PRELIMINARY DRAINAGE REPORT
FOR
DUKE – STATE STREET
INDUSTRIAL PROJECT SITE

CITY OF ONTARIO
CALIFORNIA

PREPARED FOR:

DUKE REALTY
200 SPECTRUM CENTER DRIVE, SUITE 1600
IRVINE, CA 92618

PREPARED BY:

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FEBRUARY 4, 2022
REVISED: APRIL 28, 2022

This report has been prepared by or under the direction of the following registered civil engineer who attests to the technical information contained herein. The registered civil engineer has also judged the qualifications of any technical specialists providing engineering data upon which recommendations, conclusions, and decisions are based.

04/28/2022

Joseph L. Castaneda RCE 59835 Registered Civil Engineer	Date	Seal

TABLE OF CONTENTS

FIGURES

APPENDICES

EXCERPTS

EXHIBITS

I. PURPOSE AND SCOPE

The purpose of this study is to evaluate the drainage patterns and potential runoff for the Duke – State Street project. The project is redeveloping an industrial site within the City of Ontario.

The scope of the study includes the following:

1. Assess the preliminary grading and determine the drainage areas and patterns for the project site.
2. Perform the post-project condition hydrology analyses for the overall project site utilizing the San Bernardino County Hydrology Manual.
3. Develop a drainage concept plan that is consistent with the hydrology and storm drain Determine the necessary storm drain improvements to convey the post-project condition flow rate.
4. Preparation of a hydrology and hydraulics report, which consists of hydrological and analytical results and exhibits.

II. PROJECT SITE AND DRAINAGE AREA OVERVIEW

Duke – State Street is a proposed industrial project in the City of Ontario. The project site is bounded by Bon View Avenue to the east, State Street to the south, Campus Avenue to the west, and railroad tracks to the north, see Figure 1. The project site is south of Emporia Street. The project site is approximately 16 acres.

The project site is located within the City of Ontario's Master Drainage Plan (MDP) watershed Area V, shown on Excerpt D. The proposed land use of industrial condition is consistent with the City of Ontario Land Use Plan, shown on Excerpt C. Based on the MDP hydrology map (Excerpt D), the project site is proposed to convey flows to a 42" storm drain system located along Bon View Avenue. The Bon View Avenue storm drain system discharges into the East State Street Storm Drain system located along State Street and Ontario Boulevard, see Figure 2. The Bon View Avenue storm drain and East State Street storm drain are MDP facilities as shown on the MDP existing facilities map, included as Excerpt E, and the MDP proposed facilities map, included as Excerpt F.

The Duke – State Street project is proposed to discharge runoff into the Bon View Avenue storm drain. This is consistent with the City of Ontario Master Drainage Plan. The MDP storm drain facilities are designed for the ultimate land use. Therefore, the project does not need to mitigate for increased runoff. Furthermore, based on the County of San Bernardino Stormwater Facility Mapping Tool, the project is exempt from HCOC mitigation.

The project site consists of one subsurface system for water quality storage and infiltration.

III. HYDROLOGY

The San Bernardino County Hydrology Manual (Reference 1) was used to develop the hydrological parameters for the hydrology analyses. The rational method was used for the analyses and the computations were performed using the computer program developed by Civil Cadd/Civil Design.

Rainfall depths were obtained from NOAA Atlas 14, included as Excerpt B. The rainfall depths used in the hydrology calculations are as follows:

Storm Event & Duration	Rainfall (inches)
10-Year, 1-Hour	0.94
100-Year, 1-Hour	1.42
Slope of Intensity	0.6

The existing soil classification for the project site consists of hydraulic Soil Groups "A" as shown in Excerpt A. Excerpt A is a Soils Map obtained from the National Resource Conservation Service Websoil Survey. An Antecedent Moisture Condition of II was used for 10-year rational method calculations. An Antecedent Moisture Condition of III was used for 100-year rational method calculations.

A land cover type of "Commercial" was used for all areas within the project site which categorizes the watershed area as 90% impervious.

The project site is 16.4 acres represented by Area A, see Exhibit A. Area A consists of ten sub-areas. A rational method analysis of Area A was performed for the 10-year and 100-year storm events. The results of the rational method are as follows:

Area	10-Year		100- Year	
	T_c (min)	Q_{100} (ft^3/s)	T_c (min)	Q_{100} (ft^3/s)
Area A	6.9	37.9	6.9	57.9

The rational method hydrology calculations have been included in Appendix A. The rational method hydrology map has been included as Exhibit A.

IV. HYDRAULICS

A drainage facilities map has been provided for the project site, see Exhibit B.

The runoff from the project site is collected by inlets located within the project site. Runoff collected by the inlets is conveyed to Subsurface System 1 through Line A through Line K. Subsurface System 1 is designed to treat the water quality volume for the project site. Line 1 is designed for the 100-year flow rate for the project site area and conveys flows from Subsurface System 1 to the Bon View Avenue storm drain.

The storm drain systems were sized based on the 100-year flow rates per the rational method hydrology analysis. The FlowMaster program was used to calculate the capacity of pipes with a percent full of 75% or less to account for hydraulic losses. This calculation was performed for different pipe sizes. The resulting flow rates were used as maximum flow rates for a given pipe size. This information was used to size the proposed storm drain systems. The pipe sizing calculations are included in Appendix B.

The water quality volume is 77,083 ft^3 for the project site and Subsurface System 1 provides 77,220 ft^3 of storage volume. The subsurface system sizing calculation is included in Appendix C.

V. FINDINGS

The hydrology analysis evaluated the proposed industrial development to assess the drainage patterns and storm drain systems. It has been concluded that:

1. The proposed land use of industrial for the project site is consistent with the City of Ontario Land Use Plan.
2. The project site is located within the City of Ontario Master Drainage Plan, which is designed for the ultimate land use condition.
3. The project will discharge into a City of Ontario Master Drainage Plan storm drain facility. Therefore the project does not need to mitigate for increased runoff.
4. Based on the County of San Bernardino Stormwater Facilities Mapping Tool, the project site is exempt from HCOC mitigation.
5. The proposed storm drain systems are sized to adequately convey the 100-year flow rates.
6. The proposed subsurface system is sized to adequately treat the water quality volume emanating from the project site.

VI. REFERENCES

1. San Bernardino Flood Control Hydrology Manual, August 1986.

FIGURES

FIGURE 1: VICINITY MAP

VICINITY MAP

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FIGURE 1

Drawing Name: O:\265.19.22\Engineering\Hydrology_Plan\Exhibits\FIGURE-1-VICINITY-MAP.dwg
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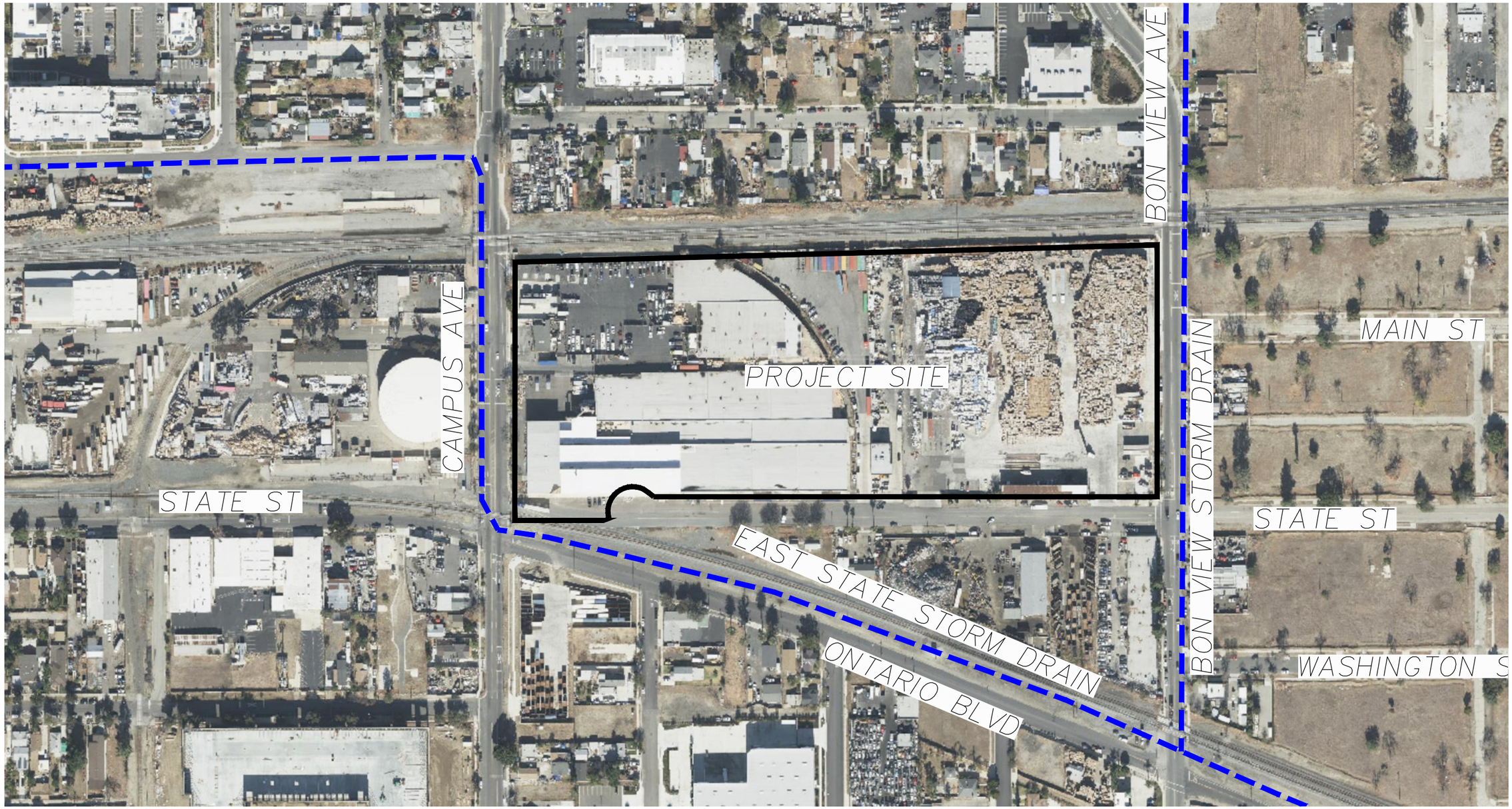
FIGURE 2: EXISTING STORM DRAIN FACILITIES



REGIONAL STORM DRAIN FACILITIES

NOTE: THE LOCATION OF STORM DRAIN FACILITIES ARE APPROXIMATELY SHOWN

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FIGURE 2

Drawing Name: O:\265.19.22\Engineering\Hydrology_Plan\Exhibits\FIGURE-2-REGIOANL SD FACILITIES.dwg
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APPENDICES

APPENDIX A: RATIONAL METHOD HYDROLOGY CALCULATIONS

APPENDIX A.1: RATIONAL METHOD ANALYSIS, AREAS "A" – 10-YEAR EVENT

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2014 Version 9.0
Rational Hydrology Study Date: 04/27/22

265.19.22 - DUKE - STATE STREET
AREA A - 10 YEAR STORM EVENT
RATIONAL METHOD ANALYSIS

Program License Serial Number 6279

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 10.0
Computed rainfall intensity:
Storm year = 10.00 1 hour rainfall = 0.940 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
Initial subarea data:
Initial area flow distance = 629.000(Ft.)
Top (of initial area) elevation = 984.000(Ft.)
Bottom (of initial area) elevation = 981.600(Ft.)
Difference in elevation = 2.400(Ft.)
Slope = 0.00382 s(%)= 0.38
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 12.191 min.
Rainfall intensity = 2.446(In/Hr) for a 10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.864
Subarea runoff = 5.072(CFS)
Total initial stream area = 2.400(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.098(In/Hr)

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Process from Point/Station 102.000 to Point/Station 105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

```
Upstream point/station elevation =   976.900(Ft.)
Downstream point/station elevation =   974.900(Ft.)
Pipe length  =   409.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     5.072(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     5.072(CFS)
Normal flow depth in pipe =   10.99(In.)
Flow top width inside pipe =   17.55(In.)
Critical Depth =   10.39(In.)
Pipe flow velocity =      4.48(Ft/s)
Travel time through pipe =    1.52 min.
Time of concentration (TC) =    13.71 min.


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Process from Point/Station      102.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.400(Ac.)
Runoff from this stream =      5.072(CFS)
Time of concentration =   13.71 min.
Rainfall intensity =     2.279(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      103.000 to Point/Station      104.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   584.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   978.000(Ft.)
Difference in elevation =     6.000(Ft.)
Slope =    0.01027  s(%)=       1.03
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.707 min.
Rainfall intensity =      2.804(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.869
Subarea runoff =      2.070(CFS)
Total initial stream area =        0.850(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   975.000(Ft.)
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Downstream point/station elevation =   974.900(Ft.)
Pipe length  =     9.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.070(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.070(CFS)
Normal flow depth in pipe =    6.36(In.)
Flow top width inside pipe =   11.98(In.)
Critical Depth =    7.38(In.)
Pipe flow velocity =      4.90(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     9.74 min.


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Process from Point/Station      104.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.850(Ac.)
Runoff from this stream =      2.070(CFS)
Time of concentration =    9.74 min.
Rainfall intensity =     2.799(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min) (In/Hr)     (In/Hr)


1      5.07     2.400     13.71    0.098      2.279
2      2.07     0.850      9.74    0.098      2.799
Qmax(1) =
         1.000 *    1.000 *     5.072) +
         0.808 *    1.000 *     2.070) + =       6.744
Qmax(2) =
         1.238 *    0.710 *     5.072) +
         1.000 *    1.000 *     2.070) + =       6.530

Total of 2 streams to confluence:
Flow rates before confluence point:
       5.072       2.070
Maximum flow rates at confluence using above data:
        6.744        6.530
Area of streams before confluence:
        2.400        0.850
Effective area values after confluence:
        3.250        2.555
Results of confluence:
Total flow rate =      6.744(CFS)
Time of concentration =    13.711 min.
Effective stream area after confluence =      3.250(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =       3.25(Ac.)


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Process from Point/Station      105.000 to Point/Station      108.000
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**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   974.900(Ft.)
Downstream point/station elevation =   974.400(Ft.)
Pipe length  =    89.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.744(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.744(CFS)
Normal flow depth in pipe =   12.82(In.)
Flow top width inside pipe =   16.30(In.)
Critical Depth =   12.05(In.)
Pipe flow velocity =      5.01(Ft/s)
Travel time through pipe =    0.30 min.
Time of concentration (TC) =    14.01 min.


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Process from Point/Station      105.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      3.250(Ac.)
Runoff from this stream =      6.744(CFS)
Time of concentration =   14.01 min.
Rainfall intensity =     2.250(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      106.000 to Point/Station      107.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   316.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   976.100(Ft.)
Difference in elevation =     7.900(Ft.)
Slope =    0.02500  s(%)=       2.50
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.356 min.
Rainfall intensity =      3.615(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.876
Subarea runoff =      4.020(CFS)
Total initial stream area =        1.270(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      107.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
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Upstream point/station elevation =   974.500(Ft.)
Downstream point/station elevation =   974.400(Ft.)
Pipe length  =     7.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.020(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     4.020(CFS)
Normal flow depth in pipe =    9.28(In.)
Flow top width inside pipe =   10.05(In.)
Critical Depth =   10.19(In.)
Pipe flow velocity =      6.17(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =     6.37 min.


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Process from Point/Station      107.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.270(Ac.)
Runoff from this stream =      4.020(CFS)
Time of concentration =    6.37 min.
Rainfall intensity =     3.609(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min)  (In/Hr)     (In/Hr)


1      6.74     3.250     14.01    0.098      2.250
2      4.02     1.270      6.37    0.098      3.609
Qmax(1) =
         1.000 *    1.000 *     6.744) +
         0.613 *    1.000 *     4.020) + =       9.208
Qmax(2) =
         1.631 *    0.455 *     6.744) +
         1.000 *    1.000 *     4.020) + =       9.026

Total of 2 streams to confluence:
Flow rates before confluence point:
       6.744       4.020
Maximum flow rates at confluence using above data:
        9.208        9.026
Area of streams before confluence:
        3.250        1.270
Effective area values after confluence:
        4.520        2.749
Results of confluence:
Total flow rate =      9.208(CFS)
Time of concentration =    14.007 min.
Effective stream area after confluence =      4.520(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =       4.52(Ac.)
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Process from Point/Station      108.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------------
Upstream point/station elevation =   974.400(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =   215.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.208(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     9.208(CFS)
Normal flow depth in pipe =   12.23(In.)
Flow top width inside pipe =   11.63(In.)
Critical Depth =   13.95(In.)
Pipe flow velocity =      8.58(Ft/s)
Travel time through pipe =    0.42 min.
Time of concentration (TC) =    14.42 min.


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Process from Point/Station      108.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.520(Ac.)
Runoff from this stream =      9.208(CFS)
Time of concentration =   14.42 min.
Rainfall intensity =     2.211(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      109.000 to Point/Station      110.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   381.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   975.800(Ft.)
Difference in elevation =     8.200(Ft.)
Slope =    0.02152  s(%)=       2.15
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.058 min.
Rainfall intensity =      3.395(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.874
Subarea runoff =      4.392(CFS)
Total initial stream area =        1.480(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      110.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   970.200(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.392(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.392(CFS)
Normal flow depth in pipe =   10.45(In.)
Flow top width inside pipe =   13.79(In.)
Critical Depth =   10.18(In.)
Pipe flow velocity =      4.81(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     7.16 min.


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Process from Point/Station      110.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.480(Ac.)
Runoff from this stream =      4.392(CFS)
Time of concentration =    7.16 min.
Rainfall intensity =     3.365(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      112.000 to Point/Station      113.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   358.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   976.000(Ft.)
Difference in elevation =     8.000(Ft.)
Slope =    0.02235  s(%)=       2.23
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.833 min.
Rainfall intensity =      3.462(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.875
Subarea runoff =      6.115(CFS)
Total initial stream area =        2.020(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      113.000 to Point/Station      125.000
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**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   970.200(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.115(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.115(CFS)
Normal flow depth in pipe =   11.24(In.)
Flow top width inside pipe =   17.43(In.)
Critical Depth =   11.46(In.)
Pipe flow velocity =      5.27(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     6.93 min.


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Process from Point/Station      113.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      2.020(Ac.)
Runoff from this stream =      6.115(CFS)
Time of concentration =    6.93 min.
Rainfall intensity =     3.433(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      114.000 to Point/Station      115.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   338.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   976.000(Ft.)
Difference in elevation =     8.000(Ft.)
Slope =    0.02367  s(%)=       2.37
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.601 min.
Rainfall intensity =      3.534(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.875
Subarea runoff =      4.577(CFS)
Total initial stream area =        1.480(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      115.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
```

```
Upstream point/station elevation =   970.200(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.577(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.577(CFS)
Normal flow depth in pipe =   10.80(In.)
Flow top width inside pipe =   13.47(In.)
Critical Depth =   10.41(In.)
Pipe flow velocity =      4.84(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     6.70 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      115.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 4
Stream flow area =      1.480(Ac.)
Runoff from this stream =      4.577(CFS)
Time of concentration =    6.70 min.
Rainfall intensity =     3.501(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      116.000 to Point/Station      117.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   370.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   976.700(Ft.)
Difference in elevation =     7.300(Ft.)
Slope =    0.01973  s(%)=       1.97
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.098 min.
Rainfall intensity =      3.383(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.874
Subarea runoff =      4.465(CFS)
Total initial stream area =        1.510(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      117.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
```

```
Upstream point/station elevation =   970.200(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     4.465(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     4.465(CFS)
Normal flow depth in pipe =   10.59(In.)
Flow top width inside pipe =   13.66(In.)
Critical Depth =   10.28(In.)
Pipe flow velocity =      4.82(Ft/s)
Travel time through pipe =    0.10 min.
Time of concentration (TC) =     7.20 min.


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Process from Point/Station      117.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 5
Stream flow area =      1.510(Ac.)
Runoff from this stream =      4.465(CFS)
Time of concentration =    7.20 min.
Rainfall intensity =     3.354(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min)  (In/Hr)     (In/Hr)


1      9.21     4.520     14.42    0.098      2.211
2      4.39     1.480      7.16    0.098      3.365
3      6.12     2.020      6.93    0.098      3.433
4      4.58     1.480      6.70    0.098      3.501
5      4.47     1.510      7.20    0.098      3.354
Qmax(1) =
         1.000 *    1.000 *     9.208) +
         0.647 *    1.000 *     4.392) +
         0.634 *    1.000 *     6.115) +
         0.621 *    1.000 *     4.577) +
         0.649 *    1.000 *     4.465) + =      21.662
Qmax(2) =
         1.546 *    0.496 *     9.208) +
         1.000 *    1.000 *     4.392) +
         0.980 *    1.000 *     6.115) +
         0.960 *    1.000 *     4.577) +
         1.003 *    0.994 *     4.465) + =      26.302
Qmax(3) =
         1.578 *    0.480 *     9.208) +
         1.021 *    0.967 *     4.392) +
         1.000 *    1.000 *     6.115) +
         0.980 *    1.000 *     4.577) +
         1.024 *    0.962 *     4.465) + =      26.316
Qmax(4) =
         1.611 *    0.465 *     9.208) +
         1.042 *    0.936 *     4.392) +
         1.020 *    0.968 *     6.115) +
         1.000 *    1.000 *     4.577) +
```

```
         1.045 *    0.931 *     4.465) + =      26.136
Qmax(5) =
         1.541 *    0.499 *     9.208) +
         0.997 *    1.000 *     4.392) +
         0.976 *    1.000 *     6.115) +
         0.957 *    1.000 *     4.577) +
         1.000 *    1.000 *     4.465) + =      26.276

Total of 5 streams to confluence:
Flow rates before confluence point:
       9.208       4.392       6.115       4.577       4.465
Maximum flow rates at confluence using above data:
       21.662      26.302      26.316      26.136      26.276
Area of streams before confluence:
        4.520       1.480       2.020       1.480       1.510
Effective area values after confluence:
       11.010       8.726       8.555       8.327       8.747
Results of confluence:
Total flow rate =     26.316(CFS)
Time of concentration =     6.927 min.
Effective stream area after confluence =      8.555(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =      11.01(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      117.000 to Point/Station      125.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      8.555(Ac.)
Runoff from this stream =     26.316(CFS)
Time of concentration =    6.93 min.
Rainfall intensity =     3.433(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


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Process from Point/Station      118.000 to Point/Station      119.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   531.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   981.300(Ft.)
Difference in elevation =     2.700(Ft.)
Slope =    0.00508  s(%)=       0.51
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
```

```
Initial area time of concentration =   10.756 min.
Rainfall intensity =      2.636(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.867
Subarea runoff =      6.306(CFS)
Total initial stream area =        2.760(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      119.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   979.100(Ft.)
Downstream point/station elevation =   975.400(Ft.)
Pipe length  =   730.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.306(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.306(CFS)
Normal flow depth in pipe =   12.67(In.)
Flow top width inside pipe =   16.44(In.)
Critical Depth =   11.66(In.)
Pipe flow velocity =      4.74(Ft/s)
Travel time through pipe =    2.56 min.
Time of concentration (TC) =    13.32 min.


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Process from Point/Station      119.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      2.760(Ac.)
Runoff from this stream =      6.306(CFS)
Time of concentration =   13.32 min.
Rainfall intensity =     2.319(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      120.000 to Point/Station      121.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   295.000(Ft.)
Top (of initial area) elevation =   984.300(Ft.)
Bottom (of initial area) elevation =   982.300(Ft.)
Difference in elevation =     2.000(Ft.)
Slope =    0.00678  s(%)=       0.68
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.027 min.
```

```
Rainfall intensity =      3.143(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.872
Subarea runoff =      1.398(CFS)
Total initial stream area =        0.510(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      121.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   975.500(Ft.)
Downstream point/station elevation =   975.400(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     1.398(CFS)
Nearest computed pipe diameter  =      9.00(In.)
Calculated individual pipe flow  =     1.398(CFS)
Normal flow depth in pipe =    6.34(In.)
Flow top width inside pipe =    8.21(In.)
Critical Depth =    6.53(In.)
Pipe flow velocity =      4.20(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     8.07 min.


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Process from Point/Station      121.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.510(Ac.)
Runoff from this stream =      1.398(CFS)
Time of concentration =    8.07 min.
Rainfall intensity =     3.133(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min) (In/Hr)     (In/Hr)


1      6.31     2.760     13.32    0.098      2.319
2      1.40     0.510      8.07    0.098      3.133
Qmax(1) =
         1.000 *    1.000 *     6.306) +
         0.732 *    1.000 *     1.398) + =       7.329
Qmax(2) =
         1.367 *    0.606 *     6.306) +
         1.000 *    1.000 *     1.398) + =       6.616

Total of 2 streams to confluence:
Flow rates before confluence point:
       6.306       1.398
Maximum flow rates at confluence using above data:
        7.329        6.616
Area of streams before confluence:
        2.760        0.510
```

```
Effective area values after confluence:
        3.270        2.181
Results of confluence:
Total flow rate =      7.329(CFS)
Time of concentration =    13.321 min.
Effective stream area after confluence =      3.270(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =       3.27(Ac.)


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Process from Point/Station      122.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   975.400(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =   440.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.329(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     7.329(CFS)
Normal flow depth in pipe =   10.36(In.)
Flow top width inside pipe =   17.79(In.)
Critical Depth =   12.59(In.)
Pipe flow velocity =      6.96(Ft/s)
Travel time through pipe =    1.05 min.
Time of concentration (TC) =    14.37 min.


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Process from Point/Station      122.000 to Point/Station      125.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.270(Ac.)
Runoff from this stream =      7.329(CFS)
Time of concentration =   14.37 min.
Rainfall intensity =     2.215(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 3


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Process from Point/Station      123.000 to Point/Station      124.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   350.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   978.200(Ft.)
```

```
Difference in elevation =     5.800(Ft.)
Slope =    0.01657  s(%)=       1.66
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.188 min.
Rainfall intensity =      3.358(In/Hr) for a    10.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.874
Subarea runoff =      6.220(CFS)
Total initial stream area =        2.120(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      124.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   970.600(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =   120.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.220(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.220(CFS)
Normal flow depth in pipe =   12.61(In.)
Flow top width inside pipe =   16.49(In.)
Critical Depth =   11.57(In.)
Pipe flow velocity =      4.71(Ft/s)
Travel time through pipe =    0.42 min.
Time of concentration (TC) =     7.61 min.


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Process from Point/Station      124.000 to Point/Station      125.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      2.120(Ac.)
Runoff from this stream =      6.220(CFS)
Time of concentration =    7.61 min.
Rainfall intensity =     3.244(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area     TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min) (In/Hr)     (In/Hr)


1     26.32     8.555      6.93    0.098      3.433
2      7.33     3.270     14.37    0.098      2.215
3      6.22     2.120      7.61    0.098      3.244
Qmax(1) =
         1.000 *    1.000 *    26.316) +
         1.575 *    0.482 *     7.329) +
         1.060 *    0.910 *     6.220) + =      37.878
Qmax(2) =
         0.635 *    1.000 *    26.316) +
         1.000 *    1.000 *     7.329) +
         0.673 *    1.000 *     6.220) + =      28.225
```

```
Qmax(3) =
         0.943 *    1.000 *    26.316) +
         1.486 *    0.530 *     7.329) +
         1.000 *    1.000 *     6.220) + =      36.811

Total of 3 main streams to confluence:
Flow rates before confluence point:
      27.316       8.329       7.220
Maximum flow rates at confluence using above data:
       37.878       28.225       36.811
Area of streams before confluence:
        8.555        3.270        2.120
Effective area values after confluence:
       12.060       13.945       12.407


Results of confluence:
Total flow rate =     37.878(CFS)
Time of concentration =     6.927 min.
Effective stream area after confluence  =     12.060(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total =      13.94(Ac.)
End of computations, Total Study Area =           16.40 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number =  32.0
```

APPENDIX A.2: RATIONAL METHOD ANALYSIS, AREAS "A" – 100-YEAR EVENT

San Bernardino County Rational Hydrology Program

(Hydrology Manual Date - August 1986)

CIVILCADD/CIVILDESIGN Engineering Software, (c) 1989-2014 Version 9.0
Rational Hydrology Study Date: 04/27/22

265.19.22 - DUKE - STATE STREET
AREA A - 100 YEAR STORM EVENT
RATIONAL METHOD ANALYSIS

Program License Serial Number 6279

********* Hydrology Study Control Information **********

Rational hydrology study storm event year is 100.0
Computed rainfall intensity:
Storm year = 100.00 1 hour rainfall = 1.420 (In.)
Slope used for rainfall intensity curve b = 0.6000
Soil antecedent moisture condition (AMC) = 2

++
Process from Point/Station 101.000 to Point/Station 102.000
**** INITIAL AREA EVALUATION ****

COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2) = 32.00
Pervious ratio(Ap) = 0.1000 Max loss rate(Fm)= 0.098(In/Hr)
Initial subarea data:
Initial area flow distance = 629.000(Ft.)
Top (of initial area) elevation = 984.000(Ft.)
Bottom (of initial area) elevation = 981.600(Ft.)
Difference in elevation = 2.400(Ft.)
Slope = 0.00382 s(%)= 0.38
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration = 12.191 min.
Rainfall intensity = 3.695(In/Hr) for a 100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.876
Subarea runoff = 7.769(CFS)
Total initial stream area = 2.400(Ac.)
Pervious area fraction = 0.100
Initial area Fm value = 0.098(In/Hr)

++
Process from Point/Station 102.000 to Point/Station 105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****

```
Upstream point/station elevation =   976.900(Ft.)
Downstream point/station elevation =   974.900(Ft.)
Pipe length  =   409.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     7.769(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     7.769(CFS)
Normal flow depth in pipe =   12.96(In.)
Flow top width inside pipe =   20.42(In.)
Critical Depth =   12.39(In.)
Pipe flow velocity =      4.99(Ft/s)
Travel time through pipe =    1.37 min.
Time of concentration (TC) =    13.56 min.


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Process from Point/Station      102.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      2.400(Ac.)
Runoff from this stream =      7.769(CFS)
Time of concentration =   13.56 min.
Rainfall intensity =     3.466(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      103.000 to Point/Station      104.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   584.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   978.000(Ft.)
Difference in elevation =     6.000(Ft.)
Slope =    0.01027  s(%)=       1.03
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    9.707 min.
Rainfall intensity =      4.236(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.879
Subarea runoff =      3.166(CFS)
Total initial stream area =        0.850(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      104.000 to Point/Station      105.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   975.000(Ft.)
```

```
Downstream point/station elevation =   974.900(Ft.)
Pipe length  =     9.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     3.166(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     3.166(CFS)
Normal flow depth in pipe =    8.44(In.)
Flow top width inside pipe =   10.97(In.)
Critical Depth =    9.14(In.)
Pipe flow velocity =      5.36(Ft/s)
Travel time through pipe =    0.03 min.
Time of concentration (TC) =     9.74 min.


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Process from Point/Station      104.000 to Point/Station      105.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      0.850(Ac.)
Runoff from this stream =      3.166(CFS)
Time of concentration =    9.74 min.
Rainfall intensity =     4.228(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min) (In/Hr)     (In/Hr)


1      7.77     2.400     13.56    0.098      3.466
2      3.17     0.850      9.74    0.098      4.228
Qmax(1) =
         1.000 *    1.000 *     7.769) +
         0.816 *    1.000 *     3.166) + =      10.351
Qmax(2) =
         1.226 *    0.718 *     7.769) +
         1.000 *    1.000 *     3.166) + =      10.006

Total of 2 streams to confluence:
Flow rates before confluence point:
       7.769       3.166
Maximum flow rates at confluence using above data:
       10.351       10.006
Area of streams before confluence:
        2.400        0.850
Effective area values after confluence:
        3.250        2.573
Results of confluence:
Total flow rate =     10.351(CFS)
Time of concentration =    13.558 min.
Effective stream area after confluence =      3.250(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =       3.25(Ac.)


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Process from Point/Station      105.000 to Point/Station      108.000
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**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   974.900(Ft.)
Downstream point/station elevation =   974.400(Ft.)
Pipe length  =    89.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    10.351(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =    10.351(CFS)
Normal flow depth in pipe =   15.16(In.)
Flow top width inside pipe =   18.81(In.)
Critical Depth =   14.39(In.)
Pipe flow velocity =      5.56(Ft/s)
Travel time through pipe =    0.27 min.
Time of concentration (TC) =    13.82 min.


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Process from Point/Station      105.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      3.250(Ac.)
Runoff from this stream =     10.351(CFS)
Time of concentration =   13.82 min.
Rainfall intensity =     3.426(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      106.000 to Point/Station      107.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   316.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   976.100(Ft.)
Difference in elevation =     7.900(Ft.)
Slope =    0.02500  s(%)=       2.50
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.356 min.
Rainfall intensity =      5.461(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.884
Subarea runoff =      6.130(CFS)
Total initial stream area =        1.270(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      107.000 to Point/Station      108.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
```

```
Upstream point/station elevation =   974.500(Ft.)
Downstream point/station elevation =   974.400(Ft.)
Pipe length  =     7.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.130(CFS)
Nearest computed pipe diameter  =     15.00(In.)
Calculated individual pipe flow  =     6.130(CFS)
Normal flow depth in pipe =   10.09(In.)
Flow top width inside pipe =   14.08(In.)
Critical Depth =   12.01(In.)
Pipe flow velocity =      6.98(Ft/s)
Travel time through pipe =    0.02 min.
Time of concentration (TC) =     6.37 min.


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Process from Point/Station      107.000 to Point/Station      108.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.270(Ac.)
Runoff from this stream =      6.130(CFS)
Time of concentration =    6.37 min.
Rainfall intensity =     5.453(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min)  (In/Hr)     (In/Hr)


1     10.35     3.250     13.82    0.098      3.426
2      6.13     1.270      6.37    0.098      5.453
Qmax(1) =
         1.000 *    1.000 *    10.351) +
         0.622 *    1.000 *     6.130) + =      14.161
Qmax(2) =
         1.609 *    0.461 *    10.351) +
         1.000 *    1.000 *     6.130) + =      13.806

Total of 2 streams to confluence:
Flow rates before confluence point:
      10.351       6.130
Maximum flow rates at confluence using above data:
       14.161       13.806
Area of streams before confluence:
        3.250        1.270
Effective area values after confluence:
        4.520        2.768
Results of confluence:
Total flow rate =     14.161(CFS)
Time of concentration =    13.824 min.
Effective stream area after confluence =      4.520(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =       4.52(Ac.)
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Process from Point/Station      108.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   974.400(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =   215.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    14.161(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =    14.161(CFS)
Normal flow depth in pipe =   13.90(In.)
Flow top width inside pipe =   15.10(In.)
Critical Depth =   16.63(In.)
Pipe flow velocity =      9.67(Ft/s)
Travel time through pipe =    0.37 min.
Time of concentration (TC) =    14.19 min.


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Process from Point/Station      108.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 1
Stream flow area =      4.520(Ac.)
Runoff from this stream =     14.161(CFS)
Time of concentration =   14.19 min.
Rainfall intensity =     3.372(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      109.000 to Point/Station      110.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   381.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   975.800(Ft.)
Difference in elevation =     8.200(Ft.)
Slope =    0.02152  s(%)=       2.15
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.058 min.
Rainfall intensity =      5.128(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.883
Subarea runoff =      6.701(CFS)
Total initial stream area =        1.480(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      110.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   970.200(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.701(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.701(CFS)
Normal flow depth in pipe =   11.98(In.)
Flow top width inside pipe =   16.99(In.)
Critical Depth =   12.02(In.)
Pipe flow velocity =      5.37(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     7.15 min.


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Process from Point/Station      110.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 2
Stream flow area =      1.480(Ac.)
Runoff from this stream =      6.701(CFS)
Time of concentration =    7.15 min.
Rainfall intensity =     5.088(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      112.000 to Point/Station      113.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   358.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   976.000(Ft.)
Difference in elevation =     8.000(Ft.)
Slope =    0.02235  s(%)=       2.23
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.833 min.
Rainfall intensity =      5.229(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.883
Subarea runoff =      9.329(CFS)
Total initial stream area =        2.020(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      113.000 to Point/Station      125.000
```

```
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   970.200(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.329(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     9.329(CFS)
Normal flow depth in pipe =   13.21(In.)
Flow top width inside pipe =   20.29(In.)
Critical Depth =   13.63(In.)
Pipe flow velocity =      5.86(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     6.92 min.


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Process from Point/Station      113.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 3
Stream flow area =      2.020(Ac.)
Runoff from this stream =      9.329(CFS)
Time of concentration =    6.92 min.
Rainfall intensity =     5.190(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      114.000 to Point/Station      115.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   338.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   976.000(Ft.)
Difference in elevation =     8.000(Ft.)
Slope =    0.02367  s(%)=       2.37
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    6.601 min.
Rainfall intensity =      5.338(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.884
Subarea runoff =      6.981(CFS)
Total initial stream area =        1.480(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      115.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
```

```
Upstream point/station elevation =   970.200(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.981(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.981(CFS)
Normal flow depth in pipe =   12.33(In.)
Flow top width inside pipe =   16.72(In.)
Critical Depth =   12.28(In.)
Pipe flow velocity =      5.41(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     6.69 min.


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Process from Point/Station      115.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 4
Stream flow area =      1.480(Ac.)
Runoff from this stream =      6.981(CFS)
Time of concentration =    6.69 min.
Rainfall intensity =     5.294(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      116.000 to Point/Station      117.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   370.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   976.700(Ft.)
Difference in elevation =     7.300(Ft.)
Slope =    0.01973  s(%)=       1.97
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.098 min.
Rainfall intensity =      5.111(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.883
Subarea runoff =      6.813(CFS)
Total initial stream area =        1.510(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      117.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
```

```
Upstream point/station elevation =   970.200(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =    30.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     6.813(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =     6.813(CFS)
Normal flow depth in pipe =   12.12(In.)
Flow top width inside pipe =   16.89(In.)
Critical Depth =   12.12(In.)
Pipe flow velocity =      5.39(Ft/s)
Travel time through pipe =    0.09 min.
Time of concentration (TC) =     7.19 min.


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Process from Point/Station      117.000 to Point/Station      125.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 1 in normal stream number 5
Stream flow area =      1.510(Ac.)
Runoff from this stream =      6.813(CFS)
Time of concentration =    7.19 min.
Rainfall intensity =     5.071(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min)  (In/Hr)     (In/Hr)


1     14.16     4.520     14.19    0.098      3.372
2      6.70     1.480      7.15    0.098      5.088
3      9.33     2.020      6.92    0.098      5.190
4      6.98     1.480      6.69    0.098      5.294
5      6.81     1.510      7.19    0.098      5.071
Qmax(1) =
         1.000 *    1.000 *    14.161) +
         0.656 *    1.000 *     6.701) +
         0.643 *    1.000 *     9.329) +
         0.630 *    1.000 *     6.981) +
         0.658 *    1.000 *     6.813) + =      33.439
Qmax(2) =
         1.524 *    0.504 *    14.161) +
         1.000 *    1.000 *     6.701) +
         0.980 *    1.000 *     9.329) +
         0.960 *    1.000 *     6.981) +
         1.003 *    0.994 *     6.813) + =      40.217
Qmax(3) =
         1.555 *    0.487 *    14.161) +
         1.020 *    0.967 *     6.701) +
         1.000 *    1.000 *     9.329) +
         0.980 *    1.000 *     6.981) +
         1.024 *    0.962 *     6.813) + =      40.230
Qmax(4) =
         1.587 *    0.472 *    14.161) +
         1.041 *    0.936 *     6.701) +
         1.020 *    0.968 *     9.329) +
         1.000 *    1.000 *     6.981) +
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```
         1.045 *    0.931 *     6.813) + =      39.944
Qmax(5) =
         1.519 *    0.507 *    14.161) +
         0.997 *    1.000 *     6.701) +
         0.977 *    1.000 *     9.329) +
         0.957 *    1.000 *     6.981) +
         1.000 *    1.000 *     6.813) + =      40.179

Total of 5 streams to confluence:
Flow rates before confluence point:
      14.161       6.701       9.329       6.981       6.813
Maximum flow rates at confluence using above data:
       33.439       40.217       40.230       39.944       40.179
Area of streams before confluence:
        4.520        1.480        2.020        1.480        1.510
Effective area values after confluence:
       11.010        8.759        8.587        8.357        8.780
Results of confluence:
Total flow rate =     40.230(CFS)
Time of concentration =     6.918 min.
Effective stream area after confluence =      8.587(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =      11.01(Ac.)


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Process from Point/Station      117.000 to Point/Station      125.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 1
Stream flow area =      8.587(Ac.)
Runoff from this stream =     40.230(CFS)
Time of concentration =    6.92 min.
Rainfall intensity =     5.190(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 2


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Process from Point/Station      118.000 to Point/Station      119.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   531.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   981.300(Ft.)
Difference in elevation =     2.700(Ft.)
Slope =    0.00508  s(%)=       0.51
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
```

```
Initial area time of concentration =   10.756 min.
Rainfall intensity =      3.983(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.878
Subarea runoff =      9.650(CFS)
Total initial stream area =        2.760(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      119.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   979.100(Ft.)
Downstream point/station elevation =   975.400(Ft.)
Pipe length  =   730.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.650(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     9.650(CFS)
Normal flow depth in pipe =   14.95(In.)
Flow top width inside pipe =   19.02(In.)
Critical Depth =   13.86(In.)
Pipe flow velocity =      5.27(Ft/s)
Travel time through pipe =    2.31 min.
Time of concentration (TC) =    13.06 min.


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Process from Point/Station      119.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 1
Stream flow area =      2.760(Ac.)
Runoff from this stream =      9.650(CFS)
Time of concentration =   13.06 min.
Rainfall intensity =     3.544(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000


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Process from Point/Station      120.000 to Point/Station      121.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   295.000(Ft.)
Top (of initial area) elevation =   984.300(Ft.)
Bottom (of initial area) elevation =   982.300(Ft.)
Difference in elevation =     2.000(Ft.)
Slope =    0.00678  s(%)=       0.68
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    8.027 min.
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Rainfall intensity =      4.747(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.881
Subarea runoff =      2.134(CFS)
Total initial stream area =        0.510(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


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Process from Point/Station      121.000 to Point/Station      122.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   975.500(Ft.)
Downstream point/station elevation =   975.400(Ft.)
Pipe length  =    10.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     2.134(CFS)
Nearest computed pipe diameter  =     12.00(In.)
Calculated individual pipe flow  =     2.134(CFS)
Normal flow depth in pipe =    6.69(In.)
Flow top width inside pipe =   11.92(In.)
Critical Depth =    7.49(In.)
Pipe flow velocity =      4.74(Ft/s)
Travel time through pipe =    0.04 min.
Time of concentration (TC) =     8.06 min.


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Process from Point/Station      121.000 to Point/Station      122.000
**** CONFLUENCE OF MINOR STREAMS ****
------------------------------------------------------------------------
Along Main Stream number: 2 in normal stream number 2
Stream flow area =      0.510(Ac.)
Runoff from this stream =      2.134(CFS)
Time of concentration =    8.06 min.
Rainfall intensity =     4.735(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area    TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min) (In/Hr)     (In/Hr)


1      9.65     2.760     13.06    0.098      3.544
2      2.13     0.510      8.06    0.098      4.735
Qmax(1) =
         1.000 *    1.000 *     9.650) +
         0.743 *    1.000 *     2.134) + =      11.236
Qmax(2) =
         1.345 *    0.617 *     9.650) +
         1.000 *    1.000 *     2.134) + =      10.147

Total of 2 streams to confluence:
Flow rates before confluence point:
       9.650       2.134
Maximum flow rates at confluence using above data:
      11.236      10.147
Area of streams before confluence:
        2.760        0.510
```

```
Effective area values after confluence:
        3.270        2.213
Results of confluence:
Total flow rate =     11.236(CFS)
Time of concentration =    13.065 min.
Effective stream area after confluence =      3.270(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total (this main stream) =       3.27(Ac.)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   975.400(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =   440.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =    11.236(CFS)
Nearest computed pipe diameter  =     18.00(In.)
Calculated individual pipe flow  =    11.236(CFS)
Normal flow depth in pipe =   14.23(In.)
Flow top width inside pipe =   14.65(In.)
Critical Depth =   15.37(In.)
Pipe flow velocity =      7.50(Ft/s)
Travel time through pipe =    0.98 min.
Time of concentration (TC) =    14.04 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      122.000 to Point/Station      125.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 2
Stream flow area =      3.270(Ac.)
Runoff from this stream =     11.236(CFS)
Time of concentration =   14.04 min.
Rainfall intensity =     3.394(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Program is now starting with Main Stream No. 3


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      123.000 to Point/Station      124.000
**** INITIAL AREA EVALUATION ****
------------------------------------------------------------------------
COMMERCIAL subarea type
Decimal fraction soil group A = 1.000
Decimal fraction soil group B = 0.000
Decimal fraction soil group C = 0.000
Decimal fraction soil group D = 0.000
SCS curve number for soil(AMC 2)  = 32.00
Pervious ratio(Ap) = 0.1000     Max loss rate(Fm)=     0.098(In/Hr)
Initial subarea data:
Initial area flow distance =   350.000(Ft.)
Top (of initial area) elevation =   984.000(Ft.)
Bottom (of initial area) elevation =   978.200(Ft.)
```

```
Difference in elevation =     5.800(Ft.)
Slope =    0.01657  s(%)=       1.66
TC = k(0.304)*[(length^3)/(elevation change)]^0.2
Initial area time of concentration =    7.188 min.
Rainfall intensity =      5.072(In/Hr) for a   100.0 year storm
Effective runoff coefficient used for area (Q=KCIA) is C = 0.883
Subarea runoff =      9.491(CFS)
Total initial stream area =        2.120(Ac.)
Pervious area fraction = 0.100
Initial area Fm value =    0.098(In/Hr)


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      124.000 to Point/Station      125.000
**** PIPEFLOW TRAVEL TIME (Program estimated size) ****
------------------------------------------------------------------------
Upstream point/station elevation =   970.600(Ft.)
Downstream point/station elevation =   970.000(Ft.)
Pipe length  =   120.00(Ft.)   Manning's N = 0.013
No. of pipes = 1  Required pipe flow  =     9.491(CFS)
Nearest computed pipe diameter  =     21.00(In.)
Calculated individual pipe flow  =     9.491(CFS)
Normal flow depth in pipe =   14.84(In.)
Flow top width inside pipe =   19.13(In.)
Critical Depth =   13.76(In.)
Pipe flow velocity =      5.23(Ft/s)
Travel time through pipe =    0.38 min.
Time of concentration (TC) =     7.57 min.


++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
Process from Point/Station      124.000 to Point/Station      125.000
**** CONFLUENCE OF MAIN STREAMS ****
------------------------------------------------------------------------
The following data inside Main Stream is listed:
In Main Stream number: 3
Stream flow area =      2.120(Ac.)
Runoff from this stream =      9.491(CFS)
Time of concentration =    7.57 min.
Rainfall intensity =     4.917(In/Hr)
Area averaged loss rate (Fm) =    0.0978(In/Hr)
Area averaged Pervious ratio (Ap) = 0.1000
Summary of stream data:

Stream Flow rate    Area     TC     Fm       Rainfall Intensity
 No.    (CFS)    (Ac.)       (min) (In/Hr)     (In/Hr)


1     40.23     8.587      6.92    0.098      5.190
2     11.24     3.270     14.04    0.098      3.394
3      9.49     2.120      7.57    0.098      4.917
Qmax(1) =
         1.000 *    1.000 *    40.230) +
         1.545 *    0.493 *    11.236) +
         1.057 *    0.914 *     9.491) + =      57.947
Qmax(2) =
         0.647 *    1.000 *    40.230) +
         1.000 *    1.000 *    11.236) +
         0.684 *    1.000 *     9.491) + =      43.768
```

```
Qmax(3) =
         0.946 *    1.000 *    40.230) +
         1.462 *    0.539 *    11.236) +
         1.000 *    1.000 *     9.491) + =      56.418

Total of 3 main streams to confluence:
Flow rates before confluence point:
      41.230      12.236      10.491
Maximum flow rates at confluence using above data:
       57.947       43.768       56.418
Area of streams before confluence:
        8.587        3.270        2.120
Effective area values after confluence:
       12.135       13.977       12.470


Results of confluence:
Total flow rate =     57.947(CFS)
Time of concentration =     6.918 min.
Effective stream area after confluence  =     12.135(Ac.)
Study area average Pervious fraction(Ap) =  0.100
Study area average soil loss rate(Fm) =    0.098(In/Hr)
Study area total =      13.98(Ac.)
End of computations, Total Study Area =           16.40 (Ac.)
The following figures may
be used for a unit hydrograph study of the same area.
Note: These figures do not consider reduced effective area
effects caused by confluences in the rational equation.

Area averaged pervious area fraction(Ap) = 0.100
Area averaged SCS curve number =  32.0
```

APPENDIX B: PIPE SIZING CALCULATIONS

APPENDIX B.1: 75% FLOW CAPACITY FOR 18" PIPE

Worksheet for Circular Pipe - 75% for 18"

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	1.50	ft
Discharge	6.70	ft³/s

Results

Normal Depth	1.11	ft
Flow Area	1.41	ft²
Wetted Perimeter	3.12	ft
Hydraulic Radius	0.45	ft
Top Width	1.31	ft
Critical Depth	1.00	ft
Percent Full	74.3	%
Critical Slope	0.00659	ft/ft
Velocity	4.76	ft/s
Velocity Head	0.35	ft
Specific Energy	1.47	ft
Froude Number	0.81	
Maximum Discharge	7.99	ft³/s
Discharge Full	7.43	ft³/s
Slope Full	0.00407	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	74.31	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 75% for 18"

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.11	ft
Critical Depth	1.00	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00659	ft/ft

Messages

Notes

265.19.22 Duke & State Street
Storm Drain System Sizing for Preliminary Study

APPENDIX B.2: 75% FLOW CAPACITY FOR 24" PIPE

Worksheet for Circular Pipe - 75% for 24"

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	2.00	ft
Discharge	14.50	ft³/s

Results

Normal Depth	1.49	ft
Flow Area	2.51	ft²
Wetted Perimeter	4.17	ft
Hydraulic Radius	0.60	ft
Top Width	1.74	ft
Critical Depth	1.37	ft
Percent Full	74.6	%
Critical Slope	0.00618	ft/ft
Velocity	5.77	ft/s
Velocity Head	0.52	ft
Specific Energy	2.01	ft
Froude Number	0.85	
Maximum Discharge	17.21	ft³/s
Discharge Full	16.00	ft³/s
Slope Full	0.00411	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	74.62	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 75% for 24"

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.49	ft
Critical Depth	1.37	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00618	ft/ft

Messages

Notes

265.19.22 Duke & State Street
Storm Drain System Sizing for Preliminary Study

APPENDIX B.3: 75% FLOW CAPACITY FOR 30" PIPE

Worksheet for Circular Pipe - 75% for 30"

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	2.50	ft
Discharge	26.40	ft³/s

Results

Normal Depth	1.87	ft
Flow Area	3.94	ft²
Wetted Perimeter	5.23	ft
Hydraulic Radius	0.75	ft
Top Width	2.17	ft
Critical Depth	1.75	ft
Percent Full	74.9	%
Critical Slope	0.00590	ft/ft
Velocity	6.69	ft/s
Velocity Head	0.70	ft
Specific Energy	2.57	ft
Froude Number	0.88	
Maximum Discharge	31.20	ft³/s
Discharge Full	29.00	ft³/s
Slope Full	0.00414	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	74.89	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 75% for 30"

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.87	ft
Critical Depth	1.75	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00590	ft/ft

Messages

Notes

265.19.22 Duke & State Street
Storm Drain System Sizing for Preliminary Study

APPENDIX B.4: 75% FLOW CAPACITY FOR 36" PIPE

Worksheet for Circular Pipe - 75% for 36"

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	3.00	ft
Discharge	42.90	ft³/s

Results

Normal Depth	2.25	ft
Flow Area	5.67	ft²
Wetted Perimeter	6.27	ft
Hydraulic Radius	0.90	ft
Top Width	2.60	ft
Critical Depth	2.13	ft
Percent Full	74.8	%
Critical Slope	0.00566	ft/ft
Velocity	7.56	ft/s
Velocity Head	0.89	ft
Specific Energy	3.13	ft
Froude Number	0.90	
Maximum Discharge	50.73	ft³/s
Discharge Full	47.16	ft³/s
Slope Full	0.00414	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	74.84	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 75% for 36"

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	2.25	ft
Critical Depth	2.13	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00566	ft/ft

Messages

Notes

265.19.22 Duke & State Street
Storm Drain System Sizing for Preliminary Study

APPENDIX B.5: 75% FLOW CAPACITY FOR 42" PIPE

Worksheet for Circular Pipe - 75% for 42"

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00500	ft/ft
Diameter	3.50	ft
Discharge	64.80	ft³/s

Results

Normal Depth	2.62	ft
Flow Area	7.73	ft²
Wetted Perimeter	7.33	ft
Hydraulic Radius	1.06	ft
Top Width	3.03	ft
Critical Depth	2.52	ft
Percent Full	74.9	%
Critical Slope	0.00549	ft/ft
Velocity	8.38	ft/s
Velocity Head	1.09	ft
Specific Energy	3.71	ft
Froude Number	0.93	
Maximum Discharge	76.52	ft³/s
Discharge Full	71.14	ft³/s
Slope Full	0.00415	ft/ft
Flow Type	SubCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	74.94	%
Downstream Velocity	Infinity	ft/s

Worksheet for Circular Pipe - 75% for 42"

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	2.62	ft
Critical Depth	2.52	ft
Channel Slope	0.00500	ft/ft
Critical Slope	0.00549	ft/ft

Messages

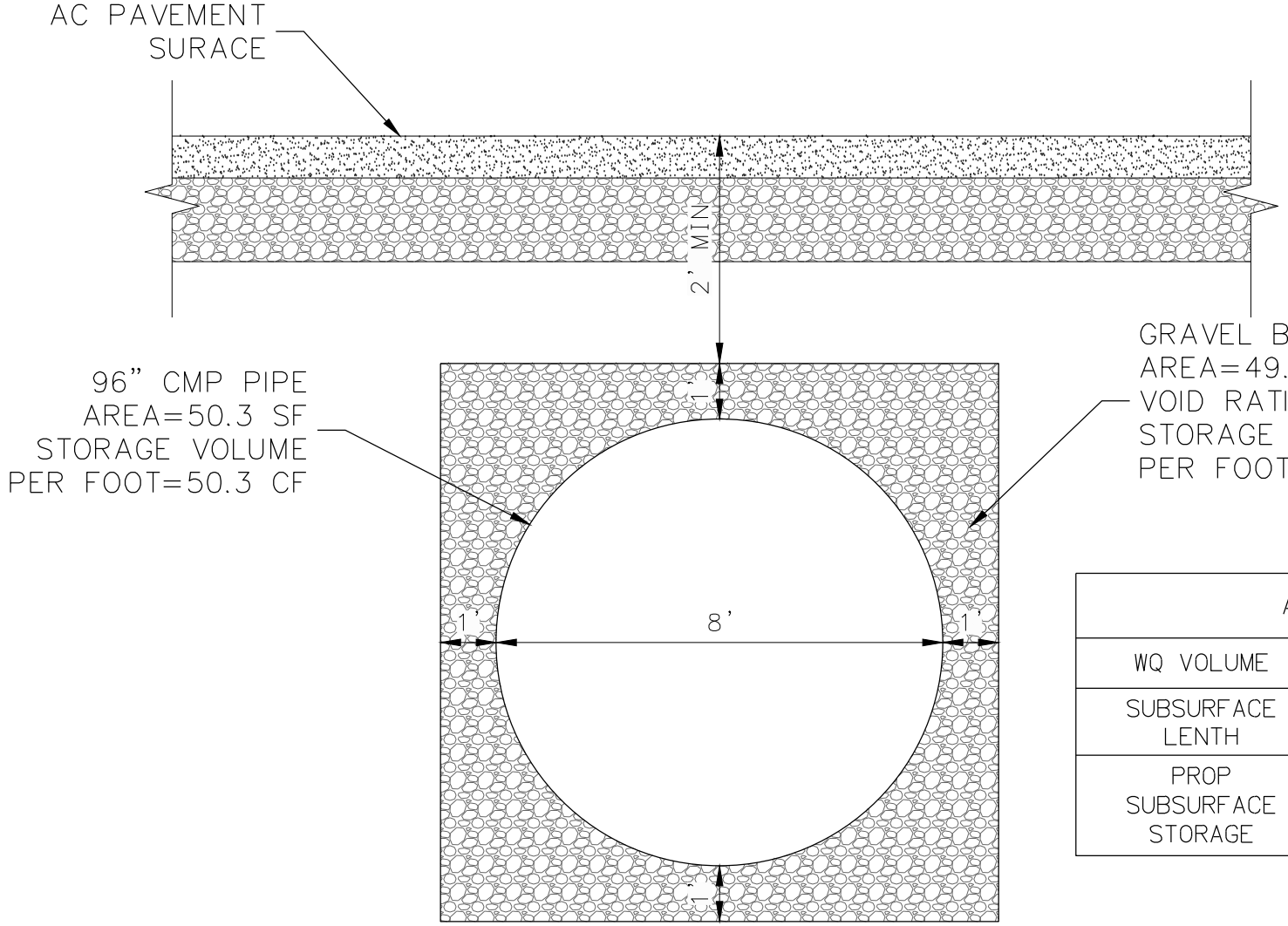
Notes

265.19.22 Duke & State Street
Storm Drain System Sizing for Preliminary Study

APPENDIX C: SUBSURFACE SYSTEM SIZING CALCULATIONS

TYPICAL 96" SUBSURFACE STORAGE CROSS SECTION AND STORAGE VOLUME PER FOOT

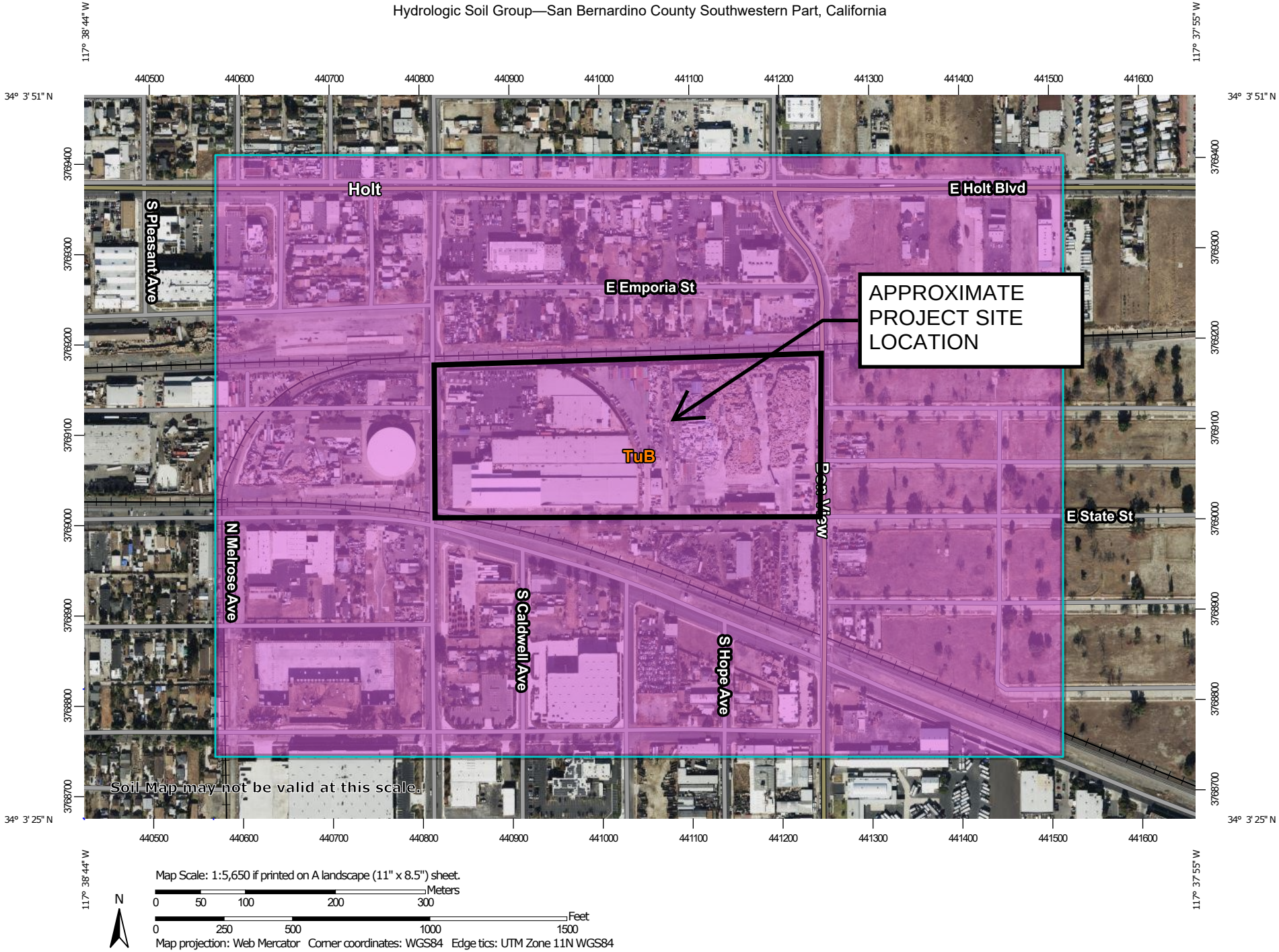
96" CMP SUBSURFACE STORAGE VOLUME CALCULATION
SUBSURFACE STORAGE PER FOOT=70.2 CF



AREA A	
WQ VOLUME	77,083 CF
SUBSURFACE LENTH	1,100 FT
PROP SUBSURFACE STORAGE	77,220 CF

EXCERPTS

EXCERPT A: NRCS HYDRAULIC SOILS MAP



Map Scale: 1:5,650 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: San Bernardino County Southwestern Part, California
Survey Area Data: Version 13, Sep 13, 2021

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

Date(s) aerial images were photographed: Dec 5, 2020—Feb 6, 2021

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

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
TuB	Tujunga loamy sand, 0 to 5 percent slopes	A	155.9	100.0%
Totals for Area of Interest			**155.9**	**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

EXCERPT B: NOAA ATLAS 14 RAINFALL DATA

NOAA Atlas 14, Volume 6, Version 2
Location name: Ontario, California, USA*
Latitude: 34.0608°, Longitude: -117.64°
Elevation: 980.94 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.118** (0.099-0.143)	**0.156** (0.130-0.189)	**0.204** (0.170-0.248)	**0.242** (0.199-0.296)	**0.291** (0.232-0.369)	**0.328** (0.255-0.425)	**0.364** (0.276-0.485)	**0.400** (0.295-0.549)	**0.448** (0.316-0.642)	**0.485** (0.330-0.719)
10-min	**0.170** (0.142-0.205)	**0.224** (0.187-0.271)	**0.292** (0.243-0.355)	**0.346** (0.285-0.425)	**0.417** (0.332-0.529)	**0.470** (0.366-0.610)	**0.522** (0.396-0.695)	**0.574** (0.423-0.787)	**0.643** (0.454-0.920)	**0.695** (0.473-1.03)
15-min	**0.205** (0.171-0.248)	**0.271** (0.226-0.328)	**0.354** (0.294-0.430)	**0.419** (0.345-0.514)	**0.504** (0.401-0.640)	**0.568** (0.442-0.737)	**0.631** (0.479-0.840)	**0.694** (0.512-0.951)	**0.777** (0.549-1.11)	**0.840** (0.572-1.25)
30-min	**0.310** (0.259-0.376)	**0.410** (0.341-0.496)	**0.535** (0.444-0.650)	**0.633** (0.522-0.777)	**0.763** (0.607-0.968)	**0.859** (0.669-1.12)	**0.954** (0.724-1.27)	**1.05** (0.773-1.44)	**1.18** (0.830-1.68)	**1.27** (0.865-1.89)
60-min	**0.460** (0.384-0.557)	**0.608** (0.506-0.737)	**0.793** (0.659-0.964)	**0.940** (0.774-1.15)	**1.13** (0.900-1.44)	**1.27** (0.992-1.65)	**1.42** (1.07-1.88)	**1.56** (1.15-2.13)	**1.74** (1.23-2.50)	**1.88** (1.28-2.80)
2-hr	**0.688** (0.574-0.833)	**0.905** (0.754-1.10)	**1.18** (0.977-1.43)	**1.39** (1.14-1.70)	**1.66** (1.32-2.11)	**1.86** (1.45-2.42)	**2.06** (1.56-2.74)	**2.26** (1.66-3.09)	**2.51** (1.77-3.59)	**2.70** (1.84-4.01)
3-hr	**0.861** (0.718-1.04)	**1.13** (0.942-1.37)	**1.47** (1.22-1.78)	**1.73** (1.42-2.12)	**2.06** (1.64-2.62)	**2.31** (1.80-3.00)	**2.55** (1.94-3.40)	**2.79** (2.06-3.83)	**3.10** (2.19-4.44)	**3.33** (2.27-4.94)
6-hr	**1.21** (1.01-1.47)	**1.59** (1.32-1.93)	**2.06** (1.71-2.50)	**2.42** (1.99-2.97)	**2.89** (2.30-3.67)	**3.24** (2.52-4.20)	**3.57** (2.71-4.75)	**3.90** (2.88-5.35)	**4.33** (3.06-6.20)	**4.65** (3.17-6.90)
12-hr	**1.57** (1.31-1.91)	**2.06** (1.72-2.50)	**2.68** (2.23-3.26)	**3.16** (2.60-3.87)	**3.78** (3.01-4.80)	**4.24** (3.30-5.51)	**4.69** (3.56-6.25)	**5.14** (3.79-7.05)	**5.73** (4.04-8.20)	**6.16** (4.20-9.14)
24-hr	**2.09** (1.85-2.40)	**2.76** (2.44-3.18)	**3.61** (3.18-4.17)	**4.28** (3.74-4.99)	**5.16** (4.37-6.22)	**5.82** (4.83-7.16)	**6.47** (5.24-8.16)	**7.13** (5.62-9.23)	**7.99** (6.05-10.8)	**8.65** (6.32-12.1)
2-day	**2.49** (2.21-2.87)	**3.36** (2.97-3.87)	**4.47** (3.94-5.17)	**5.36** (4.69-6.26)	**6.57** (5.56-7.92)	**7.48** (6.21-9.21)	**8.40** (6.81-10.6)	**9.34** (7.36-12.1)	**10.6** (8.02-14.3)	**11.6** (8.47-16.2)
3-day	**2.67** (2.36-3.08)	**3.64** (3.22-4.20)	**4.90** (4.32-5.67)	**5.93** (5.19-6.92)	**7.33** (6.21-8.84)	**8.41** (6.98-10.3)	**9.50** (7.70-12.0)	**10.6** (8.38-13.8)	**12.2** (9.20-16.4)	**13.4** (9.77-18.6)
4-day	**2.86** (2.53-3.30)	**3.93** (3.47-4.54)	**5.33** (4.70-6.17)	**6.48** (5.67-7.56)	**8.05** (6.82-9.71)	**9.27** (7.69-11.4)	**10.5** (8.51-13.2)	**11.8** (9.29-15.3)	**13.5** (10.2-18.3)	**14.9** (10.9-20.8)
7-day	**3.34** (2.96-3.85)	**4.63** (4.09-5.34)	**6.32** (5.57-7.31)	**7.71** (6.75-9.00)	**9.62** (8.15-11.6)	**11.1** (9.21-13.7)	**12.6** (10.2-15.9)	**14.2** (11.2-18.4)	**16.4** (12.4-22.1)	**18.1** (13.2-25.2)
10-day	**3.63** (3.22-4.19)	**5.05** (4.47-5.83)	**6.93** (6.11-8.02)	**8.47** (7.41-9.89)	**10.6** (8.97-12.8)	**12.3** (10.2-15.1)	**14.0** (11.3-17.6)	**15.7** (12.4-20.4)	**18.2** (13.7-24.5)	**20.1** (14.7-28.0)
20-day	**4.39** (3.89-5.07)	**6.18** (5.46-7.13)	**8.57** (7.55-9.91)	**10.6** (9.23-12.3)	**13.3** (11.3-16.1)	**15.5** (12.9-19.1)	**17.8** (14.4-22.4)	**20.1** (15.9-26.1)	**23.4** (17.7-31.6)	**26.0** (19.0-36.3)
30-day	**5.11** (4.52-5.89)	**7.20** (6.37-8.31)	**10.0** (8.85-11.6)	**12.4** (10.9-14.5)	**15.7** (13.3-19.0)	**18.4** (15.3-22.6)	**21.2** (17.1-26.7)	**24.1** (19.0-31.2)	**28.2** (21.3-38.0)	**31.5** (23.0-43.9)
45-day	**6.14** (5.44-7.08)	**8.62** (7.62-9.95)	**12.0** (10.6-13.9)	**14.9** (13.0-17.3)	**18.9** (16.0-22.8)	**22.2** (18.4-27.3)	**25.7** (20.8-32.3)	**29.3** (23.1-38.0)	**34.5** (26.1-46.6)	**38.8** (28.3-54.1)
60-day	**7.18** (6.36-8.28)	**9.98** (8.82-11.5)	**13.8** (12.2-16.0)	**17.1** (15.0-20.0)	**21.8** (18.5-26.3)	**25.7** (21.3-31.6)	**29.7** (24.1-37.5)	**34.1** (26.9-44.2)	**40.4** (30.5-54.4)	**45.5** (33.2-63.4)

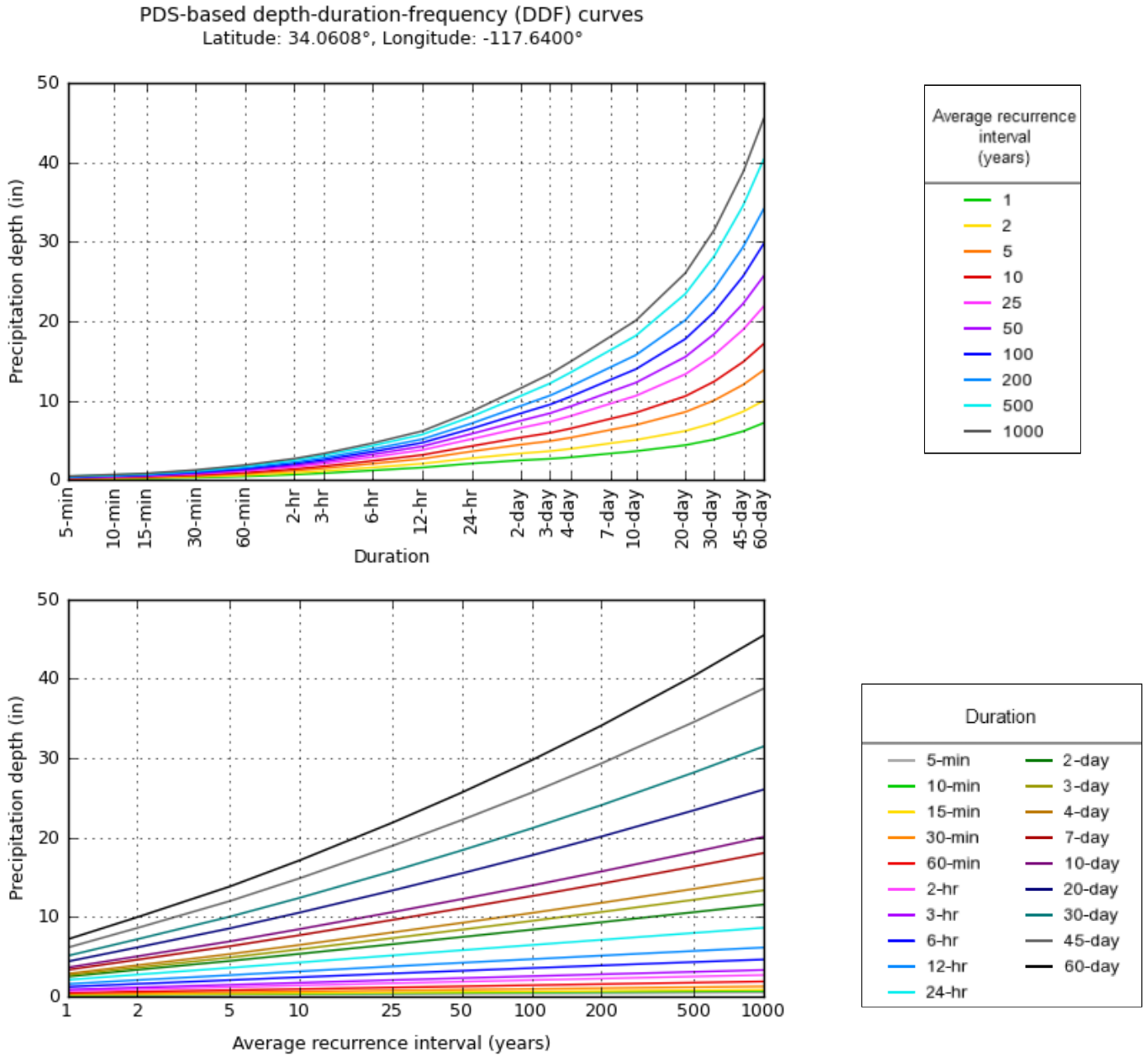
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical



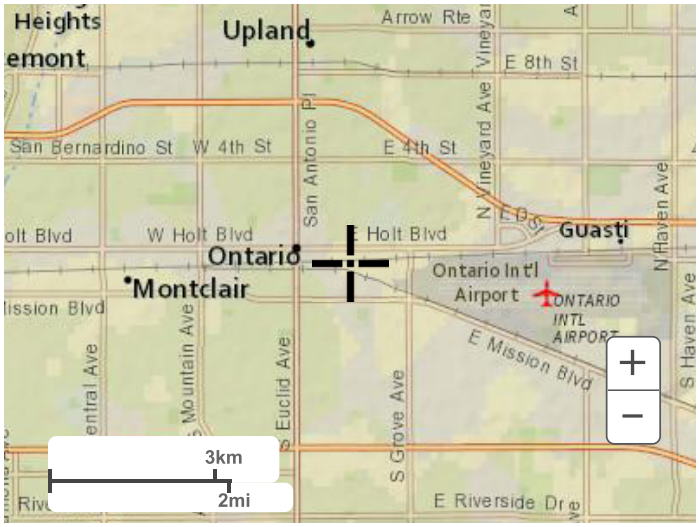
NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Mon Jan 31 23:02:02 2022

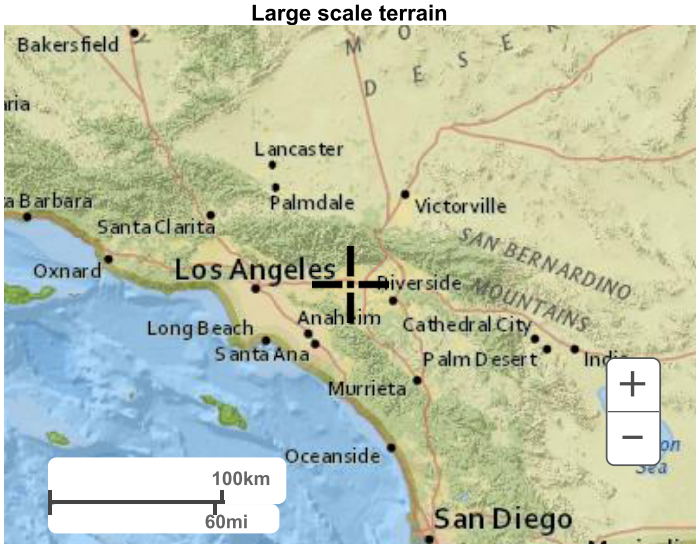
Back to Top

Maps & aerials

Small scale terrain



Large scale terrain



Large scale map

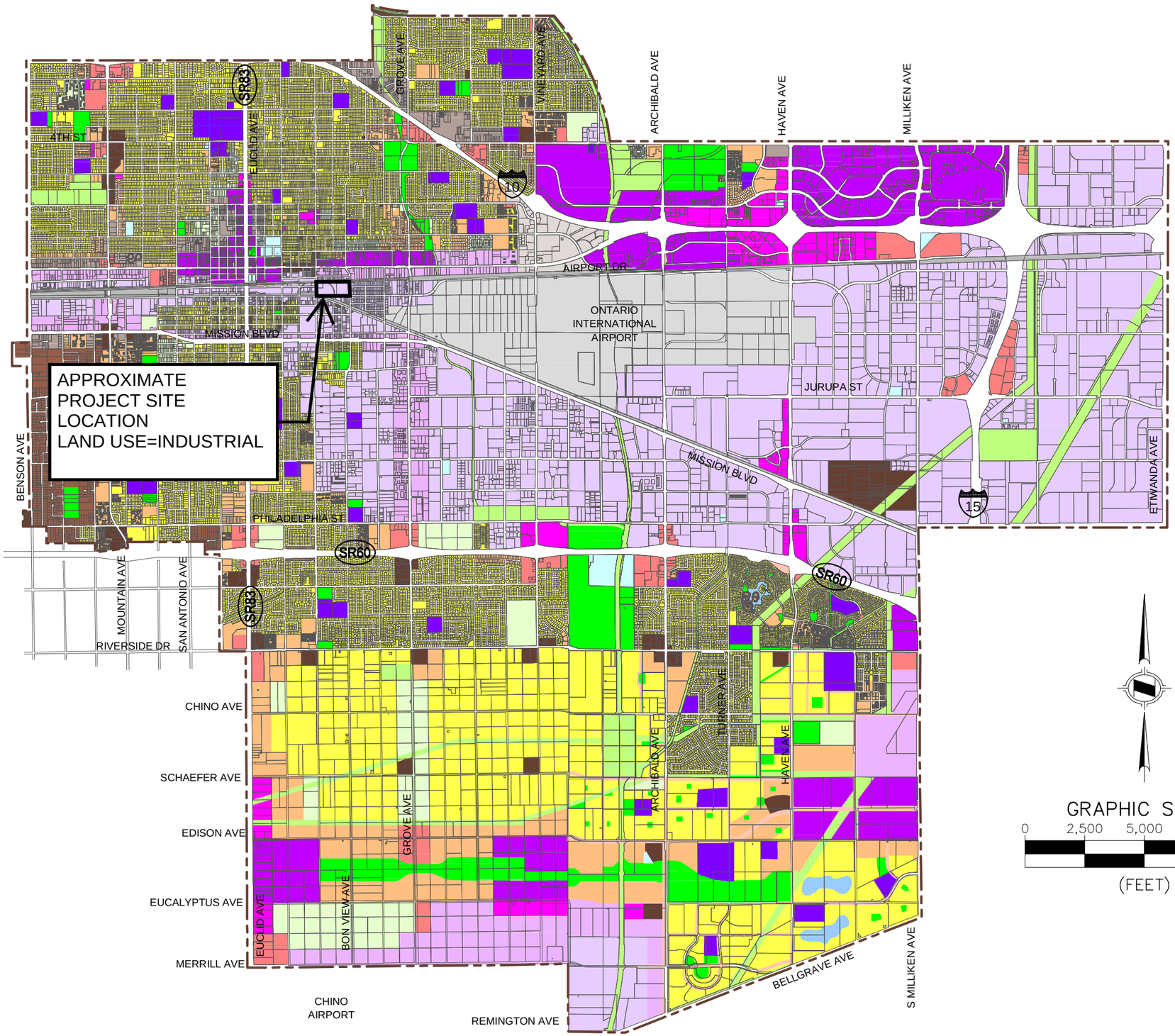
Large scale aerial

Back to Top

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

EXCERPT C: CITY OF ONTARIO MASTER DRAINAGE PLAN LAND USE MAP



Residential
- Rural
- Low Density
- Low - Medium Density
- Medium Density
- High Density

Retail/Service
- Neighborhood Commercial
- General Commercial
- Office Commercial
- Hospitality

Employment
- Business Park
- Industrial

Other
- Open Space - Non Recreation
- Open Space - Parkland
- Open Space - Water
- Public Facility
- Public School
- Airport
- Rail
- Landfill

Mixed Use
- Mixed Use

GRAPHIC SCALE

0 2,500 5,000 10,000

(FEET)

*ADOPTED BY CITY COUNCIL
ON JANUARY 27, 2010

03/10/2012

EXHIBIT 4

MARCH 2012

CITY OF ONTARIO
MASTER PLAN OF DRAINAGE

LAND USE PLAN

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EXCERPT D: CITY OF ONTARIO MASTER DRAINAGE PLAN HYDROLOGY MAP

OFF-SITE FLOWS FROM CITY OF UPLAND
AREA = 223.3 AC
Q(100) = 394 CFS
Q(25) = 302 CFS
Q(10) = 239 CFS

OFF-SITE FLOWS FROM CITY OF UPLAND
AREA = 138.8 AC
Q(100) = 411 CFS
Q(24) = 324 CFS
Q(10) = 281 CFS

PROPOSED STORM DRAIN PER CITY OF MONTCLAIR MASTER PLAN

I-10 SAN BERNARDINO FREEWAY

8th ST BASINS

CUCAMONGA CHANNEL

TO CITY OF MONTCLAIR SAN BERNARDINO AVE. STORM DRAIN

OFF-SITE Q100=4

SAN BERNARDINO FREEWAY

AREA F13 BOUNDARY

APPROXIMATE PROJECT SITE LOCATION

WEST CUCAMONGA CHANNEL

EAST STATE ST. STORM DRAIN

WEST STATE STREET STORM DRAIN

EAST STATE STREET STORM DRAIN

ONTARIO INTERNATIONAL

FUTURE STORM DRAIN PER CITY OF CHINO MASTER PLAN (SYSTEM 28)

FRANCIS ST STORM DRAIN

ELY BASIN

SR-60 POMONA FREEWAY

CHINO STORM DRAIN

MAGNOLIA STORM DRAIN

SULTANA CYPRESS STORM DRAIN

CYPRESS CHANNEL

RIVERSIDE DR STORM DRAIN 1

GROVE AVE BASIN

RIVERSIDE DR STORM DRAIN 2

LOWER CUCAMONGA SPREADING GROUNDS

LEGEND

- COUNTY LIMITS
- CITY LIMITS
- X" / XXXX-X-X — PLANNED STORM DRAIN, SIZE AND LINE ID
- DRAINAGE AREA BOUNDARY
- DRAINAGE SYSTEM BOUNDARY
- MINOR DRAINAGE BOUNDARY
- (X) — EXISTING CITY STORM DRAIN AND SIZE (IN INCHES)
- EXISTING CITY OPEN CHANNEL
- EXISTING COUNTY OPEN CHANNEL
- (X) — EXISTING COUNTY STORM DRAIN AND SIZE (IN INCHES)
- EXISTING CALTRANS STORM DRAIN
- (X) / X" — EXISTING NEIGHBORING CITIES STORM DRAIN AND SIZE (IN INCHES)
- FUTURE NEIGHBORING CITIES STORM DRAIN AND SIZE
- EXISTING DETENTION BASIN
- X — DRAINAGE AREA #

DRAINAGE SYSTEM NAME — WLKR - XII - 3 — SYSTEM IDENTIFICATION
DRAINAGE AREA NUMBER — LINE NUMBER

X / X.X — AREA DESIGNATION / AREA ACREAGE (IN ACRES)

Q_{10} =861.0cfs
Q_{25} =981.1cfs
Q_{100}=1213.7cfs
833.9 AC
NODE 350

PEAK FLOW RATE
AREA (IN ACRES)
NODE NO.

SCALE: 1" = 900'

900 450 0 900 2700
GRAPHIC SCALE 1"=900'

DATED: 3/15/2012 10:48 AM

MARCH 2012

REVISIONS

HUNSAKER & ASSOCIATES
IRVINE, INC.
PLANNING ▪ ENGINEERING ▪ SURVEYING
Three Hughes ▪ Irvine, CA 92618 ▪ PH: (949) 583-1010 ▪ FX: (949) 583-0759

CITY OF ONTARIO
MASTER PLAN OF DRAINAGE
HYDROLOGY MAP
OLD MODEL COLONY-WEST

1 OF 3

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EXCERPT E: CITY OF ONTARIO MASTER DRAINAGE PLAN EXISTING FACILITIES MAP

APPROXIMATE PROJECT SITE LOCATION

8th ST STORM DRAIN
8th ST INTERCEPT
8th ST BASINS
MONTCLAIR BASINS
SAN BERNARDINO AVE STORM DRAIN
BROOKS ST STORM DRAIN
BROOKS BASIN
WEST STATE ST STORM DRAIN
EAST STATE ST STORM DRAIN
PRINCETON BASIN
CUCAMONGA-GUASTI REGIONAL PARK
TURNER BASINS
COMMERCE CENTER STORM DRAIN
WINEVILLE BASIN
FRANCIS ST STORM DRAIN
WEST CUCAMONGA CHANNEL
ELY BASINS
SULTANA CYPRESS STORM DRAIN
CHINO STORM DRAIN
MAGNOLIA STORM DRAIN
RIVERSIDE DR STORM DRAIN 2
GROVE AVE BASIN
RIVERSIDE DR STORM DRAIN 1
GROVE AVE BASIN DRAIN
LOWER CUCAMONGA SPREADING GROUNDS
CHRIS BASIN
LOWER DEER CREEK CHANNEL
AIRPORT CHANNEL
GROVE AVE STORM DRAIN
RIVERSIDE BASIN
SAN BERNARDINO/ RIVERSIDE COUNTY LINE
COUNTY LINE CHANNEL
EASTVALE
JURUPA VALLEY
CHINO
MONTCLAIR
UPLAND
RANCHO CUCAMONGA
FONTANA
S.B. COUNTY
CHINO AIRPORT
ONTARIO INTERNATIONAL AIRPORT
SAN ANTONIO CHANNEL
CHINO CREEK
CYPRESS CHANNEL
DEER CREEK CHANNEL
CUCAMONGA CHANNEL
DAY CREEK CHANNEL
LOWER ETIWANDA CREEK CHANNEL
SAN SEVAINE CHANNEL
TO PRADO BASIN

LEGEND

- COUNTY LIMITS
- CITY LIMITS
- ULTIMATE REGIONAL (SBCFCD) OPEN CHANNELS WITH SIZES IN INCHES
- ULTIMATE REGIONAL (SBCFCD) STORM DRAINS WITH SIZES IN INCHES
- ULTIMATE REGIONAL (SBCFCD) DETENTION BASINS
- INTERIM REGIONAL (SBCFCD) OPEN CHANNELS WITH SIZES IN INCHES
- INTERIM REGIONAL (SBCFCD) STORM DRAINS WITH SIZES IN INCHES
- INTERIM REGIONAL (SBCFCD) DETENTION BASINS
- STORM DRAINS – CALTRANS
- OPEN CHANNELS – CITY OF ONTARIO WITH SIZES IN INCHES
- STORM DRAINS – CITY OF ONTARIO WITH SIZES IN INCHES
- STORM DRAINS/CHANNELS – CITY OF CHINO WITH SIZES IN INCHES
- EXISTING STORM DRAINS – CITY OF MONTCLAIR

GRAPHIC SCALE
0 1,000 2,000 3,000 4,000 5,000
(FEET)

05/13/2012

EXHIBIT 3
MARCH 2012
CITY OF ONTARIO
MASTER PLAN OF DRAINAGE
EXISTING FACILITIES MAP

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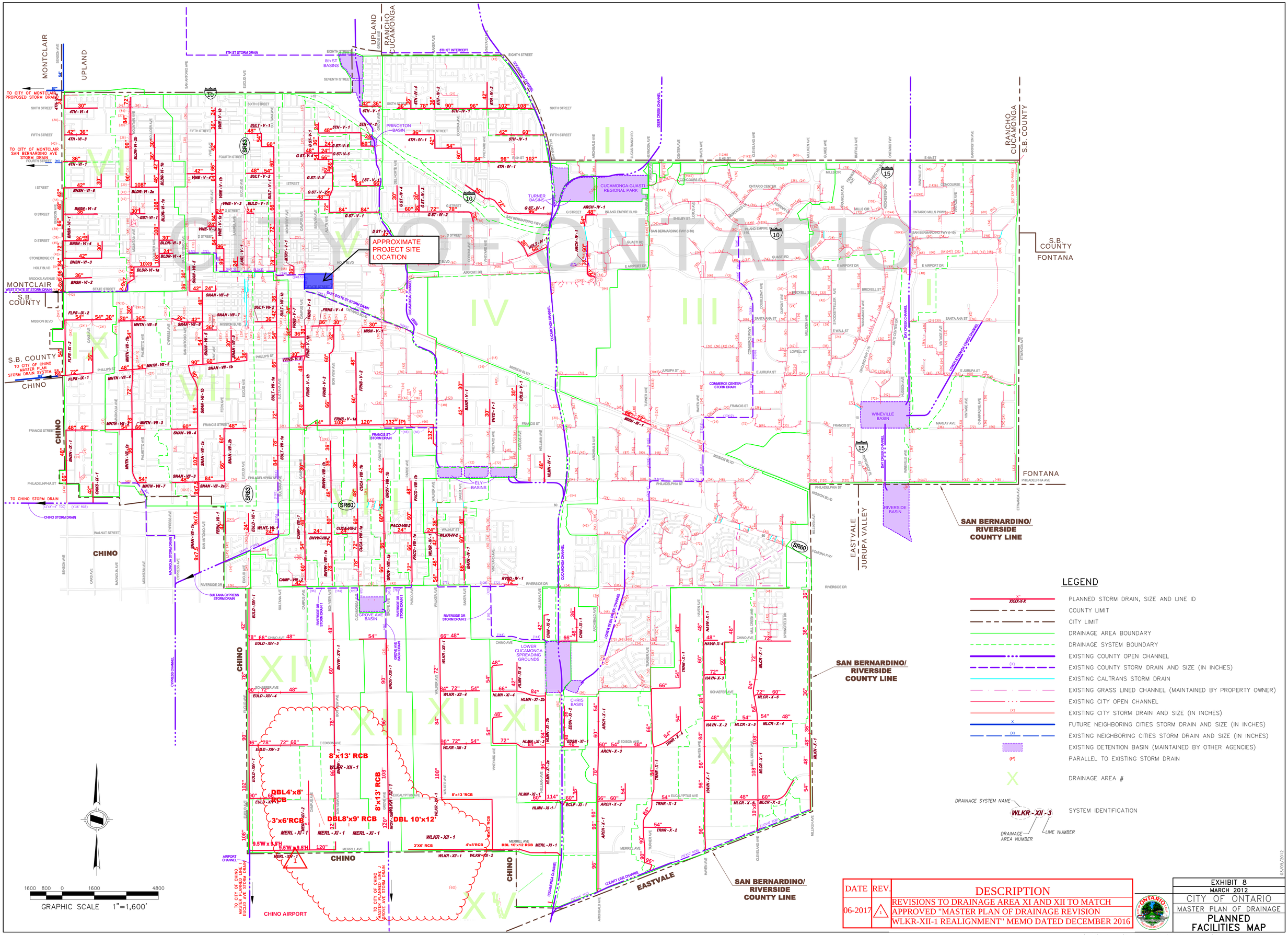
EXCERPT F: **CITY OF ONTARIO MASTER DRAINAGE PLAN PLANNED FACILITATES MAP**



1600 800 0 1600 4800

GRAPHIC SCALE 1"=1,600'

LEGEND

- PLANNED STORM DRAIN, SIZE AND LINE ID (XXXX-X-X)
- COUNTY LIMIT
- CITY LIMIT
- DRAINAGE AREA BOUNDARY
- DRAINAGE SYSTEM BOUNDARY
- EXISTING COUNTY OPEN CHANNEL
- EXISTING COUNTY STORM DRAIN AND SIZE (IN INCHES) (X)
- EXISTING CALTRANS STORM DRAIN
- EXISTING GRASS LINED CHANNEL (MAINTAINED BY PROPERTY OWNER)
- EXISTING CITY OPEN CHANNEL
- EXISTING CITY STORM DRAIN AND SIZE (IN INCHES) (X)
- FUTURE NEIGHBORING CITIES STORM DRAIN AND SIZE (IN INCHES) X
- EXISTING NEIGHBORING CITIES STORM DRAIN AND SIZE (IN INCHES) (XX)
- EXISTING DETENTION BASIN (MAINTAINED BY OTHER AGENCIES)
- (P) PARALLEL TO EXISTING STORM DRAIN
- X DRAINAGE AREA #
- DRAINAGE SYSTEM NAME — WLKR - XII - 3 — LINE NUMBER; DRAINAGE AREA NUMBER — SYSTEM IDENTIFICATION

DATE	REV.	DESCRIPTION
06-2017	1	REVISIONS TO DRAINAGE AREA XI AND XII TO MATCH APPROVED "MASTER PLAN OF DRAINAGE REVISION WLKR-XII-1 REALIGNMENT" MEMO DATED DECEMBER 2016

EXHIBIT 8
MARCH 2012
CITY OF ONTARIO
MASTER PLAN OF DRAINAGE
PLANNED FACILITIES MAP

03/09/2012

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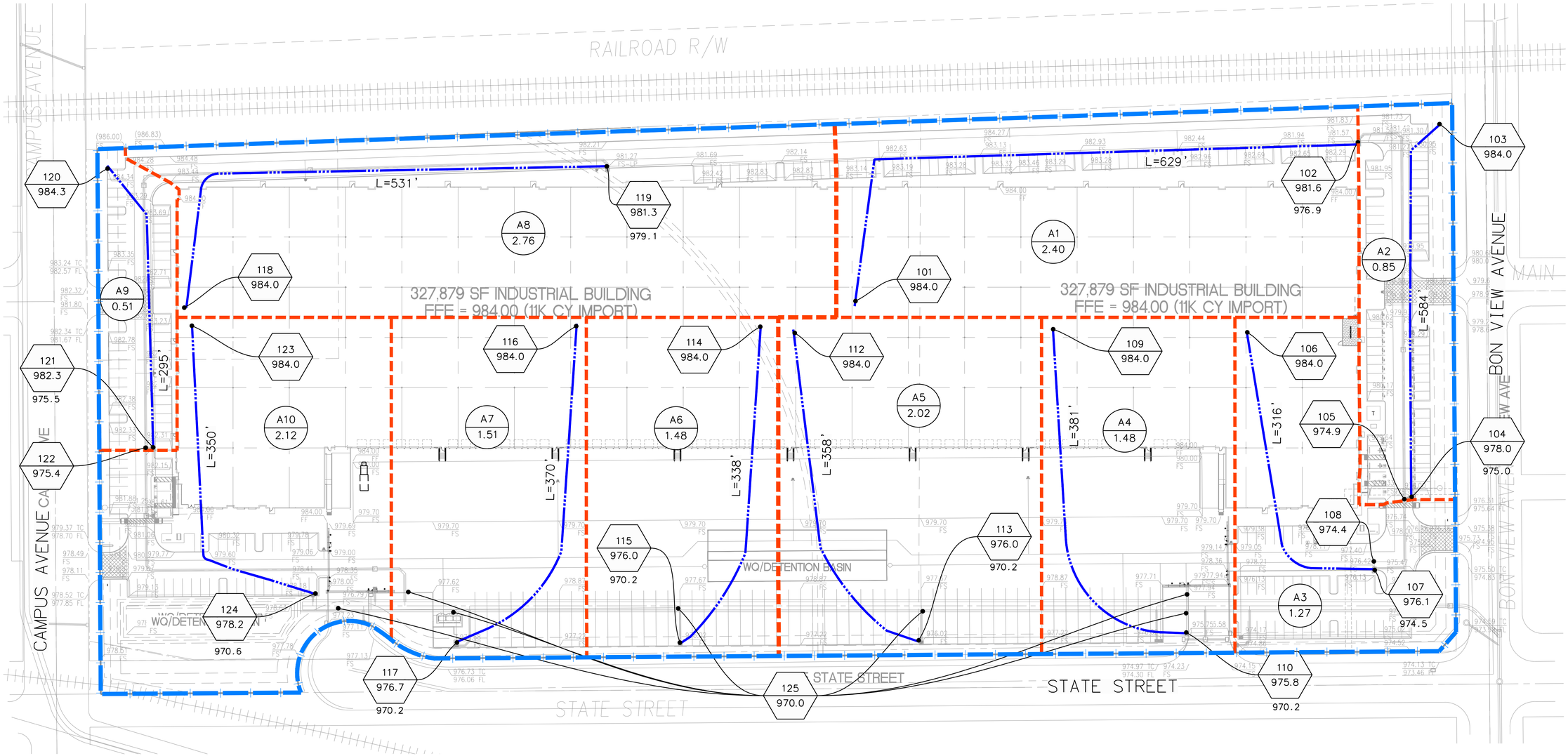
EXHIBITS

EXHIBIT A: PRELIMINARY RATIONAL METHOD HYDROLOGY MAP

DUKE - STATE STREET

IN THE CITY OF ONTARIO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

POST-PROJECT CONDITION SITE HYDROLOGY MAP



LEGEND:

XXX.X / XXXX	NODE/CONCENTRATION POINT / FLOWLINE ELEVATION
XXXX.X	APPROXIMATE INVERT ELEVATION
XXX / X.X	SUB AREA / ACRES
L=XXX'	FLOW DISTANCE
	FLOW PATH
	WATERSHED BOUNDARY
	WATERSHED SUB-BOUNDARY

RATIONAL METHOD RESULTS

AREA	10-YEAR		100-YEAR	
	T_C(MIN)	Q_{10} (CFS)	T_C (MIN	Q_{100} (CFS)
A	6.9	37.9	6.9	57.9

N

GRAPHIC SCALE
50' 0 25' 50' 100'
1" = 50'

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "A"

DUKE - STATE STREET

POST-PROJECT CONDITION SITE HYDROLOGY MAP

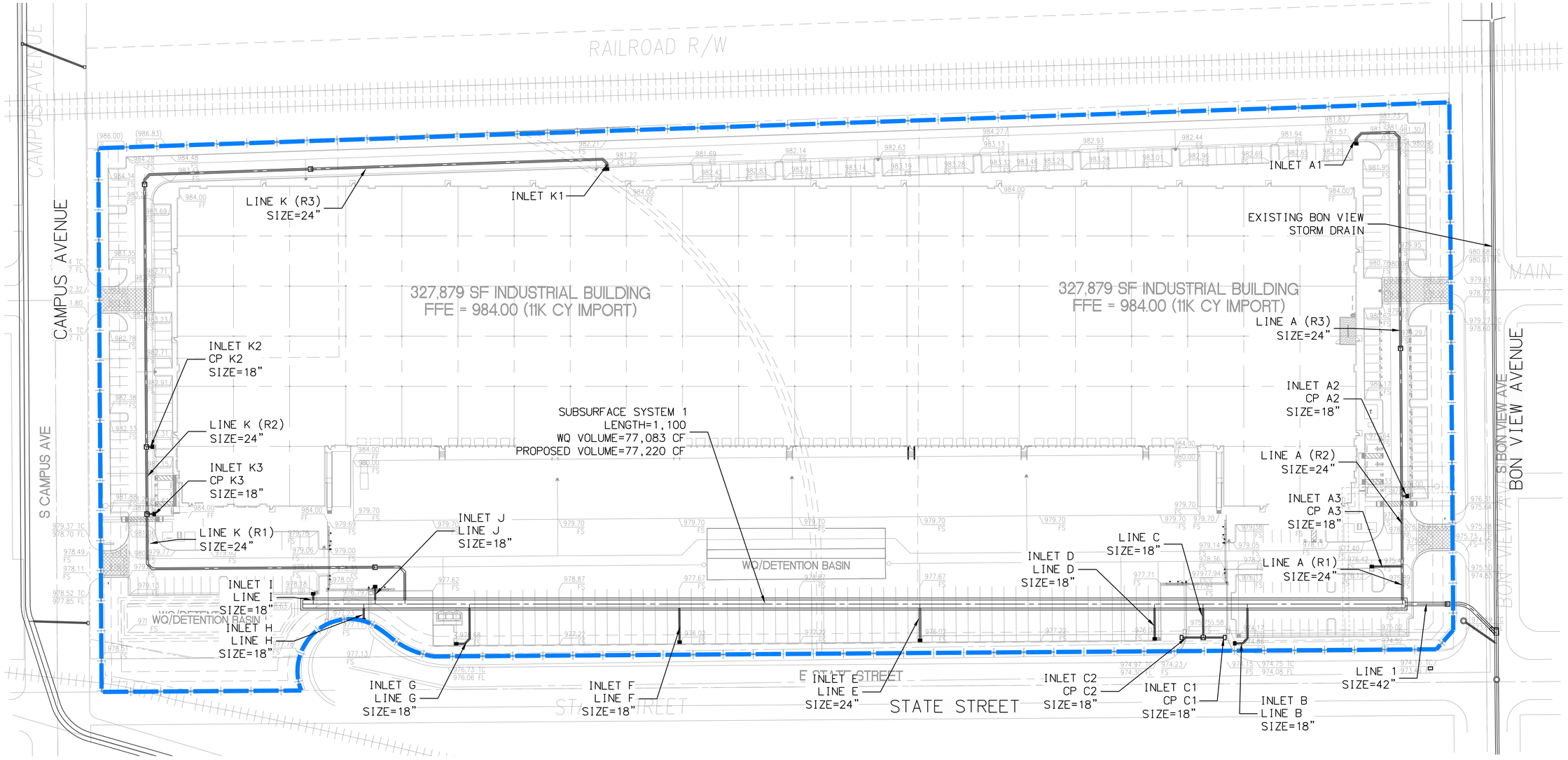
Drawing Name: O:\265.19.22\Engineering\Hydrology_Plan\Exhibits\EXHIBIT_A_RATIONAL-MAP.dwg
Last Opened: Apr 27, 2022 - 3:38pm by stanner

EXHIBIT B: DRAINAGE FACILITIES MAP

DUKE - STATE STREET

IN THE CITY OF ONTARIO, COUNTY OF SAN BERNARDINO, STATE OF CALIFORNIA

DRAINAGE FACILITIES MAP



LEGEND:

XXX / X.X — SUB AREA / ACRES

WATERSHED BOUNDARY

N

GRAPHIC SCALE
50' 0 25' 50' 100'
1" = 50'

JLC Engineering & Consulting, Inc.
41660 IVY STREET, SUITE A
MURRIETA, CA 92562
PH. 951.304.9552 FAX 951.304.3568

EXHIBIT "B"

DUKE - STATE STREET

DRAINAGE FACILITIES MAP

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