EMK CONSULTANTS, INC. LAND DEVELOPMENT
ENGINEERING SURVEYING SERVICES AND SOLUTIONS
7006 S. Alton Way, Building F Centennial, Colorado 80112-2019 (303)694-1520 www.EMKC.com

KINGS POINT NORTH - WEST INFRASTRUCTURE

PRELIMINARY DRAINAGE REPORT

Aurora, Colorado

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EMK Job. No. 12187.63

Prepared For:
Clayton Properties Group II, Inc.
4908 Tower Road
Denver, CO 80249
Contact: Randy Bauer
Phone: (303) 486-8500
rbauer@oakwoodhomesco.com

Prepared By:
EMK Consultants, Inc.
7006 S. Alton Way, Bldg F
Centennial, CO 80112
Contact: Barry O. Moore
Phone: (303) 694-1520
bmoore@emkc.com

Approved For One Year From This Date

_____

_____ _____
City Engineer Date

_____ _____
Water Department Date

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Drainage Plans

Preliminary Drainage Map Cover Sheet (1 sheet)
Rational Basin Maps (1” = 200’, 2 sheets)
Preliminary Drainage Map (1” = 50’, 7 sheets)

A. INTRODUCTION

1. Location

Kings Point North is located within the City of Aurora in the most southern portion of Arapahoe County, approximately 1.5 miles south of Arapahoe Road on the east side of Parker Road (Vicinity Map, Appendix A1). More specifically, the project is located in Sections 33, 34, and 35 of Township 5 South, Range 66 West of the 6th Principal Meridian.

Krageland Acres subdivision is located at the northwest corner with Chenango Filings 1, 2, and 3 completing the north side of the project. To the east is currently undeveloped land that will become Kings Point Subdivision Filing No. 2. Highway E470 and the Douglas County northern boundary form the south property boundary of Kings Point Subdivision Filing No. 1. On the southeast side of E470 is a future multi-family site within the Kings Point North development. A future development known as Kings Point South lies along the southern border with the Valley Hi subdivision located at the southwest corner of the project. South Parker Road completes the west boundary with unplatted lands to the west. A vicinity map is included in Appendix A1.

2. Proposed Development

The project site is currently undeveloped. This site generally slopes toward the west, but a small portion at the east end of the site slopes to the east. Based on NRCS Soil Survey maps for Arapahoe County, the soils are primarily sandy to sandy clay loam and are considered to be in the hydrologic soil groups B, C, and D (Appendix A2).

This drainage study covers only the infrastructure construction for the western portion of the Kings Point North development. This includes the construction of Aurora Parkway from Parker Road to the roundabout with Kings Point Drive and the construction of Kings Point Drive from the Aurora Parkway/ Kings Point Drive roundabout to the proposed water tank along Kings Point Drive.

No variances are being requested at this time.

B. HISTORIC DRAINAGE

1. Overall Basin Description

This portion of the Kings Point North development is divided into two major drainage basins. The first major designation is Basin C, which is referred to as the Kragelund Tributary in the *Cherry Creek Minor Tributaries in Arapahoe County Major Drainageway Plan* (herein referred to as the MDP, 2019). The second major basin designation is Basin D, which is known as the 17 Mile Tributary in the MDP. A small area south of the 17 Mile Tributary is referred to as Basin E. Some portions of Basin C and D are located upstream of the site, which is southeast of E-470. No FEMA regulated drainageways are currently located within this project. A new floodplain boundary is currently in the process of being implemented along the

Kragelund Tributary. This floodplain is preliminary and not currently in effect as a FEMA special flood hazard area. A copy of this proposed floodplain is included in Appendix A. Historic drainage calculations for these basins are available in the MDP, and in the appendices of this drainage study.

2. Drainage Patterns Through Property

Runoff currently traverses this undeveloped property through wide, ill defined grass swales. Upstream basins discharge into Kings Point through existing culverts under E-470.

3. Outfalls Downstream from Property

Basins C discharges through the 17 Mile House property to the west of Parker Road. Basin D discharges just north of the Basin C discharge point into Cherry Creek. Basin E discharges under Parker Road, then outfalls into Cherry Creek.

C. DESIGN CRITERIA

1. References

Drainage improvements implemented on this project will be in accordance with the latest *Mile High Flood District Urban Storm Drainage Criteria Manual* (USDCM), and the *City of Aurora Storm Drainage Design and Technical Criteria* (COACM). The previously mentioned *Cherry Creek Minor Tributaries in Arapahoe County Major Drainageway Plan* (MDP) will serve as a key planning document for this study. A master drainage study, of which EMK Consultants is a contributor to, is currently underway for the entire Kings Point North development. Directives from this master drainage study will be incorporated into the final version of this drainage study.

2. Hydrologic Criteria

Drainage improvements in this report were evaluated and designed using the 2-year storm as the minor storm and the 100-yr storm as the major storm. Per City of Aurora (COA) policy, design rainfall depth used depends on the hydrologic calculation method used. Calculations performed using the Colorado Urban Hydrograph Procedure (CUHP) use a 2-yr 1-hour rainfall depth of 0.87 inches and the 100-yr 1-hour rainfall depth of 2.36 inches. This is consistent with the depths used in the MDP. Hydrologic calculations performed using the Rational Method or MHFD-Detention workbook have a 2-yr 1-hour rainfall depth of 0.97 inches and a 100-yr 1-hour rainfall depth of 2.63 inches. These rainfall depths were obtained from the 2004 version of the USDCM, figures RA-1 through RA-6.

Detention pond design was adopted from the *Kings Point Master Drainage Report*. Full spectrum detention design concepts were incorporated into the design, with COACM storage and release rate requirements being met. Additional COA specific requirements were worked into the design. These requirements include the following:

- ½ of the EURV is added to the maximum 100-yr stored volume as calculated using SWMM.
- A minimum of 1' of freeboard is provided between the 100-yr + ½ EURV water surface elevation and the spillway crest.
- 1' minimum of freeboard must be provided between the top of the water surface through the emergency overflow spillway and the top of embankment.

This report contains hydrologic calculations performed using the rational method and CUHP methods. The rational method was used for calculating flowrates for storm sewer design. CUHP methods were used to size the detention ponds. CUHP methods were also used to compare existing versus proposed peak discharge rates for the 17 Mile and Kragelund Tributaries at points discharging from the Kings Point property.

3. Hydraulic Criteria

Street capacities were analyzed using the latest version of the MHFD-Inlet spreadsheet, and figures 4A and 4B in the COACM. No curb overtopping was allowed when designing drainage improvements for the minor (2-yr) storm event. A maximum flowline depth of 12-inches was used when designing for the major (100-yr) storm.

D. DRAINAGE PLAN

1. General Concept

The drainage improvements proposed in this infrastructure phase will be adequate to get the major roads built across the Kings Point site. These improvements are designed to stand alone as long as needed until future plans are approved and constructed. A master drainage report is currently in the process of being developed for the overall Kings Point North development. This report will outline concepts for future detention and conveyance of stormwater in Kings Point. Future drainage improvements will be designed to work with the improvements built in the initial infrastructure phase. Note that the improvements proposed in this preliminary drainage report are conceptual and subject to change in the final drainage report.

Runoff from the roadways in this development will be captured in storm sewer systems. These storm sewers will discharge to one of the two proposed detention basins. A small area of the site will not discharge to one of these two main detention basins but will instead discharge to a temporary sediment trap that will serve as a small water quality pond. The detention ponds were designed as full-spectrum detention facilities. Peak discharge rates leaving the site will be below existing levels for both Basin C and Basin D.

2. Specific Details

The details of this design are organized based upon the detention pond that the drainage feature is associated with. There are three detention facilities, Pond C1, Pond C4 and Pond D1. Pond C1 will exist as a temporary sediment basin in the infrastructure phase as it will have been previously constructed for the mass site grading. Pond C1 will be built to its final condition after the initial infrastructure is constructed.

Pond C4

Pond C4 will be located on the eastern portion of the project along the Kragelund Tributary, just downstream of E-470. Pond C4 was designed as a full-spectrum extended detention basin. The pond releases the water quality capture volume over 40 hours to satisfy water quality enhancement requirements.

Pond C4 was designed to meet the detention and water quality requirements for all areas east of the pond and north of Kings Point Drive. The imperviousness in this area was assumed to be residential lots, single family, less than 0.25 acres in area. Imperviousness along and including E-470 is also taken into account in the pond design. For areas south and east of E-470, existing (undeveloped) conditions were used for pond design. Future development south and east of E-470 will be required to implement detention and water quality per the *Kings Point North Master Drainage Report*. This master plan requires that Pond C1 be constructed before Ponds C5 and C6 so that Pond C1 can provide water quality for the entire tributary area upstream of Pond C1.

Runoff to Pond C4 is captured via a storm sewer system in Kings Point Drive. This storm sewer ties into existing culverts crossing E-470. Type R inlets along Kings Point Drive capture runoff and convey it west. A low point in Kings Point Drive is located at design points 9C and 10C. Storm sewer discharge is stepped down through a series of manholes in this area in order to dissipate energy and reduce velocities. Emergency overflow from design points 9C and 10C is to the north toward Pond C4.

Runoff from design point 10C discharges into Pond C4. Pond C4 has been graded to fit in with surrounding golf course facilities. An outlet control structure (OCS) is proposed at the northend of the pond. Runoff that passes through the OCS will discharge into a channel through the golf course. An emergency overflow spillway is located at the northend of the pond.

Pond C1

Pond C1 is located along the Kragelund Tributary near the discharge point to Chenengo. It will be initially constructed as a sediment basin during mass grading of the site.

Runoff from basins C-11a/b and C-12a/b collects at design points 11C and 12C. Type R inlets at these design points capture runoff for discharge into the downstream channel. The downstream channel will convey runoff to Pond C1.

Pond D1

Pond D1 is located just southeast of the proposed intersection of Aurora Parkway and Parker Road. It is located on the 17-Mile Tributary described in the MDP. Pond D1 was designed as a full-spectrum extended detention basin. The pond releases the water quality capture volume over 40 hours to satisfy water quality enhancement requirements.

Pond D1 is designed for imperviousness beyond what is constructed in the initial infrastructure phase. Imperviousness values reflect future development in basins D-11a, D-13a, D-14a, D-15a, D-18, D-20 and D-21. Development in these basins can be completed with no additional water quality or detention improvements once the infrastructure phase is completed. Basin D-17 does not include future development in its imperviousness calculation. This is because a separate pond, Pond D2, is proposed for basin D-17. Pond D2 will provide detention and water quality for basin D-17 when basin D-17 is developed.

Runoff captured in Pond D1 is collected in a storm sewer system along Aurora Parkway. Inlets at design points 1D and 2D are proposed because of the superelevation related cross slope reversal at these points. Type R on-grade inlets at design points 3D and 5D capture runoff on the south side of Aurora Parkway before the roundabout with Kings Point Drive. Runoff at design point 4D is captured in an on-grade inlet.

Design points 6D and 7D are sump inlets just north of the Aurora Parkway/ Kings Point Drive roundabout. These inlets capture runoff and covey it overt to the main storm sewer system in Aurora Parkway. Emergency overflow is through the roundabout into Aurora Parkway.

An on-grade inlet is proposed at design point 8D due to cross slope reversal. Design points 9D and 10D are area inlets that capture runoff from basins D-9 and D-10 to the south.

Inlets at design points 11D and 12D capture runoff from Aurora Parkway in on-grade Type R inlets. The inlet at design point 12D exists due to superelevation cross slope reversal. Pipes through these inlets are sized to handle future developed condition runoff from basin D-11a.

Inlets at design points 13D, 14D and 15D capture runoff from Aurora Parkway in on-grade Type R inlets. Pipes through these inlets are sized to pass future developed condition runoff from future inlets in their upstream basins.

Inlets at design points 16D, 17D, 18D, 19D and 20D capture runoff from Aurora Parkway in on-grade Type R Inlets. Piping through the inlet at design point 17D is extended northeast in anticipation of Pond D2 being constructed there in the future.

The Aurora Parkway storm sewer discharges into Pond D1 just downstream of design point 20D. Outflow from Pond D1 will combine with local runoff from the Parker Road and Aurora Parkway Intersection. Emergency overflow from Pond D1 provided by an emergency overflow spillway the discharges into Aurora Parkway.

<u>Parker Road Basins</u>

Design Points 23D and 24D are Type R sump inlets just east of Parker Road. These inlets, along with runoff captured by the flared end section at design point 25D, combine with runoff from Pond D1 in a manhole at design point 25.5D. This manhole is located at the end of existing twin 48-inch CMPs that cross under Parker Road.

The required discharge through the existing 48-inch twin CMPs was compared to the capacity of these pipes. Analysis performed by EMK Consultants in previous studies indicates the capacity of these pipes to be 123 cfs. CHUP-SWMM modeling of the proposed condition with Pond D1 indicates a 100-yr peak flowrate of 109 cfs through these pipes. The MDP reports an existing peak 100-yr flowrate of 141 cfs at the culvert.

E. CONCLUSIONS

1. Compliance with Standards

This Preliminary Drainage Study has been prepared in general conformance with the Aurora Storm Drainage Design and Technical Criteria Manual and the Mile High Flood District Urban Storm Drainage Criteria Manual.

2. Summary of Concept

Drainage within the development of Kings Point North - West Infrastructure will be accommodated by storm sewer, channels, and detention basins sized such that no significant negative onsite or offsite impacts are anticipated. Offsite flows entering the property shall be allowed to enter unimpeded and are conveyed safely through the site. The onsite drainage system includes storm sewer sized for the 100-year storm event. Onsite and offsite tributary flows will be detained within two detention basins per City of Aurora requirements prior to their release into the respective drainage ways. Onsite flows not detained have been compensated for by the detention basins.

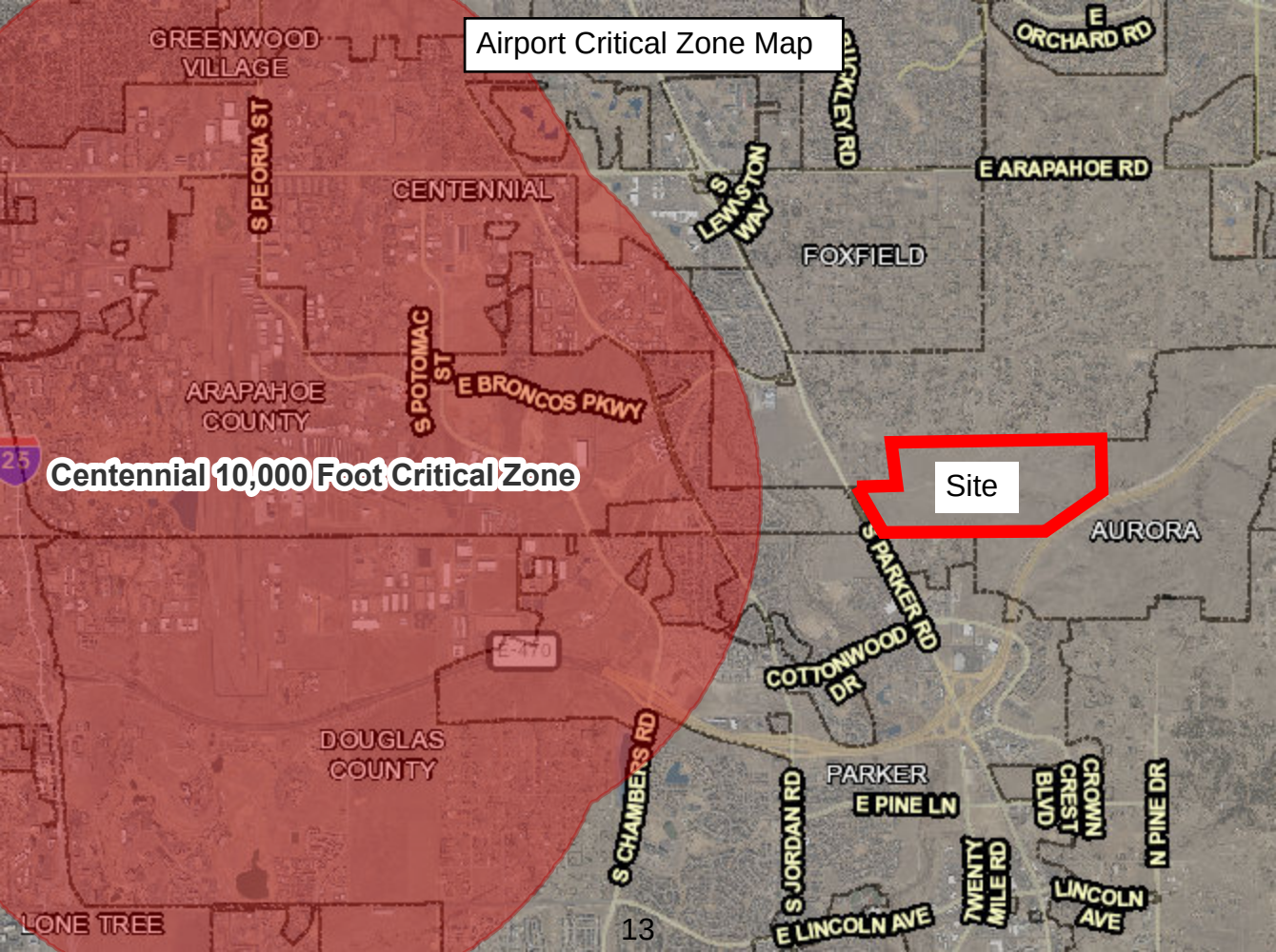
Prepared by:	Reviewed by:
David Ott, P.E., CFM Project Engineer	Barry O Moore, P.E. Vice President / Project Manager

F. LIST OF REFERENCES

1. City of Aurora Storm Drainage Design and Technical Criteria, Aurora, Colorado, revised October 11, 2010.
2. Urban Storm Drainage Criteria Manual, Mile High Flood District, accessed online at mhfd.org.
3. Cherry Creek Minor Tributaries in Arapahoe County Major Drainageway Plan (Baseline Hydrology), prepared by Dewberry, February 22, 2019.
4. Flood Insurance Rate Map, Federal Emergency Management Agency, Federal Insurance Administration, Map Number 08005C0483K, December 17, 2010 and February 17, 2017.
5. Web Soil Survey of Arapahoe County, Colorado, U.S. Department of Agriculture, Natural Resources Conservation Service, retrieved October 26, 2015.
6. Final Drainage Report for Kings Point Filing No. 1, prepared by EMK Consultants, approved June 29, 2020.
7. Kings Point Master Drainage Report, prepared by Core Consultants, currently under review with the City of Aurora.

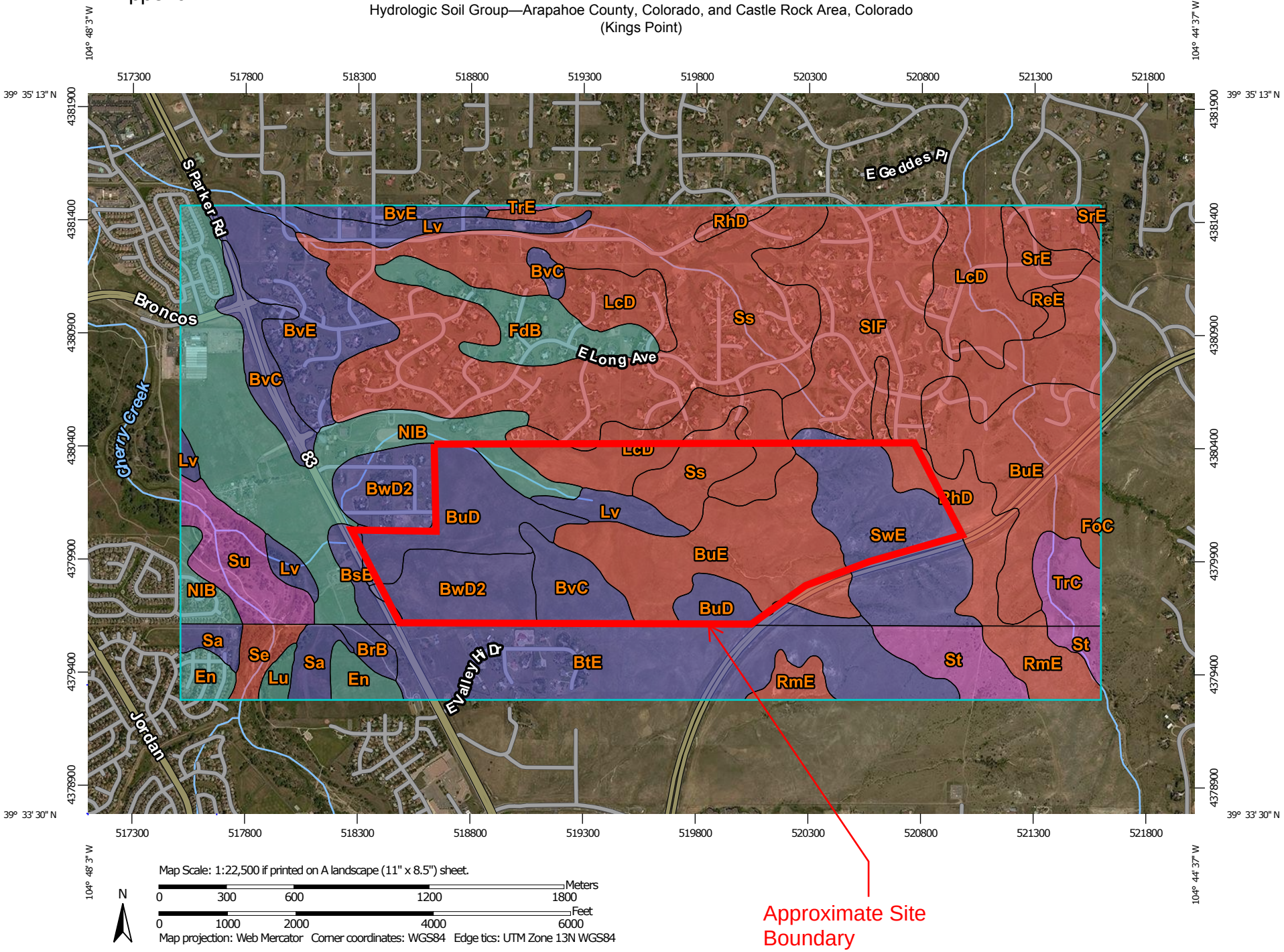
DRAINGE REPORT
for
KINGS POINT FILING NO. 1 - INFRASTRUCTURE

APPENDIX A
Hydrologic Computations


Airport Critical Zone Map
GREENWOOD VILLAGE
S PEORIA ST
CENTENNIAL
S POTOMAC ST
E BRONCOS PKWY
ARAPAHOE COUNTY
Centennial 10,000 Foot Critical Zone
DOUGLAS COUNTY
LONE TREE
S CHAMBERS RD
S LEWISTON WAY
S HICKLEY RD
E ORCHARD RD
E ARAPAHOE RD
FOXFIELD
Site
AURORA
S PARKER RD
COTTONWOOD DR
PARKER
E PINE LN
S JORDAN RD
E LINCOLN AVE
TWENTY MILE RD
CROWN CREST BLVD
N PINE DR
LINCOLN AVE

Appendix A2

Hydrologic Soil Group—Arapahoe County, Colorado, and Castle Rock Area, Colorado
(Kings Point)



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.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: Arapahoe County, Colorado
Survey Area Data: Version 11, Sep 22, 2015

Soil Survey Area: Castle Rock Area, Colorado
Survey Area Data: Version 8, Sep 23, 2014

Your area of interest (AOI) includes more than one soil survey area. These survey areas may have been mapped at different scales, with a different land use in mind, at different times, or at different levels of detail. This may result in map unit symbols, soil properties, and interpretations that do not completely agree across soil survey area boundaries.

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

Date(s) aerial images were photographed: Jun 10, 2014—Aug 21, 2014

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Arapahoe County, Colorado (CO005)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
BsB	Bresser sandy loam, terrace, 0 to 3 percent slopes	B	13.4	0.6%
BuD	Bresser-Stapleton sandy loams, 3 to 9 percent slopes	B	83.3	3.8%
BuE	Bresser-Stapleton sandy loams, 9 to 20 percent slopes	D	232.9	10.5%
BvC	Bresser-Truckton sandy loams, 3 to 5 percent slopes	B	67.1	3.0%
BvE	Bresser-Truckton sandy loams, 5 to 20 percent slopes	B	94.1	4.2%
BwD2	Bresser and Truckton soil, 3 to 9 slopes, eroded	B	86.3	3.9%
FdB	Fondis silt loam, 1 to 3 percent slopes	C	52.2	2.4%
FoC	Fondis-Colby silt loams, 3 to 5 percent slopes	C	0.4	0.0%
LcD	Litle silty clay loam, 1 to 9 percent slopes	D	173.2	7.8%
Lv	Loamy alluvial land	B	53.6	2.4%
NlB	Nunn loam, 1 to 3 percent slopes	C	193.4	8.7%
ReE	Renohill loam,reddish variant, 5 to 20 percent slopes	D	5.9	0.3%
RhD	Renohill-Buick loams, 3 to 9 percent slopes	D	54.6	2.5%
SlF	Samsil-Litle stony clays, 20 to 50 percent slopes	D	194.3	8.8%
SrE	Samsil-Renohill clay loams, 3 to 20 percent slopes	D	21.6	1.0%
Ss	Samsil-Shale outcrop complex	D	378.3	17.1%
Su	Sandy alluvial land	A	46.1	2.1%
SwE	Stapleton sandy loam, 9 to 30 percent slopes	B	102.9	4.6%

Hydrologic Soil Group— Summary by Map Unit — Arapahoe County, Colorado (CO005)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
TrC	Truckton loamy sand, 1 to 5 percent slopes	A	25.3	1.1%
TrE	Truckton loamy sand, 5 to 20 percent slopes	A	1.5	0.1%
Subtotals for Soil Survey Area			**1,880.6**	**84.9%**
Totals for Area of Interest			**2,215.8**	**100.0%**

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**
BrB	Bresser sandy loam, 1 to 3 percent slopes	B	8.9	0.4%
BtE	Bresser-Truckton sandy loams, 5 to 25 percent slopes	B	177.2	8.0%
En	Englewood clay loam	C	24.5	1.1%
Lu	Loamy alluvial land, dark surface	C	6.1	0.3%
RmE	Renohill-Buick complex, 5 to 25 percent slopes	D	38.6	1.7%
Sa	Sampson loam	B	24.0	1.1%
Se	Sandy wet alluvial land	D	14.7	0.7%
St	Stapleton-Bresser association	A	41.2	1.9%
Subtotals for Soil Survey Area			**335.2**	**15.1%**
Totals for Area of Interest			**2,215.8**	**100.0%**

Description

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

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

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

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

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

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

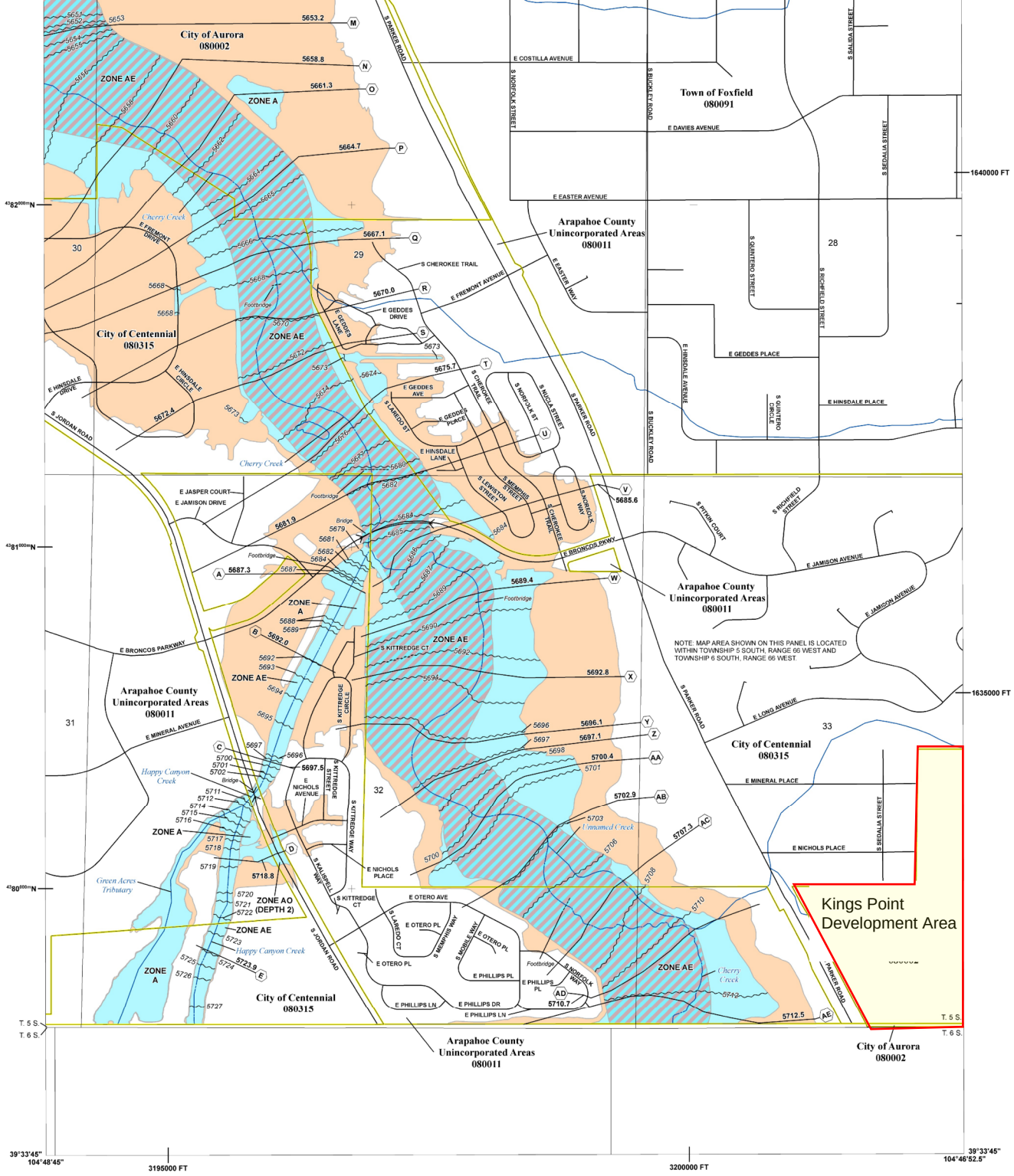
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



FLOOD HAZARD INFORMATION

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

THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT

HTTPS://MSC.FEMA.GOV

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99* With BFE or Depth *Zone AE, AO, AH, VE, AR* Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X* Future Conditions 1% Annual Chance Flood Hazard *Zone X* Area with Reduced Flood Risk due to Levee See Notes. *Zone X*
OTHER AREAS	NO SCREEN Areas of Minimal Flood Hazard *Zone X* Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer Accredited or Provisionally Accredited Levee, Dike, or Floodwall Non-accredited Levee, Dike, or Floodwall
	E 18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)

NOTES TO USERS

For information and questions about this Flood Insurance Rate Map (FIRM), available products associated with this FIRM, including historic versions, the current map date for each FIRM panel, how to order products, or the National Flood Insurance Program (NFIP) in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Flood Map Service Center website at https://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Flood Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction.

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

Base map information shown on this FIRM is current as of 2015, provided in digital format by the Arapahoe County, City of Aurora, and City of Littleton Geographic Information System (GIS) Departments.

SCALE

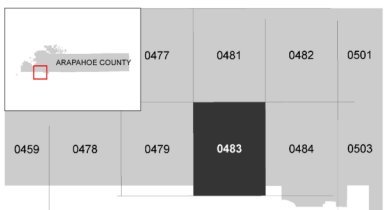
Map Projection:
NAD83 UTM Zone 13N
Western Hemisphere; Vertical Datum: NAVD88

1 inch = 500 feet 1:6,000

0 1,000 2,000 Feet

0 250 500 Meters

PANEL LOCATOR



National Flood Insurance Program

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

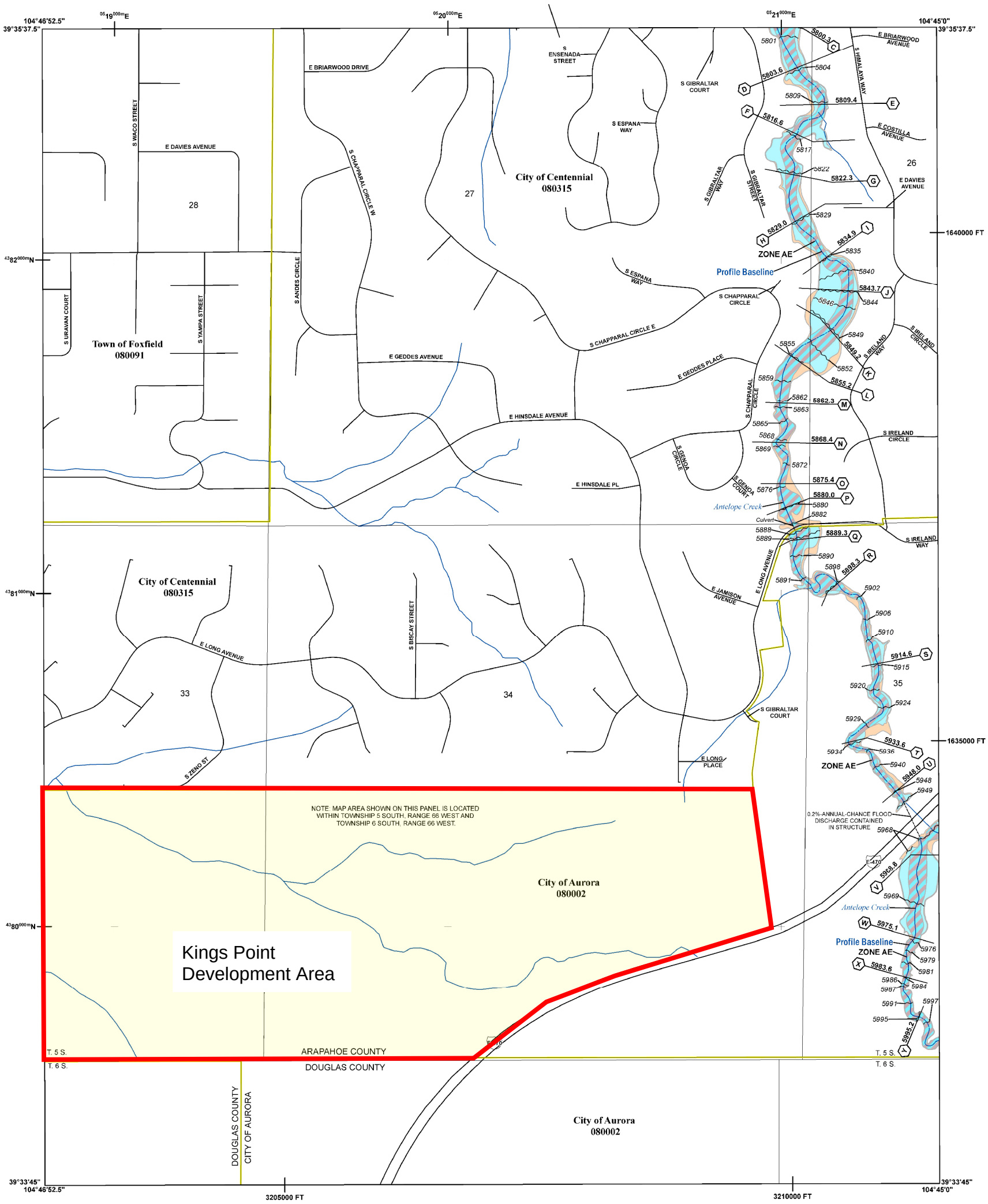
ARAPAHOE COUNTY, COLORADO
And Incorporated Areas

PANEL 483 OF 725

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
ARAPAHOE COUNTY	080011	0483	L
AURORA, CITY OF	080002	0483	L
CENTENNIAL, CITY OF	080315	0483	L
FOXFIELD, TOWN OF	080091	0483	L



FLOOD HAZARD INFORMATION

SEE FIS REPORT FOR ZONE DESCRIPTIONS AND INDEX MAP
THE INFORMATION DEPICTED ON THIS MAP AND SUPPORTING DOCUMENTATION ARE ALSO AVAILABLE IN DIGITAL FORMAT AT
HTTP://MSC.FEMA.GOV

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

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee See Notes. *Zone X*

OTHER AREAS
- NO SCREEN Areas of Minimal Flood Hazard *Zone X*
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Accredited or Provisionally Accredited Levee, Dike, or Floodwall
- Non-accredited Levee, Dike, or Floodwall
- E 18.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation (BFE)
- 8 Coastal Transect
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature
- 513 Base Flood Elevation Line (BFE)

OTHER FEATURES
- Limit of Study
- Jurisdiction Boundary

NOTES TO USERS

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

Communities annexing land on adjacent FIRM panels must obtain a current copy of the adjacent panel as well as the current FIRM Index. These may be ordered directly from the Map Service Center at the number listed above.

For community and countywide map dates refer to the Flood Insurance Study report for this jurisdiction. To determine if flood insurance is available in the community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

Base map information shown on this FIRM was provided by the Arapahoe County and Cities of Aurora and Littleton GIS depts. The coordinate system used for production of the digital FIRM is Universal Transverse Mercator, Zone 13N, referenced to the North American Datum of 1983 and the GRS 1980 spheroid, Western Hemisphere.

SCALE

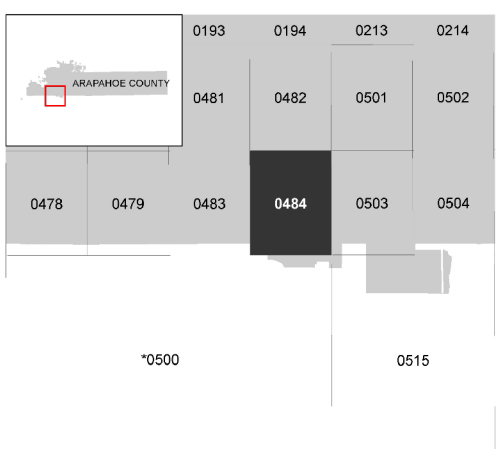
Map Projection:
NAD83 UTM Zone 13N
Western Hemisphere; Vertical Datum: NAVD88

1 inch = 500 feet 1:6,000

0 1,000 2,000 Feet

0 250 500 Meters

PANEL LOCATOR



* PANEL NOT PRINTED

NATIONAL FLOOD INSURANCE PROGRAM
FLOOD INSURANCE RATE MAP

ARAPAHOE COUNTY, COLORADO
And Incorporated Areas

PANEL 484 OF 725

FEMA

Panel Contains:

COMMUNITY	NUMBER	PANEL	SUFFIX
AURORA, CITY OF	080002	0484	L
CENTENNIAL, CITY OF	080315	0484	L
FOXFIELD, TOWN OF	080091	0484	L

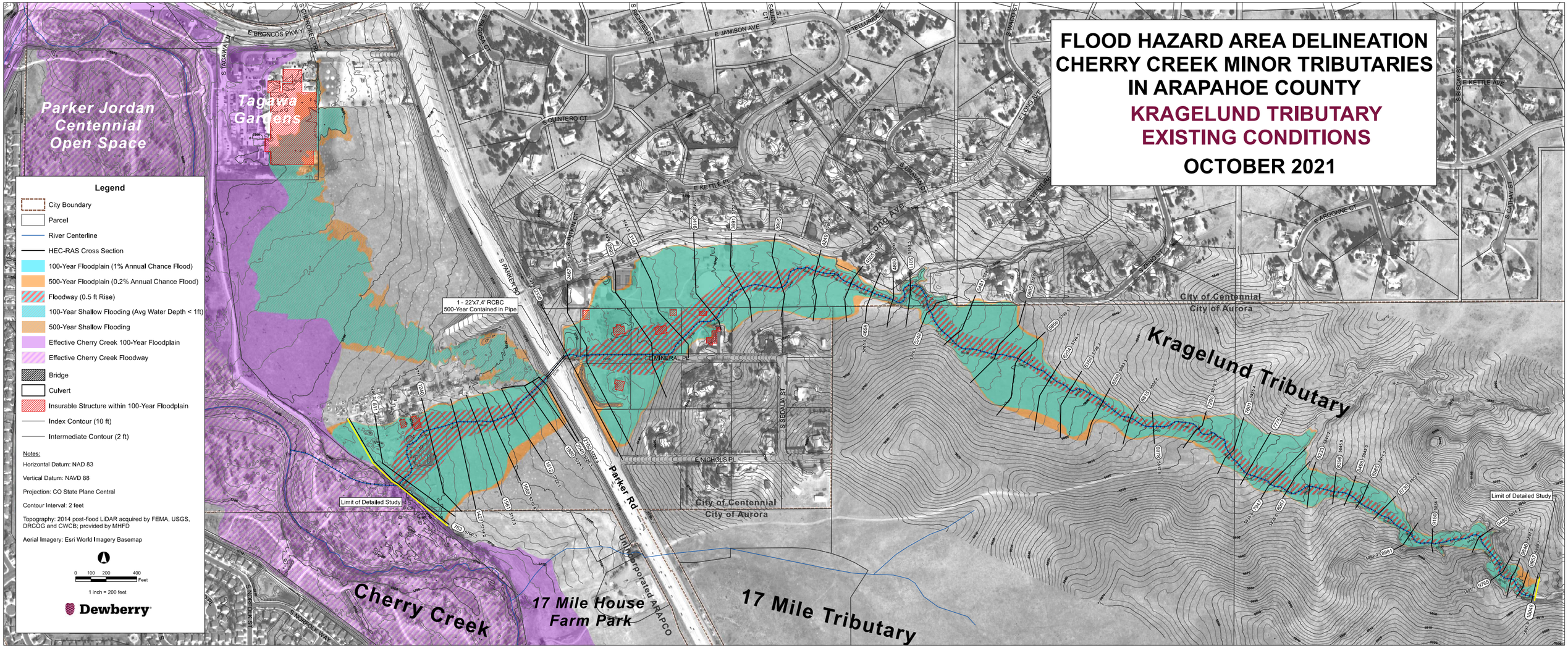
VERSION NUMBER
2.3.3.2

MAP NUMBER
08005C0484L

MAP REVISED
FEBRUARY 17, 2017

This is a map of a future floodplain that will be implemented.
It is not in effect as of preparation of this drainage study.

FLOOD HAZARD AREA DELINEATION
CHERRY CREEK MINOR TRIBUTARIES
IN ARAPAHOE COUNTY
KRAGELUND TRIBUTARY
EXISTING CONDITIONS
OCTOBER 2021

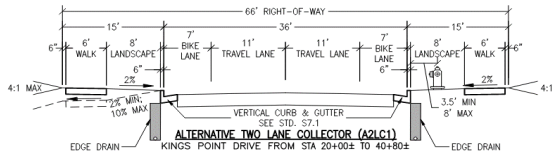


Weighted Rational C Calculation By Landuse
Prepared by: DJO
Date: 05/16/22

Basin	Total Area (acres)	Streets - Paved (acres)	Concrete Drive and Sidewalk (acres)	A2LC1 ROW (acres)	SF 4.5 lots/ac, 2000 SF ranch (acres)	Lawns (Undeveloped) A/B Soil 2-7% avg slope (acres)	C_2	C_5	C_{100}
C-9	0.3			0.34			0.69	0.70	0.74
C-10	4.9		0.2	0.34		4.35	0.17	0.18	0.22

A2LC1 Calculations (Alternative Two Lane Collector)
66' ROW

Section	Width (ft)	
Paved Street	37	
Walk	12	
Lawns C/D Soil	17	
	C2 =	0.69
	C5 =	0.70
	C100 =	0.74



Land Use	C2	C5	C100
Streets - Paved	0.87	0.88	0.93
Concrete Drive and Sidewalk	0.87	0.87	0.89
SF 4.5 lots/ac, 2000 SF ranch	0.4	0.45	0.6
Lawns (Undeveloped) C/D Soil 2-7% avg slope	0.18	0.19	0.22
Lawns (Undeveloped) A/B Soil 2-7% avg slope	0.1	0.11	0.15
A2LC1	0.69	0.70	0.74

All values based upon COA Table 1

STANDARD FORM SF-1
TIME OF CONCENTRATION

SUBDIVISION: KINGS POINT - DEVELOPED BASINS
CALCULATED B DJO **DATE:** 5/16/2022

SUB BASIN DATA				*INITIAL/OVERLAND TIME*				*TRAVEL TIME*						t_c CHECK				*FINAL t_c*
DESIGN POINT	**BASIN(S)**	**AREA** (acres)	**C_5** COASDC, Table 1	**LENGTH** 500 ft max non-urban,300 ft max urban (feet)	**DROP** (ft)	**AVERAGE BASIN SLOPE** (ft/ft)	**t_i** COASDC, CH5, Equ 5.3 (min)	**CHANNELIZED FLOW LENGTH** (feet)	**DROP** (ft)	**CHANNELIZED FLOW SLOPE (S_o)** (ft/ft)	**CONVEYANCE FACTOR (K)** USDCM Tbl 6-2	**VELOCITY** $V = KS_o^{0.5}$ (ft/sec)	**t_t** USDCM V1, CH6, Equ 6-4 (min)	**$t_c = t_i + t_t$** COASDC, CH5, Equ 5.2 (min)	**L' FOR** COASDC, CH5, Equ 5.4 (feet)	**$t_c = (L'/180) + 10$** COASDC, CH5, Equ 5.4 (min)	**URBANIZED?**	See COASDC explanation (min)
9C	C-9	0.34	0.70	300	41	0.137	5.3	277	2	0.007	20	1.70	2.7	8.0	577	13.2	Y	8.0
10c	C-10	4.89	0.18	20	1	0.050	4.4	218	4	0.018	20	2.71	1.3	5.7	238	11.3	Y	5.7

JOB NO: 12187.61
PROJECT: Kings Point Filing 1 - Pond C4
DESIGN STORM: 2-year
CALCULATED BY: DJO

STORM DRAINAGE SYSTEM DESIGN - POND C4
RATIONAL METHOD

I=28.5*P1/(10+T)^0.786

1 HR STORM=		*0.97*		DIRECT RUNOFF				TOTAL RUNOFF				TRAVEL TIME				STREET FLOW		PIPE FLOW		
Design Point	Area Designation	Ac	C	Tc	CA	I	Q	Tc	CA	I	Q	Length	Velocity	Time	From	CA	Q	CA	Q	
				(min)		IN/HR	CFS			IN/HR	CFS	(ft)	(ft/s)	(min)	To		CFS		CFS	Flow Notes
9C	C-9	0.3	0.69	8.0	0.23	2.9	0.7													DIRECT
10C	C-10	4.9	0.17	5.7	0.84	3.2	2.7													DIRECT

JOB NO: 12187.61
PROJECT: Kings Point Filing 1 - Pond C4
DESIGN STORM: 100-year
CALCULATED BY: DJO

STORM DRAINAGE SYSTEM DESIGN - POND C4
RATIONAL METHOD

I=28.5*P1/(10+T)^0.786

1 HR STORM=		*2.63*		DIRECT RUNOFF				TOTAL RUNOFF				TRAVEL TIME				STREET FLOW		PIPE FLOW		
Design Point	Area Designation	Ac	C	Tc	CA	I	Q	Tc	CA	I	Q	Length	Velocity	Time	From DP	CA	Q	CA	Q	
						IN/HR	CFS			IN/HR	CFS	(ft)	(ft/s)	(min)	To DP		CFS		CFS	Flow Notes
9C	C-9	0.3	0.74	8.0	0.25	7.7	1.9													DIRECT
10C	C-10	4.9	0.22	5.7	1.08	8.6	9.3													DIRECT

Weighted Rational C Calculation By Landuse - Basin C1
Prepared by: DJO
Date: 05/16/22

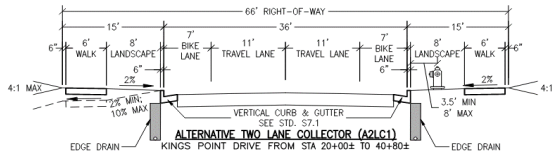
Basin	Total Area (acres)	Streets - Paved (acres)	Concrete Drive and Sidewalk (acres)	A2LC1 ROW (acres)	SF 4.5 lots/ac, 2000 SF ranch (acres)	Lawns (Undeveloped) C/D Soil 2-7% avg slope (acres)	C_2	C_5	C_{100}
C-11a	17.6			1.36		16.24	0.22	0.23	0.26
C-11b	3.4			0.36		3.04	0.23	0.24	0.28
C-12a	1.4			1.36			0.69	0.70	0.74
C-12b	0.4			0.36			0.69	0.70	0.74

Land Use	C2	C5	C100
Streets - Paved	0.87	0.88	0.93
Concrete Drive and Sidewalk	0.87	0.87	0.89
SF 4.5 lots/ac, 2000 SF ranch	0.4	0.45	0.6
Lawns (Undeveloped) C/D Soil 2-7% avg slope	0.18	0.19	0.22
Lawns (Undeveloped) A/B Soil 2-7% avg slope	0.1	0.11	0.15
A2LC1	0.69	0.70	0.74

All values based upon COA Table 1

A2LC1 Calculations (Alternative Two Lane Collector)
66' ROW

Section	Width (ft)	
Paved Street	37	
Walk	12	
Lawns C/D Soil	17	
	C2 =	0.69
	C5 =	0.70
	C100 =	0.74



STANDARD FORM SF-1
TIME OF CONCENTRATION

SUBDIVISION: KINGS POINT - DEVELOPED BASINS
CALCULATED B DJO **DATE:** 5/16/2022

SUB BASIN DATA				*INITIAL/OVERLAND TIME*				*TRAVEL TIME*						*t_c* CHECK				*FINAL t_c*
DESIGN POINT	**BASIN(S)**	**AREA** (acres)	**C_5** COASDC, Table 1	**LENGTH** 500 ft max non-urban,300 ft max urban (feet)	**DROP** (ft)	**AVERAGE BASIN SLOPE** (ft/ft)	**t_i** COASDC, CH5, Equ 5.3 (min)	**CHANNELIZED FLOW LENGTH** (feet)	**DROP** (ft)	**CHANNELIZED FLOW SLOPE (S_o)** (ft/ft)	**CONVEYANCE FACTOR (K)** USDCM Tbl 6-2	**VELOCITY** $V = KS_o^{0.5}$ (ft/sec)	**t_t** USDCM V1, CH6, Equ 6-4 (min)	**$t_c = t_i + t_t$** COASDC, CH5, Equ 5.2 (min)	**L' FOR** COASDC, CH5, Equ 5.4 (feet)	**t_c = (L'/180) + 10** COASDC, CH5, Equ 5.4 (min)	**URBANIZED?**	See COASDC explanation (min)
11C	C-11a	17.6	0.23	300	24	0.080	13.7	1727	48	0.028	20	3.33	8.6	22.3	2027	21.3	Y	21.3
11C	C-11b	3.4	0.24	300	14	0.047	16.1	463	13	0.028	20	3.35	2.3	18.4	763	14.2	Y	14.2
12C	C-12a	1.4	0.70	27	1	0.037	2.4	1755	47	0.027	20	3.27	8.9	11.4	1782	19.9	Y	11.4
12C	C-12b	0.4	0.70	27	1	0.037	2.4	406	10	0.025	20	3.14	2.2	4.6	433	12.4	Y	5.0

JOB NO: 13095.10
PROJECT: Kings Point Filing 1 - Pond WQ1
DESIGN STORM: 2-year
CALCULATED BY: DJO

STORM DRAINAGE SYSTEM DESIGN - POND C1
RATIONAL METHOD

I=28.5*P1/(10+T)^0.786

1 HR STORM=		*0.97*		DIRECT RUNOFF				TOTAL RUNOFF				TRAVEL TIME				STREET FLOW		CARRYOVER ROUTED TO INLET	PIPE FLOW		
Design Point	Area Designation	Ac	C	Tc	CA	I	Q	Tc	CA	I	Q	Length	Velocity	Time	From	CA	Q		CA	Q	
				(min)		IN/HR	CFS			IN/HR	CFS	(ft)	(ft/s)	(min)	To		CFS			CFS	Flow Notes
11C	C-11a	17.6	0.22	21.3	3.86	1.8	7.1														DIRECT
11C	C-11b	3.4	0.23	14.2	0.80	2.3	1.8														DIRECT
11C	C-11a + C-11b							21.3	4.66	1.8	8.6					4.66	8.6		4.66	8.6	INLET INTERCEPT/PIPE FLOW
12C	C-12a	1.4	0.69	11.4	0.94	2.5	2.3														DIRECT
12C	C-12b	0.4	0.69	5.0	0.25	3.3	0.8														DIRECT
12C	C-12a + C-12b							11.4	1.19	2.5	3.0					1.19	3.0				INLET INTERCEPT
12C	All Above Basins							21.3	5.84	1.8	10.8								5.84	10.8	COMBINED/PIPE FLOW

JOB NO: 13095.10
PROJECT: Kings Point Filing 1 - Pond WQ1
DESIGN STORM: 100-year
CALCULATED BY: DJO

STORM DRAINAGE SYSTEM DESIGN - POND C1
RATIONAL METHOD

I=28.5*P1/(10+T)^0.786

1 HR STORM=		*2.63*		DIRECT RUNOFF				TOTAL RUNOFF				TRAVEL TIME				STREET FLOW		CARRYOVER ROUTED TO INLET	PIPE FLOW		
Design Point	Area Designation	Ac	C	Tc	CA	I	Q	Tc	CA	I	Q	Length	Velocity	Time	From DP	CA	Q		CA	Q	
						IN/HR	CFS			IN/HR	CFS	(ft)	(ft/s)	(min)	To DP		CFS			CFS	Flow Notes
11C	C-11a	17.6	0.26	21.3	4.58	5.0	22.9														DIRECT
11C	C-11b	3.4	0.28	14.2	0.94	6.1	5.7														DIRECT
11C	C-11a + C-11b							21.3	5.5	5.0	27.6					5.51	27.6	DP 12	4.47	33.5	INLET INTERCEPT/PIPE FLOW
12C	C-12a	1.4	0.74	11.4	1.01	6.8	6.8														DIRECT
12C	C-12b	0.4	0.74	5.0	0.27	8.9	2.4														DIRECT
12C	C-12a + C-12b							11.4	1.27	6.8	8.6					2.32	2.7				INLET INTERCEPT
12C	All Above Basins							21.3	6.79	5.0	34.0								6.79	34.0	COMBINED/PIPE FLOW

Weighted Rational C Calculation By Landuse - Basin D1
Prepared by: DJO
Date: 05/16/22

Basin	Total Area (acres)	Streets - Paved (acres)	Concrete Drive and Sidewalk (acres)	SF 4.5 lots/ac, 2000 SF ranch (acres)	Lawns (Undeveloped) A/B Soil 2-7% avg slope (acres)	C_2	C_5	C_{100}
D-1	0.8	0.8				0.87	0.88	0.93
D-2	0.9	0.63	0.15		0.13	0.76	0.77	0.81
D-3	5.9	2.23	0.51		3.13	0.46	0.47	0.51
D-4	5.2	1.69	0.26	3.02	0.22	0.56	0.60	0.70
D-5	0.6	0.37	0.09		0.18	0.65	0.66	0.71
D-6	3.3	1.1	0.14	1.9	0.15	0.56	0.60	0.70
D-7	2.0	1.01	0.1	0.66	0.19	0.64	0.66	0.74
D-8	1.2	0.8	0.11		0.33	0.67	0.67	0.72
D-9	4.1			3.06	1.04	0.32	0.36	0.49
D-10	8.9			8.11	0.78	0.37	0.42	0.56
D-11a	8.5	2.86		5.65		0.56	0.59	0.71
D-12	2.2	0.69	0.16		1.32	0.40	0.41	0.45
D-13a	3.3	0.89		2.42		0.53	0.57	0.69
D-14a	2.8	0.79		2		0.53	0.57	0.69
D-15a	3.5	0.82		2.69		0.51	0.55	0.68
D-16	2.1	1.02	0.2	0.66	0.24	0.64	0.66	0.74
D-17	17.0	0.32	0.06		16.57	0.12	0.13	0.17
D-18	1.4	0.69	0.05	0.61	0.06	0.63	0.66	0.75
D-19	4.2	0.36	0.1	1.27	2.46	0.28	0.30	0.37
D-20	0.8	0.29	0.06	0.38	0.05	0.59	0.62	0.72
D-11b	4.1	1.25	0.22	2.39	0.27	0.55	0.58	0.69
D-13b	0.5	0.22	0.04	0.22	0.05	0.60	0.63	0.72
D-14b	0.8	0.32	0.06	0.37	0.07	0.59	0.62	0.71
D-15b	1.4	0.36	0.07	0.88	0.08	0.53	0.56	0.67

Land Use	C2	C5	C100
Streets - Paved	0.87	0.88	0.93
Concrete Drive and Sidewalk	0.87	0.87	0.89
SF 4.5 lots/ac, 2000 SF ranch	0.4	0.45	0.6
Lawns (Undeveloped) A/B Soili 2-7% avg slope	0.1	0.11	0.15

All values based upon COA Table 1

STANDARD FORM SF-1
TIME OF CONCENTRATION

SUBDIVISION: KINGS POINT - DEVELOPED BASINS
CALCULATED B DJO **DATE:** 5/16/2022

SUB BASIN DATA				*INITIAL/OVERLAND TIME*				*TRAVEL TIME*						t_c CHECK				*FINAL t_c*
DESIGN POINT	**BASIN(S)**	**AREA** (acres)	C_5 COASDC, Table 1	**LENGTH** 500 ft max non-urban,300 ft max urban (feet)	**DROP** (ft)	**AVERAGE BASIN SLOPE** (ft/ft)	t_i COASDC, CH5, Equ 5.3 (min)	**CHANNELIZED FLOW LENGTH** (feet)	**DROP** (ft)	**CHANNELIZED FLOW SLOPE (S_o)** (ft/ft)	**CONVEYANCE FACTOR (K)** USDCM Tbl 6-2	**VELOCITY** $V = KS_o^{0.5}$ (ft/sec)	t_t USDCM V1, CH6, Equ 6-4 (min)	$t_c = t_i + t_t$ COASDC, CH5, Equ 5.2 (min)	**L' FOR** COASDC, CH5, Equ 5.4 (feet)	$t_c = (L'/180) + 10$ COASDC, CH5, Equ 5.4 (min)	**URBANIZED?**	See COASDC explanation (min)
1D	D-1	0.8	0.88	26	1	0.038	1.3	546	14	0.026	20	3.20	2.8	4.1	572	13.2	Y	5.0
2D	D-2	0.91	0.77	83	3	0.036	3.6	603	24	0.040	20	3.99	2.5	6.1	686	13.8	Y	6.1
3D	D-3	5.87	0.47	300	11	0.037	12.9	1218	47	0.039	20	3.93	5.2	18.0	1518	18.4	Y	18.0
4D	D-4	5.19	0.60	185	2	0.011	12.0	762	31	0.041	20	4.03	3.1	15.2	947	15.3	Y	15.2
5D	D-5	0.64	0.66	20	1	0.050	2.1	361	14	0.039	20	3.94	1.5	3.6	381	12.1	Y	5.0
6D	D-6	3.29	0.60	300	14	0.047	9.5	214	12	0.056	20	4.74	0.8	10.2	514	12.9	Y	10.2
7D	D-7	1.96	0.66	176	4	0.023	8.0	269	8	0.030	20	3.45	1.3	9.3	445	12.5	Y	9.3
8D	D-8	1.24	0.67	53	5	0.094	2.7	602	14	0.023	20	3.05	3.3	6.0	655	13.6	Y	6.0
9D	D-9	4.1	0.36	300	12	0.040	14.6	358	7	0.020	20	2.80	2.1	16.7	658	13.7	Y	13.7
10D	D-10	8.89	0.42	300	17	0.057	12.0	675	26	0.039	7	1.37	8.2	20.2	975	15.4	Y	15.4
11D	D-11a	8.51	0.59	142	3	0.021	8.5	1220	47	0.039	20	3.93	5.2	13.7	1362	17.6	Y	13.7
12D	D-12	2.17	0.41	110	2	0.018	10.7	705	33	0.047	20	4.33	2.7	13.4	815	14.5	Y	5.0
13D	D-13a	3.31	0.57	110	4	0.036	6.6	637	29	0.046	20	4.27	2.5	9.1	747	14.2	Y	9.1
14D	D-14a	2.79	0.57	110	3	0.027	7.2	565	24	0.042	20	4.12	2.3	9.5	675	13.8	Y	9.5
15D	D-15a	3.51	0.55	110	3	0.027	7.5	621	26	0.042	20	4.09	2.5	10.0	731	14.1	Y	5.0
16D	D-16	2.12	0.66	20	1	0.050	2.1	1105	41	0.037	20	3.85	4.8	6.9	1125	16.3	Y	6.9
17D	D-17	16.95	0.13	300	21	0.070	16.0	614	42	0.068	7	1.83	5.6	21.6	914	15.1	Y	15.1
18D	D-18	1.41	0.66	89	4	0.045	4.6	273	16	0.059	20	4.84	0.9	5.5	362	12.0	Y	5.5
19D	D-19	4.19	0.30	300	18	0.060	13.9	714	59	0.083	7	2.01	5.9	19.8	1014	15.6	Y	15.6
20D	D-20	0.78	0.62	132	14	0.106	4.6	214	11	0.051	20	4.53	0.8	5.4	346	11.9	Y	5.4
11D	D-11b	4.13	0.58	55	2	0.036	4.5	1152	47	0.041	20	4.04	4.8	9.3	1207	16.7	Y	9.3
13D	D-13b	0.53	0.63	56	5	0.089	3.1	214	8	0.037	20	3.87	0.9	4.0	270	11.5	Y	5.0
14D	D-14b	0.82	0.62	42	2	0.048	3.4	308	7	0.023	20	3.02	1.7	5.1	350	11.9	Y	5.1
15D	D-15b	1.39	0.56	138	3	0.022	8.8	265	10	0.038	20	3.89	1.1	10.0	403	12.2	Y	10.0

JOB NO: 12187.61
PROJECT: Kings Point Filing 1
DESIGN STORM: 2-year
CALCULATED BY: DJO

I=28.5*P1/(10+T)^0.786

STORM DRAINAGE SYSTEM DESIGN - POND D1
RATIONAL METHOD

1 HR STORM=		*0.97*		DIRECT RUNOFF				TOTAL RUNOFF				TRAVEL TIME				STREET FLOW		PIPE FLOW		
Design Point	Area Designation	Ac	C	Tc	CA	I	Q	Tc	CA	I	Q	Length	Velocity	Time	From	CA	Q	CA	Q	
				(min)		IN/HR	CFS			IN/HR	CFS	(ft)	(ft/s)	(min)	To		CFS		CFS	Flow Notes
1D	D-1	0.8	0.87	5.0	0.70	3.3	2.3											0.70	2.3	DIRECT/INLET INTERCEPT
2D	D-2	0.9	0.76	6.1	0.69	3.1	2.2													DIRECT
2D	D-1 + D-2							6.1	1.39	3.1	4.3							1.39	4.3	COMBINED/ PIPE FLOW
3D	D-3	5.9	0.46	18.0	2.70	2.0	5.4					400	8	0.8	3D to 5D			2.70	5.4	DIRECT/INLET INTERCEPT
3D	DP 2D + D-3							18.0	4.08	2.0	8.2							4.08	8.2	COMBINED/ PIPE FLOW
4D	D-4	5.2	0.56	15.2	2.93	2.2	6.4													DIRECT
5D	D-5	0.6	0.65	5.0	0.42	3.3	1.4													DIRECT
5D	3D + 4D + 5D							18.9	7.43	2.0	14.6	350	8	0.7	5D to 7.5D			7.43	14.6	COMBINED/ PIPE FLOW
6D	D-6	3.3	0.56	10.2	1.85	2.6	4.8													DIRECT
7D	D-7	2.0	0.64	9.3	1.25	2.7	3.4													DIRECT
7D	DP 6D + DP 7D							10.2	3.10	2.6	8.1							3.10	8.1	COMBINED/ PIPE FLOW
7.5D	DP 5D + DP 7D							19.6	10.53	1.9	20.3	325	8	0.7	7.5D to 8D			10.53	20.3	COMBINED/ PIPE FLOW
8D	D-8	1.2	0.67	6.0	0.82	3.1	2.6											0.82	2.6	INLET INTERCEPT/ PIPE FLOW
8D	7.5D + 8D							20.3	11.36	1.9	21.5	200	8	0.4	8D to 9.5D			11.36	21.5	COMBINED/ PIPE FLOW
9D	D-9	4.1	0.32	13.7	1.33	2.3	3.1											1.33	3.1	DIRECT/INLET INTERCEPT
9.5D	DP 8D + DP 9D							20.7	12.68	1.9	23.8	375	8	0.8	9.5D to 10.5D			12.68	23.8	COMBINED/ PIPE FLOW
10D	D-10	8.9	0.37	15.4	3.32	2.2	7.2											3.32	7.2	DIRECT/INLET INTERCEPT
10.5D	DP 9.5D + DP 10.5D							21.5	16.01	1.8	29.4	170	8	0.4	10.5D to 12.5D			16.01	29.4	COMBINED/ PIPE FLOW
11D	D-11a	8.5	0.56	13.7	4.75	2.3	10.9													DIRECT
11D	D-11b	4.1	0.55	9.3	2.26	2.7	6.1													DIRECT
11D	D-11a + D-11b							13.7	7.01	2.3	16.1							7.01	16.1	COMBINED/ PIPE FLOW
12D	D-12	2.2	0.40	5.0	0.87	3.3	2.9													DIRECT
12D	DP 11D + D-12							5.0	7.88	3.3	25.9							7.88	25.9	COMBINED/ PIPE FLOW
12.5D	DP 10.5 D + DP 12D							21.8	23.89	1.8	43.5	300	8	0.6	12.5D to 13.5D			23.89	43.5	COMBINED/ PIPE FLOW
13D	D-13a	3.3	0.53	9.1	1.74	2.7	4.7													DIRECT
13D	D-13b	0.5	0.60	5.0	0.32	3.3	1.1													DIRECT
13D	D-13a + D-13b							9.1	2.06	2.7	5.6							2.06	5.6	COMBINED/ PIPE FLOW
13.5D	DP 12.5D + DP 13D							22.4	25.95	1.8	46.6	325	8	0.7	13.5D to 14.5D			25.95	46.6	COMBINED/ PIPE FLOW
14D	D-14a	2.8	0.53	9.5	1.49	2.7	4.0													DIRECT
14D	D-14b	0.8	0.59	5.1	0.49	3.3	1.6													DIRECT
14D	D-14a + D-14b							9.5	1.97	2.7	5.3							1.97	5.3	COMBINED/ PIPE FLOW
14.5D	DP 13.5D + DP 14D							23.1	27.92	1.8	49.3	390	8	0.8	14.5D to 15.5D			27.92	49.3	COMBINED/ PIPE FLOW
15D	D-15a	3.5	0.51	5.0	1.79	3.3	5.9													DIRECT
15D	D-15b	1.4	0.53	10.0	0.73	2.6	1.9													DIRECT
15D	D-15a + D-15b							10.0	2.52	2.6	6.6							2.52	6.6	COMBINED/ PIPE FLOW
15.5D	DP 14.5D + DP 15D							23.9	30.45	1.7	52.7	140	8	0.3	15.5D to 16D			30.45	52.7	COMBINED/ PIPE FLOW
16D	D-16	2.1	0.64	6.9	1.35	3.0	4.0													DIRECT
16D	DP 15.5D + DP 16D							24.2	31.80	1.7	54.7	350	8	0.7	16D to 18D			31.80	54.7	COMBINED/ PIPE FLOW
17D	D-17	17.0	0.12	15.1	1.99	2.2	4.4													DIRECT/ PIPE FLOW
18D	D-18	1.4	0.63	5.5	0.89	3.2	2.9													DIRECT
18D	DP 16D + DP 17D + DP 18D							25.0	34.68	1.7	58.7	225	8	0.5	18D to 20D			34.68	58.7	COMBINED/ PIPE FLOW
19D	D-19	4.2	0.28	15.6	1.15	2.2	2.5											1.15	2.5	INLET INTERCEPT/ PIPE FLOW
20D	D-20	0.8	0.59	5.4	0.46	3.2	1.5													DIRECT
20D	DP 18D + DP 19D + DP 20D							25.4	36.29	1.7	60.8							36.29	60.8	COMBINED/ PIPE FLOW

JOB NO: 12187.61
PROJECT: Kings Point Filing 1
DESIGN STORM: 100-year
CALCULATED BY: DJO

STORM DRAINAGE SYSTEM DESIGN - POND D1
RATIONAL METHOD

I=28.5*P1/(10+T)^0.786

1 HR STORM=		*2.63*		DIRECT RUNOFF				TOTAL RUNOFF				TRAVEL TIME				STREET FLOW		PIPE FLOW		
Design Point	Area Designation	Ac	C	Tc	CA	I	Q	Tc	CA	I	Q	Length	Velocity	Time	From DP	CA	Q	CA	Q	
						IN/HR	CFS			IN/HR	CFS	(ft)	(ft/s)	(min)	To DP		CFS		CFS	Flow Notes
1D	D-1	0.8	0.93	5.0	0.74	8.9	6.6											0.74	6.6	DIRECT/INLET INTERCEPT
2D	D-2	0.9	0.81	6.1	0.74	8.4	6.2													DIRECT
2D	D-1 + D-2							6.1	1.48	8.4	12.5							1.48	12.5	COMBINED/ PIPE FLOW
3D	D-3	5.9	0.51	18.0	3.00	5.5	16.4					400	8	0.8	3D to 5D			3.00	16.4	DIRECT/INLET INTERCEPT
3D	DP 2D + D-3							18.0	4.48	5.5	24.5							4.48	24.5	COMBINED/ PIPE FLOW
4D	D-4	5.2	0.70	15.2	3.65	5.9	21.6													DIRECT
5D	D-5	0.6	0.71	5.0	0.45	8.9	4.0													DIRECT
5D	3D + 4D + 5D							18.9	8.58	5.3	45.8	350	8	0.7	5D to 7.5D			8.58	45.8	COMBINED/ PIPE FLOW
6D	D-6	3.3	0.70	10.2	2.31	7.1	16.3													DIRECT
7D	D-7	2.0	0.74	9.3	1.45	7.3	10.6													DIRECT
7D	DP 6D + DP 7D							10.2	3.76	7.1	26.5							3.76	26.5	COMBINED/ PIPE FLOW
7.5D	DP 5D + DP 7D							19.6	12.34	5.2	64.5	325	8	0.7	7.5D to 8D			12.34	64.5	COMBINED/ PIPE FLOW
8D	D-8	1.2	0.72	6.0	0.89	8.5	7.6											0.89	7.6	INLET INTERCEPT/ PIPE FLOW
8D	7.5D + 8D							20.3	13.23	5.1	68.0	200	8	0.4	8D to 9.5D			.	68.0	COMBINED/ PIPE FLOW
9D	D-9	4.1	0.49	13.7	1.99	6.2	12.4											1.99	12.4	DIRECT/INLET INTERCEPT
9.5D	DP 8D + DP 9D							20.7	15.23	5.1	77.4	375	8	0.8	9.5D to 10.5D			15.23	77.4	COMBINED/ PIPE FLOW
10D	D-10	8.9	0.56	15.4	4.98	5.9	29.4											4.98	29.4	DIRECT/INLET INTERCEPT
10.5D	DP 9.5D + DP 10.5D							21.5	20.21	5.0	100.7	170	8	0.4	10.5D to 12.5D			20.21	100.7	COMBINED/ PIPE FLOW
11D	D-11a	8.5	0.71	13.7	6.05	6.2	37.7													DIRECT
11D	D-11b	4.1	0.69	9.3	2.83	7.3	20.7													DIRECT
11D	D-11a + D-11b							13.7	8.88	6.2	55.4							8.88	55.4	COMBINED/ PIPE FLOW
12D	D-12	2.2	0.45	5.0	0.98	8.9	8.8													DIRECT
12D	DP 11D + D-12							5.0	9.86	8.9	88.0							9.86	88.0	COMBINED/ PIPE FLOW
12.5D	DP 10.5 D + DP 12D							21.8	30.07	4.9	148.5	300	8	0.6	12.5D to 13.5D			30.07	148.5	COMBINED/ PIPE FLOW
13D	D-13a	3.3	0.69	9.1	2.28	7.4	16.8													DIRECT
13D	D-13b	0.5	0.72	5.0	0.38	8.9	3.4													DIRECT
13D	D-13a + D-13b							9.1	2.66	7.4	19.6							2.66	19.6	COMBINED/ PIPE FLOW
13.5D	DP 12.5D + DP 13D							22.4	32.73	4.9	159.2	325	8	0.7	13.5D to 14.5D			32.73	159.2	COMBINED/ PIPE FLOW
14D	D-14a	2.8	0.69	9.5	1.93	7.3	14.1													DIRECT
14D	D-14b	0.8	0.71	5.1	0.58	8.9	5.2													DIRECT
14D	D-14a + D-14b							9.5	2.52	7.3	18.3							2.52	18.3	COMBINED/ PIPE FLOW
14.5D	DP 13.5D + DP 14D							23.1	35.25	4.8	168.7							35.25	168.7	COMBINED/ PIPE FLOW
15D	D-15a	3.5	0.68	5.0	2.38	8.9	21.2													DIRECT
15D	D-15b	1.4	0.67	10.0	0.94	7.1	6.7													DIRECT
15D	D-15a + D-15b							10.0	3.31	7.1	23.6							3.31	23.6	COMBINED/ PIPE FLOW
15.5D	DP 14.5D + DP 15D							23.9	38.56	4.7	181.1	140	8	0.3	15.5D to 16D			38.56	181.1	COMBINED/ PIPE FLOW
16D	D-16	2.1	0.74	6.9	1.56	8.1	12.7													DIRECT
16D	DP 15.5D + DP 16D							24.2	40.12	4.7	187.2	350	8	0.7	16D to 18D			40.12	187.2	COMBINED/ PIPE FLOW
17D	D-17	17.0	0.17	15.1	2.84	6.0	16.9													DIRECT/ PIPE FLOW
18D	D-18	1.4	0.75	5.5	1.06	8.7	9.2													DIRECT
18D	DP 16D + DP 17D + DP 18D							25.0	44.02	4.6	202.0	225	8	0.5	18D to 20D			44.02	202.0	COMBINED/ PIPE FLOW
19D	D-19	4.2	0.37	15.6	1.55	5.9	9.1													INLET INTERCEPT/ PIPE FLOW
20D	D-20	0.8	0.72	5.4	0.56	8.8	4.9													DIRECT
20D	DP 18D + DP 19D + DP 20D							25.4	46.13	4.5	209.4							46.13	209.4	COMBINED/ PIPE FLOW

Weighted Rational C Calculation By Landuse - Parker Rd and Aurora Parkway Intersection
Prepared by: DJO
Date: 05/16/22

Basin	Total Area (acres)	Streets - Paved (acres)	Concrete Drive and Sidewalk (acres)	Residential 1/2 acre lot or larger (acres)	Lawns (Undeveloped) A/B Soil 2-7% avg slope (acres)	C_2	C_5	C_{100}
D-23	12.4	1.59		7.8	3.03	0.32	0.36	0.53
D-24	2.1	1.04			1.07	0.48	0.49	0.53
D-25	5.3	1.52			3.78	0.32	0.33	0.37

Land Use	C2	C5	C100
Streets - Paved	0.87	0.88	0.93
Concrete Drive and Sidewalk	0.87	0.87	0.89
Residential 1/2 acre lot or larger	0.3	0.35	0.6
Lawns (Undeveloped) A/B Soili 2-7% avg slope	0.1	0.11	0.15

All values based upon COA Table 1

STANDARD FORM SF-1
TIME OF CONCENTRATION

SUBDIVISION: KINGS POINT - DEVELOPED BASINS
CALCULATED B DJO **DATE:** 5/16/2022

SUB BASIN DATA				*INITIAL/OVERLAND TIME*				*TRAVEL TIME*						t_c CHECK				*FINAL t_c*
DESIGN POINT	**BASIN(S)**	**AREA** (acres)	**C_5** COASDC, Table 1	**LENGTH** 500 ft max non-urban,300 ft max urban (feet)	**DROP** (ft)	**AVERAGE BASIN SLOPE** (ft/ft)	**t_i** COASDC, CH5, Equ 5.3 (min)	**CHANNELIZED FLOW LENGTH** (feet)	**DROP** (ft)	**CHANNELIZED FLOW SLOPE (S_o)** (ft/ft)	**CONVEYANCE FACTOR (K)** USDCM Tbl 6-2	**VELOCITY** $V = KS_o^{0.5}$ (ft/sec)	**t_t** USDCM V1, CH6, Equ 6-4 (min)	**$t_c = t_i + t_t$** COASDC, CH5, Equ 5.2 (min)	**L' FOR** COASDC, CH5, Equ 5.4 (feet)	**$t_c = (L'/180) + 10$** COASDC, CH5, Equ 5.4 (min)	**URBANIZED?**	See COASDC explanation (min)
23D	D-23	12.42	0.36	300	24	0.080	11.7	987	55	0.056	20	4.72	3.5	15.1	1287	17.2	Y	15.1
24D	D-24	2.11	0.49	65	4	0.062	4.9	476	7	0.015	20	2.43	3.3	8.1	541	13.0	Y	8.1
25D	D-25	5.3	0.33	300	41	0.137	10.1	842	8	0.010	7	0.68	20.6	30.7	1142	16.3	Y	16.3

JOB NO: 12187.61
PROJECT: Kings Point Filing 1
DESIGN STORM: 2-year
CALCULATED BY: DJO

STORM DRAINAGE SYSTEM DESIGN - PARKER ROAD
RATIONAL METHOD

I=28.5*P1/(10+T)^0.786

1 HR STORM=		*0.97*		DIRECT RUNOFF				TOTAL RUNOFF				TRAVEL TIME				STREET FLOW		PIPE FLOW		
Design Point	Area Designation	Ac	C	Tc	CA	I	Q	Tc	CA	I	Q	Length	Velocity	Time	From	CA	Q	CA	Q	
				(min)		IN/HR	CFS			IN/HR	CFS	(ft)	(ft/s)	(min)	To		CFS		CFS	Flow Notes
23D	D-23	12.4	0.32	15.1	4.03	2.2	8.8									4.03	8.8	4.03	8.8	DIRECT/INLET INTERCEPT
24D	D-24	2.1	0.48	8.1	1.01	2.8	2.9									1.01	2.9			DIRECT/INLET INTERCEPT
24D	D-24 + POND D1 (Q2 = 4.4 cfs)																		7.3	COMBINED/ PIPE FLOW
25D	D-25	5.3	0.32	16.3	1.70	2.1	3.6											1.70	3.6	DIRECT/FES INTERCEPT
25.5D	DP 23D + DP 24D + DP 25D							15.1	6.74	2.2	14.8							6.74	19.2	COMBINED/ PIPE FLOW

JOB NO: 12187.61
PROJECT: Kings Point Filing 1
DESIGN STORM: 100-year
CALCULATED BY: DJO

STORM DRAINAGE SYSTEM DESIGN - PARKER ROAD
RATIONAL METHOD

I=28.5*P1/(10+T)^0.786

1 HR STORM=		*2.63*		DIRECT RUNOFF				TOTAL RUNOFF				TRAVEL TIME				STREET FLOW		PIPE FLOW		
Design Point	Area Designation	Ac	C	Tc	CA	I	Q	Tc	CA	I	Q	Length	Velocity	Time	From DP	CA	Q	CA	Q	
						IN/HR	CFS			IN/HR	CFS	(ft)	(ft/s)	(min)	To DP		CFS		CFS	Flow Notes
23D	D-23	12.4	0.53	15.1	6.61	5.9	39.3									6.61	39.3	6.61	39.3	DIRECT/INLET INTERCEPT
24D	D-24	2.1	0.53	8.1	1.13	7.7	8.7									1.13	8.7			DIRECT/INLET INTERCEPT
24D	D-24 + POND D1 (Q100 = 70.7 cfs)																		87.0	COMBINED/ PIPE FLOW
25D	D-25	5.3	0.37	16.3	1.98	5.7	11.3											1.98	11.3	DIRECT/FES INTERCEPT
25.5D	DP 23D + DP 24D + DP 25D							15.1	9.72	5.9	57.8							9.72	128.5	COMBINED/ PIPE FLOW

3.6 PREVIOUS STUDIES

Two (2) sources of previous hydrologic analysis are available for the Cherry Creek Minor Tributaries to-date. The first is the 1999 Cherry Creek Corridor Reservoir to County Line Outfall Systems Plan (WRC Engineering, Inc., 1999). This is a regional study that provides a limited number of common design points for reference and comparison. The second source is individual site drainage reports. Drainage reports were referenced only where necessary for the modeling of regional detention ponds, as discussed in Section 3.4 DETENTION.

3.7 RESULTS OF ANALYSIS

Peak flow rates for the existing and future land use conditions models were established at design points after incorporating the rainfall data, hydrologic characteristics, and drainage conveyance parameters within EPA SWMM. The basin-wide peak flow rate results at each of the design points along the stream corridor for the WQ, 1-, 2-, 5-, 10-, 25-, 50-, 100-, and 500-year storm events are presented in **Appendix B** with key points shown in **Table 3-2**. As noted earlier, only Kragelund Tributary and 17 Mile Tributary have existing conditions hydrology.

A summarized input and output file from the EPA SWMM version 5.1 model are included in **Appendix B**. The summarized input and output files provide the detailed information regarding subwatershed hydrologic input and the resulting hydrograph routing and peak flows.

Table 3-2. Peak Flows at Key Design Points

Basin	Location	Existing (cfs)			Future (cfs)		
		Q_5	Q_{25}	Q_{100}	Q_5	Q_{25}	Q_{100}
Little Raven Creek (LR)	Outfall to Reservoir	-	-	-	72	253	454
	E. Belleview Ave.	-	-	-	86	242	404
Suhaka Creek (S)	Cottonwood Creek Confluence	-	-	-	65	238	423
Joplin Tributary (J)	Outfall to Cherry Creek	-	-	-	173	348	613
	S. Parker Rd.	-	-	-	182	331	535
	RB1-4 Pond Outflow	-	-	-	110	205	353
	RB1-4 Pond Inflow	-	-	-	146	345	570
Grove Ranch Tributary (GR)	Outfall to Cherry Creek	-	-	-	43	96	150
Valley Club Acres Tributary (VCA)	Outfall to Cherry Creek	-	-	-	83	211	349
North Arapahoe Tributary (NA)	Outfall to Cherry Creek	-	-	-	82	229	476
	S. Buckley Rd.	-	-	-	45	150	325
South Arapahoe Tributary (SA)	Outfall to Cherry Creek	-	-	-	66	229	426
	S. Parker Rd.	-	-	-	36	163	318
Chenango Tributary (C)	Outfall to Cherry Creek	-	-	-	112	478	942
	S. Parker Rd.	-	-	-	96	436	857
Tagawa Tributary (T)	Outfall to Cherry Creek	-	-	-	14	52	105
Kragelund Tributary (K)	Outfall to Cherry Creek	49	308	626	151	478	859
	S. Parker Rd.	50	307	615	149	472	839
	Tributary Confluence	36	181	334	121	309	505
17 Mile Tributary (17)	Outfall to Cherry Creek	8	84	169	52	155	267
	S. Parker Rd.	6	70	141	47	135	229

Existing 100-year Peak Flowrate at the Parker Road Crossing

DRAINGE REPORT
for
KINGS POINT FILING NO. 1 - INFRASTRUCTURE

APPENDIX B
Hydraulic Computations

MILE HIGH FLOOD DISTRICT

DETENTION BASIN DESIGN WORKBOOK

MHFD-Detention, Version 4.04 (February 2021)
Mile High Flood District
Denver, Colorado
www.mhfd.org

Purpose:

This workbook aids in the estimation of stormwater detention basin sizing and outlet routing based on the modified puls routing method for urban watersheds. Several different BMP types and various outlet configurations can be sized.

Function:

1. Approximates the stage-area-volume relationship for a detention basin based on watershed parameters and basin geometry parameters. Also evaluates existing user-defined basin stage-area relationships.

2. Sizes filtration media orifice, outlet orifices, elliptical slots, weirs, trash racks, and develops stage-discharge relationships. Uses the Modified Puls method to route a series of hydrographs (i.e., 2-, 5-, 10-, 25-, 50-, 100- and 500-year) and calibrates the peak discharge out of the basin to match the pre-development peak discharges for the watershed.

Content: **This workbook consists of the following sheets:**

Basin	Tabulates stage-area-volume relationship estimates based on watershed parameters
Outlet Structure	Tabulates a stage-discharge relationship for the user-defined outlet structure (inlet control).
Reference	Provides reference equations and figures.
User Tips and Tools	Provides instructions and video links to assist in using this workbook. Includes a stage-area calculator.
BMP Zone Images	Provides images of typical BMP zone confirgurations corresponding with Zone pulldown selections.

Acknowledgements: ***Spreadsheet Development Team:***
Ken MacKenzie, P.E., Holly Piza, P.E.
Mile High Flood District

Derek N. Rapp, P.E.
Peak Stormwater Engineering, LLC

Dr. James C.Y. Guo, Ph.D., P.E.
Professor, Department of Civil Engineering, University of Colorado at Denver

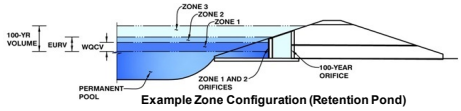
Comments? Direct all comments regarding this spreadsheet workbook to: **MHFD E-Mail**
Revisions? Check for revised versions of this or any other workbook at: **Downloads**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Kings Point Filing 1

Basin ID: Pond C4 (Stage 0.00 = 5879.50')



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	134.40	acres
Watershed Length =	3,768	ft
Watershed Length to Centroid =	1,661	ft
Watershed Slope =	0.054	ft/ft
Watershed Imperviousness =	33.20%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	59.6%	percent
Percentage Hydrologic Soil Groups C/D =	40.4%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

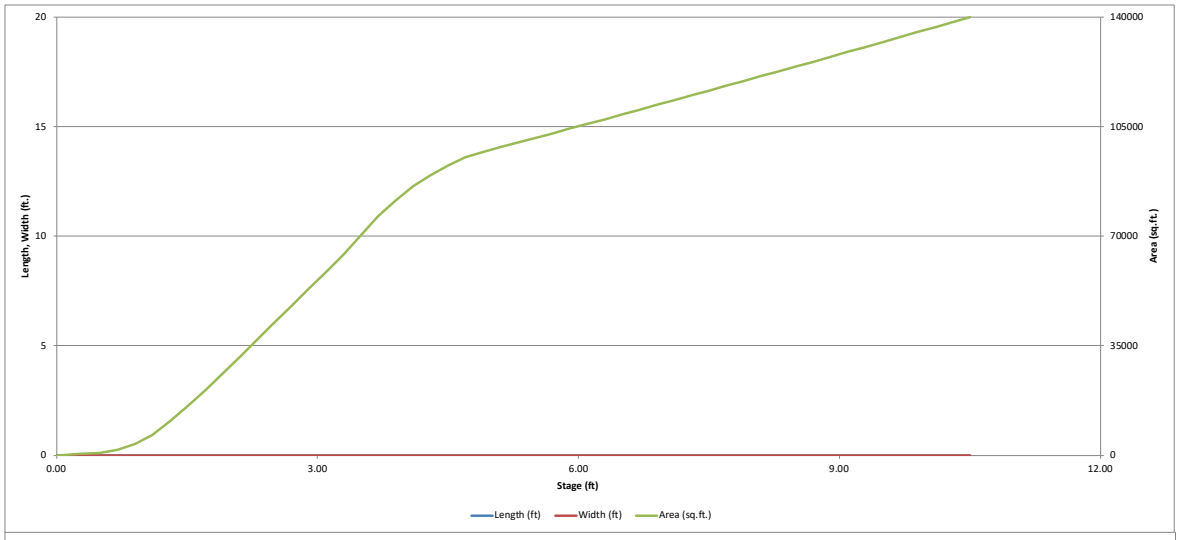
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	1.804	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	4.402	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	2.536	acre-feet	0.84	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	4.006	acre-feet	1.11	inches
10-yr Runoff Volume (P1 = 1.36 in.) =	6.137	acre-feet	1.36	inches
25-yr Runoff Volume (P1 = 1.73 in.) =	10.826	acre-feet	1.73	inches
50-yr Runoff Volume (P1 = 2.03 in.) =	14.105	acre-feet	2.03	inches
100-yr Runoff Volume (P1 = 2.35 in.) =	18.256	acre-feet	2.35	inches
500-yr Runoff Volume (P1 = 3.18 in.) =	27.866	acre-feet	3.18	inches
Approximate 2-yr Detention Volume =	2.410	acre-feet		
Approximate 5-yr Detention Volume =	3.808	acre-feet		
Approximate 10-yr Detention Volume =	5.213	acre-feet		
Approximate 25-yr Detention Volume =	6.570	acre-feet		
Approximate 50-yr Detention Volume =	7.190	acre-feet		
Approximate 100-yr Detention Volume =	8.802	acre-feet		

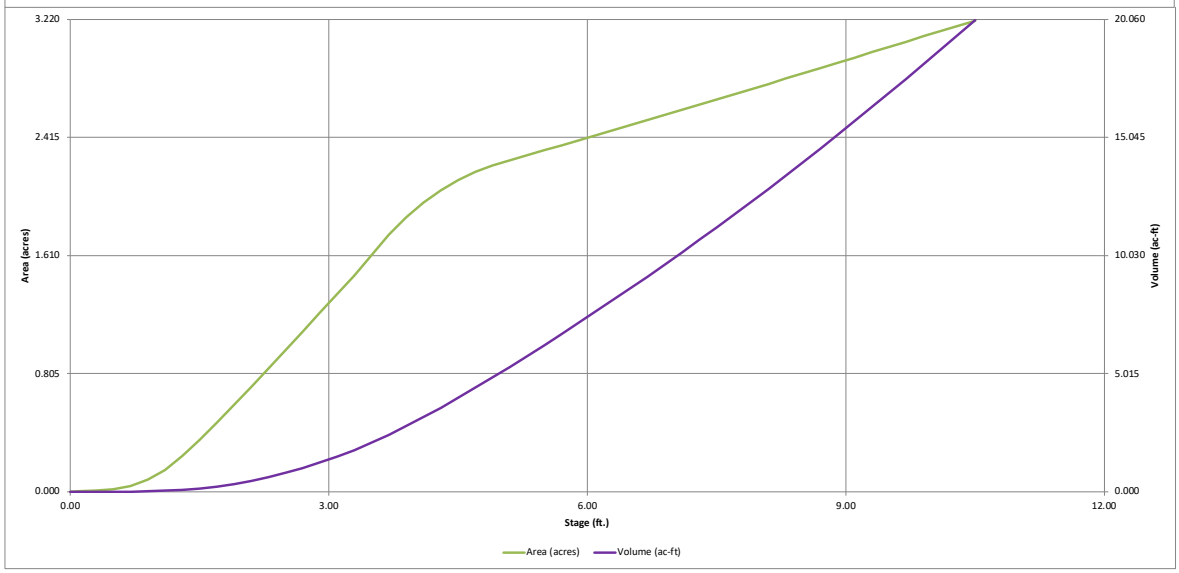
Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	1.804	acre-feet
Zone 2 Volume (EURV - Zone 1) =	2.598	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	4.400	acre-feet
Total Detention Basin Volume =	8.802	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.10	--	--	--	140	0.003	7	0.000
	--	0.30	--	--	--	447	0.010	66	0.002
	--	0.50	--	--	--	756	0.017	186	0.004
	--	0.70	--	--	--	1,623	0.037	424	0.010
	--	0.90	--	--	--	3,522	0.081	938	0.022
	--	1.10	--	--	--	6,499	0.149	1,940	0.045
	--	1.30	--	--	--	10,606	0.243	3,651	0.084
	--	1.50	--	--	--	15,327	0.352	6,244	0.143
	--	1.70	--	--	--	20,526	0.471	9,829	0.226
	--	1.90	--	--	--	25,908	0.595	14,473	0.332
	--	2.10	--	--	--	31,202	0.716	20,184	0.463
	--	2.30	--	--	--	36,667	0.842	26,971	0.619
	--	2.50	--	--	--	42,109	0.967	34,848	0.800
	--	2.70	--	--	--	47,472	1.090	43,806	1.006
	--	2.90	--	--	--	53,218	1.222	53,875	1.237
	--	3.10	--	--	--	58,661	1.347	65,063	1.494
	--	3.30	--	--	--	64,150	1.473	77,344	1.776
	--	3.50	--	--	--	70,226	1.612	90,782	2.084
	--	3.70	--	--	--	76,277	1.751	105,432	2.420
	--	3.90	--	--	--	81,514	1.871	121,211	2.783
	--	4.10	--	--	--	85,903	1.972	137,953	3.167
	--	4.30	--	--	--	89,522	2.055	155,495	3.570
	--	4.50	--	--	--	92,563	2.125	173,704	3.988
	--	4.70	--	--	--	95,081	2.183	192,468	4.418
	--	4.90	--	--	--	96,904	2.225	211,667	4.859
	--	5.10	--	--	--	98,382	2.259	231,196	5.308
	--	5.30	--	--	--	99,866	2.293	251,020	5.763
	--	5.50	--	--	--	101,353	2.327	271,142	6.225
	--	5.70	--	--	--	102,845	2.361	291,562	6.693
	--	5.90	--	--	--	104,342	2.395	312,281	7.169
	--	6.10	--	--	--	105,843	2.430	333,299	7.651
	--	6.30	--	--	--	107,348	2.464	354,618	8.141
	--	6.50	--	--	--	108,858	2.499	376,239	8.637
	--	6.70	--	--	--	110,372	2.534	398,162	9.141
	--	6.90	--	--	--	111,890	2.569	420,388	9.651
	--	7.10	--	--	--	113,413	2.604	442,918	10.168
	--	7.30	--	--	--	114,941	2.639	465,754	10.692
	--	7.50	--	--	--	116,472	2.674	488,895	11.223
	--	7.70	--	--	--	118,009	2.709	512,343	11.762
	--	7.90	--	--	--	119,549	2.744	536,099	12.307
	--	8.10	--	--	--	121,094	2.780	560,163	12.860
	--	8.30	--	--	--	122,644	2.816	584,537	13.419
	--	8.50	--	--	--	124,198	2.851	609,221	13.986
	--	8.70	--	--	--	125,756	2.887	634,216	14.560
	--	8.90	--	--	--	127,319	2.923	659,524	15.141
	--	9.10	--	--	--	128,886	2.959	685,144	15.729
	--	9.30	--	--	--	130,458	2.995	711,079	16.324
	--	9.50	--	--	--	132,034	3.031	737,328	16.927
	--	9.70	--	--	--	133,614	3.067	763,893	17.537
	--	9.90	--	--	--	135,199	3.104	790,774	18.154
	--	10.10	--	--	--	136,788	3.140	817,973	18.778
	--	10.30	--	--	--	138,382	3.177	845,490	19.410
	--	10.50	--	--	--	139,980	3.214	873,326	20.049


20
15
10
5
0
140000
105000
70000
35000
0
Length, Width (ft.)
Area (sq.ft.)
0.00
3.00
6.00
9.00
12.00
Stage (ft)
Length (ft)
Width (ft)
Area (sq.ft.)


3.220
2.415
1.610
0.805
0.000
20.060
15.045
10.030
5.015
0.000
Area (acres)
Volume (ac-ft)
0.00
3.00
6.00
9.00
12.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

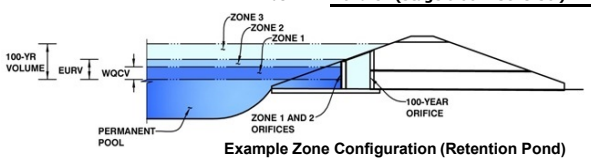
NOT REVIEWED OR APPROVED IN THE PD

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Kings Point Filing 1

Basin ID: Pond C4 (Stage 0.00 = 5879.50')



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.32	1.804	Orifice Plate
Zone 2 (EURV)	4.70	2.598	Rectangular Orifice
Zone 3 (100-year)	6.57	4.400	Weir&Pipe (Restrict)
Total (all zones)		8.802	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	7.278E-02	ft²
Depth at top of Zone using Orifice Plate =	3.32	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	13.30	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	10.48	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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							
Orifice Area (sq. inches)	10.48							

	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)

	Zone 2 Rectangular	Not Selected		Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.32	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	1.56	N/A	ft²
Depth at top of Zone using Vertical Orifice =	4.70	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.42	N/A	feet
Vertical Orifice Height =	10.00	N/A	inches				
Vertical Orifice Width =	22.40		inches				

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected		Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	4.70	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	6.20	N/A	feet
Overflow Weir Front Edge Length =	22.00	N/A	feet	Overflow Weir Slope Length =	6.18	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	8.69	N/A	
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	94.70	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	94.70	N/A	ft²
Debris Clogging % =	0%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected		Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	10.90	N/A	ft²
Outlet Pipe Diameter =	60.00	N/A	inches	Outlet Orifice Centroid =	1.56	N/A	feet
Restrictor Plate Height Above Pipe Invert =	32.60		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.66	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	8.70	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	91.00	feet	Stage at Top of Freeboard =	9.67	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	3.06	acres
Freeboard above Max Water Surface =	0.00	feet	Basin Volume at Top of Freeboard =	17.44	acre-ft

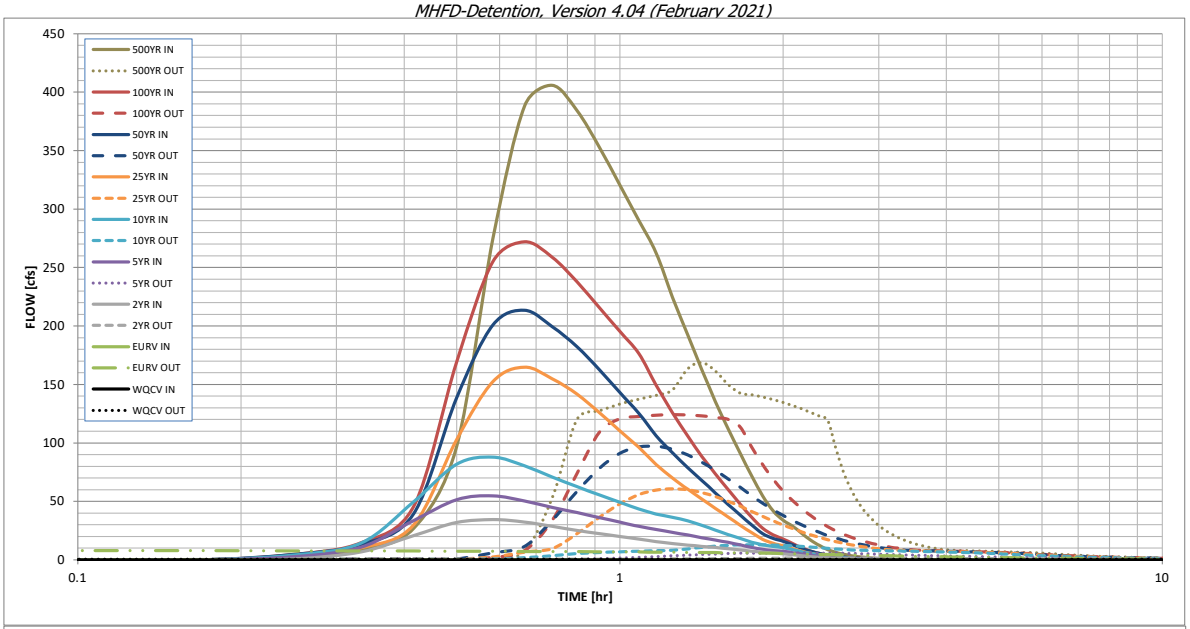
Calculated Parameters for Spillway

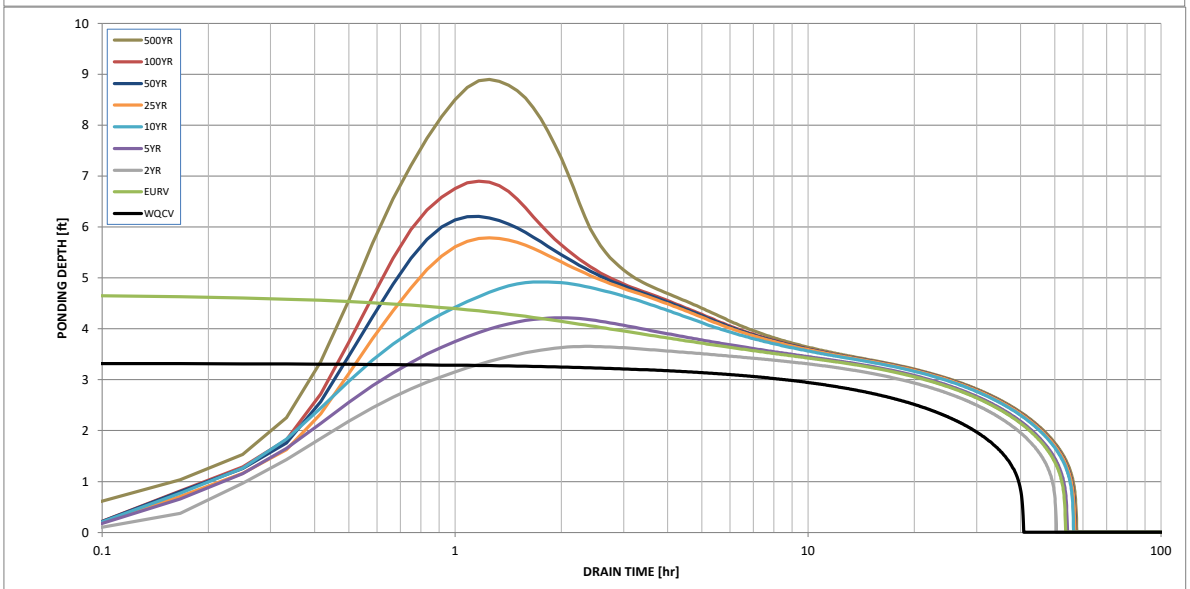
Routed Hydrograph Results *The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).*

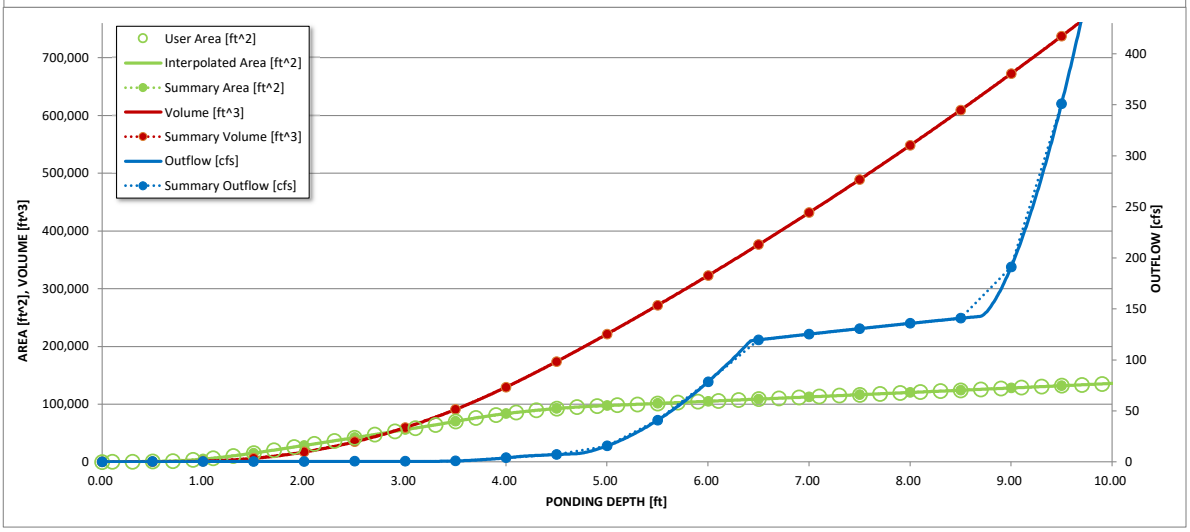
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.11	1.36	1.73	2.03	2.35	3.18
CUHP Runoff Volume (acre-ft) =	1.804	4.402	2.536	4.006	6.137	10.826	14.105	18.256	27.866
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	2.536	4.006	6.137	10.826	14.105	18.256	27.866
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	1.5	7.6	32.3	96.4	134.3	182.6	288.2
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.06	0.24	0.72	1.00	1.36	2.14
Peak Inflow Q (cfs) =	N/A	N/A	34.3	54.7	87.8	164.8	213.5	272.0	405.9
Peak Outflow Q (cfs) =	0.6	8.0	1.6	5.9	12.9	60.7	97.0	124.1	168.5
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.8	0.4	0.6	0.7	0.7	0.6
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	0.0	0.5	0.9	1.2	1.3
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) =	39	49	48	50	51	48	45	42	36
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	50	53	54	53	53	51	49
Maximum Ponding Depth (ft) =	3.32	4.70	3.65	4.21	4.92	5.78	6.21	6.90	8.90
Area at Maximum Ponding Depth (acres) =	1.49	2.18	1.72	2.02	2.23	2.37	2.45	2.57	2.92
Maximum Volume Stored (acre-ft) =	1.805	4.418	2.334	3.386	4.881	6.883	7.895	9.625	15.111

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename: _____

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.27
	0:15:00	0.00	0.00	0.90	2.64	3.99	3.16	4.53	4.71	8.44
	0:20:00	0.00	0.00	6.91	10.85	14.54	10.30	13.19	14.64	27.02
	0:25:00	0.00	0.00	20.74	33.73	49.90	30.04	39.64	45.99	97.05
	0:30:00	0.00	0.00	32.03	51.41	81.89	102.92	138.73	169.42	274.63
	0:35:00	0.00	0.00	34.33	54.71	87.77	152.41	200.91	255.15	388.17
	0:40:00	0.00	0.00	32.30	50.44	80.31	164.77	213.51	272.01	405.95
	0:45:00	0.00	0.00	28.62	44.86	70.93	154.76	199.42	258.90	384.27
	0:50:00	0.00	0.00	25.21	40.37	62.57	141.74	182.30	237.68	352.82
	0:55:00	0.00	0.00	22.42	36.21	55.54	125.85	162.54	215.58	320.58
	1:00:00	0.00	0.00	19.99	32.23	49.25	110.23	143.06	195.27	290.40
	1:05:00	0.00	0.00	17.77	28.59	43.46	96.19	125.35	176.50	262.44
	1:10:00	0.00	0.00	15.62	25.86	39.20	81.43	106.14	149.30	224.69
	1:15:00	0.00	0.00	13.95	23.55	36.46	69.99	91.57	125.91	192.49
	1:20:00	0.00	0.00	12.66	21.21	33.39	60.32	78.92	105.83	162.48
	1:25:00	0.00	0.00	11.54	18.96	29.41	52.01	67.87	88.49	135.45
	1:30:00	0.00	0.00	10.51	16.88	25.39	44.01	57.27	73.58	112.10
	1:35:00	0.00	0.00	9.48	14.92	21.64	36.58	47.43	60.09	91.06
	1:40:00	0.00	0.00	8.46	12.72	18.20	29.65	38.28	47.65	71.80
	1:45:00	0.00	0.00	7.46	10.59	15.14	23.22	29.79	36.31	54.71
	1:50:00	0.00	0.00	6.64	8.95	12.96	17.60	22.51	26.96	41.79
	1:55:00	0.00	0.00	5.83	7.99	11.58	14.12	18.41	21.40	33.86
	2:00:00	0.00	0.00	5.17	7.30	10.42	12.02	15.86	17.87	28.72
	2:05:00	0.00	0.00	4.30	6.11	8.66	9.61	12.72	13.89	22.51
	2:10:00	0.00	0.00	3.46	4.85	6.87	7.31	9.67	10.24	16.69
	2:15:00	0.00	0.00	2.76	3.80	5.38	5.57	7.35	7.43	12.15
	2:20:00	0.00	0.00	2.19	2.99	4.19	4.23	5.55	5.33	8.77
	2:25:00	0.00	0.00	1.73	2.33	3.23	3.20	4.19	3.88	6.42
	2:30:00	0.00	0.00	1.36	1.80	2.45	2.42	3.17	2.95	4.82
	2:35:00	0.00	0.00	1.06	1.37	1.83	1.81	2.36	2.23	3.60
	2:40:00	0.00	0.00	0.83	1.03	1.38	1.36	1.77	1.70	2.74
	2:45:00	0.00	0.00	0.64	0.78	1.05	1.03	1.35	1.31	2.11
	2:50:00	0.00	0.00	0.48	0.58	0.79	0.78	1.01	0.98	1.57
	2:55:00	0.00	0.00	0.35	0.42	0.56	0.56	0.72	0.70	1.11
	3:00:00	0.00	0.00	0.23	0.28	0.38	0.38	0.48	0.46	0.72
	3:05:00	0.00	0.00	0.15	0.18	0.23	0.23	0.29	0.27	0.42
	3:10:00	0.00	0.00	0.08	0.10	0.12	0.12	0.15	0.13	0.20
	3:15:00	0.00	0.00	0.03	0.05	0.05	0.04	0.05	0.04	0.06
	3:20:00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00
	3:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

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

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

Stage - Storage Description	Stage [ft]	Area [ft^2]	Area [acres]	Volume [ft^3]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	0	0.000	0	0.000	0.00
	0.50	756	0.017	186	0.004	0.25
	1.00	5,011	0.115	1,365	0.031	0.35
	1.50	15,327	0.352	6,244	0.143	0.43
	2.00	28,555	0.656	17,196	0.395	0.50
	2.50	42,109	0.967	34,848	0.800	0.55
	3.00	55,940	1.284	59,333	1.362	0.61
	3.50	70,226	1.612	90,782	2.084	0.96
	4.00	83,709	1.922	129,472	2.972	4.05
	4.50	92,563	2.125	173,704	3.988	7.29
	5.00	97,643	2.242	221,394	5.083	15.66
	5.50	101,353	2.327	271,142	6.225	40.84
	6.00	105,092	2.413	322,752	7.409	78.49
	6.50	108,858	2.499	376,239	8.637	119.62
	7.00	112,652	2.586	431,615	9.909	125.24
	7.50	116,472	2.674	488,895	11.223	130.62
	8.00	120,322	2.762	548,092	12.582	135.79
	8.50	124,198	2.851	609,221	13.986	140.77
	9.00	128,102	2.941	672,295	15.434	190.91
	9.50	132,034	3.031	737,328	16.927	351.07

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

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

MILE HIGH FLOOD DISTRICT

DETENTION BASIN DESIGN WORKBOOK

MHFD-Detention, Version 4.04 (February 2021)
Mile High Flood District
Denver, Colorado
www.mhfd.org

Purpose:

This workbook aids in the estimation of stormwater detention basin sizing and outlet routing based on the modified puls routing method for urban watersheds. Several different BMP types and various outlet configurations can be sized.

Function:

1. Approximates the stage-area-volume relationship for a detention basin based on watershed parameters and basin geometry parameters. Also evaluates existing user-defined basin stage-area relationships.

2. Sizes filtration media orifice, outlet orifices, elliptical slots, weirs, trash racks, and develops stage-discharge relationships. Uses the Modified Puls method to route a series of hydrographs (i.e., 2-, 5-, 10-, 25-, 50-, 100- and 500-year) and calibrates the peak discharge out of the basin to match the pre-development peak discharges for the watershed.

Content: **This workbook consists of the following sheets:**

Basin	Tabulates stage-area-volume relationship estimates based on watershed parameters
Outlet Structure	Tabulates a stage-discharge relationship for the user-defined outlet structure (inlet control).
Reference	Provides reference equations and figures.
User Tips and Tools	Provides instructions and video links to assist in using this workbook. Includes a stage-area calculator.
BMP Zone Images	Provides images of typical BMP zone confirgurations corresponding with Zone pulldown selections.

Acknowledgements: ***Spreadsheet Development Team:***
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Peak Stormwater Engineering, LLC

Dr. James C.Y. Guo, Ph.D., P.E.
Professor, Department of Civil Engineering, University of Colorado at Denver

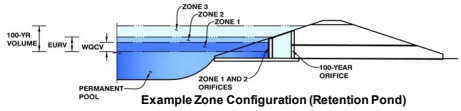
Comments? Direct all comments regarding this spreadsheet workbook to: **MHFD E-Mail**
Revisions? Check for revised versions of this or any other workbook at: **Downloads**

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.04 (February 2021)

Project: Kings Point Filing 1

Basin ID: Pond D1 (Stage 0.00 = 5735.50', EURV increased from 5.920 ac -ft to 6.214 ac-ft for overdetention, 100-yr increased by 0.103 ac-ft for overdetention)



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	115.10	acres
Watershed Length =	5,913	ft
Watershed Length to Centroid =	2,023	ft
Watershed Slope =	0.036	ft/ft
Watershed Imperviousness =	48.50%	percent
Percentage Hydrologic Soil Group A =	0.0%	percent
Percentage Hydrologic Soil Group B =	95.2%	percent
Percentage Hydrologic Soil Groups C/D =	4.8%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

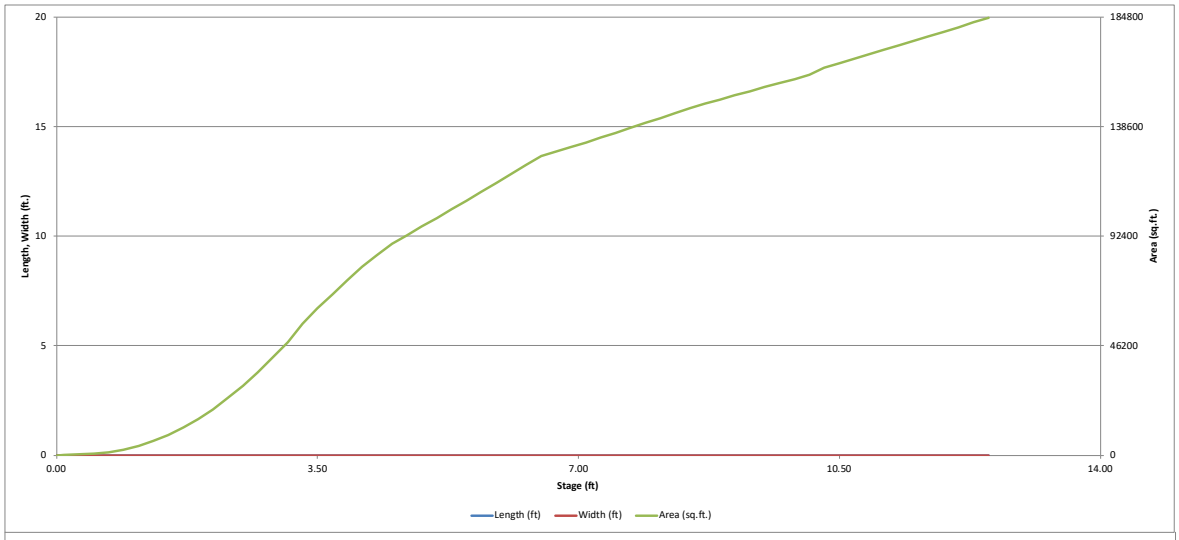
			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	2.137	acre-feet	2.137	acre-feet
Excess Urban Runoff Volume (EURV) =	6.214	acre-feet	6.214	acre-feet
2-yr Runoff Volume (P1 = 0.84 in.) =	3.457	acre-feet	0.84	inches
5-yr Runoff Volume (P1 = 1.11 in.) =	4.938	acre-feet	1.11	inches
10-yr Runoff Volume (P1 = 1.36 in.) =	6.926	acre-feet	1.36	inches
25-yr Runoff Volume (P1 = 1.73 in.) =	10.873	acre-feet	1.73	inches
50-yr Runoff Volume (P1 = 2.03 in.) =	13.719	acre-feet	2.03	inches
100-yr Runoff Volume (P1 = 2.35 in.) =	17.263	acre-feet	2.35	inches
500-yr Runoff Volume (P1 = 3.18 in.) =	25.543	acre-feet	3.18	inches
Approximate 2-yr Detention Volume =	3.166	acre-feet		
Approximate 5-yr Detention Volume =	4.582	acre-feet		
Approximate 10-yr Detention Volume =	6.356	acre-feet		
Approximate 25-yr Detention Volume =	7.759	acre-feet		
Approximate 50-yr Detention Volume =	8.461	acre-feet		
Approximate 100-yr Detention Volume =	9.806	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	2.137	acre-feet
Zone 2 Volume (EURV - Zone 1) =	4.077	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	3.592	acre-feet
Total Detention Basin Volume =	9.806	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	0	0.000		
	--	0.10	--	--	--	109	0.003	5	0.000
	--	0.30	--	--	--	330	0.008	49	0.001
	--	0.50	--	--	--	554	0.013	138	0.003
	--	0.70	--	--	--	1,078	0.025	301	0.007
	--	0.90	--	--	--	2,165	0.050	625	0.014
	--	1.10	--	--	--	3,798	0.087	1,221	0.028
	--	1.30	--	--	--	5,928	0.136	2,194	0.050
	--	1.50	--	--	--	8,530	0.196	3,640	0.084
	--	1.70	--	--	--	11,607	0.266	5,653	0.130
	--	1.90	--	--	--	15,185	0.349	8,333	0.191
	--	2.10	--	--	--	19,323	0.444	11,783	0.271
	--	2.30	--	--	--	24,067	0.553	16,122	0.370
	--	2.50	--	--	--	29,249	0.671	21,454	0.493
	--	2.70	--	--	--	34,979	0.803	27,877	0.640
	--	2.90	--	--	--	41,252	0.947	35,500	0.815
	--	3.10	--	--	--	47,654	1.094	44,391	1.019
	--	3.30	--	--	--	55,476	1.274	54,704	1.256
	--	3.50	--	--	--	61,778	1.418	66,429	1.525
	--	3.70	--	--	--	67,890	1.559	79,396	1.823
	--	3.90	--	--	--	73,850	1.695	93,570	2.148
	--	4.10	--	--	--	79,339	1.821	108,889	2.500
	--	4.30	--	--	--	84,433	1.938	125,266	2.876
	--	4.50	--	--	--	89,273	2.049	142,636	3.274
	--	4.70	--	--	--	92,806	2.131	160,844	3.692
	--	4.90	--	--	--	96,382	2.213	179,763	4.127
	--	5.10	--	--	--	100,040	2.297	199,405	4.578
	--	5.30	--	--	--	103,698	2.381	219,779	5.045
	--	5.50	--	--	--	107,382	2.465	240,887	5.530
	--	5.70	--	--	--	111,096	2.550	262,735	6.032
	--	5.90	--	--	--	114,823	2.636	285,327	6.550
	--	6.10	--	--	--	118,537	2.721	308,663	7.086
	--	6.30	--	--	--	122,273	2.807	332,744	7.639
	--	6.50	--	--	--	126,044	2.894	357,575	8.209
	--	6.70	--	--	--	128,001	2.939	382,980	8.792
	--	6.90	--	--	--	129,977	2.984	408,778	9.384
	--	7.10	--	--	--	131,971	3.030	434,973	9.986
	--	7.30	--	--	--	133,984	3.076	461,568	10.596
	--	7.50	--	--	--	136,015	3.122	488,568	11.216
	--	7.70	--	--	--	138,064	3.170	515,976	11.845
	--	7.90	--	--	--	140,132	3.217	543,795	12.484
	--	8.10	--	--	--	142,218	3.265	572,030	13.132
	--	8.30	--	--	--	144,322	3.313	600,684	13.790
	--	8.50	--	--	--	146,445	3.362	629,761	14.457
	--	8.70	--	--	--	148,204	3.402	659,226	15.134
	--	8.90	--	--	--	149,968	3.443	689,043	15.818
	--	9.10	--	--	--	151,732	3.483	719,213	16.511
	--	9.30	--	--	--	153,499	3.524	749,736	17.212
	--	9.50	--	--	--	155,208	3.563	780,607	17.920
	--	9.70	--	--	--	156,866	3.601	811,814	18.637
	--	9.90	--	--	--	158,526	3.639	843,353	19.361
	--	10.10	--	--	--	160,561	3.686	875,262	20.093
	--	10.30	--	--	--	163,346	3.750	907,653	20.837
	--	10.50	--	--	--	165,319	3.795	940,519	21.591
	--	10.70	--	--	--	167,184	3.838	973,770	22.355
	--	10.90	--	--	--	169,060	3.881	1,007,394	23.127
	--	11.10	--	--	--	170,947	3.924	1,041,395	23.907
	--	11.30	--	--	--	172,844	3.968	1,075,774	24.696
	--	11.50	--	--	--	174,751	4.012	1,110,533	25.494
	--	11.70	--	--	--	176,668	4.056	1,145,675	26.301
	--	11.90	--	--	--	178,596	4.100	1,181,201	27.117
	--	12.10	--	--	--	180,534	4.144	1,217,114	27.941
	--	12.30	--	--	--	182,482	4.189	1,253,416	28.774
	--	12.50	--	--	--	184,491	4.235	1,290,114	29.617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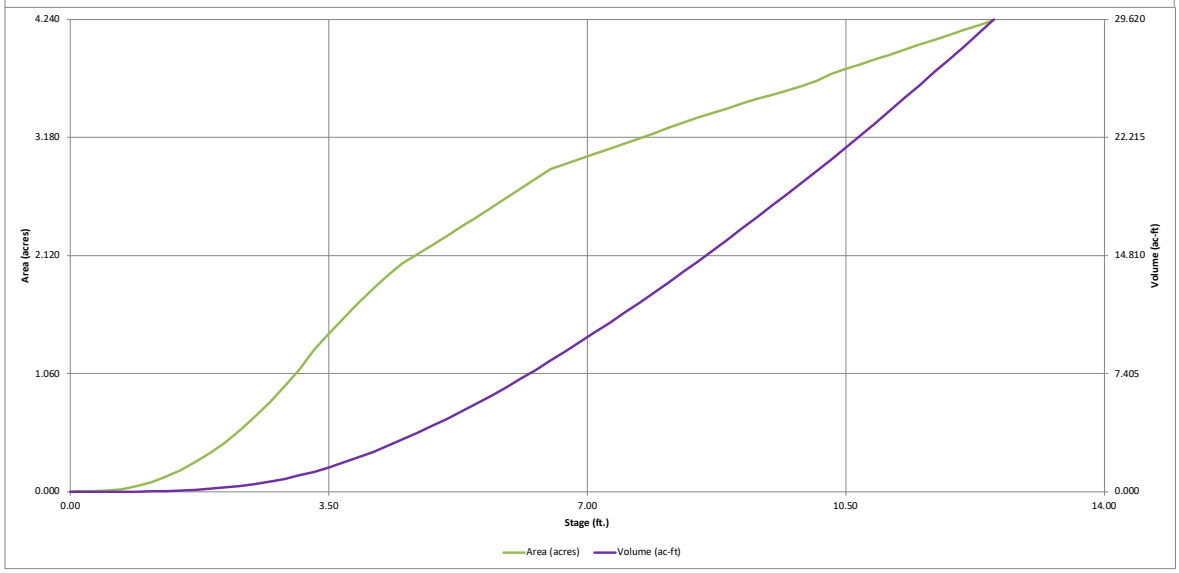
Length (ft)
Width (ft)
Area (sq.ft.)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Volume (ac-ft)
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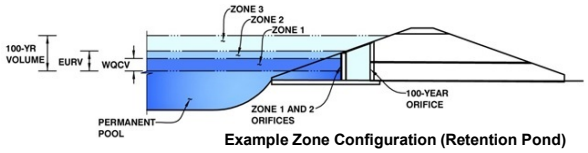
3.50
7.00
10.50
14.00
Stage (ft.)
Area (acres)
Volume (ac-ft)

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Project: Kings Point Filing 1

Basin ID: Pond D1 (Stage 0.00 = 5735.50', EURV increased from 5.920 ac -ft to 6.214 ac-ft for overdetention, 100-yr increased by 0.103 ac-ft for overdetention)



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	3.90	2.137	Orifice Plate
Zone 2 (EURV)	5.78	4.077	Rectangular Orifice
Zone 3 (100-year)	7.05	3.592	Weir&Pipe (Restrict)
Total (all zones)		9.806	

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

Underdrain Orifice Invert Depth =	N/A	ft (distance below the filtration media surface)	Underdrain Orifice Area =	N/A	ft²
Underdrain Orifice Diameter =	N/A	inches	Underdrain Orifice Centroid =	N/A	feet

Calculated Parameters for Underdrain

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

Invert of Lowest Orifice =	0.00	ft (relative to basin bottom at Stage = 0 ft)	WQ Orifice Area per Row =	7.861E-02	ft²
Depth at top of Zone using Orifice Plate =	3.90	ft (relative to basin bottom at Stage = 0 ft)	Elliptical Half-Width =	N/A	feet
Orifice Plate: Orifice Vertical Spacing =	15.10	inches	Elliptical Slot Centroid =	N/A	feet
Orifice Plate: Orifice Area per Row =	11.32	sq. inches (use rectangular openings)	Elliptical Slot Area =	N/A	ft²

Calculated Parameters for Plate

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							
Orifice Area (sq. inches)	11.32							

	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)

	Zone 2 Rectangular	Not Selected			Zone 2 Rectangular	Not Selected	
Invert of Vertical Orifice =	3.90	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Area =	1.93	N/A	ft²
Depth at top of Zone using Vertical Orifice =	5.60	N/A	ft (relative to basin bottom at Stage = 0 ft)	Vertical Orifice Centroid =	0.42	N/A	feet
Vertical Orifice Height =	10.00	N/A	inches				
Vertical Orifice Width =	27.75		inches	28.4			

Calculated Parameters for Vertical Orifice

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected			Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	5.78	N/A	ft (relative to basin bottom at Stage = 0 ft)	Height of Grate Upper Edge, H_t =	7.28	N/A	feet
Overflow Weir Front Edge Length =	25.00	N/A	feet	Overflow Weir Slope Length =	6.18	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V	Grate Open Area / 100-yr Orifice Area =	13.90	N/A	
Horiz. Length of Weir Sides =	6.00	N/A	feet	Overflow Grate Open Area w/o Debris =	107.61	N/A	ft²
Overflow Grate Type =	Type C Grate	N/A		Overflow Grate Open Area w/ Debris =	107.61	N/A	ft²
Debris Clogging % =	0%	N/A	%				

Calculated Parameters for Overflow Weir

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

	Zone 3 Restrictor	Not Selected			Zone 3 Restrictor	Not Selected	
Depth to Invert of Outlet Pipe =	0.25	N/A	ft (distance below basin bottom at Stage = 0 ft)	Outlet Orifice Area =	7.74	N/A	ft²
Outlet Pipe Diameter =	48.00	N/A	inches	Outlet Orifice Centroid =	1.35	N/A	feet
Restrictor Plate Height Above Pipe Invert =	28.40		inches	Half-Central Angle of Restrictor Plate on Pipe =	1.76	N/A	radians

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage=	9.20	ft (relative to basin bottom at Stage = 0 ft)	Spillway Design Flow Depth=	0.97	feet
Spillway Crest Length =	74.00	feet	Stage at Top of Freeboard =	10.17	feet
Spillway End Slopes =	4.00	H:V	Basin Area at Top of Freeboard =	3.71	acres
Freeboard above Max Water Surface =	0.00	feet	Basin Volume at Top of Freeboard =	20.35	acre-ft

Calculated Parameters for Spillway

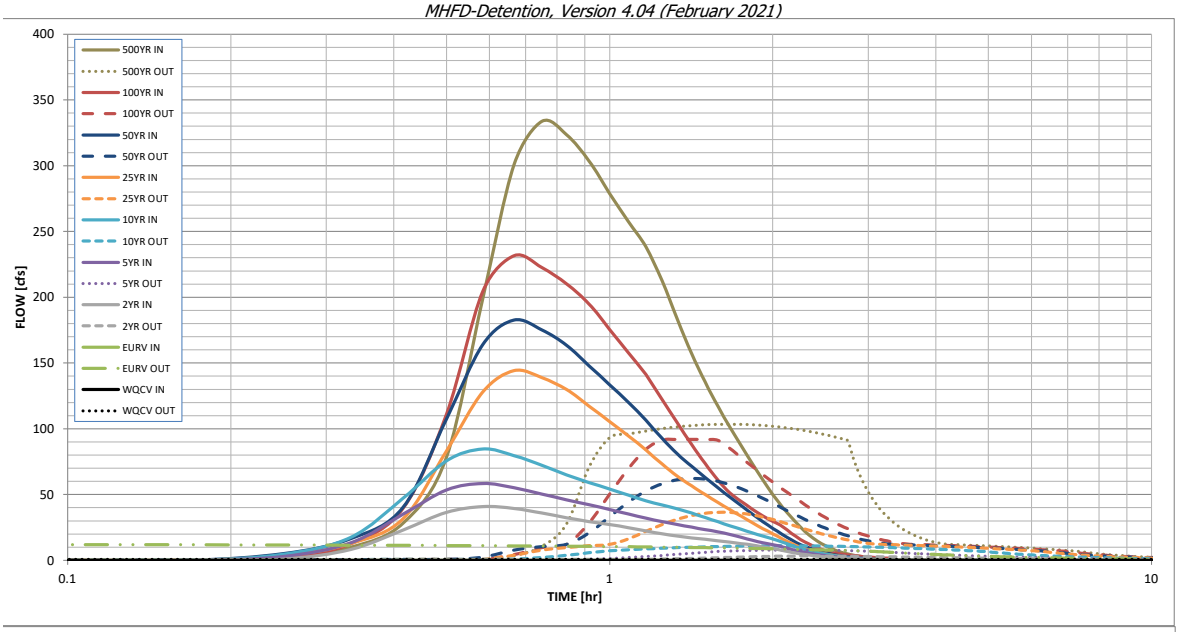
Routed Hydrograph Results

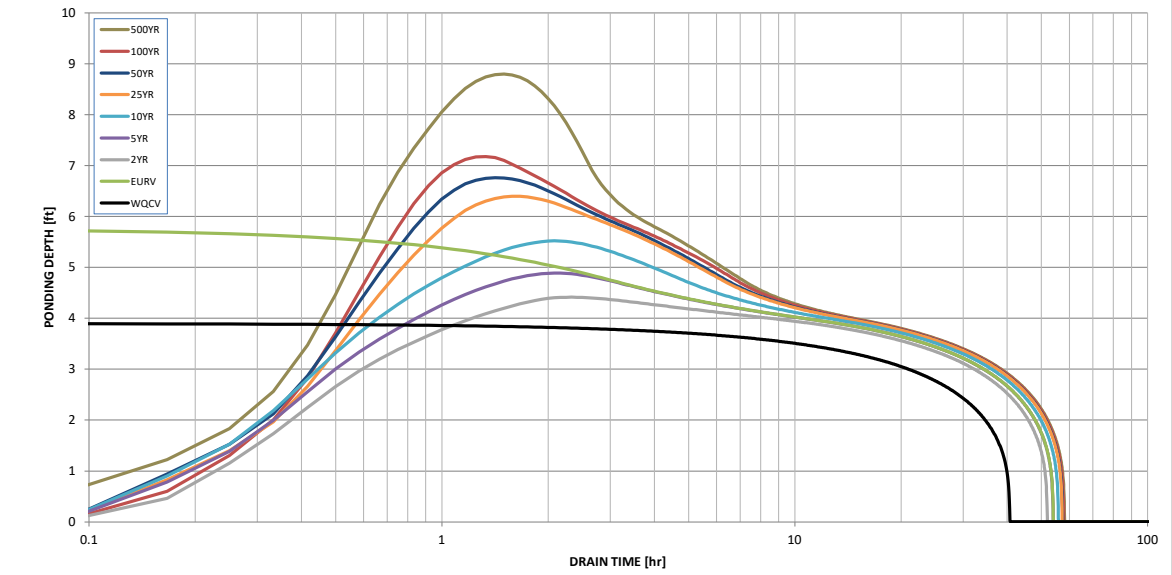
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

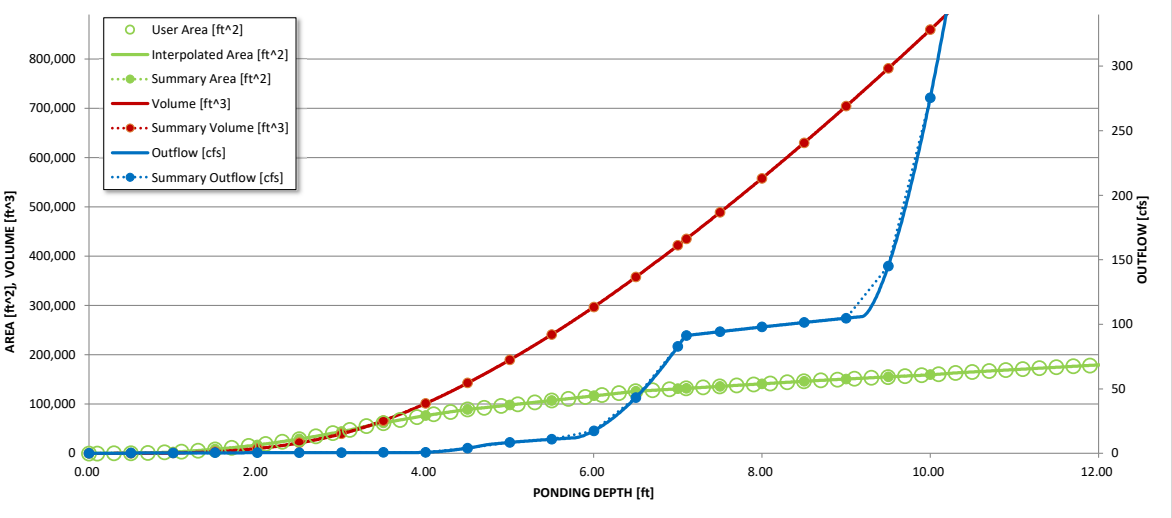
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.84	1.11	1.36	1.73	2.03	2.35	3.18
CUHP Runoff Volume (acre-ft) =	2.137	6.214	3.457	4.938	6.926	10.873	13.719	17.263	25.543
User Override Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	3.457	4.938	6.926	10.873	13.719	17.252	25.543
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.8	1.6	15.4	54.2	77.2	108.0	172.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.13	0.47	0.67	0.94	1.50
Peak Inflow Q (cfs) =	N/A	N/A	40.9	58.5	84.6	144.1	182.6	231.7	333.7
Peak Outflow Q (cfs) =	0.7	12.0	3.3	7.8	11.1	36.5	62.3	91.9	103.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	5.0	0.7	0.7	0.8	0.9	0.6
Structure Controlling Flow =	Vertical Orifice 1	Overflow Weir 1	Vertical Orifice 1	Vertical Orifice 1	Vertical Orifice 1	Overflow Weir 1	Overflow Weir 1	Outlet Plate 1	Outlet Plate 1
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.2	0.4	0.7	0.8
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) =	39	49	49	50	50	49	48	46	41
Time to Drain 99% of Inflow Volume (hours) =	**40**	52	51	52	54	54	54	53	52
Maximum Ponding Depth (ft) =	3.90	5.78	4.41	4.89	5.52	6.39	6.76	7.18	8.80
Area at Maximum Ponding Depth (acres) =	1.70	2.58	2.00	2.20	2.47	2.85	2.95	3.05	3.42
Maximum Volume Stored (acre-ft) =	2.148	6.237	3.092	4.083	5.555	7.893	8.969	10.198	15.441

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)







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

DETENTION BASIN OUTLET STRUCTURE DESIGN

Outflow Hydrograph Workbook Filename:

Inflow Hydrographs

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

	SOURCE	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	CUHP	USER	CUHP
Time Interval	TIME	WQCV [cfs]	EURV [cfs]	2 Year [cfs]	5 Year [cfs]	10 Year [cfs]	25 Year [cfs]	50 Year [cfs]	100 Year [cfs]	500 Year [cfs]
5.00 min	0:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41
	0:15:00	0.00	0.00	1.04	3.01	4.52	3.56	5.08	1.64	9.84
	0:20:00	0.00	0.00	8.33	13.38	17.60	12.77	16.47	12.54	28.43
	0:25:00	0.00	0.00	23.17	35.23	47.34	31.74	40.55	39.77	78.44
	0:30:00	0.00	0.00	36.54	53.50	75.64	83.16	107.55	111.18	198.79
	0:35:00	0.00	0.00	40.92	58.48	84.63	127.87	163.85	204.40	300.89
	0:40:00	0.00	0.00	39.40	55.12	79.64	144.12	182.62	231.65	333.70
	0:45:00	0.00	0.00	35.88	50.30	72.12	138.90	175.06	222.50	323.54
	0:50:00	0.00	0.00	32.37	45.94	65.00	129.80	163.44	210.22	303.60
	0:55:00	0.00	0.00	29.49	42.20	59.15	117.31	147.93	194.89	279.12
	1:00:00	0.00	0.00	27.16	38.66	54.21	105.51	133.52	175.71	257.51
	1:05:00	0.00	0.00	24.90	35.18	49.53	94.70	120.26	157.76	238.46
	1:10:00	0.00	0.00	22.39	32.09	45.24	83.93	106.55	141.23	212.44
	1:15:00	0.00	0.00	20.08	29.40	41.99	73.14	92.60	122.08	183.28
	1:20:00	0.00	0.00	18.37	27.16	39.17	63.95	80.91	104.57	157.20
	1:25:00	0.00	0.00	17.08	25.16	35.91	56.56	71.56	88.06	135.61
	1:30:00	0.00	0.00	15.93	23.35	32.48	49.99	63.09	73.66	117.13
	1:35:00	0.00	0.00	14.86	21.65	29.29	44.04	55.31	61.10	101.38
	1:40:00	0.00	0.00	13.79	19.62	26.34	38.55	48.14	51.34	86.97
	1:45:00	0.00	0.00	12.73	17.38	23.52	33.46	41.48	44.73	73.61
	1:50:00	0.00	0.00	11.67	15.22	20.87	28.61	35.21	38.97	61.22
	1:55:00	0.00	0.00	10.27	13.38	18.41	24.14	29.45	33.70	50.04
	2:00:00	0.00	0.00	8.88	11.93	16.28	20.21	24.42	29.77	40.60
	2:05:00	0.00	0.00	7.44	10.23	13.84	16.34	19.72	25.80	32.49
	2:10:00	0.00	0.00	6.08	8.36	11.31	12.79	15.42	20.51	25.19
	2:15:00	0.00	0.00	4.91	6.72	9.12	9.94	11.97	15.85	19.20
	2:20:00	0.00	0.00	4.00	5.42	7.37	7.81	9.37	12.30	14.66
	2:25:00	0.00	0.00	3.23	4.36	5.91	6.14	7.34	9.50	11.11
	2:30:00	0.00	0.00	2.60	3.51	4.71	4.84	5.74	7.36	8.37
	2:35:00	0.00	0.00	2.07	2.78	3.69	3.76	4.44	5.87	6.26
	2:40:00	0.00	0.00	1.64	2.17	2.86	2.91	3.42	4.91	4.79
	2:45:00	0.00	0.00	1.30	1.68	2.21	2.24	2.62	4.16	3.68
	2:50:00	0.00	0.00	1.03	1.31	1.72	1.75	2.04	3.53	2.91
	2:55:00	0.00	0.00	0.80	1.00	1.34	1.36	1.58	2.99	2.27
	3:00:00	0.00	0.00	0.60	0.75	1.01	1.03	1.20	2.54	1.71
	3:05:00	0.00	0.00	0.43	0.53	0.72	0.75	0.87	2.18	1.23
	3:10:00	0.00	0.00	0.28	0.36	0.49	0.52	0.59	1.88	0.83
	3:15:00	0.00	0.00	0.17	0.23	0.30	0.32	0.37	1.65	0.50
	3:20:00	0.00	0.00	0.09	0.13	0.16	0.18	0.20	1.49	0.26
	3:25:00	0.00	0.00	0.04	0.06	0.06	0.07	0.08	1.36	0.09
	3:30:00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	1.26	0.01
	3:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.16	0.00
	3:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00
	3:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.01	0.00
	3:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00
	3:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.00
	4:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.00
	4:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00
	4:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00
	4:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.97	0.00
	4:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00
	4:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00
	4:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00
	4:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00
	4:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00
	4:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00
	4:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00
	4:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00
	5:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00
	5:05:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92	0.00
	5:10:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.00
	5:15:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.91	0.00
	5:20:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00
	5:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.90	0.00
	5:30:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00
	5:35:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00
	5:40:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00
	5:45:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.88	0.00
	5:50:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.87	0.00
	5:55:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00
	6:00:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.86	0.00

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.04 (February 2021)

Summary Stage-Area-Volume-Discharge Relationships

The user can create a summary S-A-V-D by entering the desired stage increments and the remainder of the table will populate automatically.
The user should graphically compare the summary S-A-V-D table to the full S-A-V-D table in the chart to confirm it captures all key transition points.

Stage - Storage Description	Stage [ft]	Area [ft²]	Area [acres]	Volume [ft³]	Volume [ac-ft]	Total Outflow [cfs]
	0.00	0	0.000	0	0.000	0.00
	0.50	554	0.013	138	0.003	0.27
	1.00	2,981	0.068	882	0.020	0.38
	1.50	8,530	0.196	3,640	0.084	0.46
	2.00	17,254	0.396	9,954	0.229	0.54
	2.50	29,249	0.671	21,454	0.493	0.60
	3.00	44,453	1.021	39,785	0.913	0.66
	3.50	61,778	1.418	66,429	1.525	0.71
	4.00	76,594	1.758	101,092	2.321	0.89
	4.50	89,273	2.049	142,636	3.274	4.11
	5.00	98,211	2.255	189,493	4.350	8.52
	5.50	107,382	2.465	240,887	5.530	10.98
	6.00	116,680	2.679	296,902	6.816	17.51
	6.50	126,044	2.894	357,575	8.209	43.22
	7.00	130,974	3.007	421,825	9.684	82.86
	7.10	131,971	3.030	434,973	9.986	91.34
	7.50	136,015	3.122	488,568	11.216	94.33
	8.00	141,175	3.241	557,861	12.807	97.95
	8.50	146,445	3.362	629,761	14.457	101.43
	9.00	150,850	3.463	704,084	16.164	104.80
	9.50	155,208	3.563	780,607	17.920	145.02
	10.00	159,543	3.663	859,257	19.726	275.58

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

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

Kings Point Filing 1 - Pond C4 Basins - Allowable Street/Gutter Flow Calculations

Design Point	Inlet ID	Street Name	Street Classification	Street Grade (%)	Calculated Flowrates		Allowable Flowrates[1]		Remarks
					Q_2 - Half Street (cfs)	Q_{100} - Half Street (cfs)	Q_2- Half Street (cfs)	Q_{100} - Half Street (cfs)	
9C		E Kings Point Drive	Collector 2-Lane Alt	2.6% into sump	0.7	1.9	13.0	94	10' and 15' Type R Inlet
10C		E Kings Point Drive	Collector 2-Lane Alt	2.6% into sump	2.7	9.3	13.0	94	10' and 15' Type R Inlet

Notes:
1. Allowable flowrates based upon COACM, Figures 4A and 4B.

Figure 4A and 4B Assumptions
1. 2% Slope from top of curb to ROW and 10% slope beyond ROW.
2. Mannings n = 0.016 for asphalt, 0.013 for concrete, 0.035 for landscaped areas.
3. Flows are computed with Haestad's Flowmaster program using the Cox Method for weighting Manning's n roughness coefficients.
4. Flows are computed for regular standard street cross sections with leveled flowlines.

Kings Point Filing 1 - Pond C1 Basins - Allowable Street/Gutter Flow Calculations

Design Point	Inlet ID	Street Name	Street Classification	Street Grade (%)	Calculated Flowrates		Allowable Flowrates[1]		Remarks
					Q_2 - Half Street (cfs)	Q_{100} - Half Street (cfs)	Q_2- Half Street (cfs)	Q_{100} - Half Street (cfs)	
11C		E Kings Point Drive	Collector 2-Lane Alt	2% into Sump	7.1	22.9	13.1	101.5	15' Type R Inlet
12C		E Kings Point Drive	Collector 2-Lane Alt	2% into Sump	2.3	6.8	13.1	101.5	10' Type R Inlet

Notes:
1. Allowable flowrates based upon COACM, Figures 4A and 4B.

Figure 4A and 4B Assumptions
1. 2% Slope from top of curb to ROW and 10% slope beyond ROW.
2. Mannings n = 0.016 for asphalt, 0.013 for concrete, 0.035 for landscaped areas.
3. Flows are computed with Haestad's Flowmaster program using the Cox Method for weighting Manning's n roughness coefficients.
4. Flows are computed for regular standard street cross sections with leveled flowlines.

Kings Point Filing 1 - Allowable Street/Gutter Flow Calculations
Basins Tributary to Detention Pond D1

Design Point	Inlet ID	Street Name	Street Classification	Street Grade (%)	Calculated Flowrates		Allowable Flowrates[1]		Remarks
					Q_2 - Half Street (cfs)	Q_{100} (cfs)	Q_2 - Half Street (cfs)	Q_{100} - Half Street (cfs)	
1D	KP-INLET-19	Aurora Parkway	4 Lane Arterial - Raised Med	2.0	2.3	6.6	16.2	131	5' Type R Inlet
2D	KP-INLET-18	Aurora Parkway	4 Lane Arterial - Raised Med	4.8	2.2	6.2	12.5	98.5	5' Type R Inlet
3D	KP-INLET-17	Aurora Parkway	4 Lane Arterial - Raised Med	4.8	5.4	16.4	12.5	98.5	10' Type R Inlet
4D	KP-INLET-15	Aurora Parkway	4 Lane Arterial - Raised Med	2.0	6.4	21.6	16.2	131	15' Type R Inlet
5D	KP-INLET-16	Aurora Parkway	4 Lane Arterial - Raised Med	2.0	1.4	4.0	16.2	131	15' Type R Inlet
6D	KP-INLET-20	Kings Point Drive	Alt 2 Lane Collector	4.0% into Sump	4.8	16.3	11.0	97	15' Type R Inlet
7D	KP-INLET-32	Kings Point Drive	Alt 2 Lane Collector	4.0% into Sump	3.4	10.6	11.0	97	5' Type R Inlet
8D	KP-INLET-14	Aurora Parkway	4 Lane Arterial - Raised Med	3.3	2.6	7.6	14.4	110	5' Type R Inlet
11D	KP-INLET-23	Aurora Parkway	4 Lane Arterial - Raised Med	4.0	6.1	20.7	13.5	106	10' Type R Inlet
12D	KP-INLET-11	Aurora Parkway	4 Lane Arterial - Raised Med	4.3	2.9	8.8	13.1	103	5' Type R Inlet
13D	KP-INLET-10	Aurora Parkway	4 Lane Arterial - Raised Med	3.5	1.1	3.4	14.4	109.5	10' Type R Inlet
14D	KP-INLET-36	Aurora Parkway	4 Lane Arterial - Raised Med	2.7	1.6	5.2	14.9	114.5	10' Type R Inlet
15D	KP-INLET-08	Aurora Parkway	4 Lane Arterial - Raised Med	4.2	1.9	6.7	13.5	106	15' Type R Inlet
16D	KP-INLET-07	Aurora Parkway	4 Lane Arterial - Raised Med	4.7	4.0	12.7	12.5	98.5	15' Type R Inlet
17D	KP-INLET-04	Aurora Parkway	6 Lane Arterial - Raised Med	5.0	4.4	16.9	12.5	99.5	15' Type R Inlet
18D	KP-INLET-03	Aurora Parkway	6 Lane Arterial - Raised Med	5.3	2.9	9.2	12.4	96.5	15' Type R Inlet
19D	KP-INLET-01	Aurora Parkway	6 Lane Arterial - Raised Med	4.9	2.5	9.1	12.5	99.5	15' Type R Inlet
20D	KP-INLET-02	Aurora Parkway	6 Lane Arterial - Raised Med	4.6	1.5	4.9	13.1	219	15' Type R Inlet

Notes:
1. Allowable flowrates based upon COACM, Figures 4A and 4B. Neareast 0.5% used.

Figure 4A and 4B Assumptions
1. 2% Slope from top of curb to ROW and 10% slope beyond ROW.
2. Mannings n = 0.016 for asphalt, 0.013 for concrete, 0.035 for landscaped areas.
3. Flows are computed with Haestad's Flowmaster program using the Cox Method for weighting Manning's n roughness coefficients
4. Flows are computed for regular standard street cross sections with leveled flowlines.

Parker Road - Allowable Street/Gutter Flow Calculations

Design Point	Inlet ID	Street Name	Street Classification	Street Grade (%)	Calculated Flowrates		Allowable Flowrates[1]		Remarks
					Q_2 - Half Street (cfs)	Q_{100} - Half Street (cfs)	Q_2- Half Street (cfs)	Q_{100} - Half Street (cfs)	
23D	KP-INLET-34	Aurora Parkway	6 Lane Arterial - Raised Med	1.0% into Sump	8.8	39.3	11.5	111	15' Type R
24D	KP-INLET05	Aurora Parkway	6 Lane Arterial - Raised Med	1.0% into Sump	2.9	8.7	11.5	111	10' Type R

Notes:
1. Allowable flowrates based upon COACM, Figures 4A and 4B. Neareast 0.5% used.

Figure 4A and 4B Assumptions
1. 2% Slope from top of curb to ROW and 10% slope beyond ROW.
2. Mannings n = 0.016 for asphalt, 0.013 for concrete, 0.035 for landscaped areas.
3. Flows are computed with Haestad's Flowmaster program using the Cox Method for weighting Manning's n roughness coefficients
4. Flows are computed for regular standard street cross sections with leveled flowlines.

DRAINGE REPORT
for
KINGS POINT FILING NO. 1 - INFRASTRUCTURE

APPENDIX C
Graphs, Tables and Nomographs

TABLE 1
RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
Business:					
Commercial Areas	95	.87	.87	.88	.89
Neighborhood Areas	85	.60	.65	.70	.80
Residential:					
Single-Family (**)	(*)	.40	.45	.50	.60
Multi-Unit (detached)	60	.45	.50	.60	.70
Multi-Unit (attached)	75	.60	.65	.70	.80
1/2 Acre Lot or Larger	(*)	.30	.35	.40	.60
Apartments	80	.65	.70	.70	.80
Industrial:					
Light Areas	80	.71	.72	.76	.82
Heavy Areas	90	.80	.80	.85	.90
Parks, Cemeteries	5	.10	.10	.35	.60
Playgrounds	10	.15	.25	.35	.65
Schools	50	.45	.50	.60	.70
Railroad Yard Areas	15	.40	.45	.50	.60
Undeveloped Areas:					
Historic Flow Analysis, Greenbelts, Agricultural	2	(See "Lawns")			
Off-Site Flow Analysis (when land use not defined)	45	.43	.47	.55	.65

TABLE 1 (continued)

RUNOFF COEFFICIENTS AND PERCENTS IMPERVIOUS

LAND USE OR SURFACE CHARACTERISTICS	PERCENT IMPERVIOUS	FREQUENCY			
		2	5	10	100
Streets:					
Paved	100	.87	.88	.90	.93
Gravel	40	.15	.25	.35	.65
Concrete Drive and Walks	96	.87	.87	.88	.89
Roofs	90	.80	.85	.90	.90
Lawns, Sandy Soil (A and B Soils):	2				
2% Slope		.05	.06	.08	.10
2-7% Slope		.10	.11	.13	.15
>7% Slope		.15	.16	.18	.20
Lawns, Clay Soil (C and D Soils):	5				
2% Slope		.13	.14	.15	.17
2-7% Slope		.18	.19	.20	.22
>7% Slope		.25	.27	.30	.35

NOTE: These Rational Formula coefficients may not be valid for large basins

(*)See Figures *RO-3 through RO-5* of USDCM Volume 1 for percent impervious.

(**)Up to 5 units per acre. Single-family with more than 5 units per acre, use values for multi-unit/detached

.

Appendix C

Table 6-3. Recommended percentage imperviousness values

Land Use or Surface Characteristics	Percentage Imperviousness (%)
Business:	
Downtown Areas	95
Suburban Areas	75
Residential:	
Single-family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial:	
Light areas	80
Heavy areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
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	2
Lawns, clayey soil	2

Appendix C3

2.4.1 Initial or Overland Flow Time

The initial or overland flow time, t_i, may be calculated using Equation 6-3:

$$t_i = \frac{0.395(1.1 - C_5)\sqrt{L}}{S_o^{0.33}} \qquad \text{Equation 6-3}$$

Where:

t_i = overland (initial) flow time (minutes)
C_5 = runoff coefficient for 5-year frequency (from Table 6-4)
L = length of overland flow (ft)
S_o = average slope along the overland flow path (ft/ft).

Equation 6-3 is adequate for distances up to 300 feet in urban areas and 500 feet in rural areas. Note that in a highly urbanized catchment, the overland flow length is typically shorter than 300 feet due to effective man-made drainage systems that collect and convey runoff.

2.4.2 Channelized Flow Time

The channelized flow time (travel time) is calculated using the hydraulic properties of the conveyance element. The channelized flow time, t_t, is estimated by dividing the length of conveyance by the velocity. The following equation, Equation 6-4 (Guo 2013), can be used to determine the flow velocity in conjunction with Table 6-2 for the conveyance factor.

$$t_t = \frac{L_t}{60K\sqrt{S_o}} = \frac{L_t}{60V_t} \qquad \text{Equation 6-4}$$

Where:

t_t = channelized flow time (travel time, min)
L_t = waterway length (ft)
S_o = waterway slope (ft/ft)
V_t = travel time velocity (ft/sec) = $K\sqrt{S_o}$
K = NRCS conveyance factor (see Table 6-2).

Table 6-2. NRCS Conveyance factors, K

Type of Land Surface	Conveyance Factor, K
Heavy meadow	2.5
Tillage/field	5
Short pasture and lawns	7
Nearly bare ground	10
Grassed waterway	15
Paved areas and shallow paved swales	20

Appendix C4

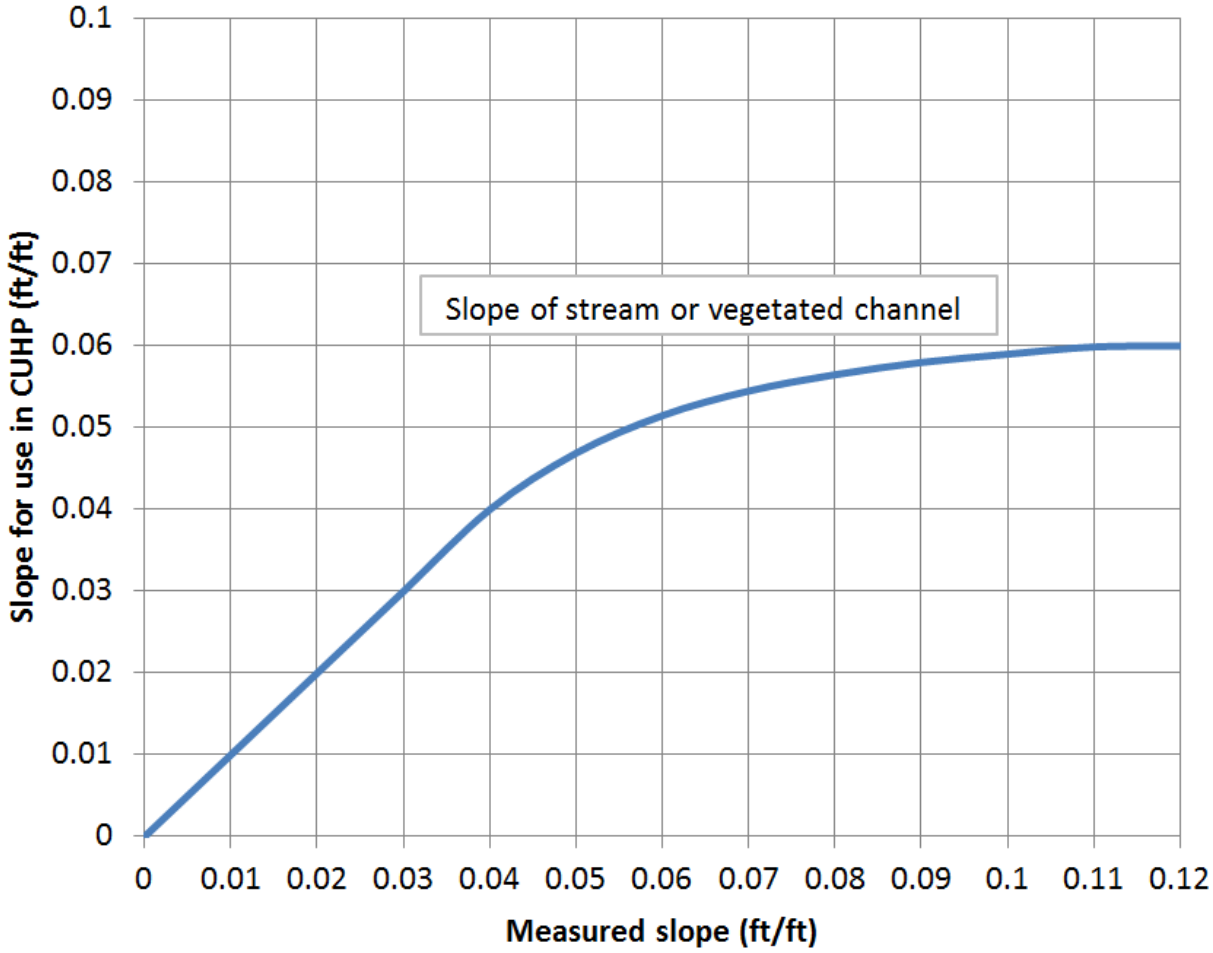


Figure 6-4. Slope correction for streams and vegetated channels

Figure 4 A

ALLOWABLE 2-YR FLOW, HALF STREET CAPACITY

Mountable curb with attached walk: water may spread to back of walk
Mountable curb with detached walk: water may spread to street crown, no overtopping
Vertical curb & gutter: maximum 6" water depth at flowline, no curb overtopping
Reduction Factor applied per Figure ST-2 of USDCM, Volume 1

Flow Q in cfs

Slope	Local	Local	Local	Local	Collector	Collector	Collector	Arterial 4 Ln	Arterial 4-Ln	Arterial 6 Lane
%	I	II	II Alt	III	2-Lane	2-Lane Alt	4-Lane	Raised Med	Paint Med	Raised Median
0.5	6.5	4.9	5.5	8.1	8.1	6.6	8.1	8.1	8.1	8.1
1.0	9.2	6.9	7.8	11.5	11.5	9.3	11.5	11.5	11.5	11.5
1.5	11.3	8.4	9.5	14.0	14.0	11.4	14.0	14.0	14.0	14.0
2.0	13.0	9.7	11.0	16.2	16.2	13.1	16.2	16.2	16.2	16.2
2.5	12.6	9.5	10.7	15.8	15.8	12.8	15.8	15.8	15.8	15.8
3.0	11.9	8.9	10.1	14.9	14.9	12.1	14.9	14.9	14.9	14.9
3.5	11.5	8.6	9.7	14.4	14.4	11.6	14.4	14.4	14.4	14.4
4.0	10.8	8.1	9.2	13.5	13.5	11.0	13.5	13.5	13.5	13.5
4.5	10.5	7.9	8.9	13.1	13.1	10.6	13.1	13.1	13.1	13.1
5.0	10.1	7.5	8.5	12.5	12.5	10.2	12.5	12.5	12.5	12.5
5.5	9.9	7.4	8.4	12.4	12.4	10.0	12.4	12.4	12.4	12.4
6.0	9.7	7.2	8.2	12.1	12.1	9.8	12.1	12.1	12.1	12.1
6.5	9.6	7.2	8.1	12.0	12.0	9.7	12.0	n/a	n/a	n/a
7.0	9.2	6.9	7.8	11.5	11.5	9.3	11.5	n/a	n/a	n/a
7.5	9.3	7.0	7.9	11.6	11.6	9.4	11.6	n/a	n/a	n/a
8.0	9.1	6.8	7.7	11.3	11.3	9.2	11.3	n/a	n/a	n/a

Figure 4 B

ALLOWABLE 100-YR FLOW, FULL WIDTH STREET CAPACITY

12" deep at flowline
Theoretical flows computed by Manning formula
Reduction Factor applied per Figure ST-2 of USDCM, Volume 1

Flow Q in cfs

Slope	Local	Local	Local	Local	Collector	Collector	Collector	Arterial 4 Ln	Arterial 4-Ln	Arterial 6 Lane
%	I	II	II Alt	III	2-Lane	2-Lane Alt	4-Lane	Raised Med	Paint Med	Raised Median
0.5	150	141	148	133	143	121	155	156	157	157
1.0	212	199	209	188	202	171	219	221	222	222
1.5	260	244	256	231	247	209	268	270	272	272
2.0	252	237	248	224	240	203	260	262	264	264
2.5	235	221	231	208	224	189	242	244	246	246
3.0	221	207	217	196	210	178	227	229	231	231
3.5	211	198	207	187	200	170	217	219	220	221
4.0	204	191	201	181	194	164	210	212	213	214
4.5	198	186	195	176	189	160	204	206	207	208
5.0	190	178	187	168	181	153	196	197	198	199
5.5	184	173	181	163	175	148	190	191	193	193
6.0	177	166	174	157	168	142	182	184	185	185
6.5	179	168	176	158	170	144	184	n/a	n/a	n/a
7.0	174	163	171	154	166	140	179	n/a	n/a	n/a
7.5	169	158	166	149	160	136	174	n/a	n/a	n/a
8.0	162	152	160	144	154	131	167	n/a	n/a	n/a

9.2010

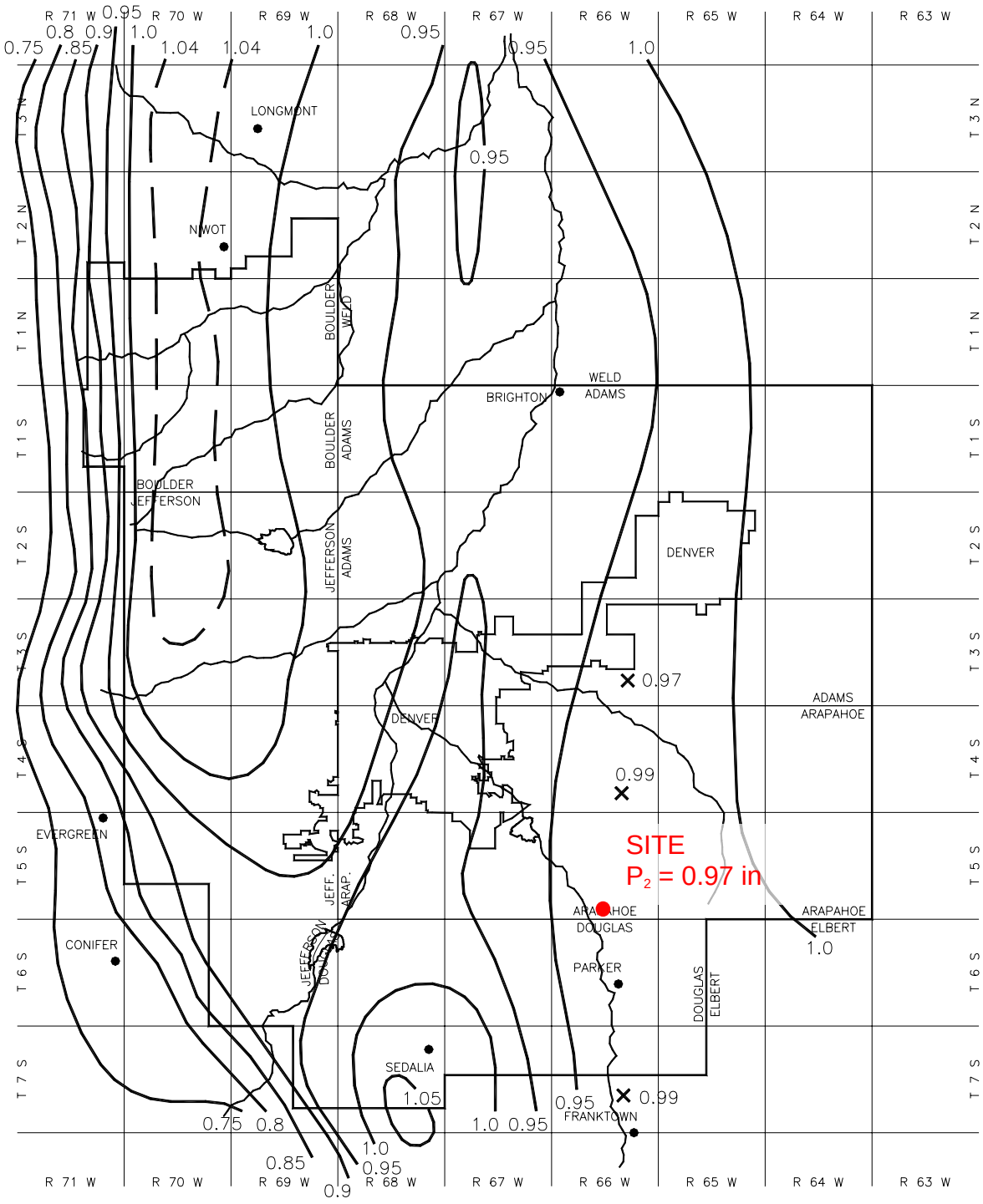


Figure RA-1—Rainfall Depth-Duration-Frequency: 2-Year, 1-Hour Rainfall

RA-1 through RA-6 Rainfall Depths for Rational Method Only.

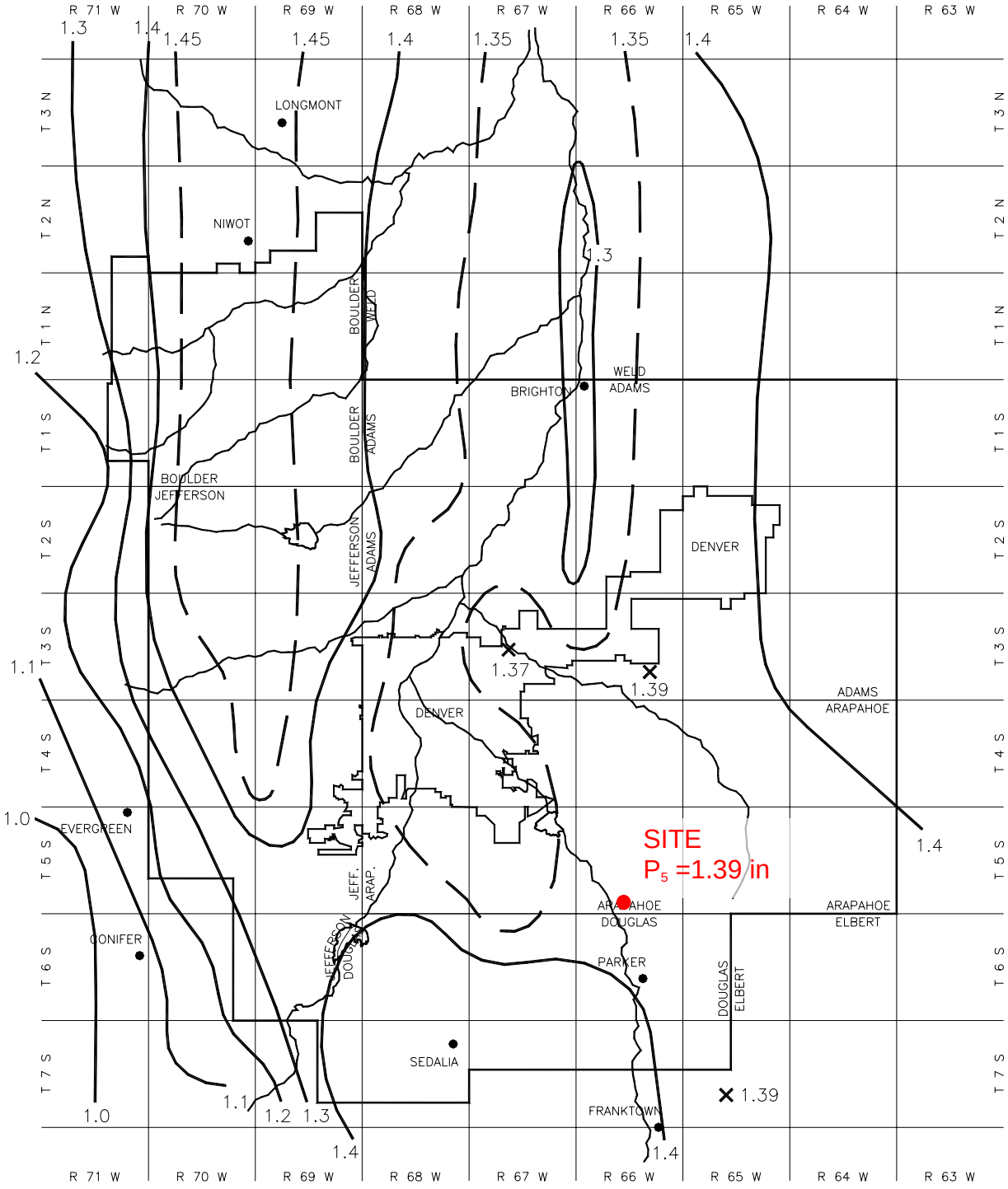


Figure RA-2—Rainfall Depth-Duration-Frequency: 5-Year, 1-Hour Rainfall

RA-1 through RA-6 Rainfall Depths for Rational Method Only.

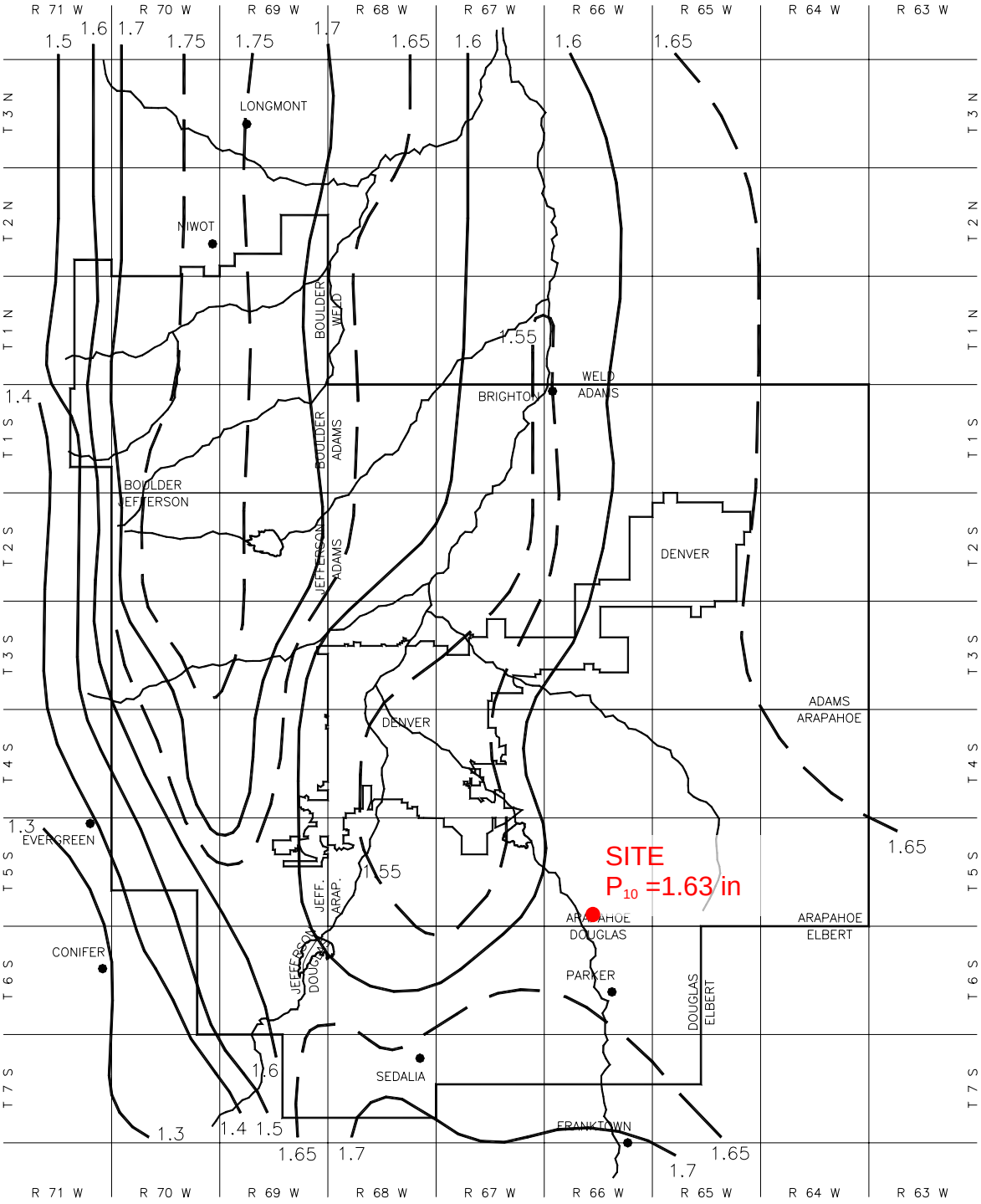


Figure RA-3—Rainfall Depth-Duration-Frequency: 10-Year, 1-Hour Rainfall

RA-1 through RA-6 Rainfall Depths for Rational Method Only.

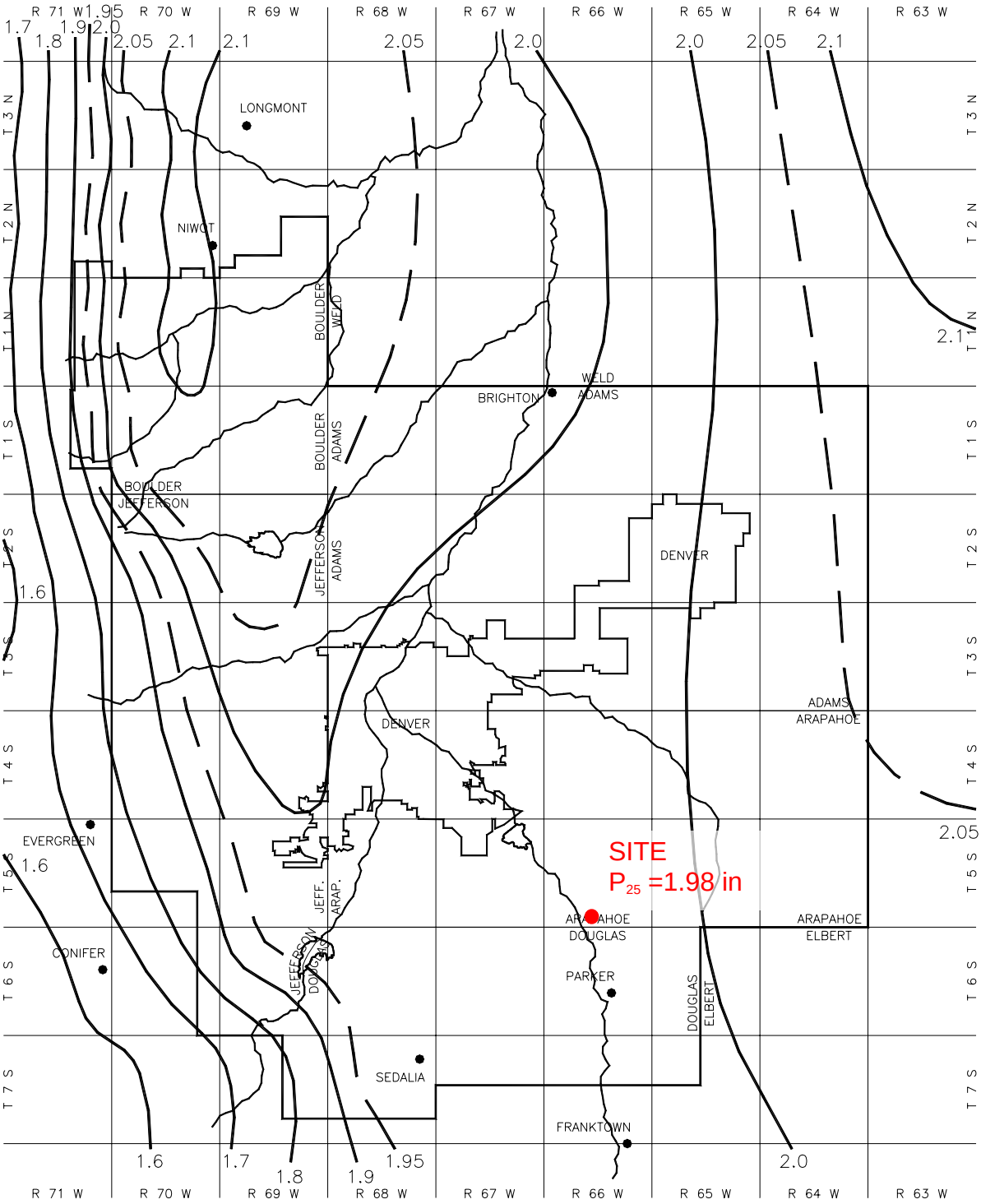


Figure RA-4—Rainfall Depth-Duration-Frequency: 25-Year, 1-Hour Rainfall

RA-1 through RA-6 Rainfall Depths for Rational Method Only.

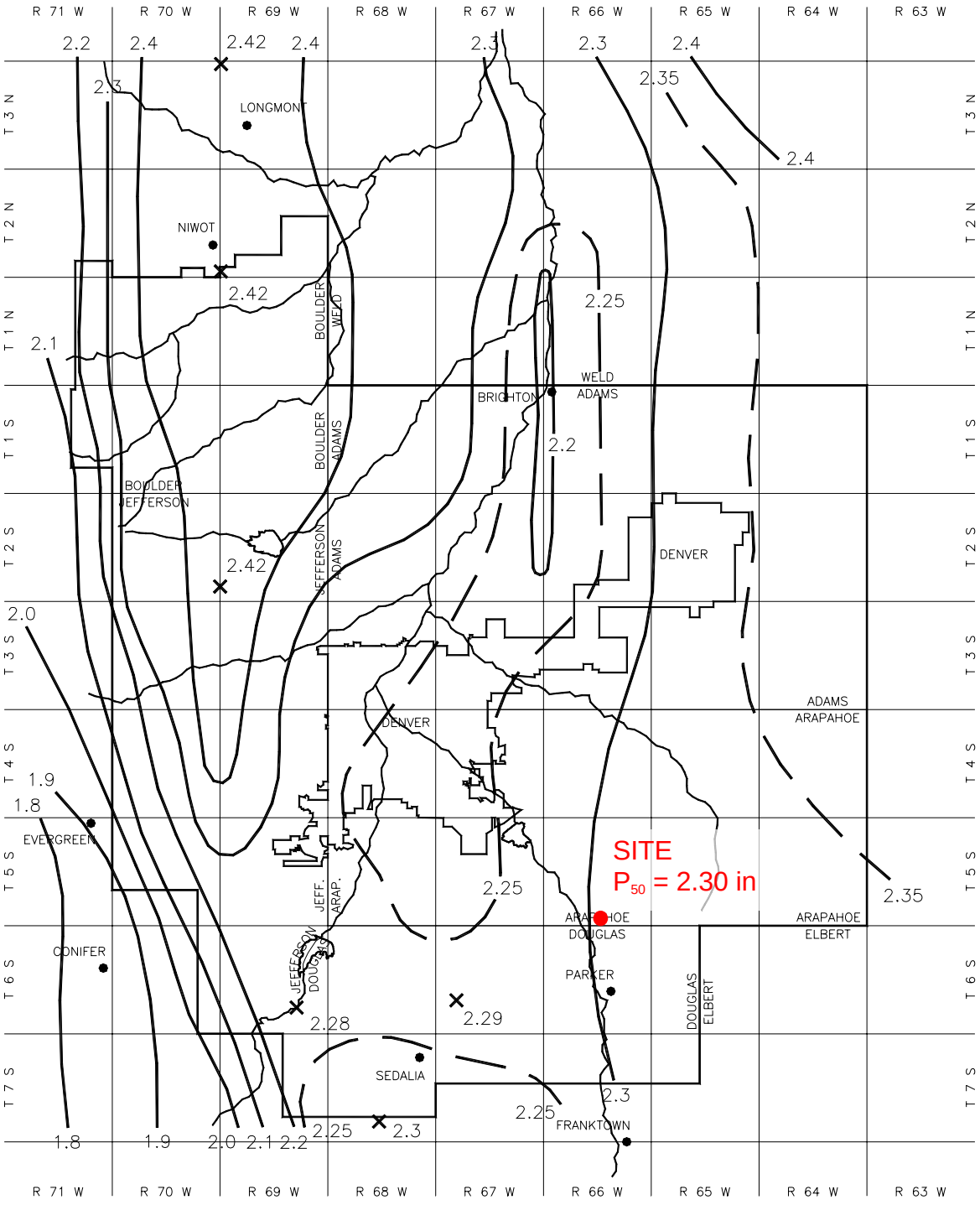


Figure RA-5—Rainfall Depth-Duration-Frequency: 50-Year, 1-Hour Rainfall

RA-1 through RA-6 Rainfall Depths for Rational Method Only.

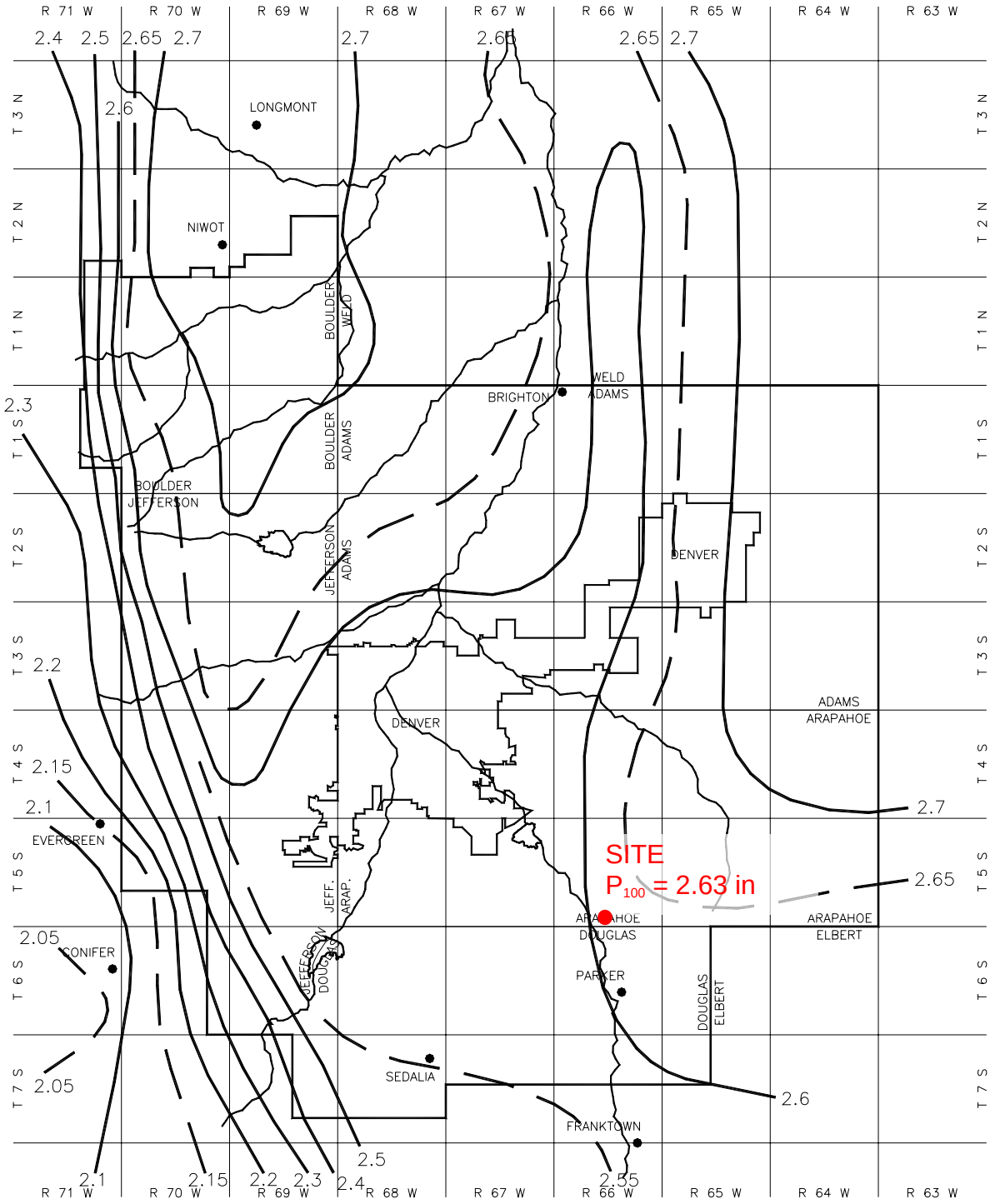


Figure RA-6—Rainfall Depth-Duration-Frequency: 100-Year, 1-Hour Rainfall

RA-1 through RA-6 Rainfall Depths for Rational Method Only.

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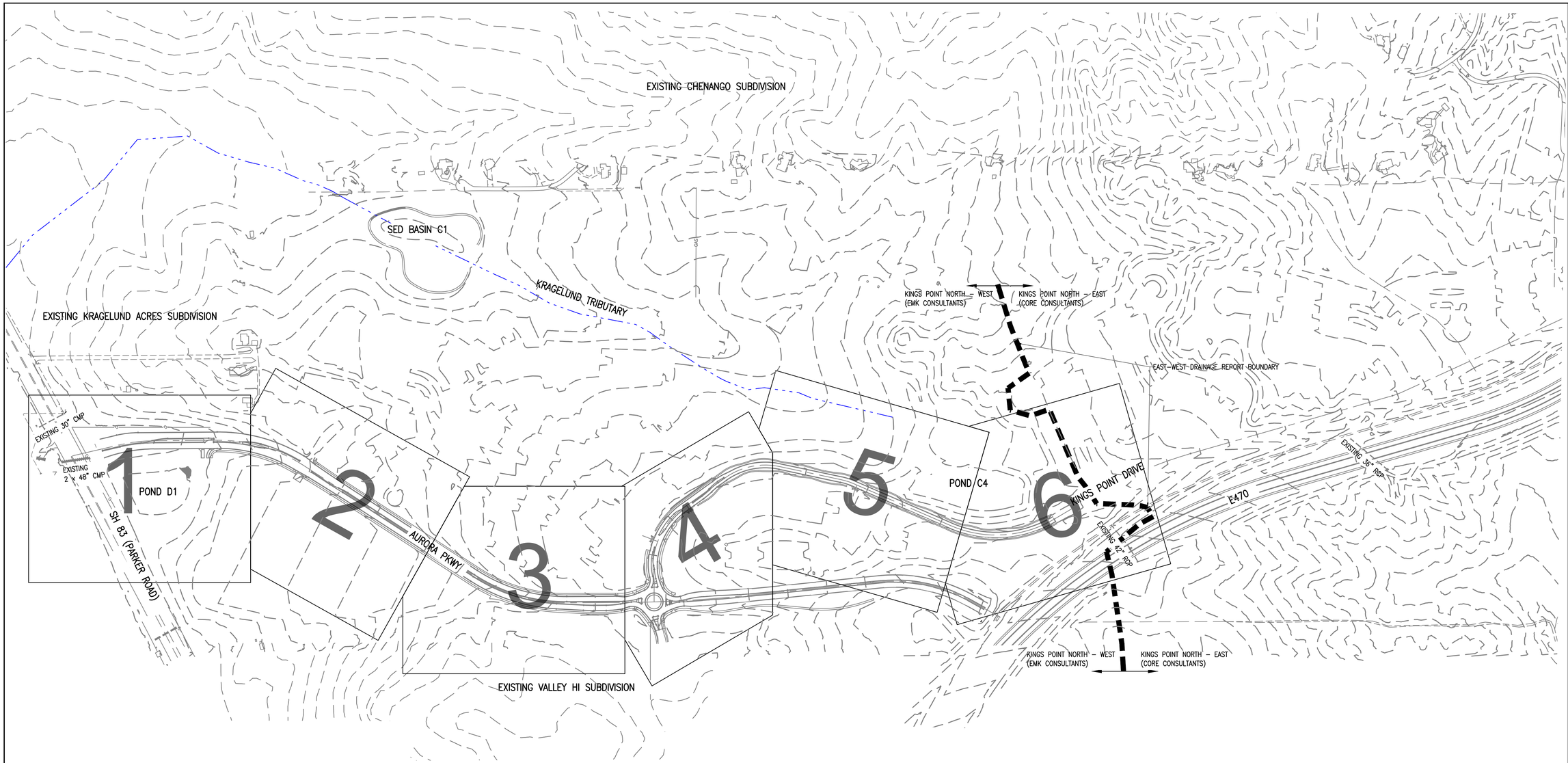
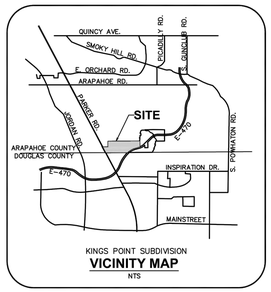
DRAWINGS
CHUP/SWMM Maps and Drainage Plans



KINGS POINT NORTH – WEST
DRAINAGE PLAN LAYOUT



KINGS POINT SUBDIVISION
VICINITY MAP
NTS

Approved For One Year From This Date

_____

City Engineer _____ **Date**

Water Department _____ **Date**

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PRELIMINARY DRAINAGE MAP
COVER SHEET

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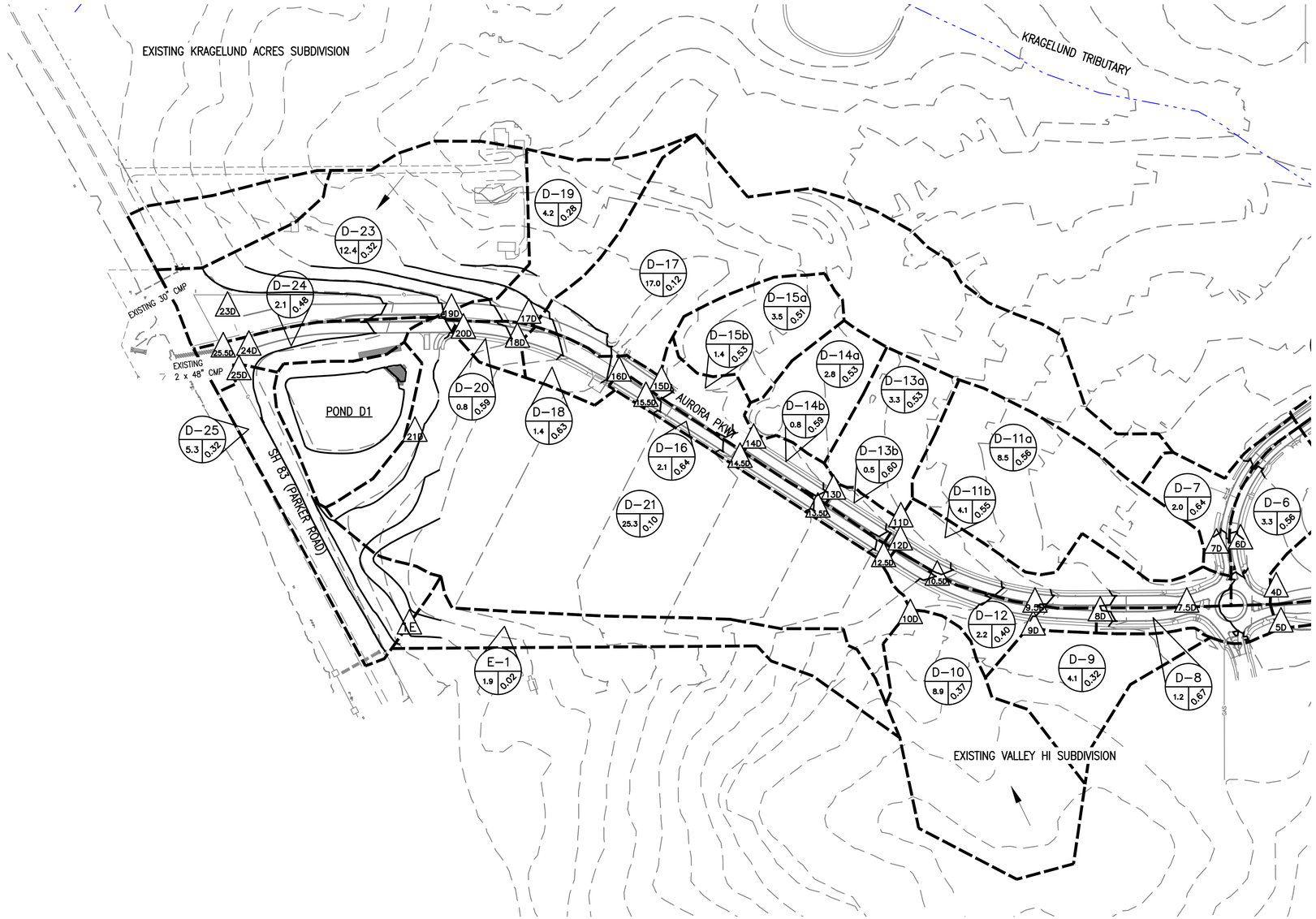
JOB NO: 12187.61
SCALE
HORIZONTAL
1" = 300'

COVER



LEGEND

- BSN_D3 / 3.9 / 17% — CATCHMENT DESIGNATION / % IMPERVIOUS / CATCHMENT AREA IN ACRES
- X — DESIGN POINT
- CATCHMENT BOUNDARY
- FLOW DIRECTION ARROW
- 5510 — EXISTING 10-FT CONTOUR
- 5510 — PROPOSED 10-FT CONTOUR

GRAPHIC SCALE
0 150 300 600 1500
1 INCH = 300 FEET

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RATIONAL BASIN MAPS

DATE: 05/27/2022
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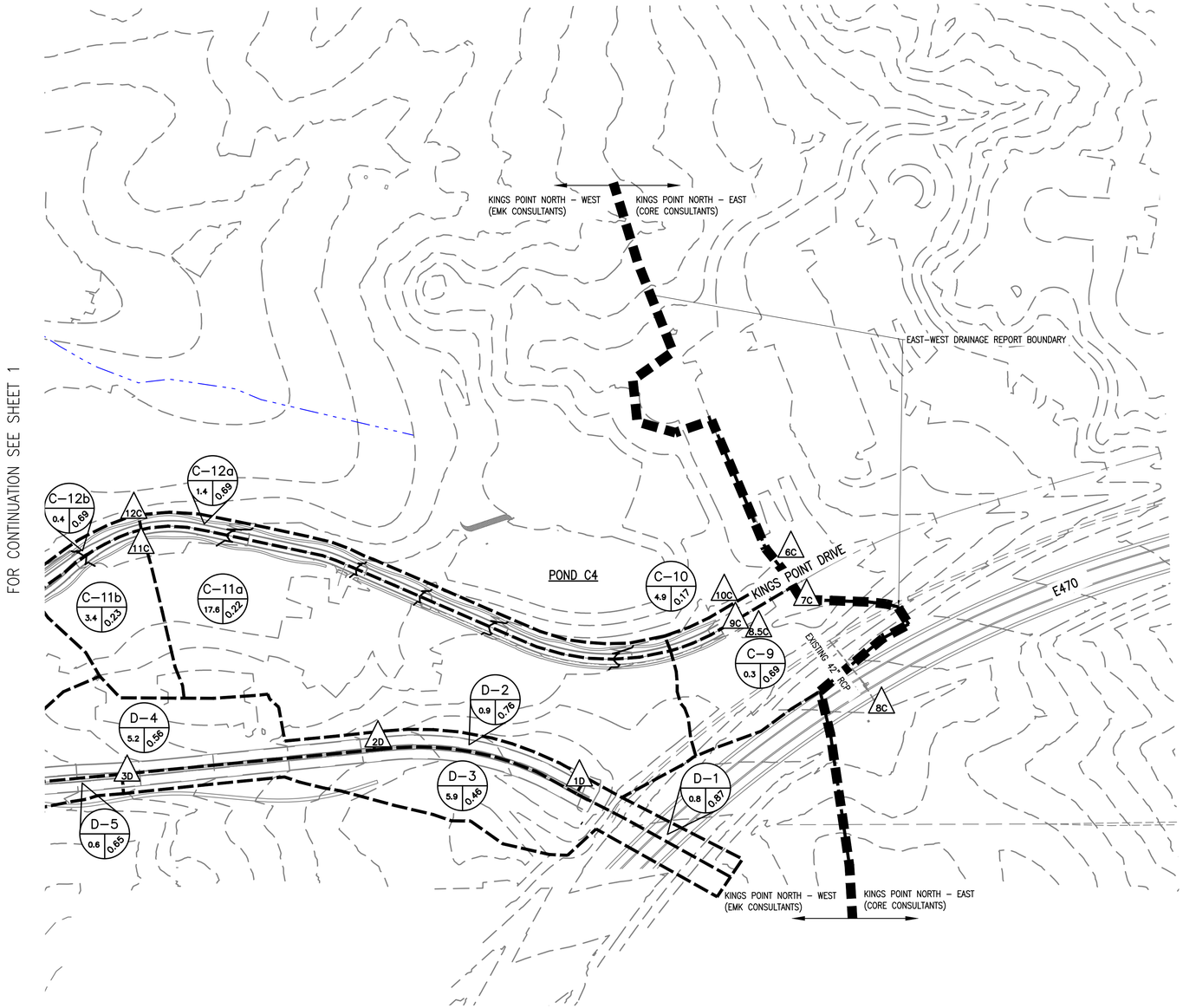
SCALE HORIZONTAL 1" = 200'

1 of 2



LEGEND

- BSN_D3 / 3.9 / 17** — CATCHMENT DESIGNATION; % IMPERVIOUS; CATCHMENT AREA IN ACRES
- X — DESIGN POINT
- CATCHMENT BOUNDARY
- FLOW DIRECTION ARROW
- 5510 — EXISTING 10–FT CONTOUR
- 5510 — PROPOSED 10–FT CONTOUR

GRAPHIC SCALE
0 150 300 600 1500
1 INCH = 300 FEET

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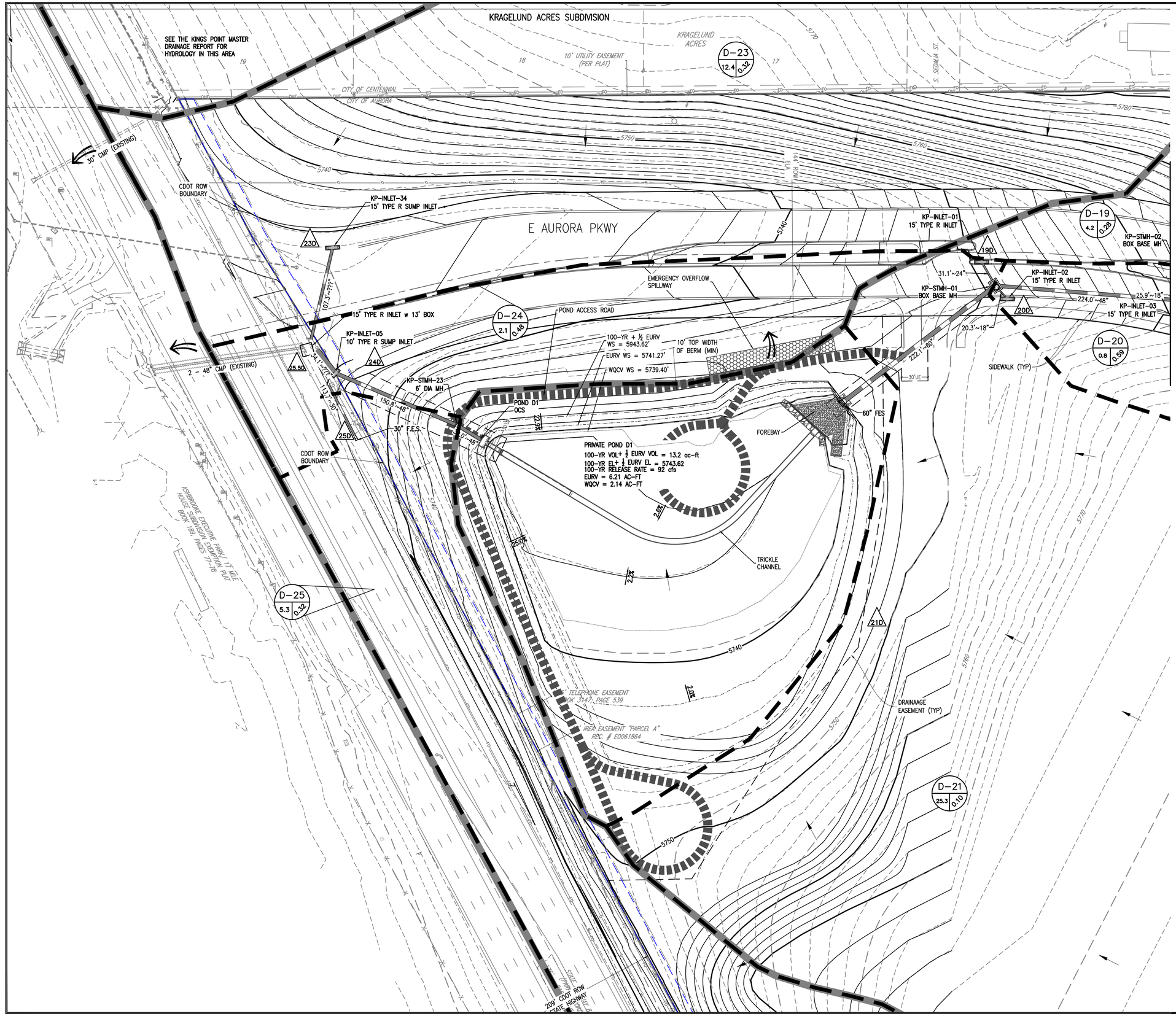
RATIONAL BASIN MAPS

DATE: 05/27/2022
JOB NO: 12187.61
SCALE HORIZONTAL 1" = 200'

2 of 2



KEY MAP
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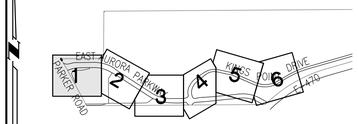

LEGEND

- C3 / 341.8 / 0.45 — BASIN DESIGNATION; 2-YR RUNOFF COEFFICIENT; BASIN AREA IN ACRES
- X — DESIGN POINT–RATIONAL METHOD
- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- 5860 — EXISTING CONTOURS
- 5770 — PROPOSED CONTOURS
- FLOW ARROW
- 100-YR EMERGENCY OVERFLOW PATH
- STORM SEWER AND INLET, MANHOLE, FLARED END SECTION
- FLOW DIRECTION ARROW
- POND MAINTENANCE ACCESS

NOTES

1. ALL DRAINAGE FACILITIES ARE PUBLIC, UNLESS LABELED AS PRIVATE. PONDS D1 AND C4 ARE PRIVATE. ALL PRIVATE STORM INFRASTRUCTURE WILL BE MAINTAINED BY THE KINGS POINT METRO DISTRICT.
2. ALL DRAINAGE FACILITIES ARE DESIGNED FOR THE 100-YEAR STORM.
3. PRIOR TO FINAL ACCEPTANCE OF PUBLIC IMPROVEMENTS, IF THE ADJACENT SITE IS NOT UNDER CONSTRUCTION, CURB CUTS AND CROSS PANS MUST BE REMOVED AND REPLACED WITH SIDEWALK, LANDSCAPING, CURB AND GUTTER AT THE DEVELOPER EXPENSE. THE DEVELOPER ACKNOWLEDGES THE RISK OF CONSTRUCTING CURB CUTS AND CURB RETURN ACCESS POINTS WITHOUT APPROVED CIVILS FOR THE ADJACENT SITES.
4. NO WORK IS ALLOWED IN THE FLOODPLAIN WITHOUT A FLOODPLAIN DEVELOPMENT PERMIT. NO WORK IS ALLOWED IN THE FLOODWAY WITHOUT A CLOMR.
5. SEE SHEET 7 FOR STREET CROSS SECTIONS CORRESPONDING TO THE CLASSIFICATION LABELS SHOWN ON THE PLANS.
6. ALL MEDIANS THAT CONTAIN LANDSCAPING ARE PRIVATE.

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GRAPHIC SCALE
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1 INCH = 50 FEET

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DENVER, COLORADO 80249
PHONE: (303) 486-8500
CONTACT: RANDY BAUER

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BENCHMARK
CITY OF AURORA BENCHMARK 5586334NE002 (FKA ZD-060)
3 INCH DIAMETER BRASS CAP ON 30 INCH LONG STEEL PIPE IN CONCRETE, APPROXIMATELY 0.4 FEET ABOVE GROUND SURFACE, 0.7 FEET NORTH OF CENTERLINE OF SEDALIA STREET AND 27.2 FEET EAST OF CENTERLINE OF EAST AURORA PARKWAY
EAST 1/4 SECTION 33, T5S, R66W NAVD 88 ELEVATION: 5861.04

REVISIONS

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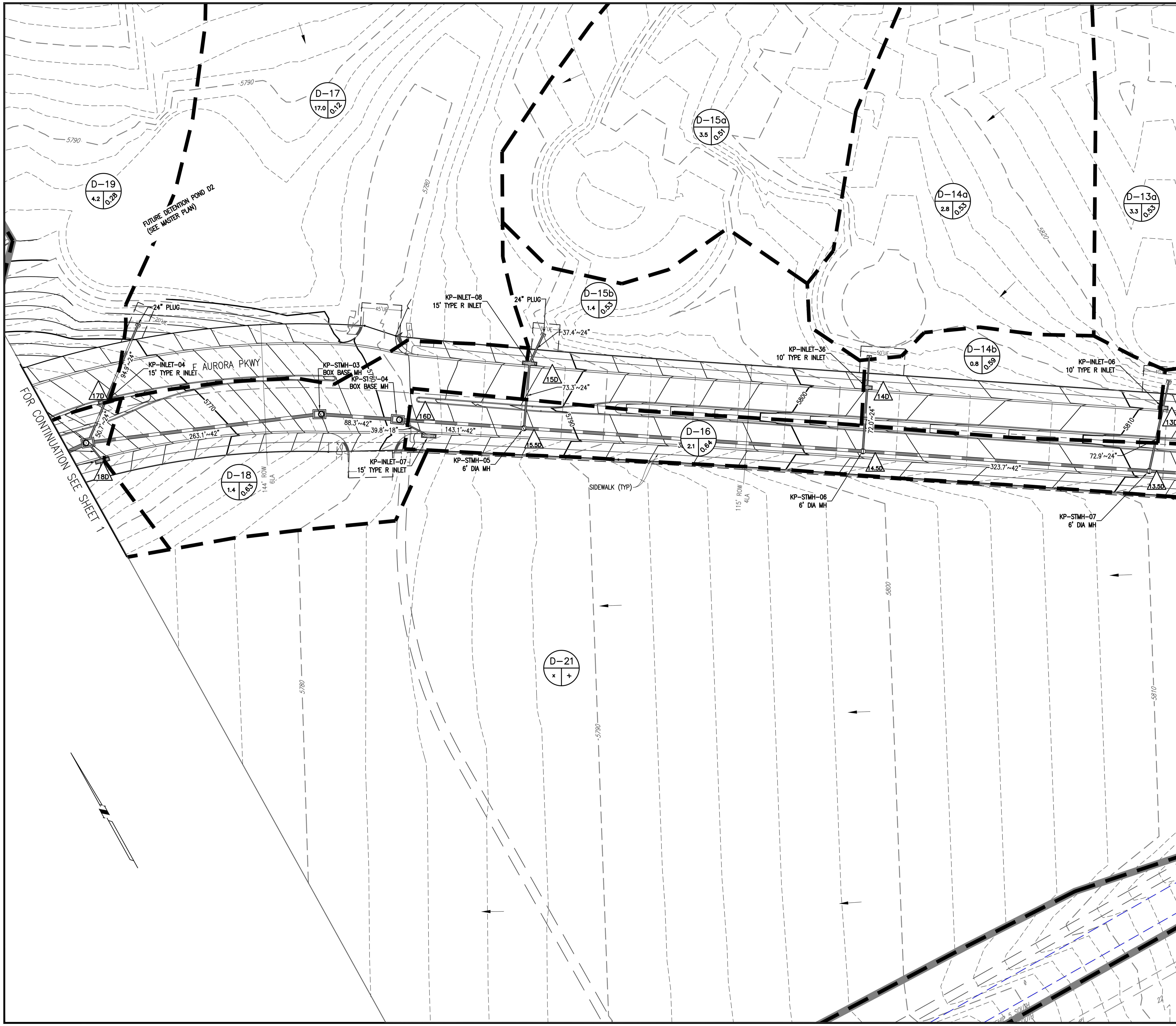
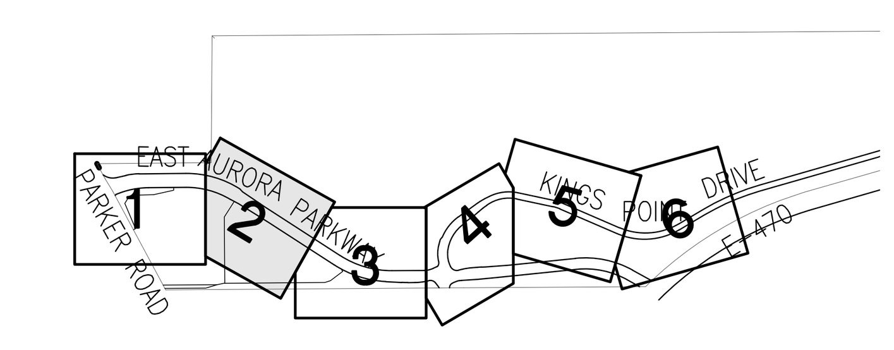
KINGS POINT NORTH WEST INFRASTRUCTURE

PRELIMINARY DRAINAGE MAP

DATE: 05/27/2022
JOB NO: 12187.61
SCALE HORIZONTAL 1" = 50'
1



KEY MAP
1"=2000'



LEGEND

- C3 — BASIN DESIGNATION
- 0.45 — 2-YR RUNOFF COEFFICIENT
- 341.8 — BASIN AREA IN ACRES
- DESIGN POINT–RATIONAL METHOD
- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- 5860 EXISTING CONTOURS
- 5770 PROPOSED CONTOURS
- FLOW ARROW
- 100-YR EMERGENCY OVERFLOW PATH
- STORM SEWER AND INLET, MANHOLE, FLARED END SECTION
- FLOW DIRECTION ARROW
- POND MAINTENANCE ACCESS

NOTES

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GRAPHIC SCALE
0 25 50 100 150
1 INCH = 50 FEET

DEVELOPER
CLAYTON PROPERTIES GROUP II, INC.
4908 TOWER ROAD
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PHONE: (303) 486-8500
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Know what's below. Call before you dig.

BENCHMARK
CITY OF AURORA BENCHMARK 5S6633NE002 (FKA ZD-060)
3 INCH DIAMETER BRASS CAP ON 30 INCH LONG STEEL PIPE IN CONCRETE,
APPROXIMATELY 0.4 FEET ABOVE GROUND SURFACE, 0.7 FEET NORTH OF
EAST/WEST 4 STRAND BARBED WIRE FENCE, AND 22.7 FEET WEST
EAST 1/4 SECTION 33, T5S, R66W NAVD 88 ELEVATION 5861.04

REVISIONS			
NO.	DESCRIPTION	DATE	BY

DESIGNED BY: DJO
DRAWN BY: DJO
CHECKED BY: BOM
APPROVED BY: BOM

KINGS POINT NORTH WEST INFRASTRUCTURE
PRELIMINARY DRAINAGE MAP

DATE: 05/27/2022
JOB NO: 12187.61
SCALE HORIZONTAL 1" = 50'
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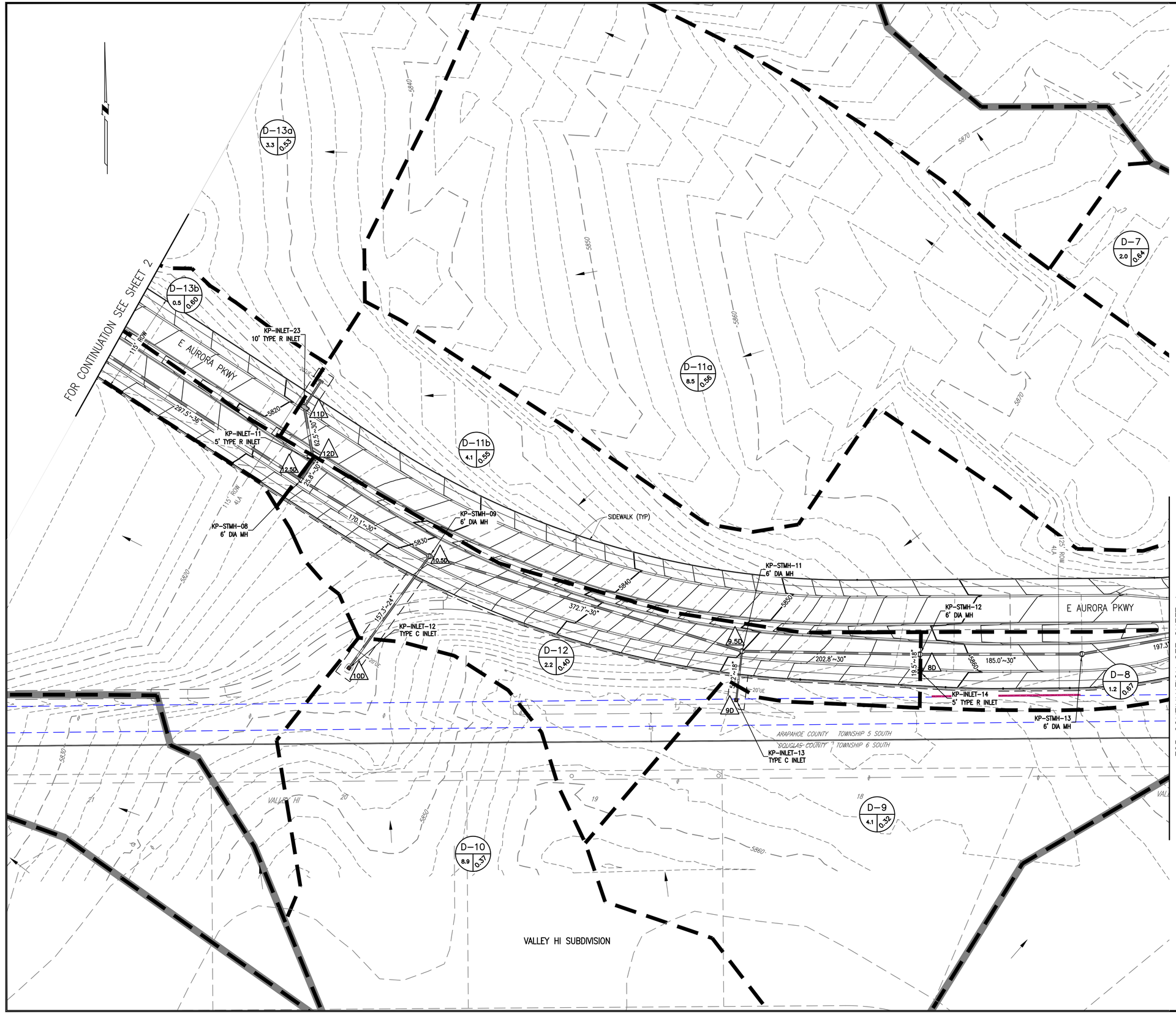

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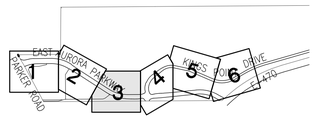

LEGEND

- C3 / 341.8 / 0.45 — BASIN DESIGNATION; 2-YR RUNOFF COEFFICIENT; BASIN AREA IN ACRES
- X — DESIGN POINT– RATIONAL METHOD
- MAJOR BASIN BOUNDARY
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3 INCH DIAMETER BRASS CAP ON 30 INCH LONG STEEL PIPE IN CONCRETE, APPROXIMATELY 4.4 FEET ABOVE GROUND SURFACE, 0.7 FEET NORTH OF EAST 1/4 SECTION 35, T5S, R66W
NAD 83 ELEVATION = 5861.04

REVISIONS

NO.	DESCRIPTION	DATE	BY

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DRAWN BY: DJO
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APPROVED BY: BOM

KINGS POINT NORTH WEST INFRASTRUCTURE

PRELIMINARY DRAINAGE MAP

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SCALE HORIZONTAL 1" = 50'

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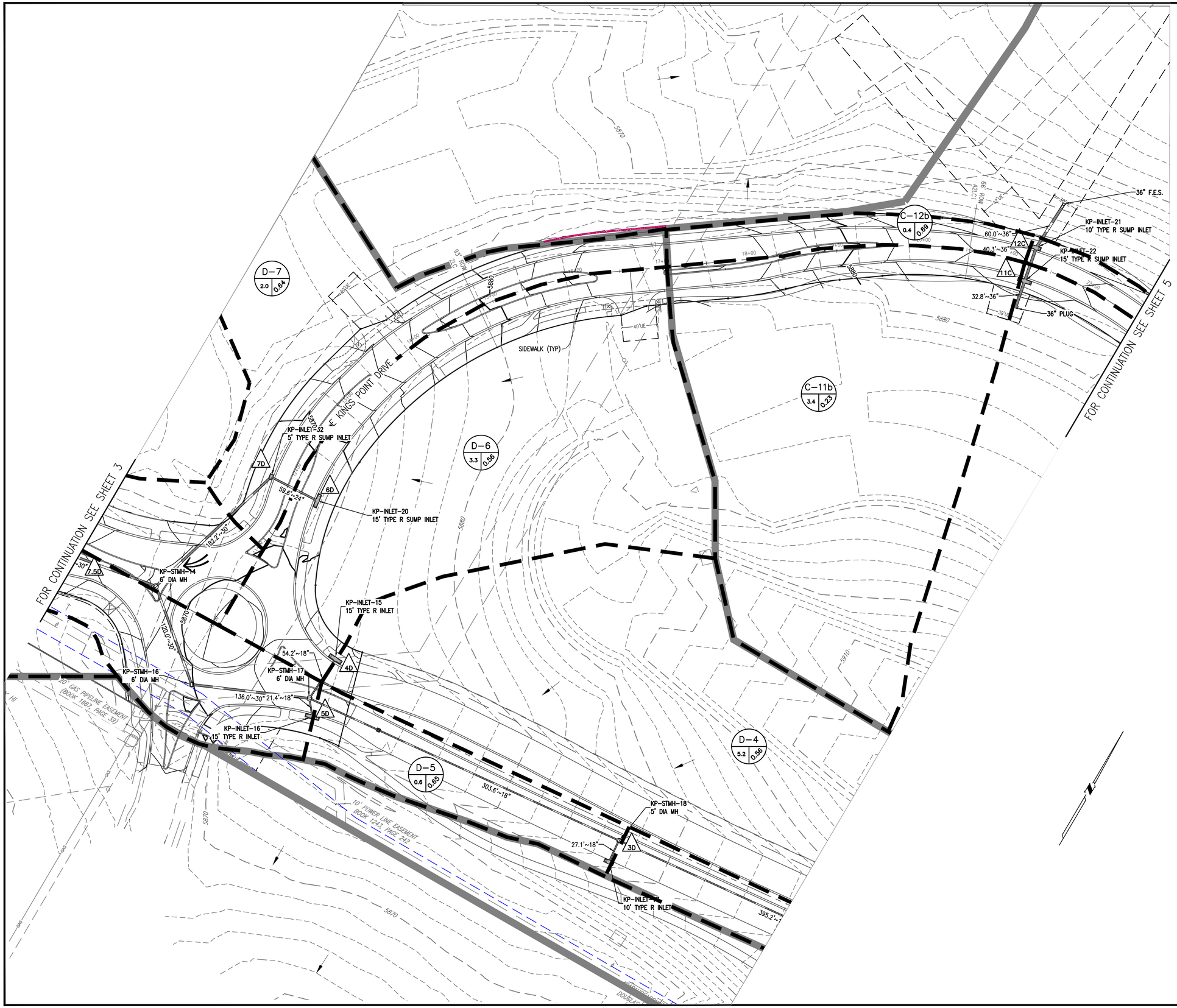

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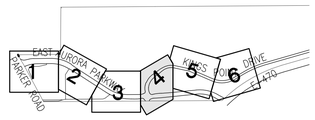

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NAVD 88 ELEVATION: 5867.104

REVISIONS

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KINGS POINT NORTH WEST INFRASTRUCTURE

PRELIMINARY DRAINAGE MAP

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SCALE
HORIZONTAL
1" = 50'

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KEY MAP
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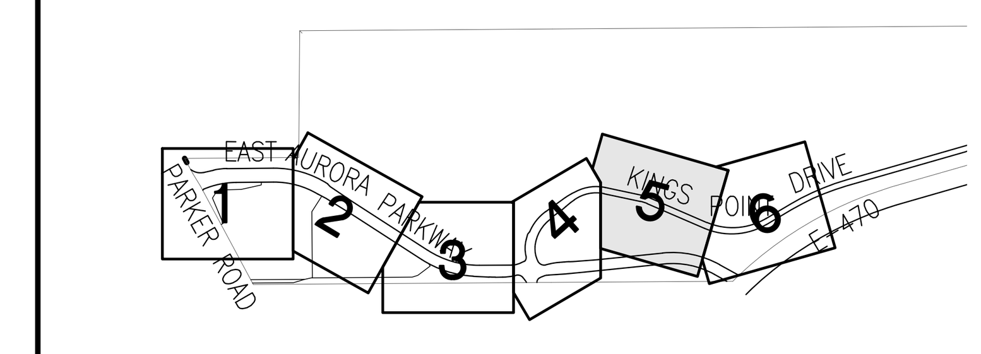

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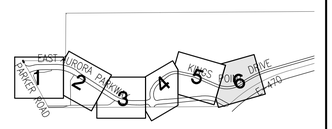

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KINGS POINT NORTH WEST INFRASTRUCTURE

PRELIMINARY DRAINAGE MAP

DATE: 05/27/2022
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SCALE HORIZONTAL 1" = 50'

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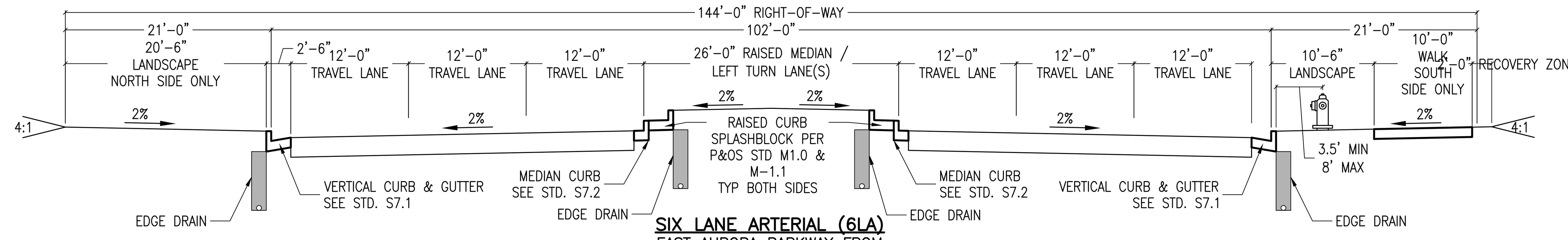
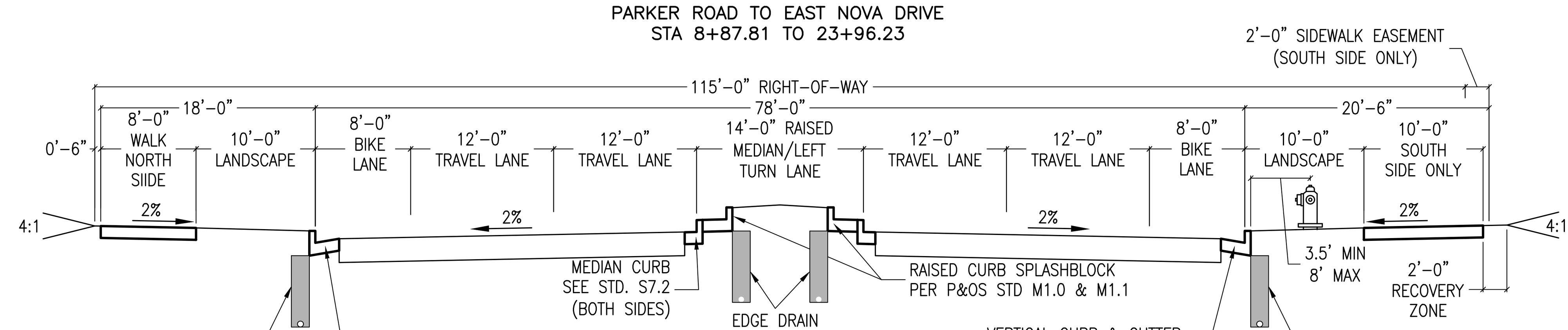
SUMMARY RUNOFF TABLE - POND D1 BASINS

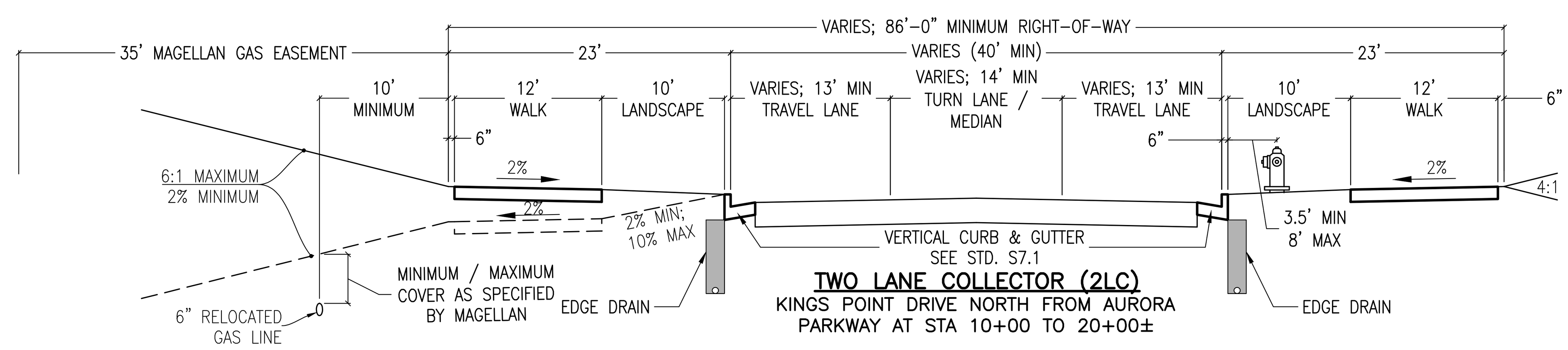
DESIGN POINT	AREA DESIGNATION(S)	AREA (acres)	%IMP	Q_2 (cfs)	Q_{100} (cfs)	REMARKS
1D	D-1	0.8	100.0%	2.3	6.6	DIRECT
2D	D-2	0.9	85.3%	2.2	6.2	DIRECT
2D	D-1 + D-2	1.7	92.2%	4.3	12.5	COMBINED/ PIPE FLOW
3D	D-3	5.9	47.4%	5.4	16.4	DIRECT/INLET INTERCEPT
3D	DP 2D + D-3	7.6	57.5%	8.2	24.5	COMBINED/ PIPE FLOW
4D	D-4	5.2	63.6%	6.4	21.6	DIRECT
5D	D-5	0.6	71.9%	1.4	4.0	DIRECT
5D	3D + 4D + 5D	13.4	60.6%	14.6	45.8	COMBINED/ PIPE FLOW
6D	D-6	3.3	63.6%	4.8	16.3	DIRECT
7D	D-7	2.0	71.8%	3.4	10.6	DIRECT
7D	DP 6D + DP 7D	5.3	66.7%	8.1	26.5	COMBINED/ PIPE FLOW
7.5D	DP 5D + DP 7D	18.7	62.3%	20.3	64.5	COMBINED/ PIPE FLOW
8D	D-8	1.2	73.6%	2.6	7.6	DIRECT
8D	7.5D + 8D	19.9	63.0%	21.5	68.0	COMBINED/ PIPE FLOW
9D	D-9	4.1	34.1%	3.1	12.4	DIRECT/INLET INTERCEPT
9.5D	DP 8D + DP 9D	24.0	58.0%	23.8	77.4	COMBINED/ PIPE FLOW
10D	D-10	8.9	41.2%	7.2	29.4	DIRECT/INLET INTERCEPT
10.5D	DP 9.5D + DP 10.5D	32.9	53.5%	29.4	100.7	COMBINED/ PIPE FLOW
11D	D-11a	8.5	63.5%	10.9	37.7	DIRECT
11D	D-11b	4.1	61.6%	6.1	20.7	DIRECT
11D	D-11a + D-11b	12.6	62.9%	16.1	55.4	COMBINED/ PIPE FLOW
12D	D-12	2.2	40.1%	2.9	8.8	DIRECT
12D	DP 11D + D-12	14.8	59.5%	25.9	88.0	COMBINED/ PIPE FLOW
12.5D	DP 10.5 D + DP 12D	47.7	55.4%	43.5	148.5	COMBINED/ PIPE FLOW
13D	D-13a	3.3	59.8%	4.7	16.8	DIRECT
13D	D-13b	0.5	67.6%	1.1	3.4	DIRECT
13D	D-13a + D-13b	3.8	60.9%	5.6	19.6	COMBINED/ PIPE FLOW
13.5D	DP 12.5D + DP 13D	51.5	55.8%	46.6	159.2	COMBINED/ PIPE FLOW
14D	D-14a	2.8	60.6%	4.0	14.1	DIRECT
14D	D-14b	0.8	66.5%	1.6	5.2	DIRECT
14D	D-14a + D-14b	3.6	61.9%	5.3	18.3	COMBINED/ PIPE FLOW
14.5D	DP 13.5D + DP 14D	55.2	56.2%	49.3	168.7	COMBINED/ PIPE FLOW
15D	D-15a	3.5	57.8%	5.9	21.2	DIRECT
15D	D-15b	1.4	59.3%	1.9	6.7	DIRECT
15D	D-15a + D-15b	4.9	58.3%	6.6	23.6	COMBINED/ PIPE FLOW
15.5D	DP 14.5D + DP 15D	60.1	56.4%	52.7	181.1	COMBINED/ PIPE FLOW
16D	D-16	2.1	71.4%	4.0	12.7	DIRECT
16D	DP 15.5D + DP 16D	62.2	56.9%	54.7	187.2	COMBINED/ PIPE FLOW
17D	D-17	17.0	4.2%	4.4	16.9	DIRECT/ PIPE FLOW
18D	D-18	1.4	71.9%	2.9	9.2	DIRECT
18D	DP 16D + DP 17D + DP 18D	80.5	46.0%	58.7	202.0	COMBINED/ PIPE FLOW
19D	D-19	4.2	25.7%	2.5	9.1	DIRECT
20D	D-20	0.8	66.6%	1.5	4.9	DIRECT
20D	DP 18D + DP 19D + DP 20D	85.5	45.2%	60.8	209.4	COMBINED/ PIPE FLOW



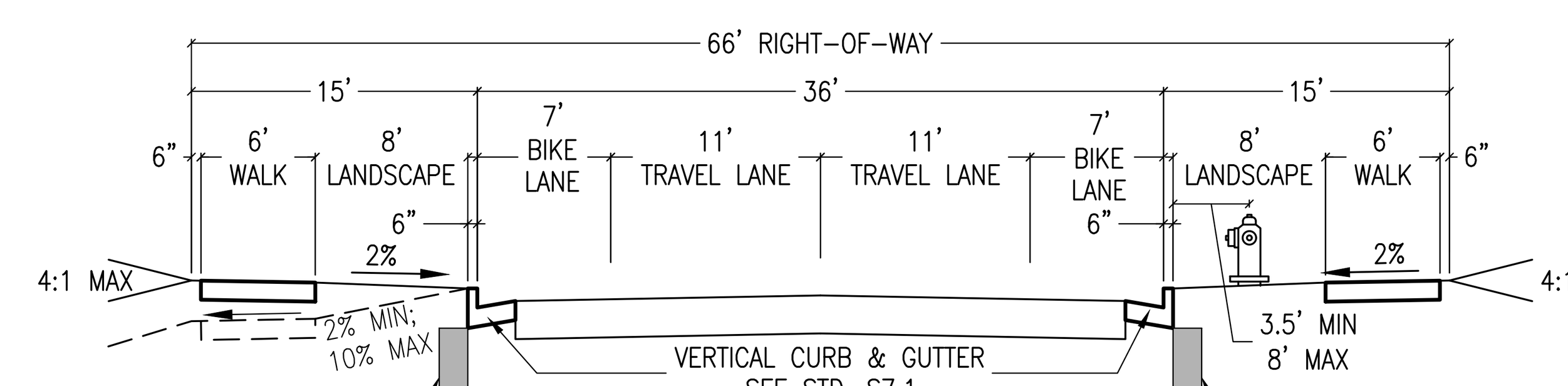
SIX LANE ARTERIAL (6LA)
EAST AURORA PARKWAY FROM PARKER ROAD TO EAST NOVA DRIVE
STA 8+87.81 TO 23+96.23



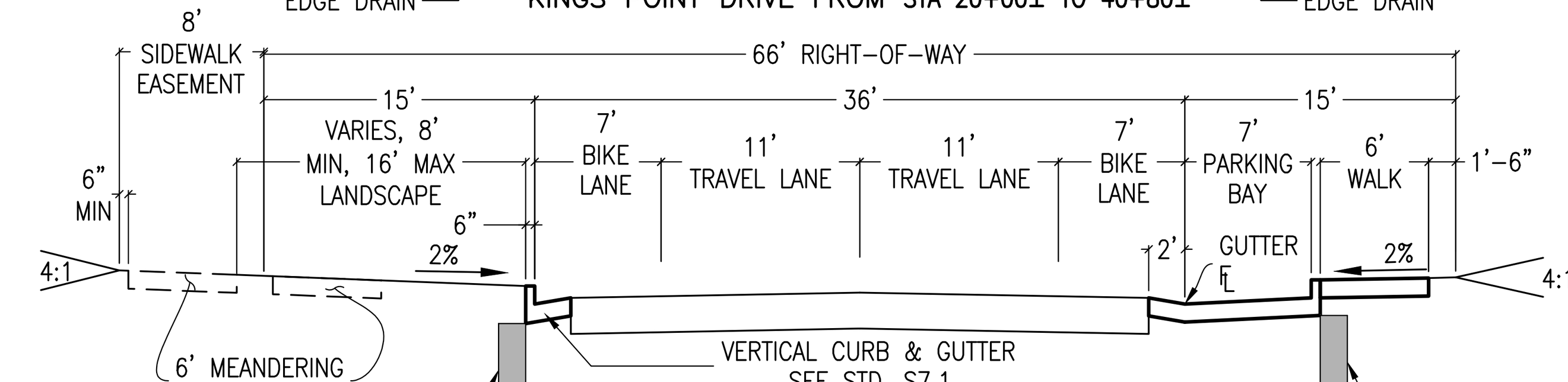
FOUR LANE ARTERIAL (4LA)
EAST AURORA PARKWAY EAST OF EAST NOVA DRIVE
STA 23+96.23 TO 68+30.53



TWO LANE COLLECTOR (2LC)
KINGS POINT DRIVE NORTH FROM AURORA PARKWAY AT STA 10+00 TO 20+00±



ALTERNATIVE TWO LANE COLLECTOR (A2LC1)
KINGS POINT DRIVE FROM STA 20+00± TO 40+80±



ALTERNATIVE TWO LANE COLLECTOR (A2LC1)
KINGS POINT DRIVE WITH PARKING BAY OR MEANDERING SIDEWALK (WHERE INDICATED)

SUMMARY RUNOFF TABLE - PARKER ROAD BASINS

DESIGN POINT	AREA DESIGNATION(S)	AREA (acres)	%IMP	Q_2 (cfs)	Q_{100} (cfs)	REMARKS
23D	D-23	12.4	42.3%	8.8	39.3	DIRECT/INLET INTERCEPT
24D	D-24	2.1	51.8%	2.9	8.7	DIRECT/INLET INTERCEPT
24D	D-24 + POND D1 (Q2 = 4.4 cfs)	120.6	51.8%	7.3	87.0	COMBINED/ PIPE FLOW
25D	D-25	5.3	32.2%	3.6	11.3	DIRECT/FES INTERCEPT
25.5D	DP 23D + DP 24D + DP 25D	125.9	40.6%	19.2	128.5	COMBINED/ PIPE FLOW

SUMMARY RUNOFF TABLE - POND C1 BASINS

DESIGN POINT	AREA DESIGNATION(S)	AREA (acres)	%IMP	Q_2 (cfs)	Q_{100} (cfs)	REMARKS
11C	C-11a	17.6	10.4%	7.1	22.9	DIRECT
11C	C-11b	3.4	12.4%	1.8	5.7	DIRECT
11C	C-11a + C-11b	21.0	10.7%	8.6	33.5	INLET INTERCEPT/PIPE FLOW
12C	C-12a	1.4	74.8%	2.3	6.8	DIRECT
12C	C-12b	0.4	74.8%	0.8	2.4	DIRECT
12C	C-12a + C-12b	1.7	74.8%	3.0	2.7	INLET INTERCEPT
12C	All Above Basins	22.7	15.6%	10.8	34.0	COMBINED/PIPE FLOW

SUMMARY RUNOFF TABLE - POND C4 BASINS

DESIGN POINT	AREA DESIGNATION(S)	AREA (acres)	%IMP	Q_2 (cfs)	Q_{100} (cfs)	REMARKS
9C	C-9	0.3	74.8%	0.7	1.9	DIRECT
10C	C-10	4.9	13.6%	2.7	9.3	DIRECT

KEY MAP
1"=2000'

LEGEND

- C3 / 341.8 / 0.45 — BASIN DESIGNATION; 2-YR RUNOFF COEFFICIENT; BASIN AREA IN ACRES
- DESIGN POINT– RATIONAL METHOD
- MAJOR BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- 5860 — EXISTING CONTOURS
- 5770 — PROPOSED CONTOURS
- FLOW ARROW
- 100-YR EMERGENCY OVERFLOW PATH
- STORM SEWER AND INLET, MANHOLE, FLARED END SECTION
- FLOW DIRECTION ARROW
- POND MAINTENANCE ACCESS

NOTES

1. ALL DRAINAGE FACILITIES ARE PUBLIC, UNLESS LABELED AS PRIVATE. PONDS D1 AND C4 ARE PRIVATE. ALL PRIVATE STORM INFRASTRUCTURE WILL BE MAINTAINED BY THE KINGS POINT METRO DISTRICT.
2. ALL DRAINAGE FACILITIES ARE DESIGNED FOR THE 100-YEAR STORM.
3. PRIOR TO FINAL ACCEPTANCE OF PUBLIC IMPROVEMENTS, IF THE ADJACENT SITE IS NOT UNDER CONSTRUCTION, CURB CUTS AND CROSS PANS MUST BE REMOVED AND REPLACED WITH SIDEWALK, LANDSCAPING, CURB AND GUTTER AT THE DEVELOPER EXPENSE. THE DEVELOPER ACKNOWLEDGES THE RISK OF CONSTRUCTING CURB CUTS AND CURB RETURN ACCESS POINTS WITHOUT APPROVED CIVILS FOR THE ADJACENT SITES.
4. NO WORK IS ALLOWED IN THE FLOODPLAIN WITHOUT A FLOODPLAIN DEVELOPMENT PERMIT. NO WORK IS ALLOWED IN THE FLOODWAY WITHOUT A CLOMR.
5. SEE SHEET 7 FOR STREET CROSS SECTIONS CORRESPONDING TO THE CLASSIFICATION LABELS SHOWN ON THE PLANS.
6. ALL MEDIANS THAT CONTAIN LANDSCAPING ARE PRIVATE.

CITY OF AURORA PLAN REVIEW IS ONLY FOR GENERAL CONFORMANCE WITH CITY OF AURORA DESIGN CRITERIA AND THE CITY CODE. THE CITY IS NOT RESPONSIBLE FOR THE ACCURACY AND ADEQUACY OF THE DESIGN, OF DIMENSIONS AND ELEVATIONS WHICH SHALL BE CONFIRMED AND CORRELATED AT THE JOB SITE. THE CITY OF AURORA, THROUGH THE APPROVAL OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT.

GRAPHIC SCALE
0 25 50 100 150
1 INCH = 50 FEET

DEVELOPER
CLAYTON PROPERTIES GROUP II, INC.
4908 TOWER ROAD
DENVER, COLORADO 80249
PHONE: (303) 486-8500
CONTACT: RANDY BAUER

EMK CONSULTANTS, INC.
LAND DEVELOPMENT
ENGINEERING SURVEYING
7006 SOUTH ALTON WAY, BLDG. F
CENTENNIAL, COLORADO 80112-2019
(303)694-1520
www.EMKC.com

SCALE VERIFICATION BAR IS ONE INCH ON ORIGINAL DRAWING
0 — 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY

811 Know what's below. Call before you dig.

BENCHMARK
CITY OF AURORA BENCHMARK 5S6633NE002 (FKA 20-060) 3 INCH DIAMETER BRASS CAP ON 30 INCH LONG STEEL PIPE IN CONCRETE, APPROXIMATELY 0.4 FEET ABOVE GROUND SURFACE, 0.7 FEET NORTH OF EAST/WEST 4 STRAND BARBED WIRE FENCE, AND 22.7 FEET WEST EAST 1/4 SECTION 33, T5S, R66W NAVD 88 ELEVATION 5861.04

REVISIONS

NO.	DESCRIPTION	DATE	BY

DESIGNED BY: DJO
DRAWN BY: DJO
CHECKED BY: BOM
APPROVED BY: BOM

KINGS POINT NORTH WEST INFRASTRUCTURE

PRELIMINARY DRAINAGE MAP

DATE: 05/27/2022
JOB NO: 12187.61
SCALE HORIZONTAL 1" = 50'
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