.73 | 1.35 | 1.35 | 5970.64 | 5970.49 | P-11 |
| 16 | 18 | 5.69 | 3.82 | 1.16 | 1.20 | 5970.71 | 5970.69 | P-10 |
| 17 | 18 | 4.91 | 2.78 | 1.50 | 1.50 | 5971.04 | 5971.02 | P-13 |
| 18 | 24 | 11.52 | 3.67 | 2.00 | 2.00 | 5970.61 | 5970.36 | P-18 |
| 19 | 18 | 4.36 | 2.47 | 1.50 | 1.50 | 5971.01 | 5970.82 | P-16 |
| 20 | 18 | 4.36 | 2.47 | 1.50 | 1.50 | 5971.11 | 5971.09 | P-15 |
| 21 | 18 | 7.16 | 4.05 | 1.50 | 1.50 | 5971.11 | 5970.82 | P-17 |
| 22 | 18 | 4.91 | 2.78 | 1.50 | 1.50 | 5969.55 | 5969.53 | P-20 |
| 23 | 36 | 36.00 | 7.34 | 1.98 | 1.95 | 5961.42 | 5959.95 | STM PIPE - 37 |
| 24 | 36 | 36.00 | 6.00 | 2.23 | 2.55 | 5962.36 | 5962.19 | STM PIPE - 38 |
| 25 | 36 | 36.00 | 7.06 | 1.95** | 2.13 | 5963.59 j | 5962.45 | STM PIPE - 39 |
| 26 | 36 | 36.00 | 6.66 | 2.14 | 2.15 | 5964.17 | 5963.99 | STM PIPE - 40 |

Hydraflow Storm Sewers Extension for Autodesk® AutoCAD® Civil 3D® Plan



Project File: Storm 2 100 yr.stm

Number of lines: 13

Date: 3/1/2018

| Line No. | Line Size | Flow Rate | Vel Ave | Depth Up | Depth Dn | HGL Up | HGL Dn | Line ID |
|----------|-----------|-----------|---------|----------|----------|---------|---------|-------------|
| | (in) | (cfs) | (ft/s) | (ft) | (ft) | (ft) | (ft) | |
| 1 | 36 | 35.96 | 7.35 | 1.96 | 1.96 | 5966.63 | 5966.30 | Pipe - (6) |
| 2 | 36 | 29.89 | 5.75 | 1.77** | 2.58 | 5967.50 | 5967.45 | Pipe - (5) |
| 3 | 36 | 23.11 | 6.23 | 1.55** | 1.57 | 5968.44 | 5967.50 | Pipe - (4) |
| 4 | 24 | 16.65 | 5.78 | 1.72 | 1.72 | 5969.89 | 5969.62 | Pipe - (10) |
| 5 | 24 | 11.35 | 3.69 | 1.84 | 2.00 | 5970.54 | 5970.40 | Pipe - (14) |
| 6 | 18 | 6.85 | 4.18 | 1.26 | 1.38 | 5970.82 | 5970.58 | Pipe - (15) |
| 7 | 18 | 6.85 | 4.28 | 1.24 | 1.31 | 5971.23 | 5971.07 | Pipe - (16) |
| 8 | 18 | 6.85 | 4.40 | 1.17 | 1.31 | 5971.86 | 5971.50 | Pipe - (17) |
| 9 | 18 | 5.53 | 4.61 | 0.96 | 0.96 | 5970.09 | 5969.35 | Pipe - (3) |
| 10 | 18 | 5.53 | 4.05 | 1.07 | 1.10 | 5970.44 | 5970.42 | Pipe - (9) |
| 11 | 18 | 5.30 | 3.00 | 1.50 | 1.50 | 5970.42 | 5970.40 | Pipe - (18) |
| 12 | 18 | 6.78 | 5.85 | 1.01** | 0.88 | 5968.40 | 5968.11 | Pipe - (11) |
| 13 | 18 | 6.07 | 4.46 | 0.95** | 1.28 | 5967.36 | 5967.45 | Pipe - (12) |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

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 11/10/2017
 JOB # 2015-015

Project: Parker Pointe

STORM SEWER DESIGN -- MANNING'S EQUATION

100-YEAR STORM

| Contributing Basins | Pipe Location Design Points | Q req'd (cfs) | Slope (%) | n | Diam (in) | Q calc (cfs) | V (Full Flow) (fps) | Friction Slope (%) | Normal Depth (ft) |
|----------------------------|------------------------------------|----------------------|------------------|----------|------------------|---------------------|----------------------------|---------------------------|--------------------------|
| SR2 - 5 Year | Stroh Crossing | 1.31 | 0.25 | 0.013 | 12 | 1.79 | 1.67 | 0.13 | 0.42 |
| * SR2 - 100 Year | Stroh Crossing | 3.51 | 0.25 | 0.013 | 12 | 1.79 | 4.47 | 0.97 | 0.80 |

* Flow to Stroh Crossing pipe = 2.66 cfs from basin SR2 plus 1/2 bypass from basin SR1 (1/2 of 1.7cfs) = 3.51 cfs

* Required capacity is 1/2 of 3.51 cfs or 1.75 cfs as 2 parallel pipes are provided.

INLET MANAGEMENT

Worksheet Protected

| INLET NAME | IN 1 | IN 2 | IN 3 | PR1 | SR1 |
|------------------------------------|--------------------------|--------------------------|----------------------------|--------------------------|--------------------------|
| Site Type (Urban or Rural) | | | | | |
| Inlet Application (Street or Area) | STREET | STREET | STREET | STREET | STREET |
| Hydraulic Condition | On Grade | In Sump | On Grade | In Sump | On Grade |
| Inlet Type | CDOT Type R Curb Opening | CDOT Type R Curb Opening | CDOT/Denver 13 Combination | CDOT Type R Curb Opening | CDOT Type R Curb Opening |

USER-DEFINED INPUT

| User-Defined Design Flows | | | | | |
|---|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Minor Q_{Known} (cfs) | 1.1 | 2.2 | 0.5 | 3.3 | 1.8 |
| Major Q_{Known} (cfs) | 2.2 | 4.5 | 0.9 | 6.0 | 7.7 |
| Bypass (Carry-Over) Flow from Upstream | | | | | |
| Receive Bypass Flow from: | No Bypass Flow Received | No Bypass Flow Received | 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 | 0.0 | 0.0 |
| Major Bypass Flow Received, Q_b (cfs) | 0.0 | 0.1 | 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) | 1.1 | 2.2 | 0.5 | 3.3 | 1.8 |
|---|-----|-----|-----|-----|-----|
| Major Total Design Peak Flow, Q (cfs) | 2.2 | 4.6 | 0.9 | 6.0 | 7.7 |
| Minor Flow Bypassed Downstream, Q_b (cfs) | 0.0 | N/A | 0.0 | N/A | 0.0 |
| Major Flow Bypassed Downstream, Q_b (cfs) | 0.0 | N/A | 0.1 | N/A | 1.7 |
| Minor Storm (Calculated) Analysis of Flow Time | | | | | |
| C | N/A | N/A | N/A | N/A | N/A |
| C_s | N/A | N/A | N/A | N/A | N/A |
| Overland Flow Velocity, V_i | N/A | N/A | N/A | N/A | N/A |
| Channel Flow Velocity, V_t | N/A | N/A | N/A | N/A | N/A |
| Overland Flow Time, T_i | N/A | N/A | N/A | N/A | N/A |
| Channel Travel Time, T_t | N/A | N/A | N/A | N/A | N/A |
| Calculated Time of Concentration, T_c | N/A | N/A | N/A | N/A | N/A |
| Regional T_c | N/A | N/A | N/A | N/A | N/A |
| Recommended T_c | N/A | N/A | N/A | N/A | N/A |
| T_c selected by User | N/A | N/A | N/A | N/A | N/A |
| Design Rainfall Intensity, I | N/A | N/A | N/A | N/A | N/A |
| Calculated Local Peak Flow, Q_p | N/A | N/A | N/A | N/A | N/A |
| Major Storm (Calculated) Analysis of Flow Time | | | | | |
| C | N/A | N/A | N/A | N/A | N/A |
| C_s | N/A | N/A | N/A | N/A | N/A |
| Overland Flow Velocity, V_i | N/A | N/A | N/A | N/A | N/A |
| Channel Flow Velocity, V_t | N/A | N/A | N/A | N/A | N/A |
| Overland Flow Time, T_i | N/A | N/A | N/A | N/A | N/A |
| Channel Travel Time, T_t | N/A | N/A | N/A | N/A | N/A |
| Calculated Time of Concentration, T_c | N/A | N/A | N/A | N/A | N/A |
| Regional T_c | N/A | N/A | N/A | N/A | N/A |
| Recommended T_c | N/A | N/A | N/A | N/A | N/A |
| T_c selected by User | N/A | N/A | N/A | N/A | N/A |
| Design Rainfall Intensity, I | N/A | N/A | N/A | N/A | N/A |
| Calculated Local Peak Flow, Q_p | N/A | N/A | N/A | N/A | N/A |

INLET MANAGEMENT

Worksheet Protected

| | |
|------------------------------------|--------------------------|
| INLET NAME | SR2 |
| Site Type (Urban or Rural) | |
| Inlet Application (Street or Area) | STREET |
| Hydraulic Condition | In Sump |
| Inlet Type | CDOT Type R Curb Opening |

USER-DEFINED INPUT**User-Defined Design Flows**

| | |
|-------------------------|-----|
| Minor Q_{Known} (cfs) | 1.3 |
| Major Q_{Known} (cfs) | 2.7 |

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) | 1.7 |

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) | 1.3 |
| Major Total Design Peak Flow, Q (cfs) | 4.4 |
| Minor Flow Bypassed Downstream, Q_b (cfs) | N/A |
| Major Flow Bypassed Downstream, Q_b (cfs) | N/A |

Minor Storm (Calculated) Analysis of Flow T_r

| | |
|---|-----|
| C | N/A |
| C_s | N/A |
| Overland Flow Velocity, V_i | N/A |
| Channel Flow Velocity, V_t | N/A |
| Overland Flow Time, T_i | N/A |
| Channel Travel Time, T_t | N/A |
| Calculated Time of Concentration, T_c | N/A |
| Regional T_c | N/A |
| Recommended T_c | N/A |
| T_c selected by User | N/A |
| Design Rainfall Intensity, I | N/A |
| Calculated Local Peak Flow, Q_p | N/A |

Major Storm (Calculated) Analysis of Flow T_r

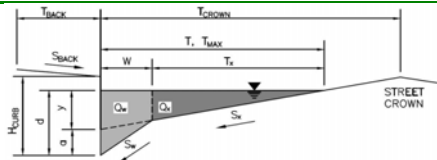
| | |
|---|-----|
| C | N/A |
| C_s | N/A |
| Overland Flow Velocity, V_i | N/A |
| Channel Flow Velocity, V_t | N/A |
| Overland Flow Time, T_i | N/A |
| Channel Travel Time, T_t | N/A |
| Calculated Time of Concentration, T_c | N/A |
| Regional T_c | N/A |
| Recommended T_c | N/A |
| T_c selected by User | N/A |
| Design Rainfall Intensity, I | N/A |
| Calculated Local Peak Flow, Q_p | N/A |

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

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

Project:
Inlet ID:

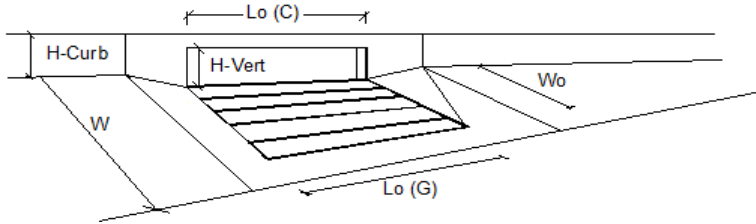
Parker Pointe
IN 1



| Gutter Geometry (Enter data in the blue cells) | | | |
|--|--|--|--|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK} =$ <input style="width: 50px;" type="text" value="0.0"/> ft | | |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK} =$ <input style="width: 50px;" type="text"/> ft/ft | | |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK} =$ <input style="width: 50px;" type="text"/> | | |
| Height of Curb at Gutter Flow Line | $H_{CURB} =$ <input style="width: 50px;" type="text" value="6.00"/> inches | | |
| Distance from Curb Face to Street Crown | $T_{CROWN} =$ <input style="width: 50px;" type="text" value="26.0"/> ft | | |
| Gutter Width | $W =$ <input style="width: 50px;" type="text" value="2.00"/> ft | | |
| Street Transverse Slope | $S_x =$ <input style="width: 50px;" type="text" value="0.020"/> ft/ft | | |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_w =$ <input style="width: 50px;" type="text" value="0.083"/> ft/ft | | |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_o =$ <input style="width: 50px;" type="text" value="0.005"/> ft/ft | | |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET} =$ <input style="width: 50px;" type="text" value="0.013"/> | | |
| Max. Allowable Spread for Minor & Major Storm | <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; text-align: center;"><input style="width: 50px;" type="text" value="26.0"/> ft</td> <td style="width: 50%; text-align: center;"><input style="width: 50px;" type="text" value="26.0"/> ft</td> </tr> </table> | <input style="width: 50px;" type="text" value="26.0"/> ft | <input style="width: 50px;" type="text" value="26.0"/> ft |
| <input style="width: 50px;" type="text" value="26.0"/> ft | <input style="width: 50px;" type="text" value="26.0"/> ft | | |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; text-align: center;"><input style="width: 50px;" type="text" value="6.0"/> inches</td> <td style="width: 50%; text-align: center;"><input style="width: 50px;" type="text" value="6.0"/> inches</td> </tr> </table> | <input style="width: 50px;" type="text" value="6.0"/> inches | <input style="width: 50px;" type="text" value="6.0"/> inches |
| <input style="width: 50px;" type="text" value="6.0"/> inches | <input style="width: 50px;" type="text" value="6.0"/> inches | | |
| Allow Flow Depth at Street Crown (leave blank for no) | <input type="checkbox"/> <input type="checkbox"/> check = yes | | |
| MINOR STORM Allowable Capacity is based on Depth Criterion | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | | | |
| | <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; text-align: center;"><input style="width: 50px;" type="text" value="12.0"/> cfs</td> <td style="width: 50%; text-align: center;"><input style="width: 50px;" type="text" value="12.0"/> cfs</td> </tr> </table> | <input style="width: 50px;" type="text" value="12.0"/> cfs | <input style="width: 50px;" type="text" value="12.0"/> cfs |
| <input style="width: 50px;" type="text" value="12.0"/> cfs | <input style="width: 50px;" type="text" value="12.0"/> cfs | | |
| Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management' Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management' | | | |

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input) | MINOR | MAJOR | |
|---|--------------------------|-------|--------|
| Type of Inlet | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | 2 | 2 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity | | | |
| Total Inlet Interception Capacity | 1.1 | 2.2 | cfs |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | 0.0 | 0.0 | cfs |
| Capture Percentage = Q_c/Q_o = | 100 | 100 | % |

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

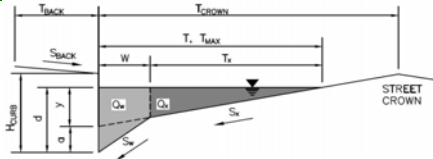
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker Pointe

Inlet ID:

IN 2



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK} = ft
 S_{BACK} = ft/ft
 n_{BACK} =
 H_{CURB} = inches
 T_{CROWN} = ft
 W = ft
 S_x = ft/ft
 S_w = ft/ft
 S_D = ft/ft
 n_{STREET} =

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

| | Minor Storm | Major Storm | |
|-----------|----------------------------------|----------------------------------|--------|
| T_{MAX} | <input type="text" value="8.0"/> | <input type="text" value="8.0"/> | ft |
| d_{MAX} | <input type="text" value="6.0"/> | <input type="text" value="6.0"/> | inches |
| | <input type="checkbox"/> | <input type="checkbox"/> | |

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

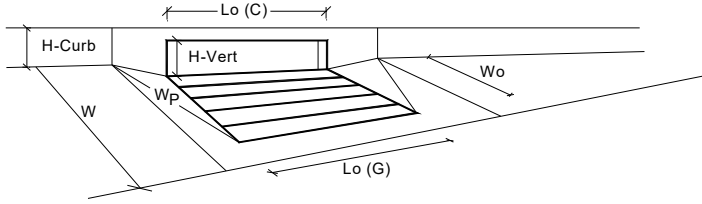
Q_{allow} =

| Minor Storm | Major Storm |
|-----------------------------------|-----------------------------------|
| <input type="text" value="SUMP"/> | <input type="text" value="SUMP"/> |

 cfs

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input) | MINOR | MAJOR | |
|--|--------------------------|-------|--|
| Type of Inlet | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | 1 | 1 | |
| Water Depth at Flowline (outside of local depression) | 6.0 | 6.0 | inches |
| Grate Information | MINOR | MAJOR | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate | N/A | N/A | feet |
| Width of a Unit Grate | N/A | N/A | feet |
| Area Opening Ratio for a Grate (typical values 0.15-0.90) | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | N/A | N/A | |
| Curb Opening Information | MINOR | MAJOR | |
| Length of a Unit Curb Opening | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | 6.00 | 6.00 | inches |
| Angle of Throat (see USDCM Figure ST-5) | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | 0.67 | 0.67 | |
| Low Head Performance Reduction (Calculated) | MINOR | MAJOR | |
| Depth for Grate Midwidth | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | 0.33 | 0.33 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | 0.77 | 0.77 | |
| Curb Opening Performance Reduction Factor for Long Inlets | 1.00 | 1.00 | |
| Grated Inlet Performance Reduction Factor for Long Inlets | N/A | N/A | |
| Total Inlet Interception Capacity (assumes clogged condition) | MINOR | MAJOR | |
| Q_a | 5.4 | 5.4 | cfs |
| Q _{PEAK REQUIRED} | 2.2 | 4.6 | cfs |

Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK)

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

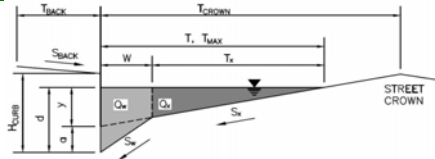
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker Pointe

Inlet ID:

IN 3



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

T_{BACK} = 0.0 ft
 S_{BACK} = ft/ft
 n_{BACK} =

H_{CURB} = 6.00 inches
 T_{CROWN} = 26.0 ft
 W = 2.00 ft
 S_x = 0.020 ft/ft
 S_w = 0.083 ft/ft
 S_D = 0.005 ft/ft
 n_{STREET} = 0.013

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Allow Flow Depth at Street Crown (leave blank for no)

| | Minor Storm | Major Storm | |
|-----------|--------------------------|--------------------------|-------------|
| T_{MAX} | 26.0 | 26.0 | ft |
| d_{MAX} | 6.0 | 6.0 | inches |
| | <input type="checkbox"/> | <input type="checkbox"/> | check = yes |

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

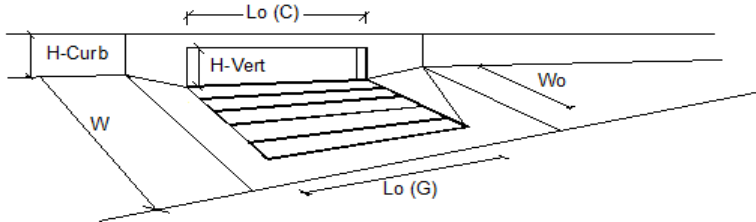
Q_{allow} =

| Minor Storm | Major Storm | |
|-------------|-------------|-----|
| 12.0 | 12.0 | cfs |

Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'
 Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input) | MINOR | MAJOR | |
|---|----------------------------|-------|--------|
| Type of Inlet | CDOT/Denver 13 Combination | | |
| Local Depression (additional to continuous gutter depression 'a') | 2.0 | 2.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | 1 | 1 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | 3.00 | 3.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | 1.73 | 1.73 | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | 0.50 | 0.50 | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity | | | |
| Total Inlet Interception Capacity | 0.5 | 0.8 | cfs |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | 0.0 | 0.1 | cfs |
| Capture Percentage = Q_c/Q_o = | 100 | 86 | % |

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

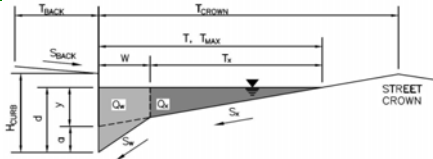
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker Pointe

Inlet ID:

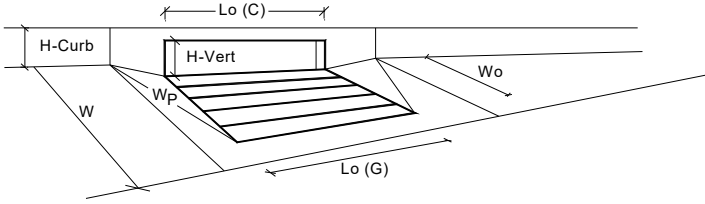
PR1



| Gutter Geometry (Enter data in the blue cells) | | | | | | | | | |
|--|--|--|-------------|-------------|--|-------------|--|--|--------|
| Maximum Allowable Width for Spread Behind Curb | $T_{BACK} =$ <input style="width: 50px;" type="text" value="0.0"/> ft | | | | | | | | |
| Side Slope Behind Curb (leave blank for no conveyance credit behind curb) | $S_{BACK} =$ <input style="width: 50px;" type="text"/> ft/ft | | | | | | | | |
| Manning's Roughness Behind Curb (typically between 0.012 and 0.020) | $n_{BACK} =$ <input style="width: 50px;" type="text"/> | | | | | | | | |
| Height of Curb at Gutter Flow Line | $H_{CURB} =$ <input style="width: 50px;" type="text" value="6.00"/> inches | | | | | | | | |
| Distance from Curb Face to Street Crown | $T_{CROWN} =$ <input style="width: 50px;" type="text" value="50.0"/> ft | | | | | | | | |
| Gutter Width | $W =$ <input style="width: 50px;" type="text" value="2.00"/> ft | | | | | | | | |
| Street Transverse Slope | $S_x =$ <input style="width: 50px;" type="text" value="0.020"/> ft/ft | | | | | | | | |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_w =$ <input style="width: 50px;" type="text" value="0.083"/> ft/ft | | | | | | | | |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_D =$ <input style="width: 50px;" type="text" value="0.000"/> ft/ft | | | | | | | | |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET} =$ <input style="width: 50px;" type="text" value="0.013"/> | | | | | | | | |
| Max. Allowable Spread for Minor & Major Storm | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"></td> <td style="text-align: center; border-bottom: 1px solid black;">Minor Storm</td> <td style="text-align: center; border-bottom: 1px solid black;">Major Storm</td> <td style="width: 10%;"></td> </tr> <tr> <td style="border-right: 1px solid black;">$T_{MAX} =$</td> <td style="border: 1px solid blue; text-align: center;"><input style="width: 40px;" type="text" value="12.0"/></td> <td style="border: 1px solid blue; text-align: center;"><input style="width: 40px;" type="text" value="15.0"/></td> <td style="border: 1px solid blue; text-align: right;">ft</td> </tr> </table> | | Minor Storm | Major Storm | | $T_{MAX} =$ | <input style="width: 40px;" type="text" value="12.0"/> | <input style="width: 40px;" type="text" value="15.0"/> | ft |
| | Minor Storm | Major Storm | | | | | | | |
| $T_{MAX} =$ | <input style="width: 40px;" type="text" value="12.0"/> | <input style="width: 40px;" type="text" value="15.0"/> | ft | | | | | | |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"></td> <td style="text-align: center; border-bottom: 1px solid black;">Minor Storm</td> <td style="text-align: center; border-bottom: 1px solid black;">Major Storm</td> <td style="width: 10%;"></td> </tr> <tr> <td style="border-right: 1px solid black;">$d_{MAX} =$</td> <td style="border: 1px solid blue; text-align: center;"><input style="width: 40px;" type="text" value="6.0"/></td> <td style="border: 1px solid blue; text-align: center;"><input style="width: 40px;" type="text" value="9.0"/></td> <td style="border: 1px solid blue; text-align: right;">inches</td> </tr> </table> | | Minor Storm | Major Storm | | $d_{MAX} =$ | <input style="width: 40px;" type="text" value="6.0"/> | <input style="width: 40px;" type="text" value="9.0"/> | inches |
| | Minor Storm | Major Storm | | | | | | | |
| $d_{MAX} =$ | <input style="width: 40px;" type="text" value="6.0"/> | <input style="width: 40px;" type="text" value="9.0"/> | inches | | | | | | |
| Check boxes are not applicable in SUMP conditions | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"></td> <td style="text-align: center; border-bottom: 1px solid black;">Minor Storm</td> <td style="text-align: center; border-bottom: 1px solid black;">Major Storm</td> <td style="width: 10%;"></td> </tr> <tr> <td style="border-right: 1px solid black;"></td> <td style="text-align: center;"><input type="checkbox"/></td> <td style="text-align: center;"><input type="checkbox"/></td> <td></td> </tr> </table> | | Minor Storm | Major Storm | | | <input type="checkbox"/> | <input type="checkbox"/> | |
| | Minor Storm | Major Storm | | | | | | | |
| | <input type="checkbox"/> | <input type="checkbox"/> | | | | | | | |
| MINOR STORM Allowable Capacity is based on Depth Criterion | | | | | | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | | | | | | | | | |
| $Q_{allow} =$ | <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%;"></td> <td style="text-align: center; border-bottom: 1px solid black;">Minor Storm</td> <td style="text-align: center; border-bottom: 1px solid black;">Major Storm</td> <td style="width: 10%;"></td> </tr> <tr> <td style="border-right: 1px solid black;"></td> <td style="border: 1px solid green; text-align: center;"><input style="width: 40px;" type="text" value="SUMP"/></td> <td style="border: 1px solid green; text-align: center;"><input style="width: 40px;" type="text" value="SUMP"/></td> <td style="border: 1px solid green; text-align: right;">cfs</td> </tr> </table> | | Minor Storm | Major Storm | | | <input style="width: 40px;" type="text" value="SUMP"/> | <input style="width: 40px;" type="text" value="SUMP"/> | cfs |
| | Minor Storm | Major Storm | | | | | | | |
| | <input style="width: 40px;" type="text" value="SUMP"/> | <input style="width: 40px;" type="text" value="SUMP"/> | cfs | | | | | | |

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|--------------------------|--|--|---------------|--------------------------|-------|--|-------------------------------|------|------|--------|---|------|------|--------|--|------|------|--------|--|-------|-------|---------|--|------|------|------|--|------|------|--|---|------|------|--|--|------|------|--|
| Design Information (Input) | | <table border="1"> <tr> <td>Type of Inlet</td> <td>CDOT Type R Curb Opening</td> </tr> </table> | | Type of Inlet | CDOT Type R Curb Opening | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Type of Inlet | CDOT Type R Curb Opening | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | | <table border="1"> <tr> <td>Type =</td> <td>MINOR</td> <td>MAJOR</td> <td></td> </tr> <tr> <td>a_{local} =</td> <td>3.00</td> <td>3.00</td> <td>inches</td> </tr> <tr> <td>Number of Unit Inlets (Grate or Curb Opening)</td> <td>2</td> <td>2</td> <td></td> </tr> <tr> <td>Water Depth at Flowline (outside of local depression)</td> <td>4.4</td> <td>5.1</td> <td>inches</td> </tr> </table> | | Type = | MINOR | MAJOR | | a_{local} = | 3.00 | 3.00 | inches | Number of Unit Inlets (Grate or Curb Opening) | 2 | 2 | | Water Depth at Flowline (outside of local depression) | 4.4 | 5.1 | inches | | | | | | | | | | | | | | | | | | | | |
| Type = | MINOR | MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| a_{local} = | 3.00 | 3.00 | inches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Number of Unit Inlets (Grate or Curb Opening) | 2 | 2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Water Depth at Flowline (outside of local depression) | 4.4 | 5.1 | inches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grate Information | | <table border="1"> <tr> <td></td> <td>MINOR</td> <td>MAJOR</td> <td><input type="checkbox"/> Override Depths</td> </tr> <tr> <td>Length of a Unit Grate</td> <td>N/A</td> <td>N/A</td> <td>feet</td> </tr> <tr> <td>Width of a Unit Grate</td> <td>N/A</td> <td>N/A</td> <td>feet</td> </tr> <tr> <td>Area Opening Ratio for a Grate (typical values 0.15-0.90)</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> <tr> <td>Clogging Factor for a Single Grate (typical value 0.50 - 0.70)</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> <tr> <td>Grate Weir Coefficient (typical value 2.15 - 3.60)</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> <tr> <td>Grate Orifice Coefficient (typical value 0.60 - 0.80)</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> </table> | | | MINOR | MAJOR | <input type="checkbox"/> Override Depths | Length of a Unit Grate | N/A | N/A | feet | Width of a Unit Grate | N/A | N/A | feet | Area Opening Ratio for a Grate (typical values 0.15-0.90) | N/A | N/A | | Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | N/A | N/A | | Grate Weir Coefficient (typical value 2.15 - 3.60) | N/A | N/A | | Grate Orifice Coefficient (typical value 0.60 - 0.80) | N/A | N/A | | | | | | | | | |
| | MINOR | MAJOR | <input type="checkbox"/> Override Depths | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Length of a Unit Grate | N/A | N/A | feet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Width of a Unit Grate | N/A | N/A | feet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Area Opening Ratio for a Grate (typical values 0.15-0.90) | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Curb Opening Information | | <table border="1"> <tr> <td></td> <td>MINOR</td> <td>MAJOR</td> <td></td> </tr> <tr> <td>Length of a Unit Curb Opening</td> <td>5.00</td> <td>5.00</td> <td>feet</td> </tr> <tr> <td>Height of Vertical Curb Opening in Inches</td> <td>6.00</td> <td>6.00</td> <td>inches</td> </tr> <tr> <td>Height of Curb Orifice Throat in Inches</td> <td>6.00</td> <td>6.00</td> <td>inches</td> </tr> <tr> <td>Angle of Throat (see USDCM Figure ST-5)</td> <td>63.40</td> <td>63.40</td> <td>degrees</td> </tr> <tr> <td>Side Width for Depression Pan (typically the gutter width of 2 feet)</td> <td>2.00</td> <td>2.00</td> <td>feet</td> </tr> <tr> <td>Clogging Factor for a Single Curb Opening (typical value 0.10)</td> <td>0.10</td> <td>0.10</td> <td></td> </tr> <tr> <td>Curb Opening Weir Coefficient (typical value 2.3-3.7)</td> <td>3.60</td> <td>3.60</td> <td></td> </tr> <tr> <td>Curb Opening Orifice Coefficient (typical value 0.60 - 0.70)</td> <td>0.67</td> <td>0.67</td> <td></td> </tr> </table> | | | MINOR | MAJOR | | Length of a Unit Curb Opening | 5.00 | 5.00 | feet | Height of Vertical Curb Opening in Inches | 6.00 | 6.00 | inches | Height of Curb Orifice Throat in Inches | 6.00 | 6.00 | inches | Angle of Throat (see USDCM Figure ST-5) | 63.40 | 63.40 | degrees | Side Width for Depression Pan (typically the gutter width of 2 feet) | 2.00 | 2.00 | feet | Clogging Factor for a Single Curb Opening (typical value 0.10) | 0.10 | 0.10 | | Curb Opening Weir Coefficient (typical value 2.3-3.7) | 3.60 | 3.60 | | Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | 0.67 | 0.67 | |
| | MINOR | MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Length of a Unit Curb Opening | 5.00 | 5.00 | feet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Height of Vertical Curb Opening in Inches | 6.00 | 6.00 | inches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Height of Curb Orifice Throat in Inches | 6.00 | 6.00 | inches | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Angle of Throat (see USDCM Figure ST-5) | 63.40 | 63.40 | degrees | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | 2.00 | 2.00 | feet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | 0.10 | 0.10 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | 3.60 | 3.60 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | 0.67 | 0.67 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Low Head Performance Reduction (Calculated) | | <table border="1"> <tr> <td></td> <td>MINOR</td> <td>MAJOR</td> <td></td> </tr> <tr> <td>Depth for Grate Midwidth</td> <td>N/A</td> <td>N/A</td> <td>ft</td> </tr> <tr> <td>Depth for Curb Opening Weir Equation</td> <td>0.20</td> <td>0.26</td> <td>ft</td> </tr> <tr> <td>Combination Inlet Performance Reduction Factor for Long Inlets</td> <td>0.41</td> <td>0.48</td> <td></td> </tr> <tr> <td>Curb Opening Performance Reduction Factor for Long Inlets</td> <td>0.82</td> <td>0.88</td> <td></td> </tr> <tr> <td>Grated Inlet Performance Reduction Factor for Long Inlets</td> <td>N/A</td> <td>N/A</td> <td></td> </tr> </table> | | | MINOR | MAJOR | | Depth for Grate Midwidth | N/A | N/A | ft | Depth for Curb Opening Weir Equation | 0.20 | 0.26 | ft | Combination Inlet Performance Reduction Factor for Long Inlets | 0.41 | 0.48 | | Curb Opening Performance Reduction Factor for Long Inlets | 0.82 | 0.88 | | Grated Inlet Performance Reduction Factor for Long Inlets | N/A | N/A | | | | | | | | | | | | | |
| | MINOR | MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Depth for Grate Midwidth | N/A | N/A | ft | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Depth for Curb Opening Weir Equation | 0.20 | 0.26 | ft | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Combination Inlet Performance Reduction Factor for Long Inlets | 0.41 | 0.48 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Curb Opening Performance Reduction Factor for Long Inlets | 0.82 | 0.88 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Grated Inlet Performance Reduction Factor for Long Inlets | N/A | N/A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total Inlet Interception Capacity (assumes clogged condition) | | <table border="1"> <tr> <td></td> <td>MINOR</td> <td>MAJOR</td> <td></td> </tr> <tr> <td>Q_a =</td> <td>4.3</td> <td>6.8</td> <td>cfs</td> </tr> <tr> <td>$Q_{PEAK REQUIRED}$ =</td> <td>3.3</td> <td>6.0</td> <td>cfs</td> </tr> </table> | | | MINOR | MAJOR | | Q_a = | 4.3 | 6.8 | cfs | $Q_{PEAK REQUIRED}$ = | 3.3 | 6.0 | cfs | | | | | | | | | | | | | | | | | | | | | | | | |
| | MINOR | MAJOR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Q_a = | 4.3 | 6.8 | cfs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $Q_{PEAK REQUIRED}$ = | 3.3 | 6.0 | cfs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

**2 - 10' INLETS PROPOSED. CAPACITY IS TWICE WHAT IS INDICATED ABOVE
4.5 CFS OVERFLOW FROM 100 YR TOPS CURB AND FLOWS DIRECTLY TO KINNEY CREEK.**

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

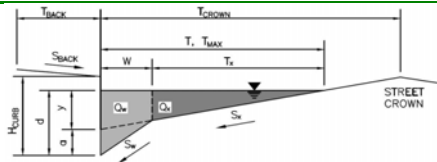
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker Pointe

Inlet ID:

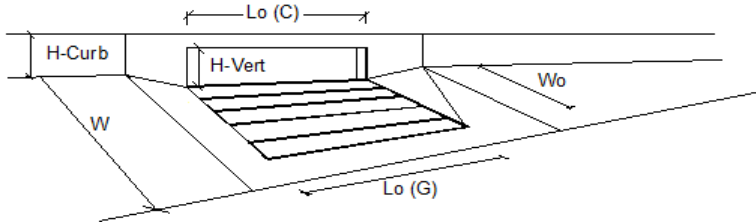
SR1



| Gutter Geometry (Enter data in the blue cells) | | | | | | | |
|---|---|--------------------------|--------------------------|-------------|------|------|--|
| 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) | $n_{BACK} =$ | | | | | | |
| Height of Curb at Gutter Flow Line | $H_{CURB} = 6.00$ inches | | | | | | |
| Distance from Curb Face to Street Crown | $T_{CROWN} = 40.0$ ft | | | | | | |
| Gutter Width | $W = 2.00$ ft | | | | | | |
| Street Transverse Slope | $S_x = 0.020$ ft/ft | | | | | | |
| Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft) | $S_w = 0.083$ ft/ft | | | | | | |
| Street Longitudinal Slope - Enter 0 for sump condition | $S_D = 0.029$ ft/ft | | | | | | |
| Manning's Roughness for Street Section (typically between 0.012 and 0.020) | $n_{STREET} = 0.013$ | | | | | | |
| Max. Allowable Spread for Minor & Major Storm | <table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>ft</th> </tr> <tr> <td>10.0</td> <td>40.0</td> <td></td> </tr> </table> | Minor Storm | Major Storm | ft | 10.0 | 40.0 | |
| Minor Storm | Major Storm | ft | | | | | |
| 10.0 | 40.0 | | | | | | |
| Max. Allowable Depth at Gutter Flowline for Minor & Major Storm | <table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>inches</th> </tr> <tr> <td>6.0</td> <td>6.0</td> <td></td> </tr> </table> | Minor Storm | Major Storm | inches | 6.0 | 6.0 | |
| Minor Storm | Major Storm | inches | | | | | |
| 6.0 | 6.0 | | | | | | |
| Allow Flow Depth at Street Crown (leave blank for no) | <table border="1"> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td>check = yes</td> </tr> </table> | <input type="checkbox"/> | <input type="checkbox"/> | check = yes | | | |
| <input type="checkbox"/> | <input type="checkbox"/> | check = yes | | | | | |
| MINOR STORM Allowable Capacity is based on Spread Criterion | | | | | | | |
| MAJOR STORM Allowable Capacity is based on Depth Criterion | | | | | | | |
| | <table border="1"> <tr> <th>Minor Storm</th> <th>Major Storm</th> <th>cfs</th> </tr> <tr> <td>6.5</td> <td>22.1</td> <td></td> </tr> </table> | Minor Storm | Major Storm | cfs | 6.5 | 22.1 | |
| Minor Storm | Major Storm | cfs | | | | | |
| 6.5 | 22.1 | | | | | | |
| <p>Minor storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'</p> <p>Major storm max. allowable capacity GOOD - greater than the design flow given on sheet 'Inlet Management'</p> | | | | | | | |

INLET ON A CONTINUOUS GRADE

Version 4.05 Released March 2017



| Design Information (Input) | MINOR | MAJOR | |
|---|--------------------------|-------|--------|
| Type of Inlet | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a') | 3.0 | 3.0 | inches |
| Total Number of Units in the Inlet (Grate or Curb Opening) | 2 | 2 | |
| Length of a Single Unit Inlet (Grate or Curb Opening) | 5.00 | 5.00 | ft |
| Width of a Unit Grate (cannot be greater than W, Gutter Width) | N/A | N/A | ft |
| Clogging Factor for a Single Unit Grate (typical min. value = 0.5) | N/A | N/A | |
| Clogging Factor for a Single Unit Curb Opening (typical min. value = 0.1) | 0.10 | 0.10 | |
| Street Hydraulics: OK - Q < Allowable Street Capacity | | | |
| Total Inlet Interception Capacity | 1.8 | 6.0 | cfs |
| Total Inlet Carry-Over Flow (flow bypassing inlet) | 0.0 | 1.7 | cfs |
| Capture Percentage = Q_b/Q_o = | 100 | 78 | % |

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

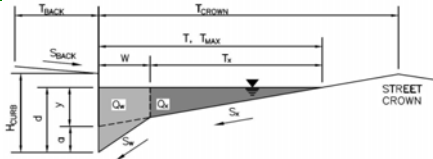
(Based on Regulated Criteria for Maximum Allowable Flow Depth and Spread)

Project:

Parker Pointe

Inlet ID:

SR2



Gutter Geometry (Enter data in the blue cells)

Maximum Allowable Width for Spread Behind Curb
 Side Slope Behind Curb (leave blank for no conveyance credit behind curb)
 Manning's Roughness Behind Curb (typically between 0.012 and 0.020)
 Height of Curb at Gutter Flow Line
 Distance from Curb Face to Street Crown
 Gutter Width
 Street Transverse Slope
 Gutter Cross Slope (typically 2 inches over 24 inches or 0.083 ft/ft)
 Street Longitudinal Slope - Enter 0 for sump condition
 Manning's Roughness for Street Section (typically between 0.012 and 0.020)

$T_{BACK} =$ ft
 $S_{BACK} =$ ft/ft
 $n_{BACK} =$

$H_{CURB} =$ inches
 $T_{CROWN} =$ ft
 $W =$ ft
 $S_X =$ ft/ft
 $S_W =$ ft/ft
 $S_D =$ ft/ft
 $n_{STREET} =$

Max. Allowable Spread for Minor & Major Storm
 Max. Allowable Depth at Gutter Flowline for Minor & Major Storm
 Check boxes are not applicable in SUMP conditions

| | Minor Storm | Major Storm | |
|-------------|-----------------------------------|-----------------------------------|--------|
| $T_{MAX} =$ | <input type="text" value="10.0"/> | <input type="text" value="14.0"/> | ft |
| $d_{MAX} =$ | <input type="text" value="6.0"/> | <input type="text" value="6.0"/> | inches |
| | <input type="checkbox"/> | <input type="checkbox"/> | |

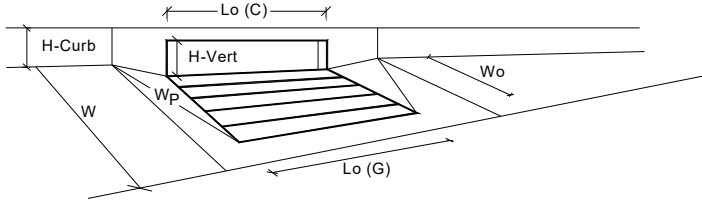
MINOR STORM Allowable Capacity is based on Depth Criterion
MAJOR STORM Allowable Capacity is based on Depth Criterion

$Q_{allow} =$

| Minor Storm | Major Storm | |
|-----------------------------------|-----------------------------------|-----|
| <input type="text" value="SUMP"/> | <input type="text" value="SUMP"/> | cfs |

INLET IN A SUMP OR SAG LOCATION

Version 4.05 Released March 2017



| Design Information (Input) | MINOR | MAJOR | |
|--|--------------------------|-------|--|
| Type of Inlet | CDOT Type R Curb Opening | | |
| Local Depression (additional to continuous gutter depression 'a' from above) | 3.00 | 3.00 | inches |
| Number of Unit Inlets (Grate or Curb Opening) | 2 | 2 | |
| Water Depth at Flowline (outside of local depression) | 4.7 | 6.0 | inches |
| Grate Information | MINOR | MAJOR | <input type="checkbox"/> Override Depths |
| Length of a Unit Grate | N/A | N/A | feet |
| Width of a Unit Grate | N/A | N/A | feet |
| Area Opening Ratio for a Grate (typical values 0.15-0.90) | N/A | N/A | |
| Clogging Factor for a Single Grate (typical value 0.50 - 0.70) | N/A | N/A | |
| Grate Weir Coefficient (typical value 2.15 - 3.60) | N/A | N/A | |
| Grate Orifice Coefficient (typical value 0.60 - 0.80) | N/A | N/A | |
| Curb Opening Information | MINOR | MAJOR | |
| Length of a Unit Curb Opening | 5.00 | 5.00 | feet |
| Height of Vertical Curb Opening in Inches | 6.00 | 6.00 | inches |
| Height of Curb Orifice Throat in Inches | 6.00 | 6.00 | inches |
| Angle of Throat (see USDCM Figure ST-5) | 63.40 | 63.40 | degrees |
| Side Width for Depression Pan (typically the gutter width of 2 feet) | 2.00 | 2.00 | feet |
| Clogging Factor for a Single Curb Opening (typical value 0.10) | 0.10 | 0.10 | |
| Curb Opening Weir Coefficient (typical value 2.3-3.7) | 3.60 | 3.60 | |
| Curb Opening Orifice Coefficient (typical value 0.60 - 0.70) | 0.67 | 0.67 | |
| Low Head Performance Reduction (Calculated) | MINOR | MAJOR | |
| Depth for Grate Midwidth | N/A | N/A | ft |
| Depth for Curb Opening Weir Equation | 0.22 | 0.33 | ft |
| Combination Inlet Performance Reduction Factor for Long Inlets | 0.44 | 0.57 | |
| Curb Opening Performance Reduction Factor for Long Inlets | 0.85 | 0.93 | |
| Grated Inlet Performance Reduction Factor for Long Inlets | N/A | N/A | |
| Total Inlet Interception Capacity (assumes clogged condition) | MINOR | MAJOR | |
| Inlet Capacity IS GOOD for Minor and Major Storms(>Q PEAK) | 5.2 | 10.5 | cfs |
| Q PEAK REQUIRED | 1.3 | 4.4 | cfs |

OUTFALL PIPE TO KINNEY CREEK

The open channel flow calculator

Select Channel Type: Circle

Depth from Q: ▼

Select unit system: Feet(ft)

| | | | | | | | | |
|------------------|-------|--------------------|------------------|----------------------|----|-------------------|--------------------|----|
| Channel slope | 0.005 | ft/ft | Water depth(y): | 1.41 | ft | Radius (r) | 3 | ft |
| Flow velocity | 7.15 | ft/s | Left Slope (Z1): | to 1 (HV) | | Right Slope (Z2): | to 1 (HV) | |
| Flow discharge | 36 | ft ³ /s | Input n value | 0.13 | | or select n | | |
| Calculator | | | Status: | Calculation finished | | Reset | | |
| Wetted perimeter | 6.06 | ft | Flow area | 5.05 | | Top width(T) | 5.08 | ft |
| Specific energy | 2.2 | ft | Froude number | 1.26 | | Flow status | Supercritical flow | |
| Critical depth | 1.59 | ft | Critical slope | 0.0031 | | Velocity head | 0.79 | ft |

Copyright 2000 Dr. Xing Fang, Department of Civil Engineering, Lamar University.

3.2.2 Low Tailwater Basin

The design of low tailwater riprap basins is necessary when the receiving channel may have little or no flow or tailwater at time when the pipe or culvert is in operation. Figure 9-37 provides a plan and profile view of a typical low tailwater riprap basin.

By providing a low tailwater basin at the end of a storm drain conduit or culvert, the kinetic energy of the discharge dissipates under controlled conditions without causing scour at the channel bottom.

Low tailwater is defined as being equal to or less than $\frac{1}{3}$ of the height of the storm drain, that is:

$$y_t \leq \frac{D}{3} \quad \text{or} \quad y_t \leq \frac{H}{3}$$

Low tailwater applies
Flow in stream is minimal

Where:

y_t = tailwater depth at design flow (feet)

D = diameter of circular pipe (feet)

H = height of rectangular pipe (feet)

Rock Size

The procedure for determining the required riprap size downstream of a conduit outlet is in Section 3.2.3.

After selecting the riprap size, the minimum thickness of the riprap layer, T , in feet, in the basin is defined as:

$$T = 2D_{50} \quad D_{50} = 12'' \quad T = 2'$$

Equation 9-15

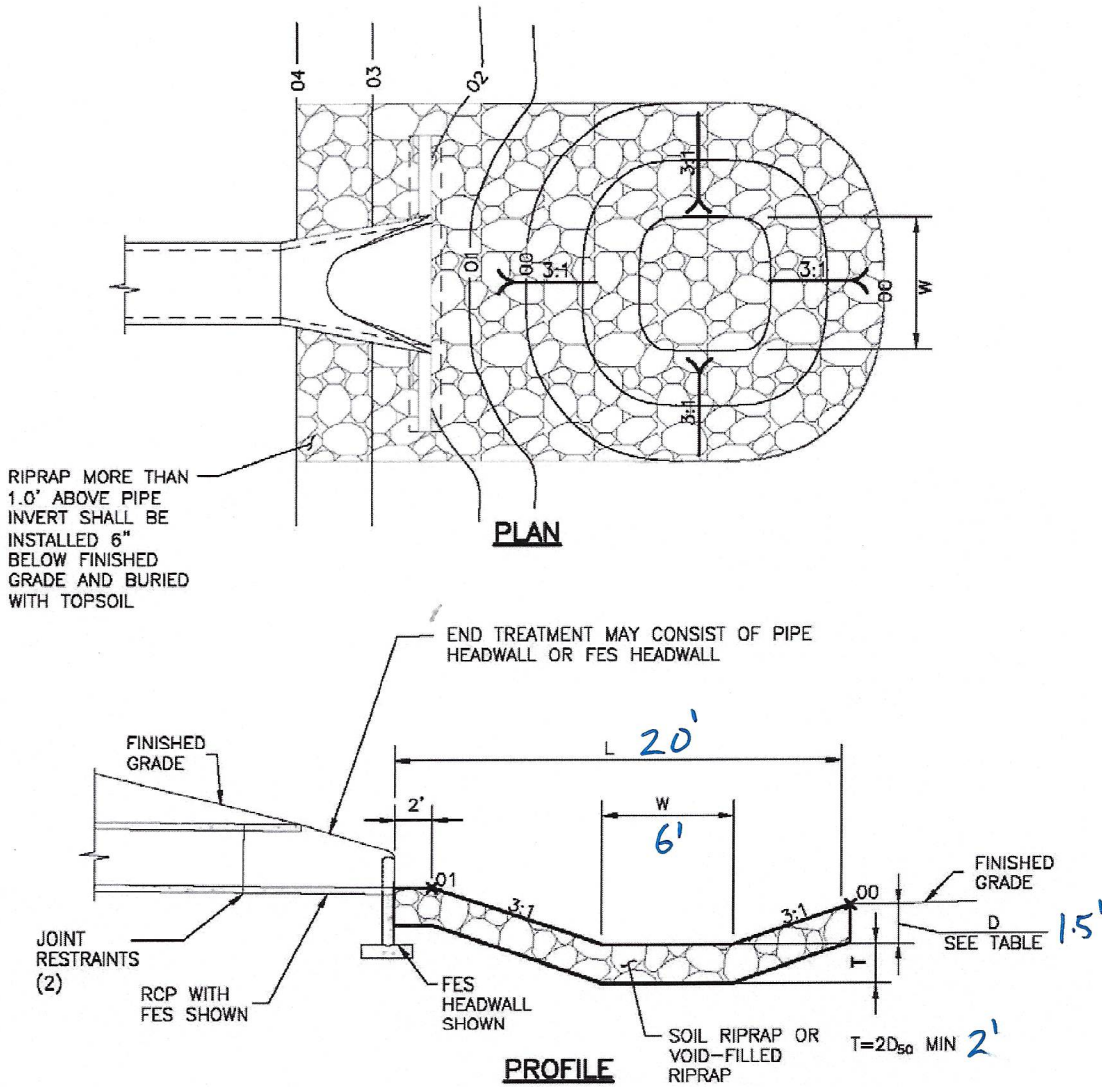
Basin Geometry

Figure 9-37 includes a layout of a standard low tailwater riprap basin with the geometry parameters provided. The minimum length of the basin (L) and the width of the bottom of the basin ($W1$) are provided in a table at the bottom of Figure 9-37. All slopes in the low tailwater basin shall be 3(H):1(V), minimum.

Other Design Requirements

Extend riprap up the outlet embankment slope to the mid-pipe level, minimum. It is recommended that riprap that extends more than 1 foot above the outlet pipe invert be installed 6 inches below finished grade and buried with topsoil.

Provide pipe end treatment in the form of a pipe headwall or a flared-end section headwall. See Section 3.1 for options.



| PIPE SIZE OR BOX HEIGHT | D | W* | L |
|-------------------------|-------|----|-----|
| 18" - 24" | 1'-0" | 4' | 15' |
| 30" - 36" | 1'-6" | 6' | 20' |
| 42" - 48" | 2'-0" | 7' | 24' |
| 54" - 60" | 2'-6" | 8' | 28' |
| 66" - 72" | 3'-0" | 9' | 32' |

* IF OUTLET PIPE IS A BOX CULVERT WITH A WIDTH GREATER THAN W, THEN W = CULVERT WIDTH

Figure 9-37. Low tailwater riprap basin

3.2.3 Rock Sizing for Riprap Apron and Low Tailwater Basin

Scour resulting from highly turbulent, rapidly decelerating flow is a common problem at conduit outlets. The following section summarizes the method for sizing riprap protection for both riprap aprons (Section 3.2.1) and low tailwater basins (Section 3.2.2).

Use Figure 9-38 to determine the required rock size for circular conduits and Figure 9-39 for rectangular conduits. Figure 9-38 is valid for $Q/D_c^{2.5}$ of 6.0 or less and Figure 9-39 is valid for $Q/WH^{1.5}$ of 8.0 or less. The parameters in these two figures are:

$$Q = 36 \text{ cfs} \quad D_c = 3' \quad Q/D_c^{2.5} = 2.3 \Rightarrow \text{Fig 9-38 applies}$$

1. $Q/D^{1.5}$ or $Q/WH^{0.5}$ in which Q is the design discharge in cfs, D_c is the diameter of a circular conduit in feet, and W and H are the width and height of a rectangular conduit in feet.
2. Y_t/D_c or Y_t/H in which Y_t is the tailwater depth in feet, D_c is the diameter of a circular conduit in feet, and H is the height of a rectangular conduit in feet. In cases where Y_t is unknown or a hydraulic jump is suspected downstream of the outlet, use $Y_t/D_c = Y_t/H = 0.40$ when using Figures 9-38 and 9-39.
3. The riprap size requirements in Figures 9-38 and 9-39 are based on the non-dimensional parametric Equations 9-16 and 9-17 (Steven, Simons, and Watts 1971 and Smith 1975).

Circular culvert:

$$d_{50} = \frac{0.023Q}{Y_t^{1.2} D_c^{0.3}} \quad \text{Equation 9-16}$$

Rectangular culvert:

$$d_{50} = \frac{0.014H^{0.5}Q}{Y_t W} \quad \text{Equation 9-17}$$

These rock size requirements assume that the flow in the culvert is subcritical. It is possible to use Equations 9-16 and 9-17 when the flow in the culvert is supercritical (and less than full) if the value of D_c or H is modified for use in Figures 9-38 and 9-39. Note that rock sizes referenced in these figures are defined in the *Open Channels* chapter. Whenever the flow is supercritical in the culvert, substitute D_a for D_c and H_a for H , in which D_a is defined as:

$$D_a = \frac{(D_c + Y_n)}{2} = \frac{3.0 + 1.41}{2} = 2.2 \quad \text{Equation 9-18}$$

Where the maximum value of D_a shall not exceed D_c , and

$$H_a = \frac{(H + Y_n)}{2} \quad \text{N/A}$$

Equation 9-19

Where the maximum value of H_a shall not exceed H , and:

D_a = parameter to use in place of D in Figure 9-38 when flow is supercritical (ft) **2.2**

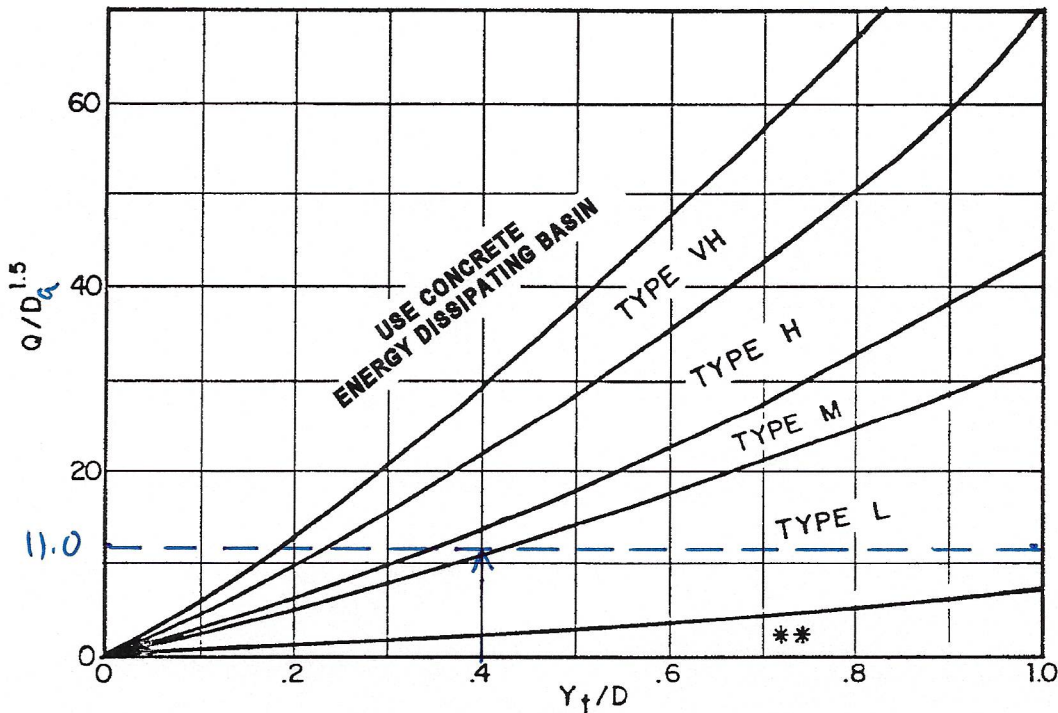
D_c = diameter of circular culvert (ft) **3.0'**

H_a = parameter to use in place of H in Figure 9-39 when flow is supercritical (ft) **N/A**

H = height of rectangular culvert (ft) **N/A**

Y_n = normal depth of supercritical flow in the culvert (ft) **1.41**

36 / 2.2^{1.5} = 11.0



0.40

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

use type M Riprap $D_{50} = 12''$

Figure 9-38. Riprap erosion protection at circular conduit outlet (valid for $Q/D2.5 \leq 6.0$)

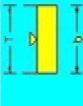
EAST PROPERTY LINE SWALE DESIGN

The open channel flow calculator


Select Channel Type: Trapezoid ▼

Select unit system: Feet(ft) ▼


Depth from Q




Rectangle



Trapezoid



Triangle



Circle

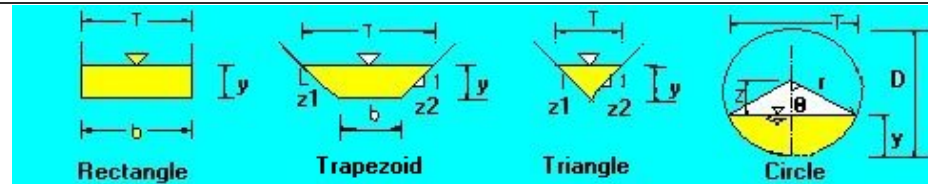
| | | | | | | | | |
|-------------------|-------|--------------------|------------------|-------|-----------------|-------------------|----------------------|------------|
| Channel slope: | 01 | ft/ft | Water depth(y): | 0.92 | ft | Bottom width(b): | 6 | ft |
| Flow velocity: | 2.789 | ft/s | Left Slope (Z1): | 4 | to 1 (H:V) | Right Slope (Z2): | 4 | to 1 (H:V) |
| Flow discharge: | 24.7 | ft ³ /s | Input n value: | 0.04 | or select n | Status: | Calculation finished | |
| Wetted perimeter: | 13.56 | ft | Flow area: | 8.86 | ft ² | Flow status: | Subcritical flow | |
| Specific energy: | 1.04 | ft | Froude number: | 0.6 | | Velocity head: | 0.12 | ft |
| Critical depth: | 0.69 | ft | Critical slope: | 0.029 | ft/ft | Reset | | |
| | | | Top width(T): | 13.33 | ft | | | |

Copyright 2000 Dr. Xing Fang, Department of Civil Engineering, Lamar University.

| | |
|------------------------|-----------------|
| Offsite Tributary Area | 5.7 Ac |
| Offsite C | 0.36 |
| I (assume 5 min Tc) | 8.85 |
| Q Offsite Area | 18.2 cfs |
| Basin 2A | 1.48 cfs |
| Basin 3A | 1.25 cfs |
| Basin 4A | 1.87 cfs |
| <u>Basin 5A</u> | <u>1.87 cfs</u> |
| Total Design Flow | 24.7 cfs |

The open channel flow calculator

Select Channel Type: Trapezoid ▼



Depth from Q ▼

Select unit system: Feet(ft) ▼

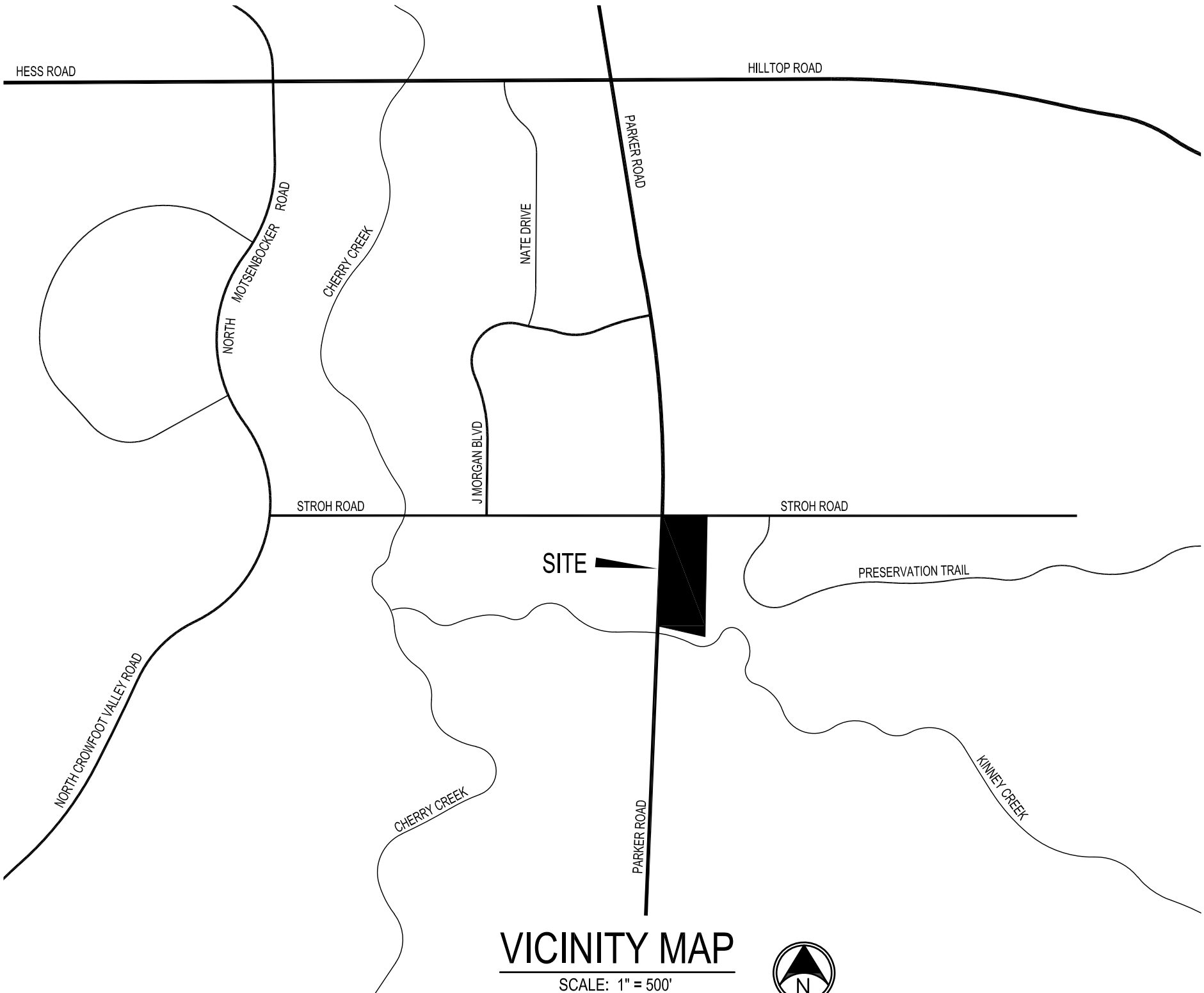
| | | |
|---|--|--|
| Channel slope: <input type="text" value=".0075"/> ft/ft | Water depth(y): <input style="color: red;" type="text" value="1.15"/> ft | Bottom width(b) <input type="text" value="16"/> ft |
| Flow velocity <input type="text" value="3.713"/> ft/s | LeftSlope (Z1): <input type="text" value="4"/> to 1 (H:V) | RightSlope (Z2): <input type="text" value="4"/> to 1 (H:V) |
| Flow discharge <input type="text" value="88.1"/> ft^3/s | Input n value <input type="text" value=".033"/> or select n | |
| <input type="button" value="Calculate!"/> | Status: Calculation finished | <input type="button" value="Reset"/> |
| Wetted perimeter <input type="text" value="25.5"/> ft | Flow area <input type="text" value="23.73"/> ft^2 | Top width(T) <input type="text" value="25.21"/> ft |
| Specific energy <input type="text" value="1.37"/> ft | Froude number <input type="text" value="0.67"/> | Flow status Subcritical flow |
| Critical depth <input type="text" value="0.91"/> ft | Critical slope <input type="text" value="0.0175"/> ft/ft | Velocity head <input type="text" value="0.21"/> ft |

Copyright 2000 Dr. Xing Fang, Department of Civil Engineering, Lamar University.

EMERGENCY OVERFLOW CHANNEL FROM POND TO KINNEY CREEK

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

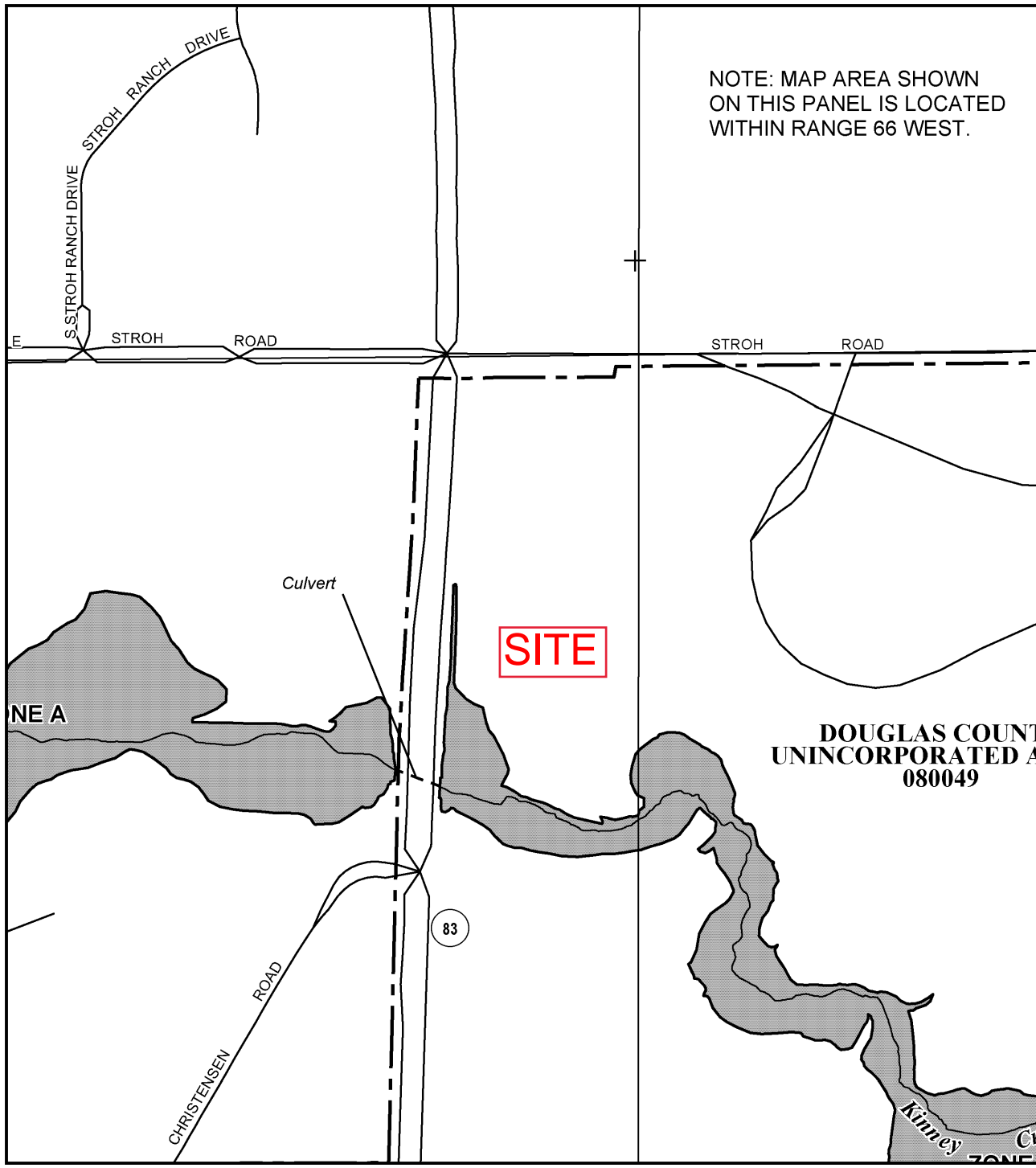
APPENDIX D KEYMAP, FIRM, SOILS



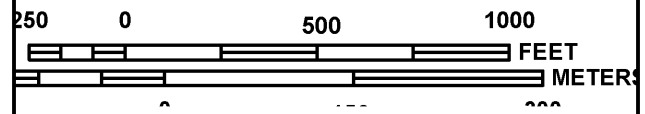
VICINITY MAP

SCALE: 1" = 500'





MAP SCALE 1" = 500'



PANEL 0182G

FIRM
FLOOD INSURANCE RATE MAP
DOUGLAS COUNTY,
COLORADO
AND INCORPORATED AREAS

PANEL 182 OF 495
 (SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

| COMMUNITY | NUMBER | PANEL | SUFFIX |
|-----------------|--------|-------|--------|
| DOUGLAS COUNTY | 080049 | 0182 | G |
| PARKER, TOWN OF | 080310 | 0182 | G |

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



MAP NUMBER
08035C0182G
MAP REVISED
MARCH 16, 2016

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov



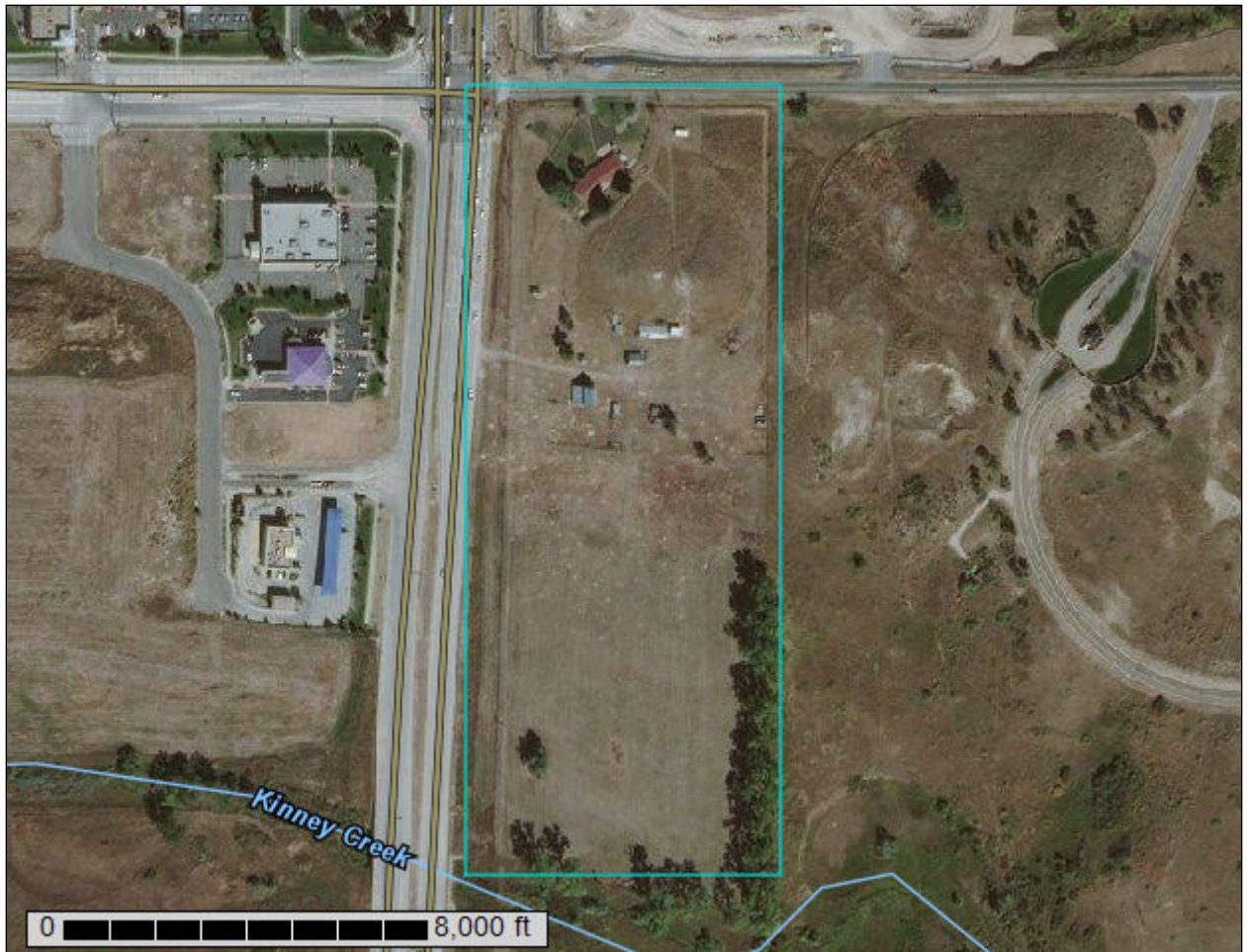
United States
Department of
Agriculture

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



Preface

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

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

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

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

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

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

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

| | |
|---|----|
| Preface | 2 |
| Soil Map | 5 |
| Soil Map..... | 6 |
| Legend..... | 7 |
| Map Unit Legend..... | 8 |
| Map Unit Descriptions..... | 8 |
| Castle Rock Area, Colorado..... | 10 |
| BtE—Bresser-Truckton sandy loams, 5 to 25 percent slopes..... | 10 |
| Lu—Loamy alluvial land, dark surface..... | 11 |
| Sa—Sampson loam..... | 13 |
| Sd—Sandy alluvial land..... | 14 |
| Soil Information for All Uses | 16 |
| Soil Properties and Qualities..... | 16 |
| Soil Qualities and Features..... | 16 |
| Hydrologic Soil Group..... | 16 |
| References | 21 |

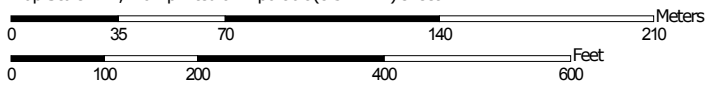
Soil Map

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

Custom Soil Resource Report
Soil Map




Map Scale: 1:2,470 if printed on A portrait (8.5" x 11") sheet.



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


MAP LEGEND

Area of Interest (AOI)

 Area of Interest (AOI)




















Soils







 Soil 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 9, Sep 22, 2016

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

Date(s) aerial images were photographed: Jul 17, 2015—Mar 9, 2017

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

| Castle Rock Area, Colorado (CO622) | | | |
|------------------------------------|---|--------------|----------------|
| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
| BtE | Bresser-Truckton sandy loams, 5 to 25 percent slopes | 6.1 | 34.7% |
| Lu | Loamy alluvial land, dark surface | 2.8 | 16.0% |
| Sa | Sampson loam | 8.7 | 49.1% |
| Sd | Sandy alluvial land | 0.0 | 0.2% |
| Totals for Area of Interest | | 17.7 | 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

Custom Soil Resource Report

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
Natural 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 storage in profile: Moderate (about 7.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: Sandy Foothill (R049BY210CO)
Hydric soil rating: No

Description of Truckton

Setting

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

Custom Soil Resource Report

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

Natural drainage class: Well drained

Runoff class: Low

Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)

Depth to water table: More than 80 inches

Frequency of flooding: None

Frequency of ponding: None

Available water storage in profile: Low (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: A

Hydric soil rating: No

Minor Components

Blakeland

Percent of map unit: 5 percent

Hydric soil rating: No

Newlin

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

Lu—Loamy alluvial land, dark surface

Map Unit Setting

National map unit symbol: jqzc

Elevation: 7,000 to 8,000 feet

Custom Soil Resource Report

Mean annual precipitation: 17 to 19 inches
Mean annual air temperature: 44 to 46 degrees F
Frost-free period: 115 to 120 days
Farmland classification: Not prime farmland

Map Unit Composition

Loamy alluvial land, dark surface: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Loamy Alluvial Land, Dark Surface

Setting

Landform: Flood plains, swales
Down-slope shape: Linear
Across-slope shape: Linear

Typical profile

H1 - 0 to 20 inches: sandy loam
H2 - 20 to 40 inches: stratified loamy sand to clay loam
H3 - 40 to 60 inches: sand and gravel

Properties and qualities

Slope: 0 to 4 percent
Natural drainage class: Well drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 6.00 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: Frequent
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4w
Hydrologic Soil Group: C
Ecological site: Loamy Foothill 14-19 P.Z. (R049XC202CO)
Hydric soil rating: No

Minor Components

Sandy alluvial land

Percent of map unit: 14 percent
Hydric soil rating: No

Fluvaquentic haplustolls

Percent of map unit: 1 percent
Landform: Terraces
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

Natural 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 in profile: 15 percent

Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)

Available water storage in profile: High (about 9.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e

Land capability classification (nonirrigated): 3c

Hydrologic Soil Group: B

Ecological site: Loamy Foothill 14-19 P.Z. (R049XC202CO)

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

Sd—Sandy alluvial land

Map Unit Setting

National map unit symbol: jr03

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: Not prime farmland

Map Unit Composition

Sandy alluvial land: 75 percent

Minor components: 25 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sandy Alluvial Land

Setting

Landform: Swales, drainageways

Down-slope shape: Linear

Across-slope shape: Linear

Parent material: Weathered alluvium derived from arkose

Typical profile

H1 - 0 to 20 inches: loamy sand

H2 - 20 to 60 inches: stratified sand to sandy loam

Properties and qualities

Slope: 1 to 5 percent

Natural drainage class: Excessively drained

Runoff class: Negligible

Custom Soil Resource Report

Capacity of the most limiting layer to transmit water (Ksat): High to very high (2.00 to 20.00 in/hr)

Depth to water table: About 60 inches

Frequency of flooding: Frequent

Calcium carbonate, maximum in profile: 5 percent

Salinity, maximum in profile: Nonsaline to slightly saline (0.0 to 4.0 mmhos/cm)

Available water storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified

Land capability classification (nonirrigated): 7w

Hydrologic Soil Group: A

Hydric soil rating: No

Minor Components

Loamy alluvial land

Percent of map unit: 8 percent

Hydric soil rating: No

Loamy alluvial land, dark surface

Percent of map unit: 8 percent

Hydric soil rating: No

Bresser

Percent of map unit: 4 percent

Hydric soil rating: No

Truckton

Percent of map unit: 4 percent

Hydric soil rating: No

Fluvaquentic haplustolls

Percent of map unit: 1 percent

Landform: Terraces

Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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

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

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

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

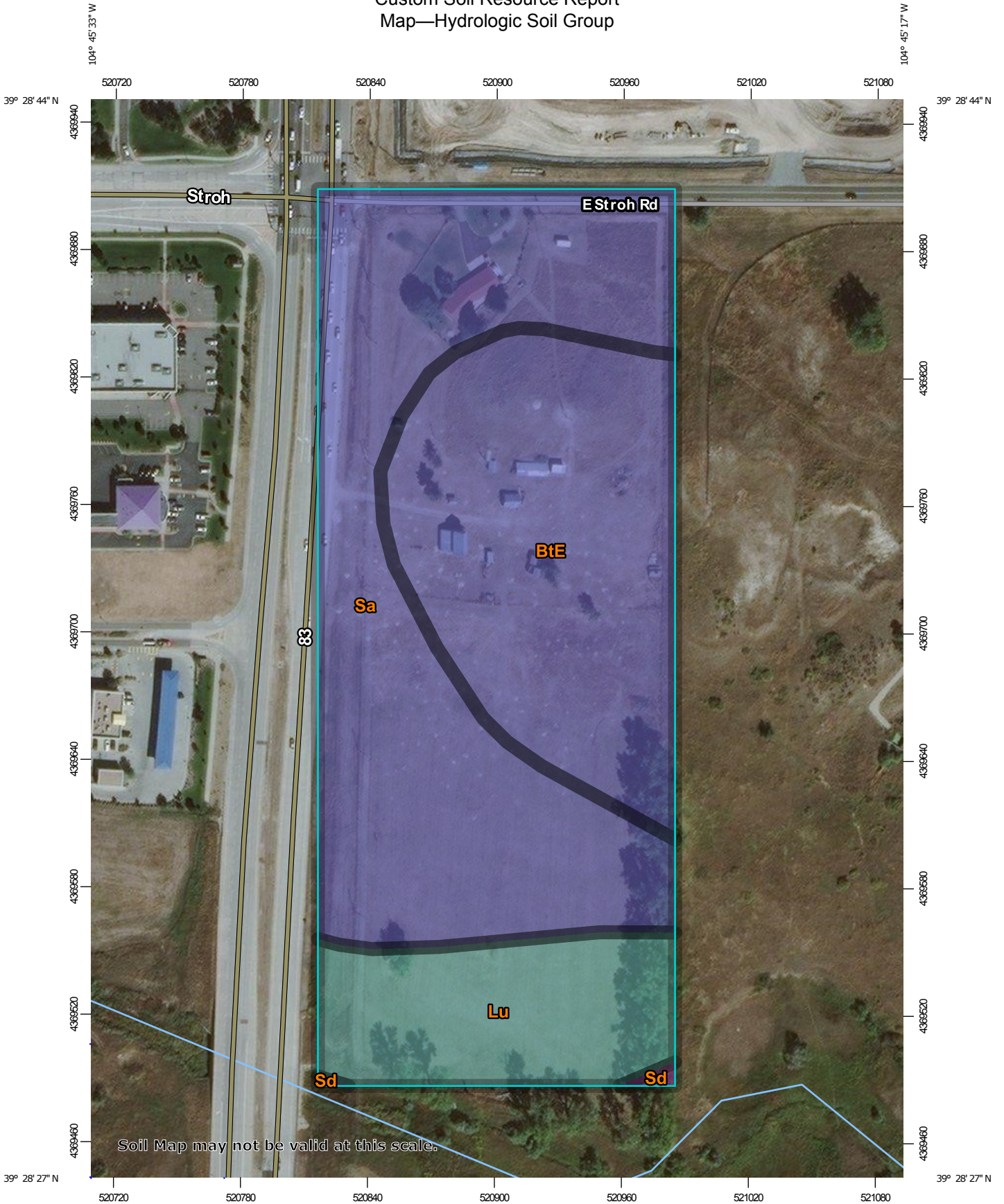
Custom Soil Resource Report

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group



Soil Map may not be valid at this scale.


Map Scale: 1:2,470 if printed on A portrait (8.5" x 11") sheet.



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

MAP LEGEND

Area of Interest (AOI)









 Area of Interest (AOI)

Soils

Soil Rating Polygons





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

Soil Rating Lines


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

Soil Rating Points






-  A
-  A/D
-  B
-  B/D

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


Water Features

 Streams and Canals

Transportation

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

Background

 Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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 9, Sep 22, 2016

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

Date(s) aerial images were photographed: Jul 17, 2015—Mar 9, 2017

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.

Table—Hydrologic Soil Group

| Hydrologic Soil Group— Summary by Map Unit — Castle Rock Area, Colorado (CO622) | | | | |
|---|--|--------|--------------|----------------|
| Map unit symbol | Map unit name | Rating | Acres in AOI | Percent of AOI |
| BtE | Bresser-Truckton sandy loams, 5 to 25 percent slopes | B | 6.1 | 34.7% |
| Lu | Loamy alluvial land, dark surface | C | 2.8 | 16.0% |
| Sa | Sampson loam | B | 8.7 | 49.1% |
| Sd | Sandy alluvial land | A | 0.0 | 0.2% |
| Totals for Area of Interest | | | 17.7 | 100.0% |

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

References

- American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.
- American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.
- Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.
- Federal Register. July 13, 1994. Changes in hydric soils of the United States.
- Federal Register. September 18, 2002. Hydric soils of the United States.
- Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.
- National Research Council. 1995. Wetlands: Characteristics and boundaries.
- Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262
- Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577
- Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580
- Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.
- United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.
- United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374
- United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. <http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084>

Custom Soil Resource Report

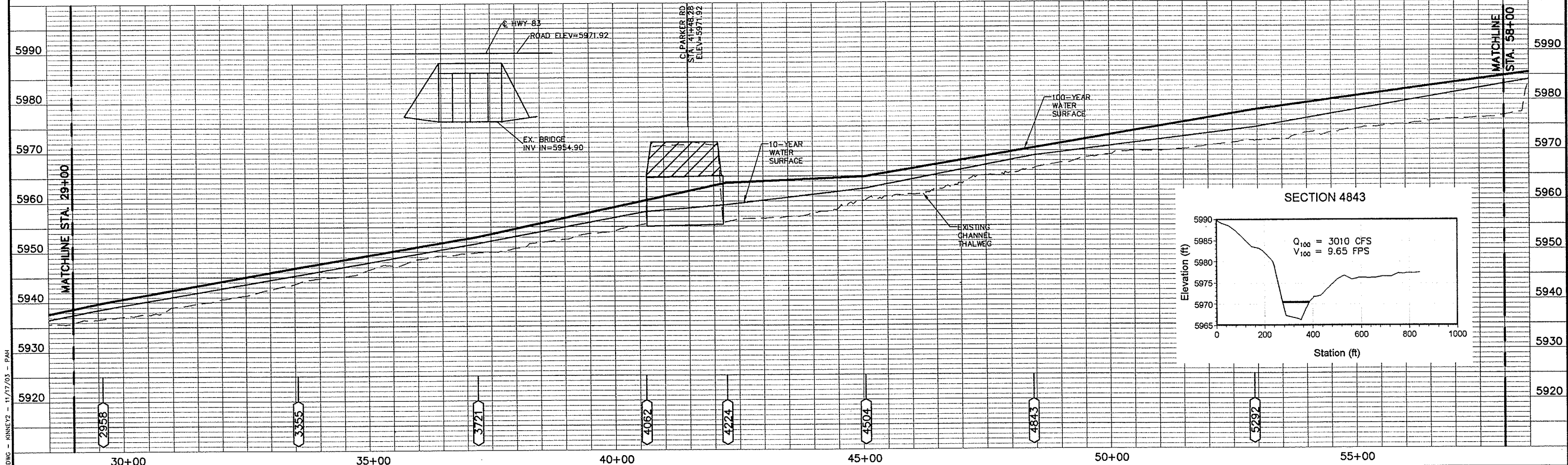
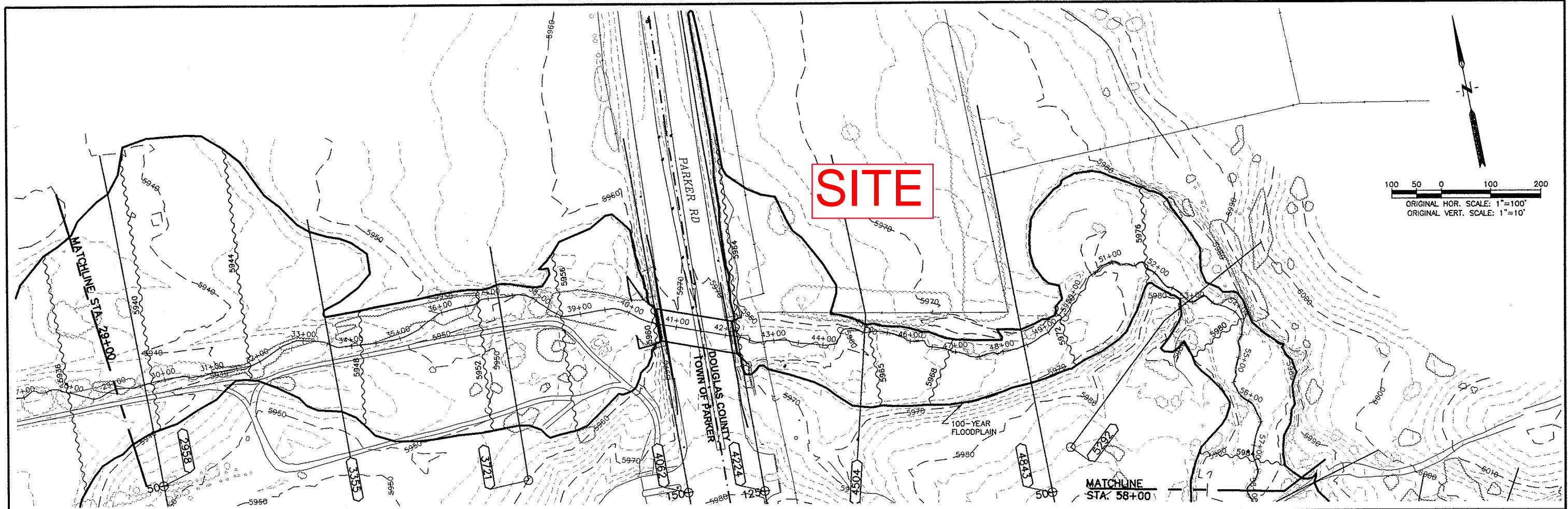
United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

APPENDIX E DRAINAGE MAP



GROUND CONTROL SURVEY BY: MOUNTAIN SURVEY & MAPPING
AERIAL PHOTOGRAPHY BY: LANDMARK MAPPING
TOPOGRAPHIC MAPPING BY: LANDMARK MAPPING
CONTOUR INTERVAL: 2 DATE FLOWN: 03/19/99

WRC ENGINEERING, INC.
350 SOUTH CHERRY STREET,
SUITE 404
DENVER, COLORADO 80246
PHONE NO: (303) 757-8513
FAX NO: (303) 758-3208

| | | | |
|----------|-----|------|---------|
| DESIGNED | RLM | DATE | 5/29/03 |
| DRAWN | PAH | DATE | 5/29/03 |
| CHECKED | | DATE | |
| REVISED | | DATE | |
| AS-BUILT | | DATE | |

**URBAN DRAINAGE & FLOOD CONTROL DISTRICT
DOUGLAS COUNTY**

**FLOOD HAZARD AREA DELINEATION
FOR KINNEY CREEK AND TRIBUTARIES**

**KINNEY CREEK
STA. 29+00 TO STA. 58+00**

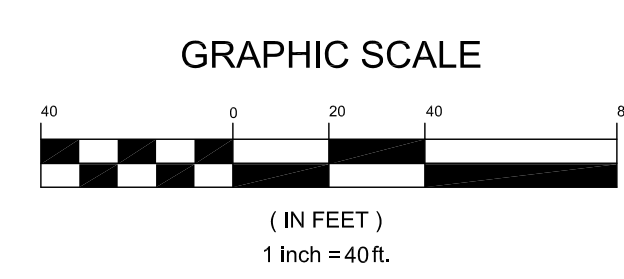
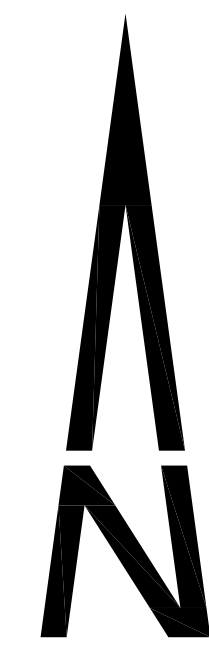
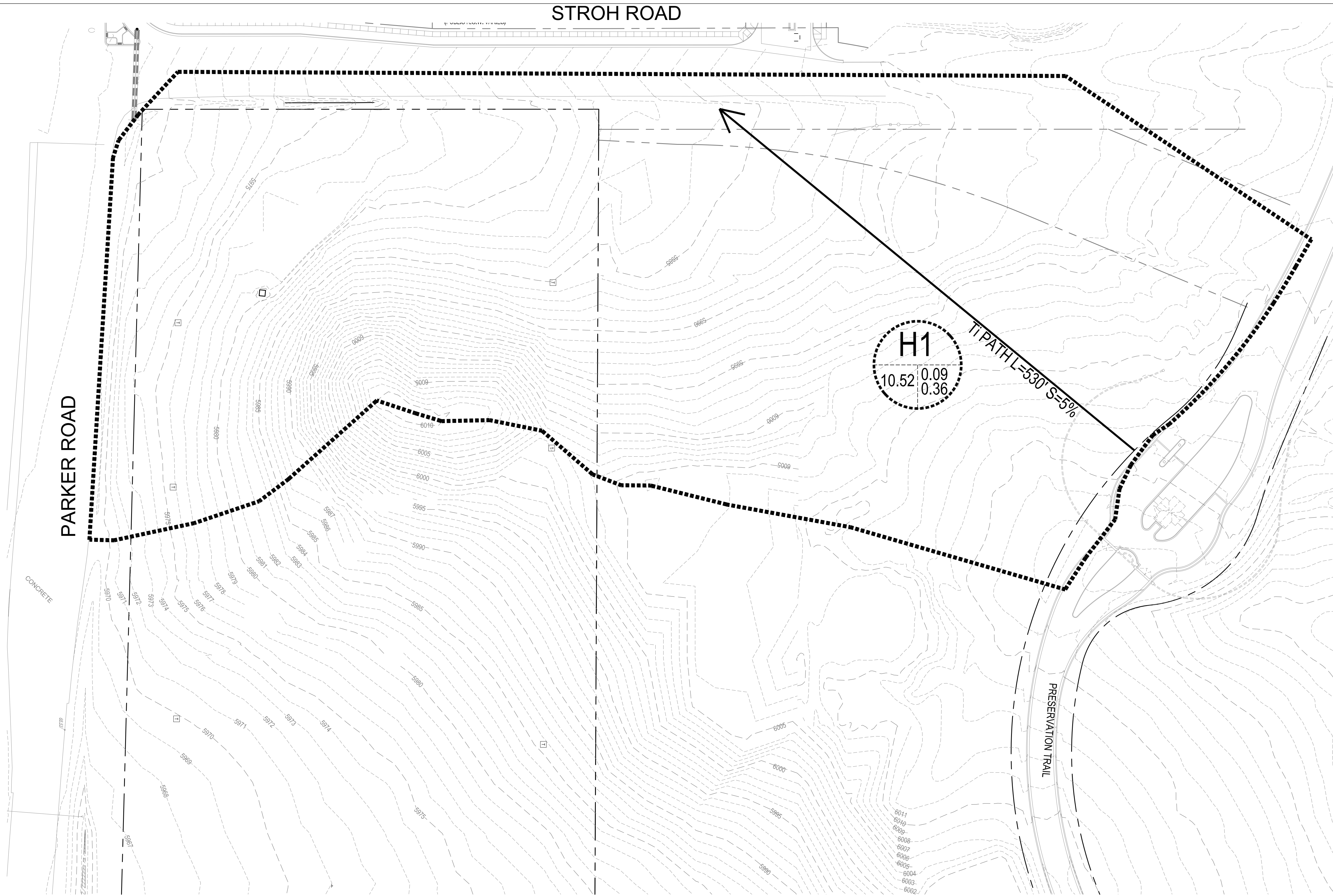
**SHEET
2 OF 34**

2122 - 2122T A02.DWG - KINNEY2 - 11/17/03 - PAH

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

APPENDIX E DRAINAGE MAP

I:\PDG-MA\PUBLIC\PROJECTS\2015-015 PARKER AND STROH\DWG\2015-015 DRAINAGE MAP.DWG 8/31/2018 6:20 PM



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 _____



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

| NO. | DATE | DESCRIPTION |
|----------|------|-------------------|
| 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 |

HISTORIC DRAINAGE PLAN

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

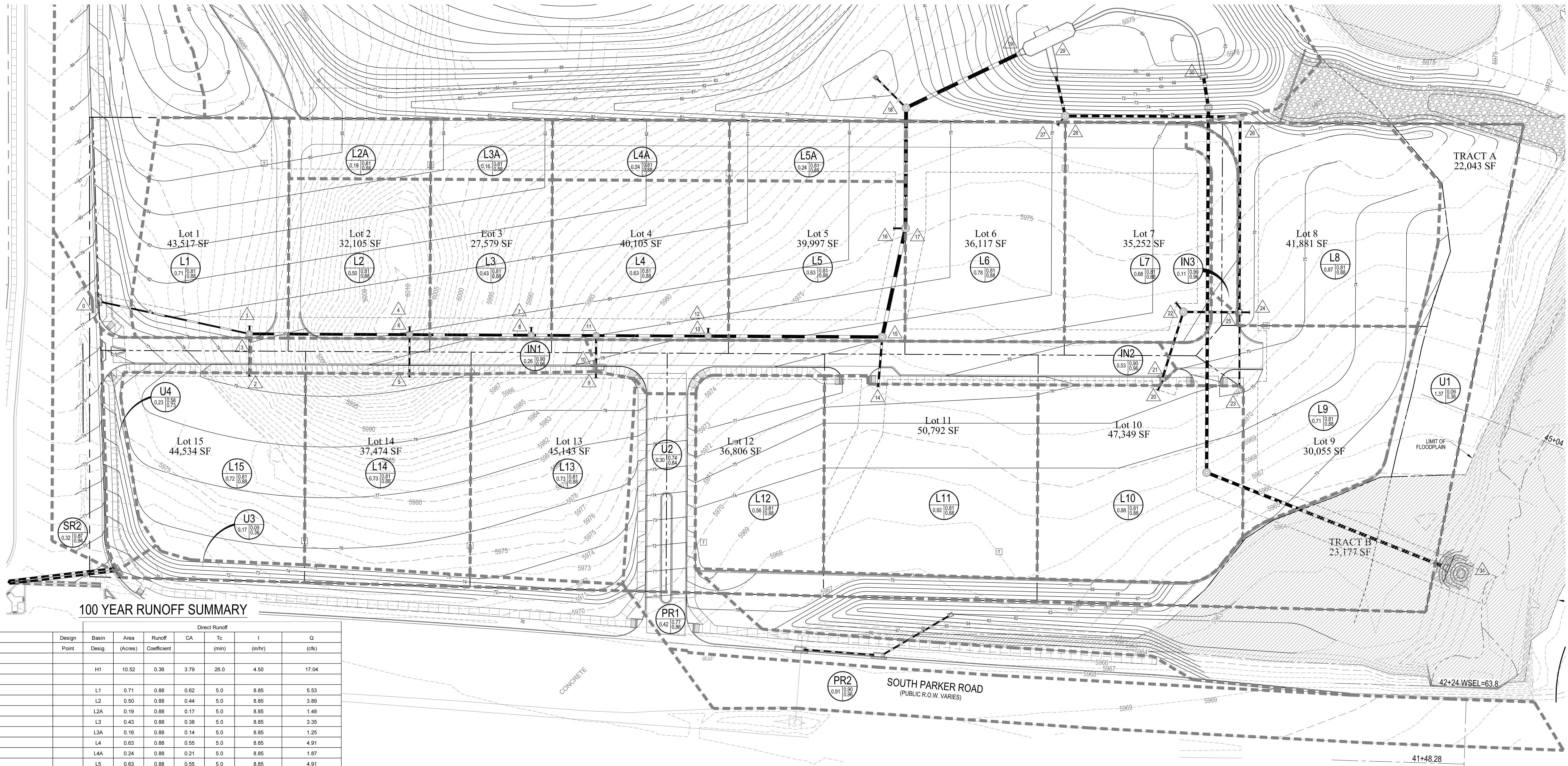
design by: JWD
 approved by: JWD
 project no.: 2015-015

date: 10/01/17

SHEET
DP1

SEE SHEET DP3

STROH ROAD



100 YEAR RUNOFF SUMMARY

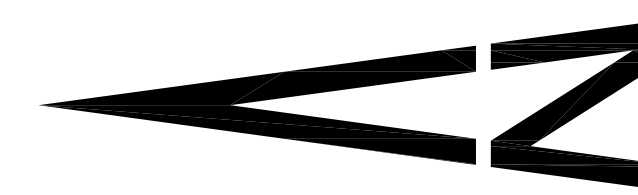
| Design Point | Basin Desig. | Area (Acres) | Runoff Coefficient | Direct Runoff | | |
|-------------------------|--------------|--------------|--------------------|---------------|----------|---------|
| | | | | CA | Tc (min) | Q (cfs) |
| | H1 | 10.52 | 0.36 | 3.79 | 26.0 | 17.04 |
| | L1 | 0.71 | 0.88 | 0.62 | 5.0 | 8.85 |
| | L2 | 0.50 | 0.88 | 0.44 | 5.0 | 8.85 |
| | L2A | 0.19 | 0.88 | 0.17 | 5.0 | 8.85 |
| | L3 | 0.43 | 0.88 | 0.38 | 5.0 | 8.85 |
| | L3A | 0.16 | 0.88 | 0.14 | 5.0 | 8.85 |
| | L4 | 0.63 | 0.88 | 0.55 | 5.0 | 8.85 |
| | L4A | 0.24 | 0.88 | 0.21 | 5.0 | 8.85 |
| | L5 | 0.63 | 0.88 | 0.55 | 5.0 | 8.85 |
| | L5A | 0.24 | 0.88 | 0.21 | 5.0 | 8.85 |
| | L6 | 0.78 | 0.88 | 0.69 | 5.0 | 8.85 |
| | L7 | 0.68 | 0.88 | 0.60 | 5.0 | 8.85 |
| | L8 | 0.87 | 0.88 | 0.77 | 5.0 | 8.85 |
| | L9 | 0.71 | 0.88 | 0.62 | 5.0 | 8.85 |
| | L10 | 0.88 | 0.88 | 0.77 | 5.0 | 8.85 |
| | L11 | 0.92 | 0.88 | 0.81 | 5.0 | 8.85 |
| | L12 | 0.56 | 0.88 | 0.49 | 5.0 | 8.85 |
| | L13 | 0.73 | 0.88 | 0.64 | 5.0 | 8.85 |
| | L14 | 0.73 | 0.88 | 0.64 | 5.0 | 8.85 |
| | L15 | 0.72 | 0.88 | 0.63 | 5.0 | 8.85 |
| | IN1 | 0.26 | 0.96 | 0.25 | 5.0 | 8.85 |
| | IN2 | 0.53 | 0.96 | 0.51 | 5.0 | 8.85 |
| | IN3 | 0.11 | 0.96 | 0.11 | 5.0 | 8.85 |
| | SR1 | 3.75 | 0.42 | 1.58 | 22.4 | 4.90 |
| TOTAL FLOW TO FOREBAY | | | | | | 103.45 |
| | OS1 | 24.54 | 0.39 | 9.57 | 25.5 | 43.07 |
| TOTAL TO POND | | | | | | 146.51 |
| | U1 | 1.37 | 0.36 | 0.49 | 25.5 | 2.22 |
| | U2 | 0.3 | 0.84 | 0.25 | 25.5 | 1.13 |
| | U3 | 0.17 | 0.36 | 0.06 | 25.5 | 0.28 |
| | U4 | 0.23 | 0.73 | 0.17 | 25.5 | 0.78 |
| UN-CAPTURED SITE RUNOFF | | | | | | 4.38 |
| | SR2 | 0.32 | 0.94 | 0.30 | 5.0 | 2.66 |
| | PR1 | 0.42 | 0.86 | 0.36 | 5.0 | 3.20 |
| | PR2 | 0.91 | 0.96 | 0.87 | 5.0 | 7.73 |

DETENTION SUMMARY

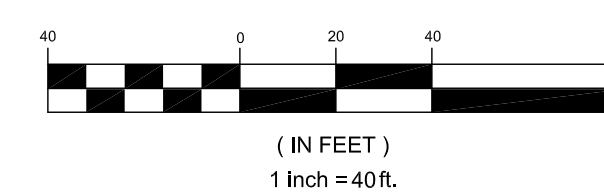
| ZONE | VOLUME | ELEVATION | RELEASE RATE |
|-----------|-------------|-----------|--------------|
| WOCV | 0.551 AC-FT | | 45 HOURS |
| EURV+WOCV | 1.253 AC-FT | 5967.59 | 81 HOURS |
| 100 YEAR | 2.680 AC-FT | 5969.57 | 36.0 CFS |

LEGEND

- 5340 --- EXISTING CONTOUR
- 42 --- PROPOSED CONTOUR
- R1** BASIN DESIGNATION
- 0.20 0.75 0.83 5 YR RUNOFF COEFFICIENT
- 100 YR RUNOFF COEFFICIENT
- BASIN AREA
- BASIN BOUNDARY LINE
- ▲ DESIGN POINT



GRAPHIC SCALE



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)

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

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

| DATE | DESCRIPTION | REVISIONS |
|----------|-------------------|-----------|
| 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 | |



I:\PDG-MAS\PUBLIC\PROJECTS\2015-015 PARKER AND STROH.DWG\2015-015 DRAINAGE MAP.DWG 8/31/2018 6:22 PM

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 _____

I:\PDG-MASTP\PROJECTS\2015-015 PARKER AND STROH.DWG\2015-015 DRAINAGE MAP.DWG 8/31/2018 6:23 PM

STROH ROAD

PRESERVATION TRAIL

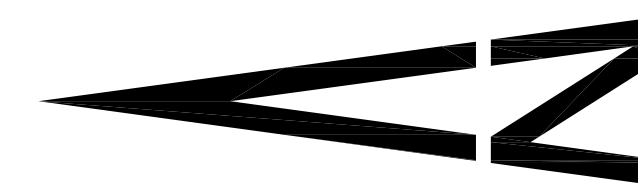
SR1
3.51 0.18
0.42

OS1
24.54 0.09
0.36

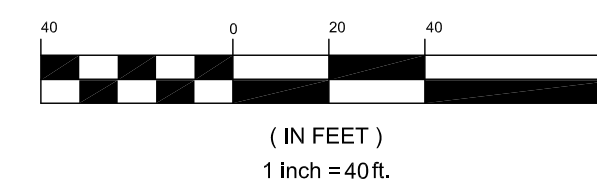
SEE SHEET DP2

LEGEND

- 5340 ----- EXISTING CONTOUR
- 42 ----- PROPOSED CONTOUR
- BASIN DESIGNATION
- 0.20 0.75 0.85 5 YR RUNOFF COEFFICIENT
- 100 YR RUNOFF COEFFICIENT
- BASIN AREA
- BASIN BOUNDARY LINE
- DESIGN POINT



GRAPHIC SCALE



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)

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

CAUTION: NOTICE TO CONTRACTOR THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES AND, WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUST CALL THE LOCAL UTILITY LOCATION CENTER AT LEAST 48 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATIONS OF THE UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS.

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

DRAINAGE PLAN EAST

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

DP3

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

| NO. | DATE | DESCRIPTION |
|----------|------|-------------------|
| 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

PERCEPTION
DESIGN GROUP, INC.
6901 SOUTH PIERCE STREET SUITE 315, LITTLETON, CO 80120 303-259-8688
WWW.PERCEPTIONDESIGNGROUP.COM

**FINAL DRAINAGE REPORT
PARKER POINTE
PARKER, COLORADO**

**APPENDIX F
FLOODPLAIN NO RISE REPORT**



June 12, 2018

Jacob James P.E., CFM
Stormwater Manager
20120 E. Mainstreet
Parker, CO 80138-7335

**RE: Parker Pointe Floodplain No Rise (Kinney Creek)
Kiowa Project Number 18036**

Dear Mr. James:

Kiowa performed a floodplain analysis on Kinney Creek directly upstream of Parker Road in Parker, Colorado to show proposed fill within the floodplain will not adversely affect the 100-year base flood elevations. We obtained the hydraulic model for the FHAD in 2004 from UDFCD. That model was used for the effective FEMA mapping. The proposed area of fill or re-grading is occurring in an ineffective flow area and shouldn't affect the floodplain. To analyze this, a cross section was added to the FHAD model in the area where the proposed fill is located upstream of Parker Road. This was needed because there was no cross section in the FHAD model located in this area and the closest cross sections showed the floodplain contained in the channel banks. The added section was cut from existing topography and modeled ineffective flow outside of a 4:1 contraction area for the culvert opening. This model is essentially existing conditions or what would be called a corrected effective model.

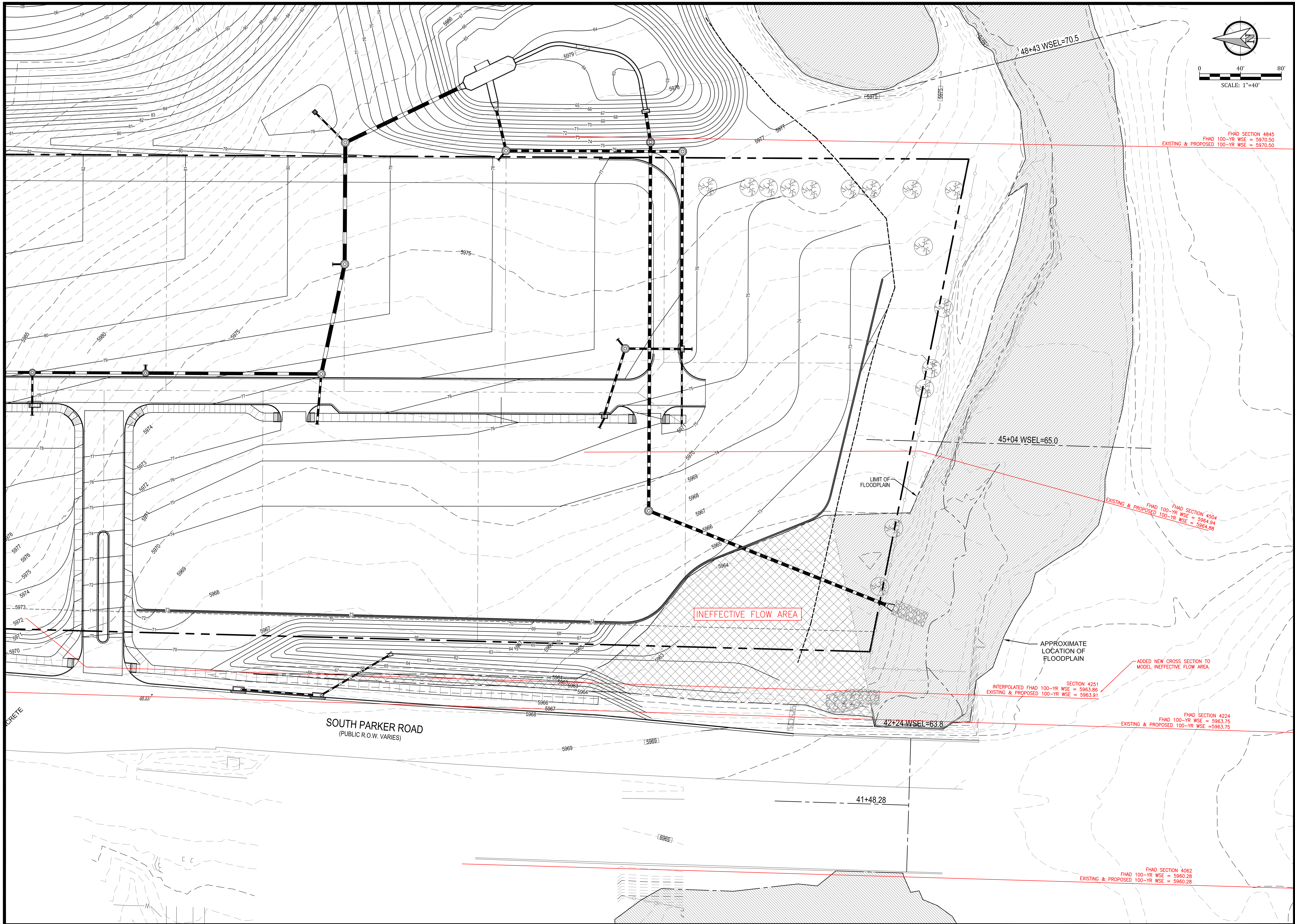
The resulting existing water surface elevation at the new cross section is 0.05-feet higher than the interpolated FHAD water surface elevation at that location and at the cross section upstream the existing water surface elevation is lower than the FHAD by 0.06-feet. These different water surface elevations are a direct result of simply adding a new cross section to show ineffective flow. The proposed grades have been added to the existing conditions model at the new cross section, the results show no rise in the floodplain as expected since the proposed grading only occurs in an ineffective flow area or outside of the floodplain entirely.

Please feel free to contact me if there are any questions or if I may be of further assistance.

Sincerely,
Kiowa Engineering Corporation

A handwritten signature in blue ink that reads "Eric L. Stream". The signature is written in a cursive style.

Eric L. Stream, P.E., CFM
Civil Engineer



**PARKER POINTE
 FLOODPLAIN ANALYSIS
 GRADING PLAN
 PARKER, COLORADO**

| | |
|--------------|--------------|
| Project No.: | 18036 |
| Date: | June 6, 2018 |
| Design: | - |
| Drawn: | ELS |
| Check: | MWE |
| Revisions: | |

HEC-RAS River: KINNEY Reach: MAIN1 Profile: 100-Year future

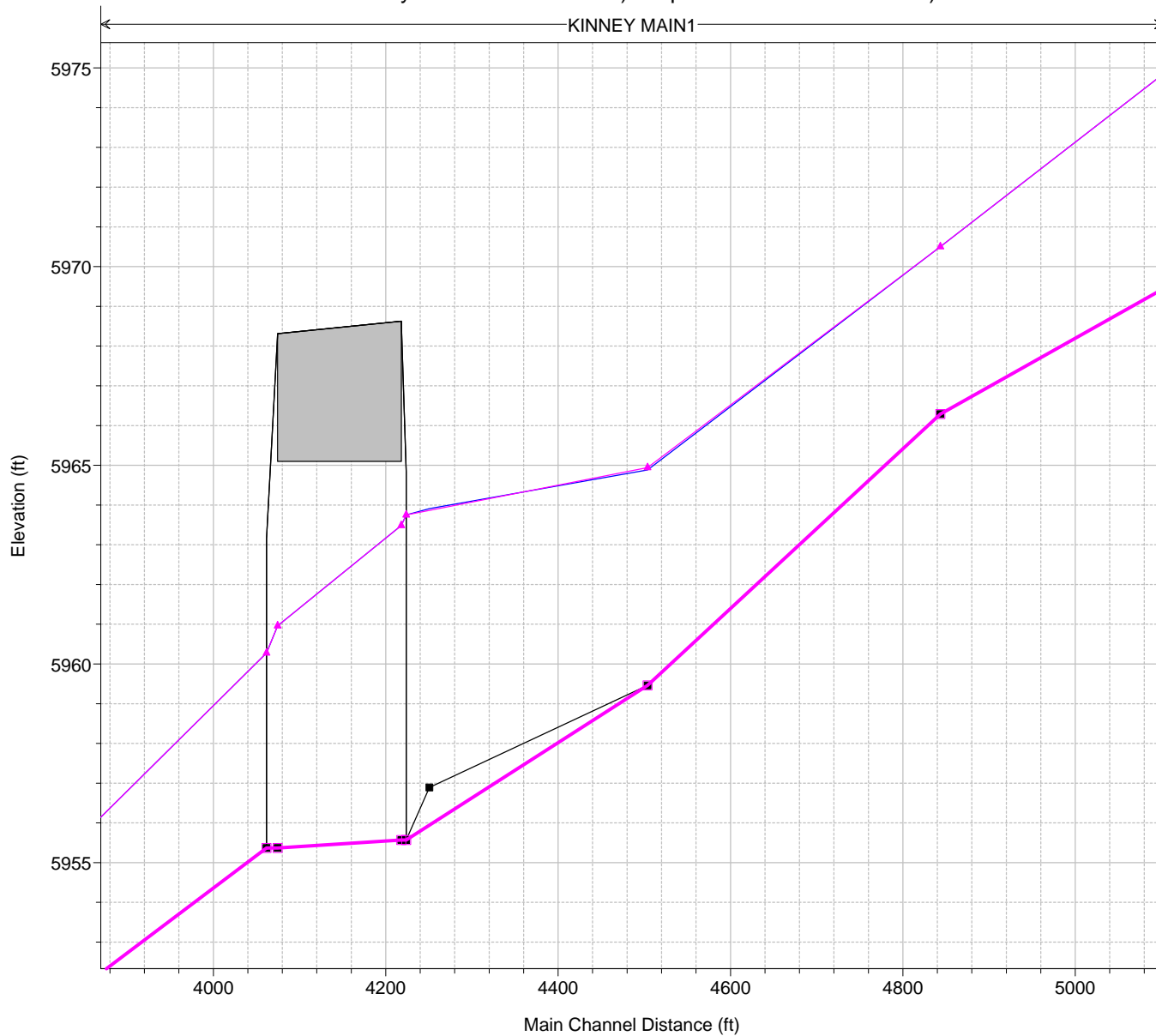
| Reach | River Sta | Profile | Plan | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|-------------------|-----------|-----------------|--------------|------------------|-------------------|-------------------|-------------------|-------------------|-----------------------|--------------------|----------------------|-------------------|--------------|
| MAIN1 | 8244.632 | 100-Year future | Full Q | 3060.00 | 6022.05 | 6027.32 | 6026.88 | 6027.94 | 0.017737 | 6.33 | 483.48 | 236.81 | 0.78 |
| MAIN1 | 8244.632 | 100-Year future | Exist. Cond. | 3060.00 | 6022.05 | 6027.32 | 6026.88 | 6027.94 | 0.017737 | 6.33 | 483.48 | 236.81 | 0.78 |
| MAIN1 | 8244.632 | 100-Year future | Prop. Cond. | 3060.00 | 6022.05 | 6027.32 | 6026.88 | 6027.94 | 0.017737 | 6.33 | 483.48 | 236.81 | 0.78 |
| MAIN1 | 7833.393 | 100-Year future | Full Q | 3060.00 | 6017.56 | 6021.60 | 6020.91 | 6022.18 | 0.011295 | 6.09 | 502.56 | 186.85 | 0.65 |
| MAIN1 | 7833.393 | 100-Year future | Exist. Cond. | 3060.00 | 6017.56 | 6021.60 | 6020.91 | 6022.18 | 0.011295 | 6.09 | 502.56 | 186.85 | 0.65 |
| MAIN1 | 7833.393 | 100-Year future | Prop. Cond. | 3060.00 | 6017.56 | 6021.60 | 6020.91 | 6022.18 | 0.011295 | 6.09 | 502.56 | 186.85 | 0.65 |
| MAIN1 | 7338.593 | 100-Year future | Full Q | 3060.00 | 6009.63 | 6012.56 | 6012.56 | 6013.28 | 0.032775 | 6.84 | 447.28 | 310.89 | 1.01 |
| MAIN1 | 7338.593 | 100-Year future | Exist. Cond. | 3060.00 | 6009.63 | 6012.56 | 6012.56 | 6013.28 | 0.032775 | 6.84 | 447.28 | 310.89 | 1.01 |
| MAIN1 | 7338.593 | 100-Year future | Prop. Cond. | 3060.00 | 6009.63 | 6012.56 | 6012.56 | 6013.28 | 0.032775 | 6.84 | 447.28 | 310.89 | 1.01 |
| MAIN1 | 6971.283 | 100-Year future | Full Q | 3060.00 | 5998.92 | 6000.76 | 6000.57 | 6001.17 | 0.022173 | 5.13 | 596.75 | 477.99 | 0.81 |
| MAIN1 | 6971.283 | 100-Year future | Exist. Cond. | 3060.00 | 5998.92 | 6000.76 | 6000.57 | 6001.17 | 0.022173 | 5.13 | 596.75 | 477.99 | 0.81 |
| MAIN1 | 6971.283 | 100-Year future | Prop. Cond. | 3060.00 | 5998.92 | 6000.76 | 6000.57 | 6001.17 | 0.022173 | 5.13 | 596.75 | 477.99 | 0.81 |
| MAIN1 | 6722.419 | 100-Year future | Full Q | 3060.00 | 5988.90 | 5996.14 | 5994.91 | 5996.98 | 0.013036 | 7.36 | 416.00 | 97.04 | 0.63 |
| MAIN1 | 6722.419 | 100-Year future | Exist. Cond. | 3060.00 | 5988.90 | 5996.14 | 5994.91 | 5996.98 | 0.013036 | 7.36 | 416.00 | 97.04 | 0.63 |
| MAIN1 | 6722.419 | 100-Year future | Prop. Cond. | 3060.00 | 5988.90 | 5996.14 | 5994.91 | 5996.98 | 0.013036 | 7.36 | 416.00 | 97.04 | 0.63 |
| MAIN1 | 6423.430 | 100-Year future | Full Q | 3080.00 | 5986.02 | 5992.80 | 5991.61 | 5993.66 | 0.009580 | 7.43 | 414.64 | 99.31 | 0.64 |
| MAIN1 | 6423.430 | 100-Year future | Exist. Cond. | 3080.00 | 5986.02 | 5992.80 | 5991.61 | 5993.66 | 0.009580 | 7.43 | 414.64 | 99.31 | 0.64 |
| MAIN1 | 6423.430 | 100-Year future | Prop. Cond. | 3080.00 | 5986.02 | 5992.80 | 5991.61 | 5993.66 | 0.009580 | 7.43 | 414.64 | 99.31 | 0.64 |
| MAIN1 | 6235.947 | 100-Year future | Full Q | 3080.00 | 5984.39 | 5990.48 | 5989.76 | 5991.47 | 0.014223 | 7.99 | 385.45 | 177.98 | 0.76 |
| MAIN1 | 6235.947 | 100-Year future | Exist. Cond. | 3080.00 | 5984.39 | 5990.48 | 5989.76 | 5991.47 | 0.014272 | 8.00 | 385.01 | 177.89 | 0.76 |
| MAIN1 | 6235.947 | 100-Year future | Prop. Cond. | 3080.00 | 5984.39 | 5990.48 | 5989.76 | 5991.47 | 0.014272 | 8.00 | 385.01 | 177.89 | 0.76 |
| MAIN1 | 5850.246 | 100-Year future | Full Q | 3080.00 | 5981.99 | 5985.47 | 5984.98 | 5985.94 | 0.013662 | 5.51 | 559.05 | 279.69 | 0.69 |
| MAIN1 | 5850.246 | 100-Year future | Exist. Cond. | 3080.00 | 5981.99 | 5985.48 | 5984.98 | 5985.95 | 0.013601 | 5.50 | 559.87 | 279.77 | 0.69 |
| MAIN1 | 5850.246 | 100-Year future | Prop. Cond. | 3080.00 | 5981.99 | 5985.48 | 5984.98 | 5985.95 | 0.013601 | 5.50 | 559.87 | 279.77 | 0.69 |
| MAIN1 | 5291.524 | 100-Year future | Full Q | 3080.00 | 5971.75 | 5978.03 | 5976.83 | 5979.16 | 0.010700 | 8.51 | 361.76 | 76.10 | 0.69 |
| MAIN1 | 5291.524 | 100-Year future | Exist. Cond. | 3080.00 | 5971.75 | 5978.03 | 5976.83 | 5979.16 | 0.010710 | 8.52 | 361.65 | 76.09 | 0.69 |
| MAIN1 | 5291.524 | 100-Year future | Prop. Cond. | 3080.00 | 5971.75 | 5978.03 | 5976.83 | 5979.16 | 0.010710 | 8.52 | 361.65 | 76.09 | 0.69 |
| FHAD | 4843.492 | 100-Year future | Full Q | 3080.00 | 5966.29 | 5970.50 | 5970.50 | 5971.97 | 0.026322 | 9.72 | 316.83 | 110.34 | 1.01 |
| MAIN1 | 4843.492 | 100-Year future | Exist. Cond. | 3080.00 | 5966.29 | 5970.50 | 5970.50 | 5971.97 | 0.026322 | 9.72 | 316.83 | 110.34 | 1.01 |
| MAIN1 | 4843.492 | 100-Year future | Prop. Cond. | 3080.00 | 5966.29 | 5970.50 | 5970.50 | 5971.97 | 0.026322 | 9.72 | 316.83 | 110.34 | 1.01 |
| FHAD | 4503.835 | 100-Year future | Full Q | 3080.00 | 5959.46 | 5964.88 | 5964.04 | 5965.49 | 0.010448 | 6.24 | 493.30 | 165.35 | 0.64 |
| MAIN1 | 4503.835 | 100-Year future | Exist. Cond. | 3080.00 | 5959.46 | 5964.88 | 5964.04 | 5965.49 | 0.010448 | 6.24 | 493.30 | 165.35 | 0.64 |
| MAIN1 | 4503.835 | 100-Year future | Prop. Cond. | 3080.00 | 5959.46 | 5964.88 | 5964.04 | 5965.49 | 0.010448 | 6.24 | 493.30 | 165.35 | 0.64 |
| NEW CROSS SECTION | 4250.593 | 100-Year future | Exist. Cond. | 3080.00 | 5956.89 | 5963.91 | 5960.78 | 5964.29 | 0.002467 | 4.95 | 624.35 | 689.00 | 0.35 |
| MAIN1 | 4250.593 | 100-Year future | Prop. Cond. | 3080.00 | 5956.89 | 5963.91 | 5960.78 | 5964.29 | 0.002467 | 4.95 | 624.35 | 357.00 | 0.35 |
| FHAD | 4223.682 | 100-Year future | Full Q | 3080.00 | 5955.57 | 5963.75 | 5959.79 | 5964.20 | 0.002655 | 5.37 | 573.55 | 75.31 | 0.34 |
| MAIN1 | 4223.682 | 100-Year future | Exist. Cond. | 3080.00 | 5955.57 | 5963.75 | 5959.79 | 5964.20 | 0.002655 | 5.37 | 573.55 | 75.31 | 0.34 |
| MAIN1 | 4223.682 | 100-Year future | Prop. Cond. | 3080.00 | 5955.57 | 5963.75 | 5959.79 | 5964.20 | 0.002655 | 5.37 | 573.55 | 75.31 | 0.34 |
| MAIN1 | 4222 | | | Bridge | | | | | | | | | |
| MAIN1 | 4061.616 | 100-Year future | Full Q | 3080.00 | 5955.37 | 5960.28 | 5959.60 | 5961.72 | 0.030241 | 9.63 | 319.71 | 68.48 | 0.79 |
| MAIN1 | 4061.616 | 100-Year future | Exist. Cond. | 3080.00 | 5955.37 | 5960.28 | 5959.60 | 5961.72 | 0.030241 | 9.63 | 319.71 | 68.48 | 0.79 |
| MAIN1 | 4061.616 | 100-Year future | Prop. Cond. | 3080.00 | 5955.37 | 5960.28 | 5959.60 | 5961.72 | 0.030241 | 9.63 | 319.71 | 68.48 | 0.79 |
| MAIN1 | 3720.643 | 100-Year future | Full Q | 3080.00 | 5949.79 | 5952.94 | 5952.86 | 5953.78 | 0.017395 | 5.05 | 450.78 | 261.91 | 0.57 |
| MAIN1 | 3720.643 | 100-Year future | Exist. Cond. | 3080.00 | 5949.79 | 5952.94 | 5952.86 | 5953.78 | 0.017395 | 5.05 | 450.78 | 261.91 | 0.57 |
| MAIN1 | 3720.643 | 100-Year future | Prop. Cond. | 3080.00 | 5949.79 | 5952.94 | 5952.86 | 5953.78 | 0.017395 | 5.05 | 450.78 | 261.91 | 0.57 |
| MAIN1 | 3355.066 | 100-Year future | Full Q | 3080.00 | 5943.78 | 5946.89 | 5946.89 | 5947.98 | 0.015141 | 4.77 | 427.37 | 192.65 | 0.53 |
| MAIN1 | 3355.066 | 100-Year future | Exist. Cond. | 3080.00 | 5943.78 | 5946.89 | 5946.89 | 5947.98 | 0.015141 | 4.77 | 427.37 | 192.65 | 0.53 |
| MAIN1 | 3355.066 | 100-Year future | Prop. Cond. | 3080.00 | 5943.78 | 5946.89 | 5946.89 | 5947.98 | 0.015141 | 4.77 | 427.37 | 192.65 | 0.53 |
| MAIN1 | 2957.704 | 100-Year future | Full Q | 3080.00 | 5936.68 | 5939.86 | 5939.86 | 5940.21 | 0.009139 | 3.47 | 710.98 | 487.42 | 0.41 |
| MAIN1 | 2957.704 | 100-Year future | Exist. Cond. | 3080.00 | 5936.68 | 5939.86 | 5939.86 | 5940.21 | 0.009139 | 3.47 | 710.98 | 487.42 | 0.41 |
| MAIN1 | 2957.704 | 100-Year future | Prop. Cond. | 3080.00 | 5936.68 | 5939.86 | 5939.86 | 5940.21 | 0.009139 | 3.47 | 710.98 | 487.42 | 0.41 |
| MAIN1 | 2536.628 | 100-Year future | Full Q | 3080.00 | 5927.79 | 5931.23 | 5931.23 | 5931.87 | 0.016705 | 4.05 | 514.71 | 421.69 | 0.53 |
| MAIN1 | 2536.628 | 100-Year future | Exist. Cond. | 3080.00 | 5927.79 | 5931.23 | 5931.23 | 5931.87 | 0.016705 | 4.05 | 514.71 | 421.69 | 0.53 |
| MAIN1 | 2536.628 | 100-Year future | Prop. Cond. | 3080.00 | 5927.79 | 5931.23 | 5931.23 | 5931.87 | 0.016705 | 4.05 | 514.71 | 421.69 | 0.53 |
| MAIN1 | 2123.380 | 100-Year future | Full Q | 3080.00 | 5923.07 | 5926.30 | 5925.43 | 5926.60 | 0.008515 | 4.82 | 732.51 | 342.92 | 0.55 |
| MAIN1 | 2123.380 | 100-Year future | Exist. Cond. | 3080.00 | 5923.07 | 5926.30 | 5925.43 | 5926.60 | 0.008515 | 4.82 | 732.51 | 342.92 | 0.55 |
| MAIN1 | 2123.380 | 100-Year future | Prop. Cond. | 3080.00 | 5923.07 | 5926.30 | 5925.43 | 5926.60 | 0.008515 | 4.82 | 732.51 | 342.92 | 0.55 |
| MAIN1 | 1496.377 | 100-Year future | Full Q | 3080.00 | 5916.02 | 5918.48 | 5918.47 | 5919.19 | 0.018859 | 6.98 | 475.78 | 338.04 | 0.97 |
| MAIN1 | 1496.377 | 100-Year future | Exist. Cond. | 3080.00 | 5916.02 | 5918.48 | 5918.47 | 5919.19 | 0.018859 | 6.98 | 475.78 | 338.04 | 0.97 |
| MAIN1 | 1496.377 | 100-Year future | Prop. Cond. | 3080.00 | 5916.02 | 5918.48 | 5918.47 | 5919.19 | 0.018859 | 6.98 | 475.78 | 338.04 | 0.97 |
| MAIN1 | 1070.307 | 100-Year future | Full Q | 3080.00 | 5910.14 | 5911.52 | 5911.34 | 5911.79 | 0.015916 | 4.17 | 746.79 | 795.04 | 0.80 |
| MAIN1 | 1070.307 | 100-Year future | Exist. Cond. | 3080.00 | 5910.14 | 5911.52 | 5911.34 | 5911.79 | 0.015916 | 4.17 | 746.79 | 795.04 | 0.80 |
| MAIN1 | 1070.307 | 100-Year future | Prop. Cond. | 3080.00 | 5910.14 | 5911.52 | 5911.34 | 5911.79 | 0.015916 | 4.17 | 746.79 | 795.04 | 0.80 |

HEC-RAS River: KINNEY Reach: MAIN1 Profile: 100-Year future (Continued)

| Reach | River Sta | Profile | Plan | Q Total (cfs) | Min Ch El (ft) | W.S. Elev (ft) | Crit W.S. (ft) | E.G. Elev (ft) | E.G. Slope (ft/ft) | Vel Chnl (ft/s) | Flow Area (sq ft) | Top Width (ft) | Froude # Chl |
|-------|-----------|-----------------|--------------|------------------|-------------------|-------------------|-------------------|-------------------|-----------------------|--------------------|----------------------|-------------------|--------------|
| MAIN1 | 996.093 | 100-Year future | Full Q | 3080.00 | 5908.42 | 5909.84 | 5909.84 | 5910.21 | 0.031427 | 4.56 | 635.45 | 894.39 | 1.06 |
| MAIN1 | 996.093 | 100-Year future | Exist. Cond. | 3080.00 | 5908.42 | 5909.84 | 5909.84 | 5910.21 | 0.031427 | 4.56 | 635.45 | 894.39 | 1.06 |
| MAIN1 | 996.093 | 100-Year future | Prop. Cond. | 3080.00 | 5908.42 | 5909.84 | 5909.84 | 5910.21 | 0.031427 | 4.56 | 635.45 | 894.39 | 1.06 |

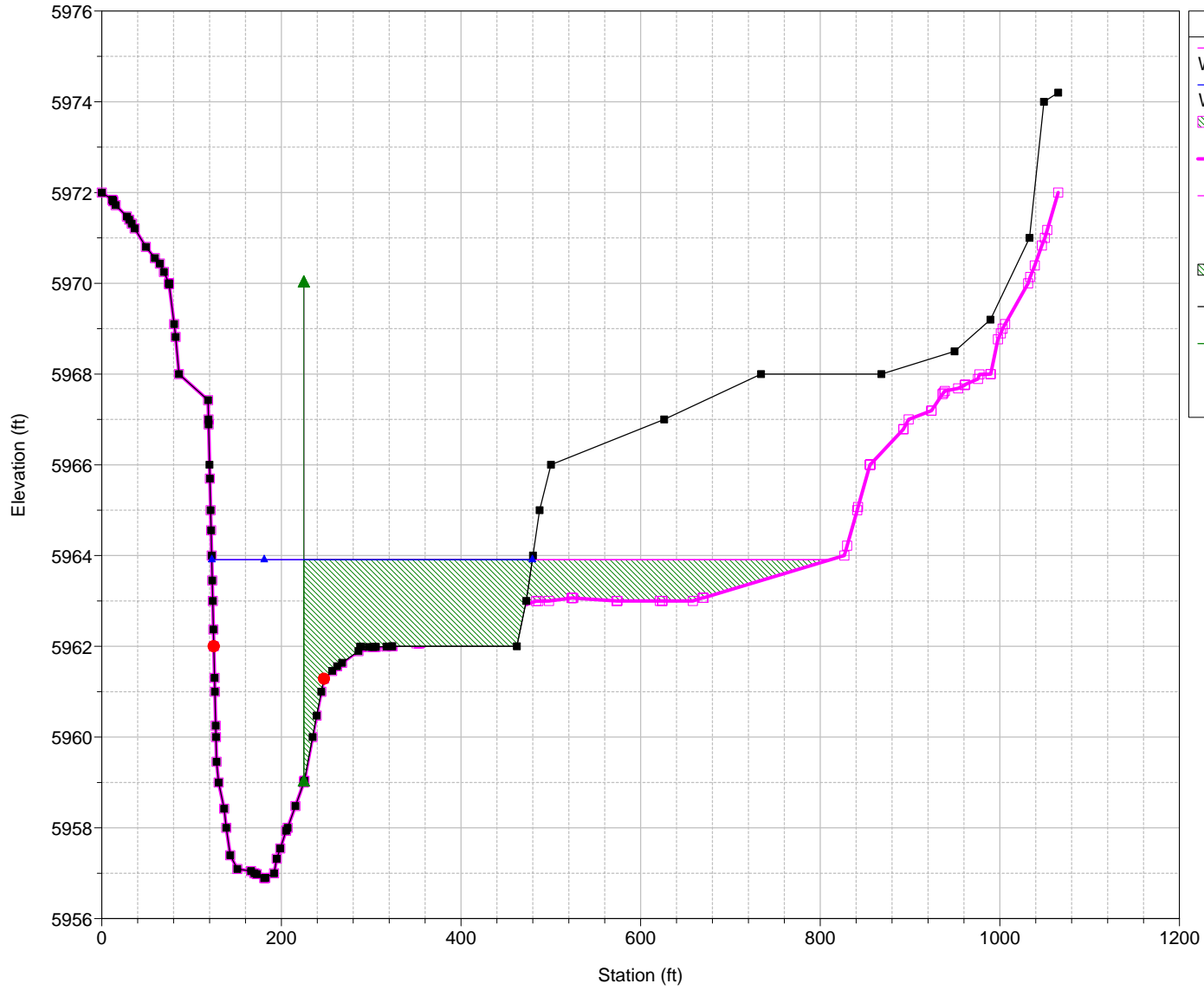
Kinney Creek Plan: 1) Prop. Cond. 6/11/2018 2) Full Q 6/11/2018

KINNEY MAIN1



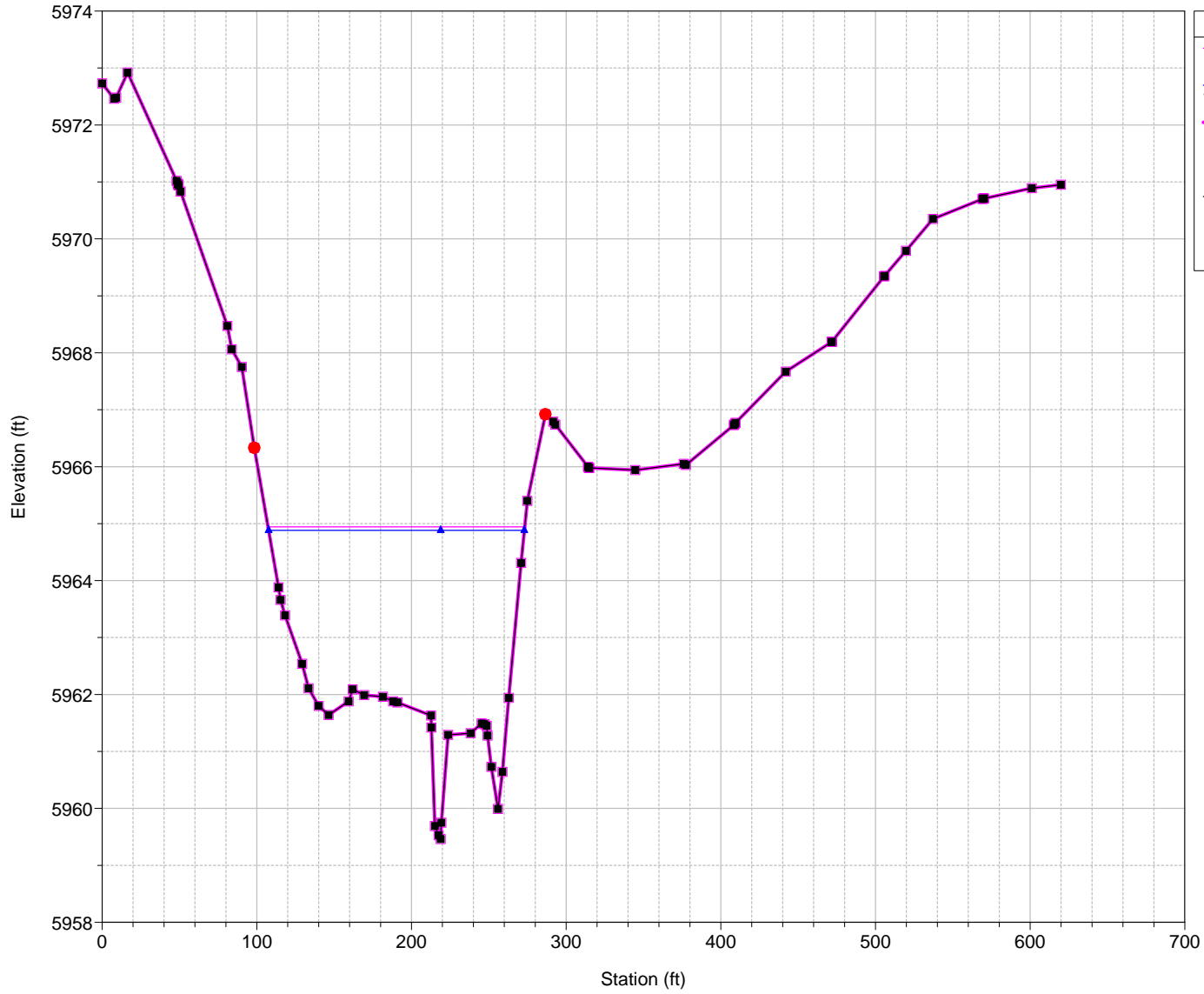
| Legend | |
|----------------------------------|---|
| WS 100-Year future - Prop. Cond. | ▲ |
| WS 100-Year future - Full Q | ▲ |
| Ground | ■ |
| Ground | □ |

Kinney Creek Plan: 1) Prop. Cond. 2) Exist. Cond.
RS = 4250.593



| Legend | |
|--------|-----------------------------------|
| | WS 100-Year future - Exist. Cond. |
| | WS 100-Year future - Prop. Cond. |
| | - Exist. Cond. |
| | Ground - Exist. Cond. |
| | Ineff - Exist. Cond. |
| | Bank Sta - Exist. Cond. |
| | - Prop. Cond. |
| | Ground - Prop. Cond. |
| | Ineff - Prop. Cond. |
| | Bank Sta - Prop. Cond. |

Kinney Creek Plan: 1) Prop. Cond. 2) Full Q
RS = 4503.835



| Legend | |
|----------------------------------|---|
| WS 100-Year future - Full Q | ▲ |
| WS 100-Year future - Prop. Cond. | ▲ |
| Ground - Full Q | ■ |
| Bank Sta - Full Q | ● |
| Ground - Prop. Cond. | ■ |
| Bank Sta - Prop. Cond. | ● |