Appendix G Hydrology Analysis

Appendix

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HYDROLOGY ANALYSIS

FOR

"THE INVITATION"

1122 N. ANAHEIM BOULEVARD

OTH2019-01207

City of Anaheim

County of Orange

PREPARED FOR:

RENAISSANCE CITY NORTH ANAHEIM LLC

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PREPARED BY:

HUNSAKER & ASSOCIATES IRVINE, INC.

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APRIL 23, 2020

W.O. #4260-3

HYDROLOGY ANALYSIS
FOR
"THE INVITATION"
1122 N. ANAHEIM BOULEVARD

City of Anaheim
County of Orange

PREPARED UNDER THE SUPERVISION OF:

Tu Trinh 4/24/2020

TU TRINH, R.C.E. 71555 DATE:

TABLE OF CONTENTS

SECTION 1

INTRODUCTION

A. PROJECT LOCATION

The approximate 4.8 acre project site "The Invitation" is located just northeast of the intersection of West La Palma Avenue and Anaheim Boulevard in the City of Anaheim (City). The site is bound by an existing recycling plant to the north, by Anaheim Boulevard to the west, by La Palma Village Residential tract development to the south, and by an existing trucking yard to the east. (See the attached Vicinity Map for more detail).

B. STUDY PURPOSE

The purpose of this hydrology study is to determine the flow rates produced from the project site in the existing and proposed conditions. It also serves as the basis for analyzing and designing the on-site storm drainage system to accommodate site runoff in the proposed condition and mitigate any potential impacts to adjacent property owners and upstream/downstream drainages and storm drain facilities.

C. METHODOLOGY

The hydrology calculations were prepared using the Orange County Hydrology Manual as incorporated in the Advanced Engineering Software (AES) "RATSC" program. The Hydrologic Classification of Soils map contained in the Orange County Hydrology Manual was used to determine the hydrologic soil type "A".

D. DISCUSSION

This hydrology study is preliminary and limited within the property boundary for both the existing and proposed conditions.

Existing Condition

The existing site is an industrial site with 99% impervious, mostly parking covered with asphalt. Existing block walls run along a majority of the property lines. There are existing block walls along the entire south property line and portions of the north and east property lines. In addition to the block walls, site improvements and existing grades for the site and surrounding properties prohibit off-site run-ons into the property from the north, south and west. Runoff produced from the site will sheet flow toward the southwest corner of the site through the driveway and discharge into an existing catch basin in Anaheim Boulevard (the centerline of Anaheim Boulevard is the site's west property line) as shown on the hydrology map. The 10-yr, 25-yr and 100-yr storm runoff produced from the site is 11.2cfs, 13.6cfs and 17.6cfs, respectively.

Proposed Condition

The project site is within Drainage Basin 15 of the City's Master Plan of Drainage for Carbon Creek Channel Tributary Area, dated September 2010 (Master Plan). The Master Plan has a recommendation to build a parallel 24" RCP in Anaheim Boulevard, with a length of 1,950 ft., to satisfy the City's flood width criteria.

The project site will consist of the development of 4-level apartment building with 269 units and a 6-level parking structure. Runoff produced from sub-areas A1 and A2 will drain into a proposed catch basin, node 3, and then drain into the existing 66" RCP located in Anaheim Boulevard. The existing 20-foot long catch basin in Anaheim Boulevard at the site's northwest corner will be removed and relocated about 90 ft. to the south to accommodate the proposed project entry drive. The new 20-foot long catch basin will accommodate tributary flows from Anaheim Boulevard to the north, as it is the same size as the existing catch basin that is being replaced. Furthermore, an additional 6-foot long catch basin is proposed at the northwest corner of the site, north of the project's entry, to provide additional capacity, in combination with the relocated 20-foot long basin, for tributary flows from Anaheim Boulevard to the north. The 10-yr, 25-yr and 100-yr storm runoff produced from the site at node 3 is 4.7cfs, 5.6cfs and 7.3cfs, respectively.

Runoff produced from sub-areas A3 and A4 will drain into proposed pipes that connect into the back of a proposed catch basin, node 7. Runoff produced from sub-area A5, Anaheim Blvd. public street flows, will drain to the proposed catch basin at the site's southwest corner, node 7. This proposed 20-foot long catch basin, node 7, is to replace the existing 20-foot long catch basin just about 25 ft. to the south of the proposed location. The 10-yr, 25-yr and 100-yr storm runoff produced from the site at node 6 is 6.2cfs, 7.4cfs and 9.6cfs, respectively.

There is a decrease in runoff produced from the proposed site, because of the change in pervious area compared to the existing condition, which has increased to approximately 17% of the site. Therefore, the development will not result in any negative impact to the existing storm drain system as well as the surrounding habitable structures.

A Ponding Exhibit is included in this report in Section 4. The sump location at the southeast corner of the project has an overflow elevation of 159.11 (top of curb). The buildings immediately west of this sump location all have a finished floor of 160.17. After passing this top of curb, water will flow west toward Anaheim Boulevard without standing water. Finished floor elevations of buildings along this flow path is more than 1-foot above the finished surface shown along the flow path. The sump location at the northwest corner of the project has an overflow elevation of 157.50. The building immediately south of this sump location has a finished floor of 159.17.

In the 100-year storm event, until ultimate Master Plan improvements have been implemented by the City of Anaheim, flooding may occur within the right-of-way of Anaheim Boulevard in the worse-case scenario. The project's design ensures that the proposed apartment building will be protected from flooding in this interim condition, until the Master Plan improvements are implemented, by providing more the 1-foot of freeboard from the estimated water surface elevations within Anaheim Boulevard and the building's finished floor elevation. The estimated 100-year storm event water surface elevations within Anaheim Boulevard's right of way will vary from approximately 157.25 ft. (at the site's southwest corner) to approximately 157.85 ft. (at the site's northwest corner). The

proposed building's finished floor elevation will be 159.17 along the project's Anaheim Boulevard frontage, thereby providing more than 1-foot of freeboard from the estimated (worse-case scenario) 100-year storm event water surface elevations in Anaheim Boulevard's right-of-way.

Summary of flows produced from the site:

	Q10	Q25	Q100
Existing Condition	11.2cfs	13.6cfs	17.6cfs
	Q10	Q25	Q100
Proposed Condition	10.9cfs	13.0cfs	16.9cfs

WATER QUALITY 2-YR STUDY (for reference only)

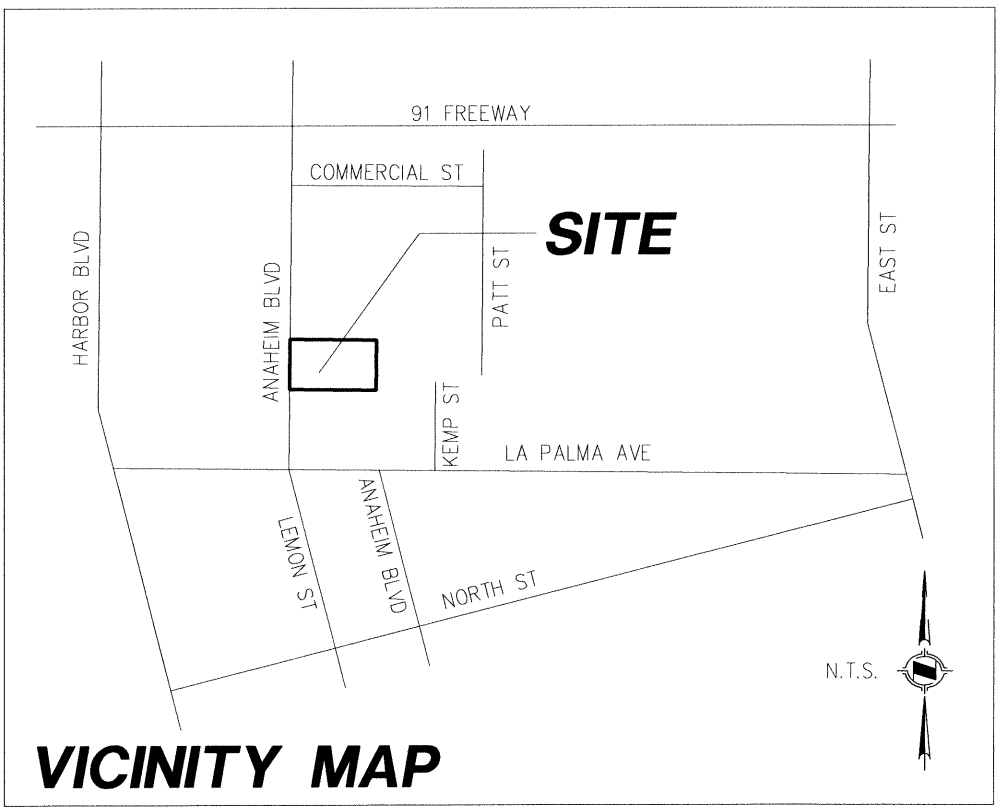
Low flows produced from the proposed site will be treated with a Modular Wetland System and a Infiltration Vault as shown on the hydrology map (See Water Quality Report for more details).

RATIONAL METHOD
In the existing condition the total area is 0.95 + 3.54 + 0.36 = 4.85ac (Software rounded down to 4.8ac) and the effective area is 4.85ac. The total flow rate produced from the site is 6.0cfs and time of concentration is 11.42min.

In the proposed condition the total area is 1.15 + 1.40 + 1.94 + 0.36 = 4.85ac (Software rounded down to 4.8ac) and the effective area is 4.85ac. The total flow rate produced from the site is 4.9cfs and time of concentration is 15.55min.

HYDROGRAPH
The 2-yr 24-hr runoff volume produced from the existing condition for 4.8ac is 0.7339ac.ft.
The 2-yr 24-hr runoff volume produced from the proposed condition for 4.8ac is 0.7241ac.ft.

The outcomes from both calculation methods shown above satisfy the conditions listed in the guidelines for North Orange County areas; therefore, the project site is not subject for a Hydro-Mod study.


91 FREEWAY
COMMERCIAL ST
SITE
HARBOR BLVD
ANAHEIM BLVD
PATT ST
EAST ST
KEMP ST
LA PALMA AVE
ANAHEIM BLVD
LEMON ST
NORTH ST
N.T.S.
VICINITY MAP

LEGEND

A B C D HYDROLOGIC SOIL GROUPS

HYDROLOGIC SOIL GROUP BOUNDARY

COUNTY BOUNDARY

SECTION 2

HYDROLOGY CALCULATIONS
EXISTING CONDITION

```
______________________________________________________________________
**********************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1239

                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                       Planning * Engineering * Surveying
          Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************ DESCRIPTION OF STUDY ************************
* W.O. #4260-3, RENAISSANCE APARTMENT                                 *
* 2-YR STUDY                                                          *
* EXISTING CONDITION                                                  *
 **********************************************************************

  FILE NAME: REN-E2.DAT
  TIME/DATE OF STUDY: 17:11 02/29/2020
======================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
======================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  =====  ====  =====  =======
  1   26.0     21.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**********************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
======================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    161.00  DOWNSTREAM(FEET) =    158.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.818
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.751
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.95      0.40      0.100    17    7.82
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      1.46
  TOTAL AREA(ACRES) =      0.95   PEAK FLOW RATE(CFS) =      1.46

**********************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  51
```

```
------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
========================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    158.60  DOWNSTREAM(FEET) =    157.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   376.00   CHANNEL SLOPE =  0.0037
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.409
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        3.54      0.40     0.100    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.66
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   1.74
  AVERAGE FLOW DEPTH(FEET) =   0.18   TRAVEL TIME(MIN.) =   3.60
  Tc(MIN.) =   11.42
  SUBAREA AREA(ACRES) =     3.54       SUBAREA RUNOFF(CFS) =    4.36
  EFFECTIVE AREA(ACRES) =      4.49     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.40  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.5         PEAK FLOW RATE(CFS) =       5.53

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.23   FLOW VELOCITY(FEET/SEC.) =   2.00
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     676.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =  81
------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
========================================================================
  MAINLINE Tc(MIN.) =   11.42
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.409
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.36      0.40     0.100    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    0.44
  EFFECTIVE AREA(ACRES) =      4.85   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        4.8       PEAK FLOW RATE(CFS) =       5.98
========================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.8  TC(MIN.) =     11.42
  EFFECTIVE AREA(ACRES) =      4.85  AREA-AVERAGED Fm(INCH/HR)=  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =       5.98
========================================================================
========================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
______________________________________________________________________
**********************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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             Ver. 23.0  Release Date: 07/01/2016  License ID 1239

                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                       Planning * Engineering * Surveying
          Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************ DESCRIPTION OF STUDY ************************
* W.O. #4260-3, RENAISSANCE APARTMENT                                 *
* 10-YR STUDY                                                         *
* EXISTING CONDITION                                                  *
 **********************************************************************

  FILE NAME: REN-E10.DAT
  TIME/DATE OF STUDY: 17:23 02/29/2020
======================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
======================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  =====  ====  =====  =======
  1   26.0     21.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**********************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
======================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    161.00  DOWNSTREAM(FEET) =    158.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.818
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.142
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.95      0.40      0.100    32    7.82
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.65
  TOTAL AREA(ACRES) =      0.95   PEAK FLOW RATE(CFS) =      2.65

**********************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  51
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    158.60  DOWNSTREAM(FEET) =    157.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   376.00   CHANNEL SLOPE =  0.0037
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.615
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        3.54      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       6.78
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.12
  AVERAGE FLOW DEPTH(FEET) =   0.25   TRAVEL TIME(MIN.) =   2.95
  Tc(MIN.) =   10.77
  SUBAREA AREA(ACRES) =     3.54       SUBAREA RUNOFF(CFS) =    8.21
  EFFECTIVE AREA(ACRES) =      4.49     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.40  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.5         PEAK FLOW RATE(CFS) =      10.41

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.32   FLOW VELOCITY(FEET/SEC.) =   2.43
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     676.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.77
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.615
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.36      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    0.83
  EFFECTIVE AREA(ACRES) =      4.85   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        4.8       PEAK FLOW RATE(CFS) =      11.24
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.8  TC(MIN.) =     10.77
  EFFECTIVE AREA(ACRES) =      4.85  AREA-AVERAGED Fm(INCH/HR)=  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      11.24
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
______________________________________________________________________
**********************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
         (c) Copyright 1983-2016 Advanced Engineering Software (aes)
             Ver. 23.0  Release Date: 07/01/2016  License ID 1239

                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                       Planning * Engineering * Surveying
          Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************ DESCRIPTION OF STUDY ************************
* W.O. #4260-3, RENAISSANCE APARTMENT                                  *
* 25-YR STUDY                                                          *
* EXISTING CONDITION                                                   *
 **********************************************************************

  FILE NAME: REN-E25.DAT
  TIME/DATE OF STUDY: 17:25 02/29/2020
======================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
======================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   26.0     21.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

**********************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
----------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
======================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    161.00  DOWNSTREAM(FEET) =    158.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.818
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.745
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.95      0.40      0.100    32    7.82
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.17
  TOTAL AREA(ACRES) =      0.95   PEAK FLOW RATE(CFS) =      3.17

**********************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  51
```

```
------------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
==============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    158.60  DOWNSTREAM(FEET) =    157.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   376.00   CHANNEL SLOPE =  0.0037
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.158
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        3.54      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       8.15
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.28
  AVERAGE FLOW DEPTH(FEET) =   0.28   TRAVEL TIME(MIN.) =   2.75
  Tc(MIN.) =   10.57
  SUBAREA AREA(ACRES) =     3.54       SUBAREA RUNOFF(CFS) =    9.93
  EFFECTIVE AREA(ACRES) =      4.49     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.40  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.5         PEAK FLOW RATE(CFS) =      12.60

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.36   FLOW VELOCITY(FEET/SEC.) =   2.61
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     676.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =  81
------------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
==============================================================================
  MAINLINE Tc(MIN.) =   10.57
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.158
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.36      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    1.01
  EFFECTIVE AREA(ACRES) =      4.85   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        4.8       PEAK FLOW RATE(CFS) =      13.61
==============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.8  TC(MIN.) =     10.57
  EFFECTIVE AREA(ACRES) =      4.85  AREA-AVERAGED Fm(INCH/HR)=  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      13.61
==============================================================================
==============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                       Planning * Engineering * Surveying
         Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************ DESCRIPTION OF STUDY ************************
* W.O. #4260-3, RENAISSANCE APARTMENT                                  *
* 100-YR STUDY                                                         *
* EXISTING CONDITION                                                   *
 ************************************************************************

  FILE NAME: REN-E100.DAT
  TIME/DATE OF STUDY: 16:00 03/26/2020
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  =====  ====  =====  =======
  1   26.0     21.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    161.00  DOWNSTREAM(FEET) =    158.60

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    7.818
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.789
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.95      0.40      0.100    52    7.82
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      4.06
  TOTAL AREA(ACRES) =      0.95   PEAK FLOW RATE(CFS) =      4.06

************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  51
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE TRAPEZOIDAL CHANNEL FLOW<<<<<
  >>>>>TRAVELTIME THRU SUBAREA (EXISTING ELEMENT)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =    158.60  DOWNSTREAM(FEET) =    157.20
  CHANNEL LENGTH THRU SUBAREA(FEET) =   376.00   CHANNEL SLOPE =  0.0037
  CHANNEL BASE(FEET) =   10.00   "Z" FACTOR =  10.000
  MANNING'S FACTOR = 0.015   MAXIMUM DEPTH(FEET) =   1.00
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.074
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        3.54      0.40     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =      10.52
  TRAVEL TIME THRU SUBAREA BASED ON VELOCITY(FEET/SEC.) =   2.46
  AVERAGE FLOW DEPTH(FEET) =   0.32   TRAVEL TIME(MIN.) =   2.55
  Tc(MIN.) =   10.37
  SUBAREA AREA(ACRES) =     3.54       SUBAREA RUNOFF(CFS) =   12.85
  EFFECTIVE AREA(ACRES) =      4.49     AREA-AVERAGED Fm(INCH/HR) =   0.04
  AREA-AVERAGED Fp(INCH/HR) =   0.40  AREA-AVERAGED Ap =   0.10
  TOTAL AREA(ACRES) =        4.5         PEAK FLOW RATE(CFS) =      16.30

  END OF SUBAREA CHANNEL FLOW HYDRAULICS:
  DEPTH(FEET) =  0.41   FLOW VELOCITY(FEET/SEC.) =   2.83
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     676.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   10.37
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.074
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.36      0.40     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    1.31
  EFFECTIVE AREA(ACRES) =      4.85   AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        4.8       PEAK FLOW RATE(CFS) =      17.61
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.8  TC(MIN.) =     10.37
  EFFECTIVE AREA(ACRES) =      4.85  AREA-AVERAGED Fm(INCH/HR)=  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)   =      17.61
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==========================================================================
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                           Analysis prepared by:

                           HUNSAKER & ASSOCIATES
                                 Irvine,Inc
                        Planning * Engineering * Surveying
          Three Hughes * Irvine, California 92618 * (949)583-1010

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  W.O. 4260-3 THE INVITATION
  2-YR STUDY
  EXISTING CONDITION
==========================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1         4.80        0.10       98.(AMC II)     0.400       0.890

    TOTAL AREA (Acres) =      4.80

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.000

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.110
==========================================================================

 Problem Descriptions:
  W.O. 4260-3 THE INVITATION
  2-YR STUDY
  EXISTING CONDITION
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    4.80
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.000
    LOW LOSS FRACTION = 0.110
    TIME OF CONCENTRATION(MIN.) = 11.42
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

--------------------------------------------------------------------------
```

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 0.73
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 0.09

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0.	2.5	5.0	7.5	10.0
0.01	0.0000	0.00	Q	.	.	.	.
0.20	0.0011	0.14	Q	.	.	.	.
0.39	0.0033	0.14	Q	.	.	.	.
0.58	0.0055	0.14	Q	.	.	.	.
0.77	0.0077	0.14	Q	.	.	.	.
0.96	0.0099	0.14	Q	.	.	.	.
1.15	0.0122	0.14	Q	.	.	.	.
1.34	0.0145	0.15	Q	.	.	.	.
1.53	0.0167	0.15	Q	.	.	.	.
1.72	0.0191	0.15	Q	.	.	.	.
1.92	0.0214	0.15	Q	.	.	.	.
2.11	0.0237	0.15	Q	.	.	.	.
2.30	0.0261	0.15	Q	.	.	.	.
2.49	0.0285	0.15	Q	.	.	.	.
2.68	0.0309	0.15	Q	.	.	.	.
2.87	0.0333	0.16	Q	.	.	.	.
3.06	0.0358	0.16	Q	.	.	.	.
3.25	0.0382	0.16	Q	.	.	.	.
3.44	0.0407	0.16	Q	.	.	.	.
3.63	0.0433	0.16	Q	.	.	.	.
3.82	0.0458	0.16	Q	.	.	.	.
4.01	0.0484	0.16	Q	.	.	.	.
4.20	0.0510	0.17	Q	.	.	.	.
4.39	0.0536	0.17	Q	.	.	.	.
4.58	0.0562	0.17	Q	.	.	.	.
4.77	0.0589	0.17	Q	.	.	.	.
4.96	0.0616	0.17	Q	.	.	.	.
5.15	0.0643	0.17	Q	.	.	.	.
5.34	0.0671	0.18	Q	.	.	.	.
5.53	0.0699	0.18	Q	.	.	.	.
5.72	0.0727	0.18	Q	.	.	.	.
5.91	0.0756	0.18	Q	.	.	.	.
6.10	0.0785	0.18	Q	.	.	.	.
6.29	0.0814	0.19	Q	.	.	.	.
6.48	0.0843	0.19	Q	.	.	.	.
6.67	0.0873	0.19	Q	.	.	.	.
6.86	0.0904	0.19	Q	.	.	.	.
7.05	0.0934	0.20	Q	.	.	.	.
7.24	0.0966	0.20	Q	.	.	.	.
7.43	0.0997	0.20	Q	.	.	.	.
7.63	0.1029	0.20	Q	.	.	.	.
7.82	0.1062	0.21	Q	.	.	.	.
8.01	0.1094	0.21	Q	.	.	.	.
8.20	0.1128	0.21	Q	.	.	.	.
8.39	0.1162	0.22	Q	.	.	.	.
8.58	0.1196	0.22	Q	.	.	.	.
8.77	0.1231	0.22	Q	.	.	.	.
8.96	0.1267	0.23	Q	.	.	.	.
9.15	0.1303	0.23	Q	.	.	.	.
9.34	0.1339	0.24	Q	.	.	.	.
9.53	0.1377	0.24	Q	.	.	.	.
9.72	0.1415	0.24	Q	.	.	.	.
9.91	0.1454	0.25	Q	.	.	.	.
10.10	0.1493	0.25	.Q	.	.	.	.
10.29	0.1533	0.26	.Q	.	.	.	.
10.48	0.1575	0.27	.Q	.	.	.	.

10.67	0.1617	0.27	.Q . . . .
10.86	0.1659	0.28	.Q . . . .
11.05	0.1703	0.28	.Q . . . .
11.24	0.1748	0.29	.Q . . . .
11.43	0.1794	0.30	.Q . . . .
11.62	0.1842	0.31	.Q . . . .
11.81	0.1890	0.31	.Q . . . .
12.00	0.1940	0.32	.Q . . . .
12.19	0.1994	0.37	.Q . . . .
12.38	0.2055	0.41	.Q . . . .
12.57	0.2121	0.42	.Q . . . .
12.76	0.2189	0.44	.Q . . . .
12.95	0.2259	0.45	.Q . . . .
13.15	0.2331	0.47	.Q . . . .
13.34	0.2406	0.48	.Q . . . .
13.53	0.2483	0.51	. Q . . . .
13.72	0.2564	0.52	. Q . . . .
13.91	0.2648	0.55	. Q . . . .
14.10	0.2736	0.57	. Q . . . .
14.29	0.2830	0.63	. Q . . . .
14.48	0.2932	0.66	. Q . . . .
14.67	0.3040	0.71	. Q . . . .
14.86	0.3155	0.75	. Q . . . .
15.05	0.3280	0.84	. Q . . . .
15.24	0.3416	0.90	. Q . . . .
15.43	0.3566	1.02	. Q . . . .
15.62	0.3727	1.02	. Q . . . .
15.81	0.3923	1.48	. Q . . . .
16.00	0.4199	2.03	. Q . . . .
16.19	0.4836	6.08	. . . Q . .
16.38	0.5408	1.19	. Q . . . .
16.57	0.5577	0.97	. Q . . . .
16.76	0.5715	0.79	. Q . . . .
16.95	0.5831	0.68	. Q . . . .
17.14	0.5932	0.61	. Q . . . .
17.33	0.6022	0.53	. Q . . . .
17.52	0.6103	0.49	.Q . . . .
17.71	0.6178	0.46	.Q . . . .
17.90	0.6248	0.43	.Q . . . .
18.09	0.6313	0.41	.Q . . . .
18.28	0.6370	0.32	.Q . . . .
18.47	0.6419	0.30	.Q . . . .
18.66	0.6465	0.29	.Q . . . .
18.86	0.6509	0.27	.Q . . . .
19.05	0.6551	0.26	.Q . . . .
19.24	0.6591	0.25	.Q . . . .
19.43	0.6630	0.24	Q . . . .
19.62	0.6667	0.23	Q . . . .
19.81	0.6703	0.23	Q . . . .
20.00	0.6738	0.22	Q . . . .
20.19	0.6772	0.21	Q . . . .
20.38	0.6805	0.21	Q . . . .
20.57	0.6837	0.20	Q . . . .
20.76	0.6868	0.20	Q . . . .
20.95	0.6899	0.19	Q . . . .
21.14	0.6928	0.19	Q . . . .
21.33	0.6957	0.18	Q . . . .
21.52	0.6985	0.18	Q . . . .
21.71	0.7013	0.17	Q . . . .
21.90	0.7040	0.17	Q . . . .
22.09	0.7066	0.17	Q . . . .
22.28	0.7092	0.16	Q . . . .
22.47	0.7118	0.16	Q . . . .

22.66	0.7143	0.16	Q	.	.	.	.
22.85	0.7167	0.15	Q	.	.	.	.
23.04	0.7191	0.15	Q	.	.	.	.
23.23	0.7215	0.15	Q	.	.	.	.
23.42	0.7238	0.15	Q	.	.	.	.
23.61	0.7261	0.14	Q	.	.	.	.
23.80	0.7284	0.14	Q	.	.	.	.
23.99	0.7306	0.14	Q	.	.	.	.
24.18	0.7328	0.14	Q	.	.	.	.
24.37	0.7339	0.00	Q	.	.	.	.

TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1450.3
10%	171.3
20%	34.3
30%	22.8
40%	11.4
50%	11.4
60%	11.4
70%	11.4
80%	11.4
90%	11.4

SECTION 3

HYDROLOGY CALCULATIONS
PROPOSED CONDITION

```
******************************************************************************
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           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                      Planning * Engineering * Surveying
          Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************* DESCRIPTION OF STUDY *************************
* W.O. #4260-3, RENAISSANCE APARTMENT                                    *
* 2-YR STUDY                                                             *
* PROPOSED CONDITION                                                     *
 ************************************************************************

  FILE NAME: REN-P2.DAT
  TIME/DATE OF STUDY: 15:46 04/17/2020
==============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
==============================================================================
                     --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =    2.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) I ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  =================  ======  ===== ====== ===== =======
  1   26.0     21.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

******************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
==============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    160.02  DOWNSTREAM(FEET) =    158.61

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.268
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.588
  SUBAREA Tc AND LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
```

```
  APARTMENTS                  A        1.15      0.40     0.200    17    9.27
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      1.56
  TOTAL AREA(ACRES) =      1.15   PEAK FLOW RATE(CFS) =      1.56

****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   158.61  DOWNSTREAM(FEET) =   157.80
  FLOW LENGTH(FEET) =   392.00   MANNING'S N =  0.013
  ESTIMATED PIPE DIAMETER(INCH) INCREASED TO 18.000
  DEPTH OF FLOW IN  18.0 INCH PIPE IS   7.3 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.33
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       1.56
  PIPE TRAVEL TIME(MIN.) =   2.81    Tc(MIN.) =   12.08
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     692.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      3.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.08
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.365
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                  A        1.40      0.40     0.200    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    1.40      SUBAREA RUNOFF(CFS) =    1.62
  EFFECTIVE AREA(ACRES) =      2.55   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.5       PEAK FLOW RATE(CFS) =       2.95

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   157.80  DOWNSTREAM(FEET) =   157.20
  FLOW LENGTH(FEET) =   470.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  12.5 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.25
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.95
  PIPE TRAVEL TIME(MIN.) =   3.47    Tc(MIN.) =   15.55
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      4.00 =    1162.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.55
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.180
  SUBAREA LOSS RATE DATA(AMC  I ):
```

```
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  A        1.94      0.40      0.100    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.94      SUBAREA RUNOFF(CFS) =    1.99
  EFFECTIVE AREA(ACRES) =      4.49   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.16
  TOTAL AREA(ACRES) =        4.5       PEAK FLOW RATE(CFS) =       4.52

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      4.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   15.55
  *   2 YEAR RAINFALL INTENSITY(INCH/HR) =  1.180
  SUBAREA LOSS RATE DATA(AMC  I ):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  A        0.36      0.40      0.100    17
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    0.37
  EFFECTIVE AREA(ACRES) =      4.85   AREA-AVERAGED Fm(INCH/HR) =  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.15
  TOTAL AREA(ACRES) =        4.8       PEAK FLOW RATE(CFS) =       4.89
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        4.8  TC(MIN.) =     15.55
  EFFECTIVE AREA(ACRES) =      4.85  AREA-AVERAGED Fm(INCH/HR)=  0.06
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.153
  PEAK FLOW RATE(CFS)   =       4.89
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                       Planning * Engineering * Surveying
         Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************ DESCRIPTION OF STUDY ************************
* W.O. #4260-3, RENAISSANCE APARTMENT                                  *
* 10-YR STUDY                                                          *
* PROPOSED CONDITION                                                   *
 ************************************************************************

  FILE NAME: REN-P10.DAT
  TIME/DATE OF STUDY: 10:22 03/27/2020
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   10.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  =====  ====  =====  =======
  1   26.0     21.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
  ELEVATION DATA: UPSTREAM(FEET) =    160.02  DOWNSTREAM(FEET) =    158.75

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.017
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  3.097
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.90      0.40      0.100    32    8.02
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.48
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      2.48

************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  62
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  158.75  DOWNSTREAM ELEVATION(FEET) =  157.20
  STREET LENGTH(FEET) =   241.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 26.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  21.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       3.74
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.38
    HALFSTREET FLOOD WIDTH(FEET) =   13.90
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.02
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.76
  STREET FLOW TRAVEL TIME(MIN.) =   1.98   Tc(MIN.) =   10.00
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.729
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       1.04      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.04      SUBAREA RUNOFF(CFS) =    2.52
  EFFECTIVE AREA(ACRES) =      1.94    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.9        PEAK FLOW RATE(CFS) =       4.69

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.40   HALFSTREET FLOOD WIDTH(FEET) =  15.21
  FLOW VELOCITY(FEET/SEC.) =  2.15   DEPTH*VELOCITY(FT*FT/SEC.) =   0.86
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     494.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    160.02  DOWNSTREAM(FEET) =    158.61

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.268
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.850
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A       1.15      0.40     0.200    32    9.27
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      2.87
  TOTAL AREA(ACRES) =      1.15   PEAK FLOW RATE(CFS) =      2.87

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   158.61  DOWNSTREAM(FEET) =   157.80
  FLOW LENGTH(FEET) =   392.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  10.4 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.71
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       2.87
  PIPE TRAVEL TIME(MIN.) =   2.41    Tc(MIN.) =   11.68
  LONGEST FLOWPATH FROM NODE      4.00 TO NODE      6.00 =     692.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.68
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.497
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        1.41      0.40     0.200    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    1.41      SUBAREA RUNOFF(CFS) =    3.07
  EFFECTIVE AREA(ACRES) =      2.56   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.6       PEAK FLOW RATE(CFS) =       5.57

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   157.80  DOWNSTREAM(FEET) =   157.20
  FLOW LENGTH(FEET) =   151.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  13.2 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.01
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       5.57
  PIPE TRAVEL TIME(MIN.) =   0.63    Tc(MIN.) =   12.31
  LONGEST FLOWPATH FROM NODE      4.00 TO NODE      7.00 =     843.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.31
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  2.423
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.36      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    0.77
  EFFECTIVE AREA(ACRES) =      2.92   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        2.9       PEAK FLOW RATE(CFS) =       6.17
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.9  TC(MIN.) =     12.31
  EFFECTIVE AREA(ACRES) =      2.92  AREA-AVERAGED Fm(INCH/HR)=  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.188
  PEAK FLOW RATE(CFS)   =       6.17
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                       Planning * Engineering * Surveying
         Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************ DESCRIPTION OF STUDY ************************
* W.O. #4260-3, RENAISSANCE APARTMENT                                  *
* 25-YR STUDY                                                          *
* PROPOSED CONDITION                                                   *
 ************************************************************************

  FILE NAME: REN-P25.DAT
  TIME/DATE OF STUDY: 10:25 03/27/2020
========================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
========================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =   25.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) II ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   26.0     21.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
========================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
  ELEVATION DATA: UPSTREAM(FEET) =    160.02  DOWNSTREAM(FEET) =    158.75

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.017
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.693
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.90      0.40      0.100    32    8.02
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      2.96
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      2.96

************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  62
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  158.75  DOWNSTREAM ELEVATION(FEET) =  157.20
  STREET LENGTH(FEET) =   241.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 26.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  21.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       4.47
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.40
    HALFSTREET FLOOD WIDTH(FEET) =   14.97
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.11
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.84
  STREET FLOW TRAVEL TIME(MIN.) =   1.90   Tc(MIN.) =    9.92
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.273
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       1.04      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.04      SUBAREA RUNOFF(CFS) =    3.03
  EFFECTIVE AREA(ACRES) =      1.94    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.9        PEAK FLOW RATE(CFS) =       5.64

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.42   HALFSTREET FLOOD WIDTH(FEET) =  16.36
  FLOW VELOCITY(FEET/SEC.) =  2.25   DEPTH*VELOCITY(FT*FT/SEC.) =   0.95
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     494.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    160.02  DOWNSTREAM(FEET) =    158.61

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.268
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  3.402
  SUBAREA Tc AND LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A       1.15      0.40     0.200    32    9.27
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      3.44
  TOTAL AREA(ACRES) =      1.15   PEAK FLOW RATE(CFS) =      3.44

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   158.61  DOWNSTREAM(FEET) =   157.80
  FLOW LENGTH(FEET) =   392.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  11.7 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.82
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       3.44
  PIPE TRAVEL TIME(MIN.) =   2.32    Tc(MIN.) =   11.59
  LONGEST FLOWPATH FROM NODE      4.00 TO NODE      6.00 =     692.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.59
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.998
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        1.41      0.40     0.200    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    1.41      SUBAREA RUNOFF(CFS) =    3.70
  EFFECTIVE AREA(ACRES) =      2.56   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.6       PEAK FLOW RATE(CFS) =       6.72

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   157.80  DOWNSTREAM(FEET) =   157.20
  FLOW LENGTH(FEET) =   151.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  13.1 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.27
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       6.72
  PIPE TRAVEL TIME(MIN.) =   0.59    Tc(MIN.) =   12.18
  LONGEST FLOWPATH FROM NODE      4.00 TO NODE      7.00 =     843.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.18
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  2.915
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.36      0.40     0.100    32
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    0.93
  EFFECTIVE AREA(ACRES) =      2.92   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        2.9       PEAK FLOW RATE(CFS) =       7.46
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.9  TC(MIN.) =     12.18
  EFFECTIVE AREA(ACRES) =      2.92  AREA-AVERAGED Fm(INCH/HR)=  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.188
  PEAK FLOW RATE(CFS)   =       7.46
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
_____________________________________________________________________________
*****************************************************************************
            RATIONAL METHOD HYDROLOGY COMPUTER PROGRAM PACKAGE
           (Reference: 1986 ORANGE COUNTY HYDROLOGY CRITERION)
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                          Analysis prepared by:

                          HUNSAKER & ASSOCIATES
                                Irvine,Inc
                       Planning * Engineering * Surveying
          Three Hughes * Irvine, California 92618 * (949)583-1010

 ************************ DESCRIPTION OF STUDY ************************
* W.O. #4260-3, RENAISSANCE APARTMENT                                   *
* 100-YR STUDY                                                          *
* PROPOSED CONDITION                                                    *
 *************************************************************************

  FILE NAME: REN-P100.DAT
  TIME/DATE OF STUDY: 10:27 03/27/2020
=============================================================================
  USER SPECIFIED HYDROLOGY AND HYDRAULIC MODEL INFORMATION:
=============================================================================
                    --*TIME-OF-CONCENTRATION MODEL*--

  USER SPECIFIED STORM EVENT(YEAR) =  100.00
  SPECIFIED MINIMUM PIPE SIZE(INCH) =  18.00
  SPECIFIED PERCENT OF GRADIENTS(DECIMAL) TO USE FOR FRICTION SLOPE = 0.90
  *DATA BANK RAINFALL USED*
  *ANTECEDENT MOISTURE CONDITION (AMC) III ASSUMED FOR RATIONAL METHOD*

  *USER-DEFINED STREET-SECTIONS FOR COUPLED PIPEFLOW AND STREETFLOW MODEL*
     HALF-  CROWN TO   STREET-CROSSFALL:   CURB  GUTTER-GEOMETRIES:  MANNING
     WIDTH  CROSSFALL  IN-  / OUT-/PARK-  HEIGHT  WIDTH  LIP   HIKE  FACTOR
NO.   (FT)     (FT)    SIDE / SIDE/ WAY    (FT)    (FT)  (FT)  (FT)    (n)
===  =====  =========  ================  ======  ===== ====== ===== =======
  1   26.0     21.0    0.018/0.018/0.020   0.50    1.50 0.0313 0.125 0.0150

  GLOBAL STREET FLOW-DEPTH CONSTRAINTS:
    1. Relative Flow-Depth =  0.00 FEET
       as (Maximum Allowable Street Flow Depth) - (Top-of-Curb)
    2. (Depth)*(Velocity) Constraint =  6.0 (FT*FT/S)
  *SIZE PIPE WITH A FLOW CAPACITY GREATER THAN
   OR EQUAL TO THE UPSTREAM TRIBUTARY PIPE.*
  *USER-SPECIFIED MINIMUM TOPOGRAPHIC SLOPE ADJUSTMENT NOT SELECTED

*****************************************************************************
  FLOW PROCESS FROM NODE      1.00 TO NODE      2.00 IS CODE =  21
-----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
=============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   253.00
  ELEVATION DATA: UPSTREAM(FEET) =    160.02  DOWNSTREAM(FEET) =    158.75

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    8.017
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.721
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  COMMERCIAL                 A        0.90      0.40      0.100    52    8.02
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =      3.79
  TOTAL AREA(ACRES) =      0.90   PEAK FLOW RATE(CFS) =      3.79

*****************************************************************************
  FLOW PROCESS FROM NODE      2.00 TO NODE      3.00 IS CODE =  62
```

```
----------------------------------------------------------------------------
  >>>>>COMPUTE STREET FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>(STREET TABLE SECTION #  1 USED)<<<<<
============================================================================
  UPSTREAM ELEVATION(FEET) =  158.75  DOWNSTREAM ELEVATION(FEET) =  157.20
  STREET LENGTH(FEET) =   241.00   CURB HEIGHT(INCHES) =  6.0
  STREET HALFWIDTH(FEET) = 26.00

  DISTANCE FROM CROWN TO CROSSFALL GRADEBREAK(FEET) =  21.00
  INSIDE STREET CROSSFALL(DECIMAL) =  0.018
  OUTSIDE STREET CROSSFALL(DECIMAL)  =  0.018

  SPECIFIED NUMBER OF HALFSTREETS CARRYING RUNOFF =  1
  STREET PARKWAY CROSSFALL(DECIMAL)  =  0.020
  Manning's FRICTION FACTOR for Streetflow Section(curb-to-curb) =   0.0150
  Manning's FRICTION FACTOR for Back-of-Walk Flow Section =   0.0200

    **TRAVEL TIME COMPUTED USING ESTIMATED FLOW(CFS) =       5.74
    STREETFLOW MODEL RESULTS USING ESTIMATED FLOW:
    STREET FLOW DEPTH(FEET) =  0.42
    HALFSTREET FLOOD WIDTH(FEET) =   16.53
    AVERAGE FLOW VELOCITY(FEET/SEC.) =    2.24
    PRODUCT OF DEPTH&VELOCITY(FT*FT/SEC.) =    0.95
  STREET FLOW TRAVEL TIME(MIN.) =   1.79   Tc(MIN.) =    9.81
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.206
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A       1.04      0.40     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    1.04      SUBAREA RUNOFF(CFS) =    3.90
  EFFECTIVE AREA(ACRES) =      1.94    AREA-AVERAGED Fm(INCH/HR) =  0.04
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.10
  TOTAL AREA(ACRES) =        1.9        PEAK FLOW RATE(CFS) =       7.27

  END OF SUBAREA STREET FLOW HYDRAULICS:
  DEPTH(FEET) = 0.45   HALFSTREET FLOOD WIDTH(FEET) =  18.17
  FLOW VELOCITY(FEET/SEC.) =  2.37   DEPTH*VELOCITY(FT*FT/SEC.) =   1.08
  LONGEST FLOWPATH FROM NODE      1.00 TO NODE      3.00 =     494.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      4.00 TO NODE      5.00 IS CODE =  21
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>USE TIME-OF-CONCENTRATION NOMOGRAPH FOR INITIAL SUBAREA<<
============================================================================
  INITIAL SUBAREA FLOW-LENGTH(FEET) =   300.00
  ELEVATION DATA: UPSTREAM(FEET) =    160.02  DOWNSTREAM(FEET) =    158.61

  Tc = K*[(LENGTH** 3.00)/(ELEVATION CHANGE)]**0.20
  SUBAREA ANALYSIS USED MINIMUM Tc(MIN.) =    9.268
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  4.344
  SUBAREA Tc AND LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS   Tc
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN  (MIN.)
  APARTMENTS                 A       1.15      0.40     0.200    52    9.27
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA RUNOFF(CFS) =      4.41
  TOTAL AREA(ACRES) =      1.15   PEAK FLOW RATE(CFS) =      4.41

****************************************************************************
  FLOW PROCESS FROM NODE      5.00 TO NODE      6.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   158.61  DOWNSTREAM(FEET) =   157.80
  FLOW LENGTH(FEET) =   392.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  18.0 INCH PIPE IS  14.3 INCHES
```

```
  PIPE-FLOW VELOCITY(FEET/SEC.) =   2.92
  ESTIMATED PIPE DIAMETER(INCH) =  18.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       4.41
  PIPE TRAVEL TIME(MIN.) =   2.24    Tc(MIN.) =   11.50
  LONGEST FLOWPATH FROM NODE      4.00 TO NODE      6.00 =     692.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      6.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   11.50
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.838
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  APARTMENTS                 A        1.41      0.40     0.200    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.200
  SUBAREA AREA(ACRES) =    1.41      SUBAREA RUNOFF(CFS) =    4.77
  EFFECTIVE AREA(ACRES) =      2.56   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.20
  TOTAL AREA(ACRES) =        2.6       PEAK FLOW RATE(CFS) =       8.66

****************************************************************************
  FLOW PROCESS FROM NODE      6.00 TO NODE      7.00 IS CODE =  31
----------------------------------------------------------------------------
  >>>>>COMPUTE PIPE-FLOW TRAVEL TIME THRU SUBAREA<<<<<
  >>>>>USING COMPUTER-ESTIMATED PIPESIZE (NON-PRESSURE FLOW)<<<<<
============================================================================
  ELEVATION DATA: UPSTREAM(FEET) =   157.80  DOWNSTREAM(FEET) =   157.20
  FLOW LENGTH(FEET) =   151.00   MANNING'S N =  0.013
  DEPTH OF FLOW IN  21.0 INCH PIPE IS  15.8 INCHES
  PIPE-FLOW VELOCITY(FEET/SEC.) =   4.46
  ESTIMATED PIPE DIAMETER(INCH) =  21.00    NUMBER OF PIPES =   1
  PIPE-FLOW(CFS) =       8.66
  PIPE TRAVEL TIME(MIN.) =   0.56    Tc(MIN.) =   12.07
  LONGEST FLOWPATH FROM NODE      4.00 TO NODE      7.00 =     843.00 FEET.

****************************************************************************
  FLOW PROCESS FROM NODE      7.00 TO NODE      7.00 IS CODE =  81
----------------------------------------------------------------------------
  >>>>>ADDITION OF SUBAREA TO MAINLINE PEAK FLOW<<<<<
============================================================================
  MAINLINE Tc(MIN.) =   12.07
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  3.735
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 A        0.36      0.40     0.100    52
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.40
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA AREA(ACRES) =    0.36      SUBAREA RUNOFF(CFS) =    1.20
  EFFECTIVE AREA(ACRES) =      2.92   AREA-AVERAGED Fm(INCH/HR) =  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap =  0.19
  TOTAL AREA(ACRES) =        2.9       PEAK FLOW RATE(CFS) =       9.62
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        2.9  TC(MIN.) =     12.07
  EFFECTIVE AREA(ACRES) =      2.92  AREA-AVERAGED Fm(INCH/HR)=  0.08
  AREA-AVERAGED Fp(INCH/HR) =  0.40  AREA-AVERAGED Ap = 0.188
  PEAK FLOW RATE(CFS)   =       9.62
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
          NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
                    AND LOW LOSS FRACTION ESTIMATIONS
==========================================================================
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                           Analysis prepared by:

                           HUNSAKER & ASSOCIATES
                                 Irvine,Inc
                        Planning * Engineering * Surveying
          Three Hughes * Irvine, California 92618 * (949)583-1010

**************************************************************************
--------------------------------------------------------------------------

 Problem Descriptions:
  W.O. 4260-3 THE INVITATION
  2-YR STUDY
  PROPOSED CONDITION
==========================================================================
*** NON-HOMOGENEOUS WATERSHED AREA-AVERAGED LOSS RATE (Fm)
    AND LOW LOSS FRACTION ESTIMATIONS FOR AMC I:

    TOTAL 24-HOUR DURATION RAINFALL DEPTH =     2.05 (inches)

    SOIL-COVER     AREA      PERCENT OF    SCS CURVE    LOSS RATE
       TYPE      (Acres)   PERVIOUS AREA     NUMBER    Fp(in./hr.)    YIELD
         1         4.80        0.15       44.(AMC II)     0.400       0.888

    TOTAL AREA (Acres) =      4.80

    AREA-AVERAGED LOSS RATE, Fm (in./hr.) =  0.001

    AREA-AVERAGED LOW LOSS FRACTION, Y = 0.112
==========================================================================

 Problem Descriptions:
  W.O. 4260-3 THE INVITATION
  2-YR STUDY
  PROPOSED CONDITION
--------------------------------------------------------------------------


    RATIONAL METHOD CALIBRATION COEFFICIENT = 0.90
    TOTAL CATCHMENT AREA(ACRES) =    4.80
    SOIL-LOSS RATE, Fm,(INCH/HR) =  0.001
    LOW LOSS FRACTION = 0.112
    TIME OF CONCENTRATION(MIN.) = 15.55
    SMALL AREA PEAK Q COMPUTED USING PEAK FLOW RATE FORMULA
    ORANGE COUNTY "VALLEY" RAINFALL VALUES ARE USED
    RETURN FREQUENCY(YEARS) =   2
       5-MINUTE POINT RAINFALL VALUE(INCHES) =  0.19
      30-MINUTE POINT RAINFALL VALUE(INCHES) =  0.40
       1-HOUR   POINT RAINFALL VALUE(INCHES) =  0.53
       3-HOUR   POINT RAINFALL VALUE(INCHES) =  0.89
       6-HOUR   POINT RAINFALL VALUE(INCHES) =  1.22
      24-HOUR   POINT RAINFALL VALUE(INCHES) =  2.05

--------------------------------------------------------------------------
```

TOTAL CATCHMENT RUNOFF VOLUME(ACRE-FEET) = 0.72
TOTAL CATCHMENT SOIL-LOSS VOLUME(ACRE-FEET) = 0.10

TIME (HOURS)	VOLUME (AF)	Q (CFS)	0. 2.5 5.0 7.5 10.0
0.19	0.0011	0.13	Q . . . .
0.45	0.0039	0.13	Q . . . .
0.71	0.0068	0.14	Q . . . .
0.97	0.0098	0.14	Q . . . .
1.23	0.0128	0.14	Q . . . .
1.49	0.0158	0.14	Q . . . .
1.75	0.0188	0.14	Q . . . .
2.00	0.0219	0.14	Q . . . .
2.26	0.0250	0.15	Q . . . .
2.52	0.0281	0.15	Q . . . .
2.78	0.0313	0.15	Q . . . .
3.04	0.0346	0.15	Q . . . .
3.30	0.0378	0.15	Q . . . .
3.56	0.0411	0.16	Q . . . .
3.82	0.0445	0.16	Q . . . .
4.08	0.0479	0.16	Q . . . .
4.34	0.0514	0.16	Q . . . .
4.60	0.0549	0.16	Q . . . .
4.86	0.0584	0.17	Q . . . .
5.11	0.0620	0.17	Q . . . .
5.37	0.0657	0.17	Q . . . .
5.63	0.0694	0.17	Q . . . .
5.89	0.0731	0.18	Q . . . .
6.15	0.0770	0.18	Q . . . .
6.41	0.0809	0.18	Q . . . .
6.67	0.0848	0.19	Q . . . .
6.93	0.0889	0.19	Q . . . .
7.19	0.0930	0.19	Q . . . .
7.45	0.0971	0.20	Q . . . .
7.71	0.1014	0.20	Q . . . .
7.97	0.1057	0.21	Q . . . .
8.23	0.1102	0.21	Q . . . .
8.48	0.1147	0.21	Q . . . .
8.74	0.1193	0.22	Q . . . .
9.00	0.1240	0.22	Q . . . .
9.26	0.1289	0.23	Q . . . .
9.52	0.1338	0.23	Q . . . .
9.78	0.1389	0.24	Q . . . .
10.04	0.1441	0.25	Q . . . .
10.30	0.1494	0.25	.Q . . . .
10.56	0.1549	0.26	.Q . . . .
10.82	0.1606	0.27	.Q . . . .
11.08	0.1664	0.28	.Q . . . .
11.34	0.1725	0.28	.Q . . . .
11.59	0.1787	0.30	.Q . . . .
11.85	0.1852	0.31	.Q . . . .
12.11	0.1920	0.33	.Q . . . .
12.37	0.1999	0.40	.Q . . . .
12.63	0.2087	0.42	.Q . . . .
12.89	0.2179	0.43	.Q . . . .
13.15	0.2275	0.46	.Q . . . .
13.41	0.2375	0.48	.Q . . . .
13.67	0.2481	0.51	. Q . . . .
13.93	0.2593	0.53	. Q . . . .
14.19	0.2713	0.59	. Q . . . .
14.45	0.2844	0.63	. Q . . . .

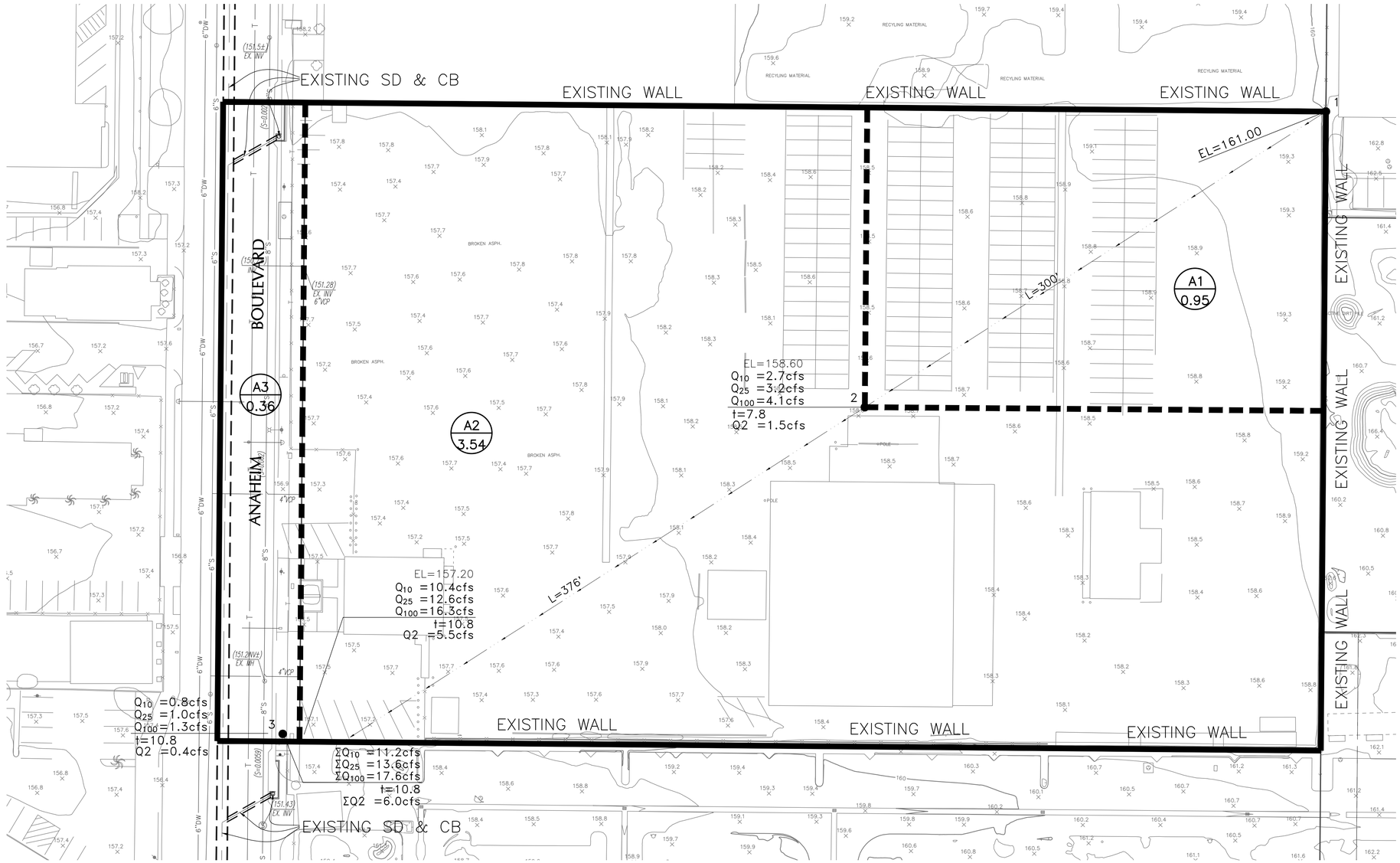
```
 14.70      0.2988      0.71  . Q       .         .         .         .
 14.96      0.3145      0.76  .  Q      .         .         .         .
 15.22      0.3321      0.89  .  Q      .         .         .         .
 15.48      0.3523      0.99  .  Q      .         .         .         .
 15.74      0.3759      1.21  .   Q     .         .         .         .
 16.00      0.4069      1.69  .     Q   .         .         .         .
 16.26      0.4792      5.07  .         .         Q         .         .
 16.52      0.5443      1.01  .   Q     .         .         .         .
 16.78      0.5638      0.82  .  Q      .         .         .         .
 17.04      0.5797      0.67  . Q       .         .         .         .
 17.30      0.5928      0.56  . Q       .         .         .         .
 17.56      0.6040      0.49  .Q        .         .         .         .
 17.81      0.6141      0.45  .Q        .         .         .         .
 18.07      0.6233      0.41  .Q        .         .         .         .
 18.33      0.6311      0.31  .Q        .         .         .         .
 18.59      0.6375      0.29  .Q        .         .         .         .
 18.85      0.6436      0.27  .Q        .         .         .         .
 19.11      0.6492      0.26  .Q        .         .         .         .
 19.37      0.6546      0.24  Q         .         .         .         .
 19.63      0.6597      0.23  Q         .         .         .         .
 19.89      0.6645      0.22  Q         .         .         .         .
 20.15      0.6691      0.21  Q         .         .         .         .
 20.41      0.6735      0.20  Q         .         .         .         .
 20.67      0.6778      0.20  Q         .         .         .         .
 20.92      0.6819      0.19  Q         .         .         .         .
 21.18      0.6859      0.18  Q         .         .         .         .
 21.44      0.6897      0.18  Q         .         .         .         .
 21.70      0.6934      0.17  Q         .         .         .         .
 21.96      0.6970      0.17  Q         .         .         .         .
 22.22      0.7005      0.16  Q         .         .         .         .
 22.48      0.7039      0.16  Q         .         .         .         .
 22.74      0.7072      0.15  Q         .         .         .         .
 23.00      0.7105      0.15  Q         .         .         .         .
 23.26      0.7136      0.15  Q         .         .         .         .
 23.52      0.7167      0.14  Q         .         .         .         .
 23.77      0.7197      0.14  Q         .         .         .         .
 24.03      0.7226      0.14  Q         .         .         .         .
 24.29      0.7241      0.00  Q         .         .         .         .
 ------------------------------------------------------------------------------
------------------------------------------------------------------------------
-
```

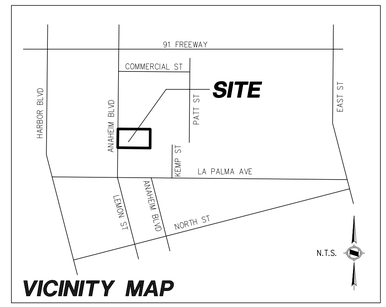
TIME DURATION(minutes) OF PERCENTILES OF ESTIMATED PEAK FLOW RATE:
(Note: 100% of Peak Flow Rate estimate assumed to have
an instantaneous time duration)

Percentile of Estimated Peak Flow Rate	Duration (minutes)
0%	1446.2
10%	233.2
20%	46.7
30%	31.1
40%	15.6
50%	15.6
60%	15.6
70%	15.6
80%	15.6
90%	15.6

SECTION 4

HYDROLOGY MAPS





VICINITY MAP

LEGEND

- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- 1 — NODE NUMBER
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
- Q_{10} =6.0cfs, Q_{25} =8.0cfs, t=10.0 — PEAK FLOW RATE / TIME OF CONCENTRATION
- A — SOIL GROUP

1" = 30'

30 15 0 30 90

GRAPHIC SCALE 1"=30'

HYDROLOGY MAP
EXISTING CONDITION

1122 N. ANAHEIM BLVD
"THE INVITATION"
CITY OF ANAHEIM

PREPARED BY:

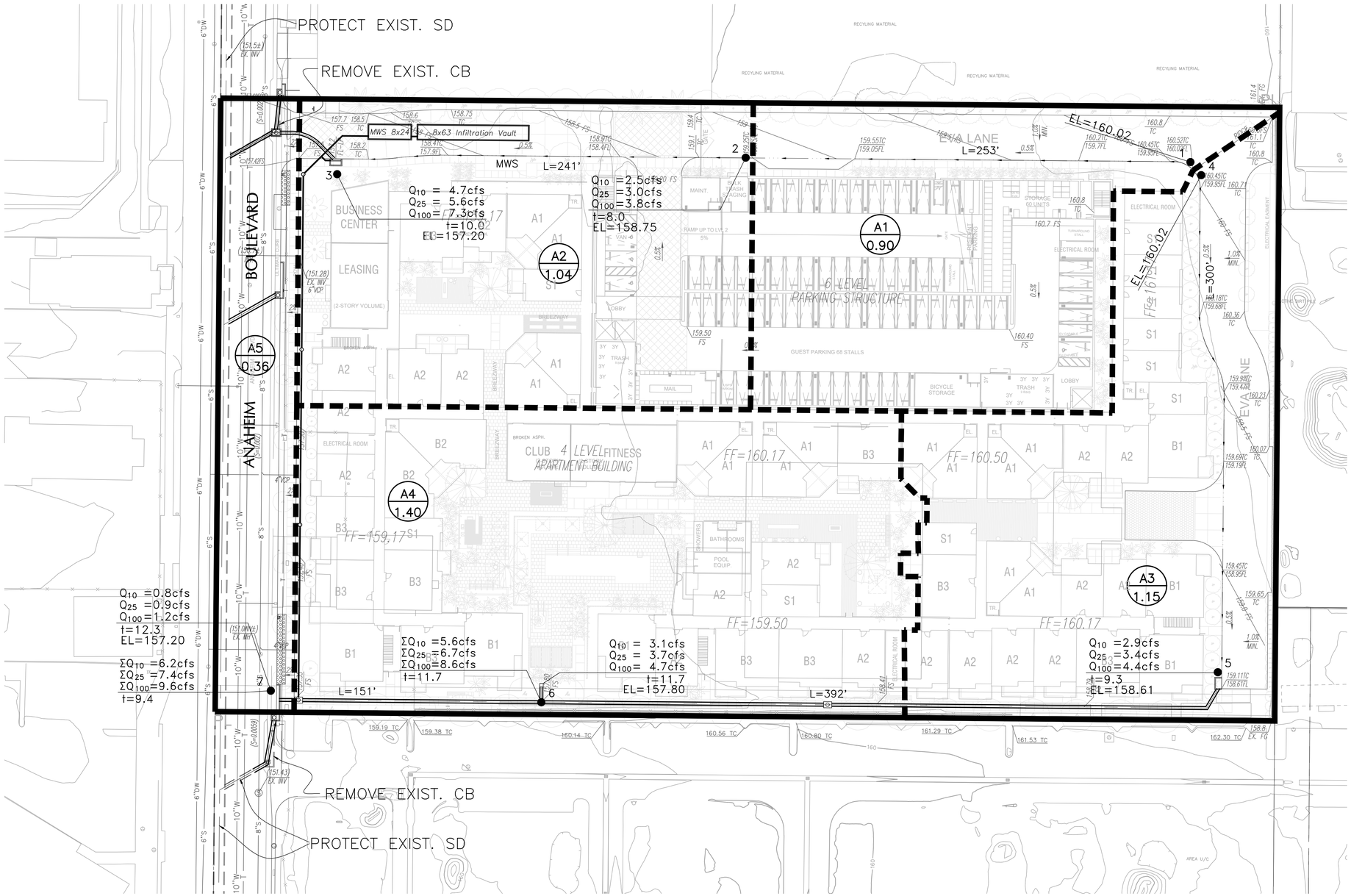
RENAISSANCE CITY NORTH ANAHEIM LLC.
RPP EQUITIES LLC.
4675 MacArthur Court, Suite 550
Newport Beach, CA 92660
CONTACT: ROBERT KIM
PHONE: (714) 658-6299

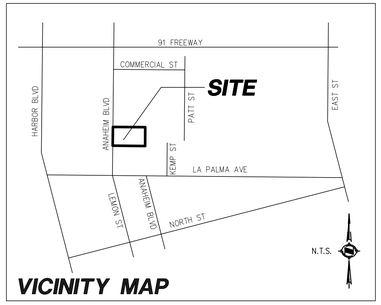
PREPARED BY:

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

W.O. #4098-3

PLOTTED BY: Tu Trinh DATE: Mar. 29, 2020 01:04:05 PM FILE: F:\1027\Engineering\SY_Hydrology\Invitation Exist Map.dwg





LEGEND

- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- NODE NUMBER
- AREA DESIGNATION / AREA ACREAGE (IN ACRES)
- Q_{10} =6.0cfs, Q_{25} =8.0cfs, t=10.0 — PEAK FLOW RATE / TIME OF CONCENTRATION
- A — SOIL GROUP
- PROPOSED STORM DRAIN

1" = 30'

30 15 0 30 90

GRAPHIC SCALE 1"=30'

PREPARED BY:

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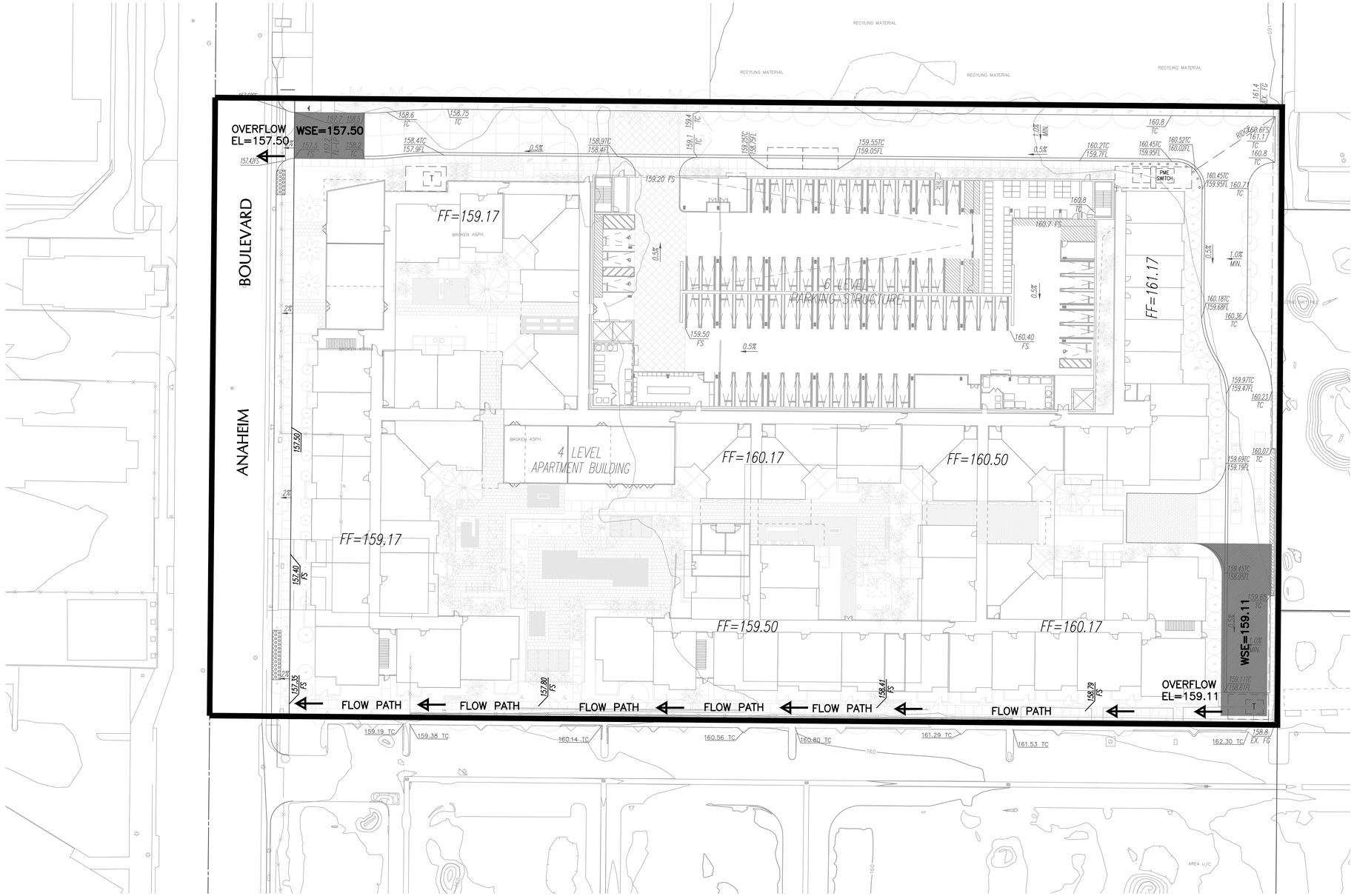
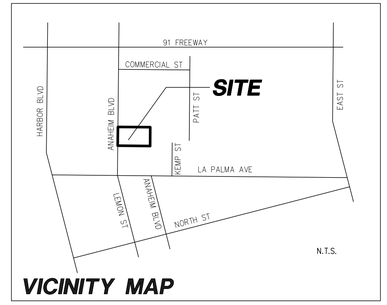
HYDROLOGY MAP
PROPOSED CONDITION

1122 N. ANAHEIM BLVD
"THE INVITATION"
CITY OF ANAHEIM

W.O. #4098-3

PLOTTED BY: Tu Trinh DATE: Apr. 24, 2020 09:58:27 AM FILE: F:\1027\Engineering\SY_Hydrology\Invitation Pro Map.dwg





LEGEND

FLOOD AREA
ASSUMED 100% CLOGGING
OR NO S.D. PIPES EXIST
IN ANY STORM EVENT

1" = 30'

30 15 0 30 90

GRAPHIC SCALE 1"=30'

HYDROLOGY MAP
FLOODING EXHIBIT

1122 N. ANAHEIM BLVD
"THE INVITATION"
CITY OF ANAHEIM

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PLOTTED BY: Tu Trinh DATE: Mar. 29, 2020 01:07:46 PM FILE: F:\1027\Engineering\SY_Hydrology\Invitation Flooding Exhibit.dwg

PROTECT EXIST. SD

REMOVE EXIST. CB

LOW FLOW LINE
OUT TO INFILTRATION VAULT

MWS 8x24

8x63 Infiltration Vault

ΣQ_2 =4.5cfs
t=15.6
EL=157.20

LOW FLOW LINE
INTO MWS
Q_2=2.0cfs
t=15.6

BOULEVARD

ANAHEIM

EVA LANE

BUSINESS CENTER

LEASING

(2-STORY VOLUME)

6 LEVEL PARKING STRUCTURE

GUEST PARKING 68 STALLS

CLUB 4 LEVEL FITNESS
APARTMENT BUILDING

FF=160.17

FF=160.50

FF=159.17

FF=159.50

EL=160.02

A3 1.94

A4 0.36

A2 1.40

A1 1.15

Q_2 =0.4cfs
t=15.6

L=470'

LOW FLOW LINE

PROPOSED DIVERSION STRUCTURE

ΣQ_2 =3.0cfs
t=12.1
EL=157.80

Q_2=1.6cfs
t=12.1

L=392'

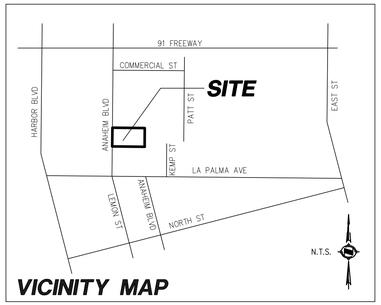
Q_2=1.6cfs
t=9.3
EL=158.61

ΣQ_2 =4.9cfs
t=15.6

PEAK STORM LINE

REMOVE EXIST. CB

PROTECT EXIST. SD



VICINITY MAP

LEGEND

———	MAJOR DRAINAGE BOUNDARY
– – – –	MINOR DRAINAGE BOUNDARY
1	NODE NUMBER
A / 1.0	AREA DESIGNATION AREA ACREAGE (IN ACRES)
Q_{10} =6.0cfs Q_{25} =8.0cfs t=10.0	PEAK FLOW RATE TIME OF CONCENTRATION
A	SOIL GROUP
═══	PROPOSED STORM DRAIN

1" = 30'

30 15 0 30 90

GRAPHIC SCALE 1"=30'

HYDROLOGY MAP
PROPOSED CONDITION
2-YR STUDY
FOR WATER QUALITY PURPOSE

1122 N. ANAHEIM BLVD
"THE INVITATION"
CITY OF ANAHEIM

W.O. #4068-3

PREPARED BY:

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PLOTTED BY: Tu Trinh DATE: Apr. 24, 2020 09:58:46 AM FILE: F:\1027\Engineering\SY_Hydrology\2-yr Invitation Pro Map.dwg

SECTION 5

REFERENCE

CITY OF ANAHEIM

Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area

SEPTEMBER 2010
VOLUME 1

RESOLUTION NO. 2010- 165

RESOLUTION OF THE CITY COUNCIL OF THE CITY OF ANAHEIM ADOPTING THE "MASTER PLAN OF STORM DRAINAGE FOR CARBON CREEK CHANNEL TRIBUTARY AREA SEPTEMBER 2010"

WHEREAS, the City Council did, in January 1974, adopt the Master Plan for Drainage for the City of Anaheim; and

WHEREAS, revised storm drainage design parameters and other studies have shown the need to update the "Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area September 2010" A copy of the "Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area September 2010" is on file and can be viewed in the City of Anaheim Public Works Department; and

WHEREAS, it is necessary and desirable to replace all applicable sections and provisions related to the "Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area September 2010" for the Master Plan for Drainage for the City of Anaheim.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Anaheim, California, as follows:

1. The City Council does hereby adopt the "Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area September 2010."

2. All other sections and provisions of prior Master Plans and/or Studies of storm drainage not related to the "Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area September 2010" shall remain in full force and effect.

THE FOREGOING RESOLUTION is approved and adopted by the City Council of the City of Anaheim this 12th day of October 2010 by the following roll-call vote:

AYES: Mayor Pringle, Council Members Sidhu, Hernandez, Galloway, Kring

NOES: NONE

ABSTAIN: NONE

ABSENT: NONE

CITY OF ANAHEIM

MAYOR OF THE CITY OF ANAHEIM

ATTEST:

CITY CLERK OF THE CITY OF ANAHEIM

79371.v1/MGordon

MASTER PLAN OF STORM DRAINAGE FOR CARBON CREEK CHANNEL TRIBUTARY AREA

SEPTEMBER 2010

Prepared for

City of Anaheim
Public Works Department
200 South Anaheim Boulevard
Anaheim, CA 92805

By

CH2M HILL
6 Hutton Centre Drive, Suite 700
Santa Ana, CA 92707

Under the Supervision of

Kathleen Higgins, P.E.

Approved By
Mark K. Vukojevic, P.E.
City Engineer

Concurred By
Natalie Meeks, P.E.
Director of Public Works

Revisions			
No.	Description	Approved by	Date

the County facility exiting Crescent Basin. This drain can convey a maximum of 115 cfs, which is equivalent to a 10-year storm event.

Areas 11-2 through 11-5, 11-8 and 11-9 are areas which drain directly to Carbon Creek or to drains adjacent to the freeway. No deficiencies were identified in these areas except in Areas 11-3 and 11-8.

In order to satisfy the City's requirement of conveying the 10-year storm event in the storm drains, and also to satisfy the flooded width criteria an extension of the storm drain in Area 11-3 in Greenleaf Avenue and a new storm drain in Area 11-8 in Brookhurst Street is recommended. The estimated cost for constructing these improvements is $1,027,000 (2010 dollars).

1.9 Drainage Basin 13

Drainage Basin 13 drains approximately 462 acres, and is generally bounded by Romneya Street and Bluejay Street on the north, West Street on the east, Interstate 5 on the south, and Euclid Street on the west. As shown in Figure 2, drainage basins are further divided into drainage areas depending on the existing flow patterns and storm drain outlets. Basin 13 consists of 14 Areas.

Four Areas, 13-1, 13-5, 13-14, and 13-16, in Basin 13 have an existing storm drain. In Area 13-1, the storm drain begins at Hermosa Avenue and flows west in La Palma Avenue to Euclid Street where it turns south and flows to Carbon Creek. This drain has a capacity of 85 cfs which is equivalent to 60 percent of a 10-year storm. In Area 13-5, the storm drain begins in Romneya Drive and turns south on West Street where it flows to Carbon Creek. This drain has a capacity of 65 cfs which is equivalent to 90 percent of a 10-year storm. In Area 13-14, the storm drain begins at Crescent Avenue and flows north in Euclid Street to Carbon Creek and has a capacity of 25 cfs which is equivalent to a 10-year storm. In Area 13-16, the storm drain flows south in Loara Street to Carbon Creek. This drain has a capacity of 115 cfs which is equivalent to 90 percent of a 10-year storm.

Areas 13-2, 13-3, 13-4, 13-6, 13-10 through 13-13 and 13-17 are small areas which drain directly to Carbon Creek. No deficiencies were identified in any of these areas.

In order to satisfy the City's requirement of conveying the 10-year storm event in the storm drains, and also to satisfy the flooded width criteria a parallel RCP is recommended in Euclid Street in Area 13-1, La Palma Avenue in Area 13-1, and Loara Street and Beverly Drive in Area 13-16. To satisfy the City's flooded width criteria an extension of the storm drains in Romneya Drive in Area 13-5 and Westmont Drive in 13-16 are proposed. The estimated cost for constructing these improvements is $6,451,000 (2010 dollars).

1.10 Drainage Basin 15

Drainage Basin 15 drains approximately 277 acres, and is generally bounded by the 91 Freeway and Discovery Street on the north, Raymond Avenue and East Street on the east, La Palma Avenue on the south, and Swan Street on the west. As shown in Figure 2, drainage basins are further divided into drainage areas depending on the existing flow patterns and storm drain outlets. Basin 15 consists of 10 Areas.

There are three existing storm drains in Area 15. In Area 15-1, the storm drain begins north of the 91 freeway crosses the freeway and flows south in Lemon Street to Carbon Creek.

This drain can convey a maximum of 145 cfs, which is equivalent to 88 percent of a 10-year storm event. In Area 15-2, the storm drain flows south in Olive Street and can convey a maximum of 30 cfs, which is equivalent to 60 percent of a 10-year storm event. In Area 15-5, the storm flows south in Patt Street where it outlets to Carbon Creek. This can convey a maximum of 16 cfs, which is equivalent to 30 percent of a 10-year storm event.

Areas 15-3, 15-4, and 15-6 through 15-10 are small areas which drain directly to Carbon Creek. No deficiencies were identified in any of these areas.

In order to satisfy the City's requirement of conveying the 10-year storm event in the storm drains, and also to satisfy the flooded width criteria improvements consisting of parallel RCPs are recommended in Lemon Street in Area 15-1, Olive Street in Area 15-2, and Patt Street in Area 15-5. The estimated cost for constructing these improvements is $4,450,000 (2010 dollars).

1.11 Drainage Basin 16

Drainage Basin 16 drains approximately 407 acres, and is generally bounded by Romneya Drive, the 91 Freeway and La Palma Avenue on the north, Pauline Street on the east, Sycamore Street on the south, and Harbor Boulevard on the west. As shown in Figure 2, drainage basins are further divided into drainage areas depending on the existing flow patterns and storm drain outlets. Basin 16 consists of 27 Areas.

Storm water in Basin 16 is conveyed through four existing storm drain systems. In Area 16-4, the storm drain flows south in Harbor Boulevard to Carbon Creek. This drain can convey a maximum of 12 cfs, which is equivalent to 20 percent of a 10-year storm event. In Area 16-20, the storm drain flows north in Olive Street where it outlets to Carbon Creek. This drain can convey a maximum of 45 cfs, which is equivalent to a 10-year storm event. In Area 16-21, the storm drain flows south on Zeyn Street where it outlets to Carbon Creek. This drain can convey a maximum of 85 cfs, which is equivalent to a 10-year storm event. In Area 16-22, the storm drain flows north in Harbor Boulevard where it outlets to Carbon Creek. This drain can convey a maximum of 50 cfs, which is equivalent to 50 percent of a 10-year storm event.

Areas 16-1 through 16-3, 16-5 through 16-19, and 16-23 through 16-27 are small areas which drain directly to Carbon Creek. Improvements are required in Areas 16-1 and 16-23 as outlined below. No deficiencies were identified in the other Areas.

In order to satisfy the City's requirement of conveying the 10-year storm event in the storm drains, and also to satisfy the flooded width criteria improvements are recommended in Village Street in Area 16-1 Harbor Boulevard in Areas 16-4 and 16-22, North Street in Area 16-21, and Citron Street in Area 16-23. The estimated cost for constructing these improvements is $5,673,000 (2010 dollars).

1.12 Drainage Basin 17

Drainage Basin 17 drains approximately 700 acres, and is generally bounded by Sycamore Street and Carbon Canyon on the north, State College Boulevard on the east, Broadway on the south, and West Street on the west. As shown in Figure 2, drainage basins are further divided into drainage areas depending on the existing flow patterns and storm drain outlets. Basin 17 consists of 1 Area.

2. Introduction

2.1 Purpose

The City of Anaheim Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area (CCCTA) covers that portion of the City of Anaheim ultimately tributary to Orange County Flood Control District (OCFCD) regional facility Carbon Creek Channel (A03). The purpose of the Master Plan is to provide comprehensive long-range planning for the implementation and development of drainage facility improvements in the area, determine the cost of implementing the facilities, and discuss funding priorities of the improvements. This Master Plan replaces that portion of Master Plan of Drainage for the Northeast Industrial Area, Final Report dated May 1998 that is tributary to Carbon Creek Channel, specifically identified as Area 29 in the report. This Master Plan is based on the criteria outlined in the City's Drainage Manual for Public and Private Drainage Facilities, dated August, 2005.

2.2 Background

In 1973, the City published a Master Plan of Drainage for the City of Anaheim. That report divided the City into 42 Drainage Districts based generally on local storm drainage facilities and the City limits at that time. In 1983, two additional Drainage Districts were added for a total of 44 Drainage Districts. Since that time the City limits have changed to include more tributary area and the City has changed its drainage classification system to watersheds which relate to the County of Orange's regional drainage facilities. The City of Anaheim is divided into seven major watershed tributary areas; Santa Ana River, Carbon Creek Channel, East Garden Grove-Wintersburg Channel, Anaheim Barber City Channel, Fullerton Creek Channel, Stanton Channel, and Moody Creek Channel. Each of these watersheds includes several of the Districts from the 1973 Master Plan.

The CCCTA includes Drainage District's 1, 2, 3, 6, 7, 8, 11, 13, 15, 16, 17, 18, 19, 28 and 29 from the 1973 Master Plan. These areas are identified as Drainage Basins instead of Districts for this Master Plan and are shown on Figure 1. The boundaries of some of the basins have been modified from the 1973 Master Plan boundaries. Figure 1 shows the new boundaries, and all references to areas in this Master Plan are based on the new boundaries.

As shown on Figure 1, Drainage Basin 1 begins at the westerly City limits at Orange Avenue just west of Knott Avenue. Basins 2, 3, 6, 7, 8 and portions of Basin 11 are west of Basin 1 and south of Interstate 5. Basins 13, 15, 16, 17, 18, 28 and portions of Basin 11 are north of Interstate 5 and Basin 29 is east of State Route 57.

3. Technical Criteria

3.1 Hydrologic Analysis

The hydrologic analysis for the City of Anaheim Master Plan of Storm Drainage for CCCTA was performed in accordance with the City of Anaheim Department of Public Works Storm Drainage Manual for Public and Private Storm Drainage Facilities, dated August of 2005. The City of Anaheim has adopted the 1986 Orange County Hydrology Manual (and the subsequent Addendum No. 1 to the Hydrology Manual, issued in 1995), except for the modifications outlined in Division 1 of the City's Manual. The modification affecting hydrology includes the requirement that the analysis of all storm events be based on the "high confidence level" storm frequency event. This criterion was used for the Master Plan. The methods, data, and criteria integrated and incorporated are consistent with accepted methods of analyzing storm water runoff throughout Orange County as outlined in the Orange County Hydrology Manual.

GIS Facility Maps and AutoCad drawings were obtained from the City, which contained streets and existing facilities for the CCCTA. Drainage Basins were delineated based on the 1973 drainage maps. A field review was then conducted, and the drainage patterns were further refined. Land use data was obtained from the City of Anaheim's October 2008 General Plan and soils information was obtained from the 1986 Orange County Hydrology Manual. Land use, soils information and subarea information was input into the Advanced Engineering Software Computer Program RATOC which is based on the 1986 Orange County Hydrology Manual. Two areas, Area 3 and Area 8, consisted of tributary acreage greater than 640 acres. For these areas the Unit hydrograph procedure was utilized to determine the flow rate.

3.2 Hydraulics Analysis

Storm drains and street flooded width analyses were performed in accordance with the City of Anaheim Department of Public Works Storm Drainage manual, dated August of 2005. The existing drainage systems were analyzed using computer analysis techniques that consisted of the storm drain analysis program, Water Surface and Pressure Gradient Hydraulic Analysis System (WSPG), originally written for use by the Los Angeles County Flood Control District. WSPG is a hydraulics program that can be used to determine the capacity of a storm drain system. The computational procedure is based on solving Bernoulli's equation for the total energy at each section and Manning's formula for friction loss between the sections in a reach. Confluences are analyzed using pressure and momentum theory. The program uses basic mathematical and hydraulic principles to calculate such data as cross sectional area, wetted perimeter, normal depth, critical depth, pressure, and momentum.

The proposed storm drains were sized using FlowMaster. Relevant storm drain information such as pipe sizes and invert elevations were obtained from storm drain improvement as-built drawings.

The hydraulic analysis performed assumed that the streets would be free and clear of any major obstructions and that the storm drains would be adequately maintained so that blockage would not occur. Street capacity analyses assumed that all streets conformed to the City of Anaheim's typical street sections. Street widths were determined from street plans and as-built drawings.

Based on the technical criteria outlined in this chapter, preliminary sizes of the Master Plan facilities were determined. The hydraulic control for calculations typically assumed that the water surface elevation was one foot below the ground surface. For lateral storm drains, the hydraulic control was taken from the water surface elevation of the major storm drain at the point of confluence between the drains.

3.3 Downstream Boundaries

The CCCTA is bordered on the west by the City Limits. This study evaluates the capacity of each facility up to the City limits. The approach for the proposed hydraulics at the boundary of the City limit is to recognize the adjacent agency's downstream parameters. The drainage facilities along the 91 Freeway and Interstate 5 are Caltrans' facilities. As-built drawings were obtained for Caltrans facilities and used to determine the downstream control. The Carbon Creek Channel is an OCFCD regional facility. Hydraulic reports for the Carbon Creek Channel were obtained to determine the downstream control. In this study, when existing downstream facilities are determined to be unable to convey the flow from the City of Anaheim's master plan storm drain at the City limits, excess flow at the City boundary is proposed to be resurfaced onto the street through equalizers.

12. Drainage Basin 15

Drainage Basin 15 drains approximately 277 acres, and is generally bounded by the 91 Freeway and Discovery Street on the north, Raymond Avenue and East Street on the east, La Palma Avenue on the south, and Swan Street on the west. As shown in Figure 12, drainage basins are further divided into drainage areas depending on the existing flow patterns and storm drain outlets. Basin 15 consists of 10 Areas 15-1 through 15-10. Areas 15-1, 15-2 and 15-5 have existing storm drains which outlet to Carbon Creek. Areas 15-3, 15-4, and 15-6 through 15-10 are small areas which drain directly to Carbon Creek.

12.1 Hydrologic Analysis

The hydrologic analysis for Basin 15 was performed in accordance with the hydrologic criteria outlined in Chapter 3 and is included in Appendix C. The hydrology map for Basin 15 is included in Appendix B. The following table highlights the flow rates at key drainage nodes for Areas within Basin 15 that have street flow and/or existing storm drains. The table shows associated drainage areas and flows for 10-, 25-, and 100-year storm events.

Table 17 – Basin 15 Summary of Hydrology

Drainage Area	Node	Location	Drainage Area (ac)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)
15-1	1507	Upstream of 91 Freeway	72	95	115	145
15-1	1509	Commercial St. at Lemon St.	97	115	140	175
15-1	1511	Lemon St at Carbon Creek	154	165	200	255
15-2	1533	Olive Street at Carbon Creek	34	55	65	90
15-3	1542	La Palma Ave. at Carbon Creek	3	4	5	7
15-4	1552	Pauline Street at Carbon Creek	4	8	10	13
15-9	1547	La Palma Ave. at Carbon Creek	4	7	8	10

12.2 Analysis of Existing Improvements

Storm water in Basin 15 is conveyed through several existing storm drain systems. In Area 15-1, the storm drain begins in Orange Fair Drive and flows east to Gemini Street and then turns south to the 91 Freeway. The storm drain flows west along the 91 freeway crossing the freeway at Patt Street. The storm drain then turns west on Commercial drive to Lemon Street where it flows south to Carbon Creek. This drain varies in size from 30-inch to 66-inch RCP. This system can convey a maximum of 145 cfs, which is equivalent to 88 percent of a

10-year storm event. The existing hydraulic calculations for Basin 5 are included in Appendix D.

In Area 15-2, the storm drain begins at Julianna Street and Olive Street. The drain flows south in Olive Street where it outlets to Carbon Creek. This drain is a 33-inch RCP, and can convey a maximum of 30 cfs, which is equivalent to 60 percent of a 10-year storm event.

In Area 15-5, the storm drain begins 185 feet north of Julianna Street and flows south in Patt Street where it outlets to Carbon Creek. This drain is a 27-inch and 30-inch RCP, and can convey a maximum of 16 cfs, which is equivalent to 30 percent of a 10-year storm event.

12.3 Proposed Improvements

In order to satisfy the City's requirement of conveying the 10-year storm event in the storm drains, and also to satisfy the flooded width criteria, the following improvements are recommended for Areas 15-1, 15-2 and 15-5. To satisfy the City's flooded width criteria in Area 15-1, 1,950 feet of 24-inch parallel RCP is recommended in Lemon Street.

To satisfy the City's flooded width criteria in Area 15-2, 604 feet of 24-inch parallel RCP is proposed in Olive Street. To satisfy the City's flooded width criteria in Area 15-5, 600 feet of 24-inch parallel RCP is proposed in Patt Street. The proposed improvements for Basin 15 are shown in Figure 12, the hydraulic calculations are included in Appendix E and the street flow calculations in Appendix F.

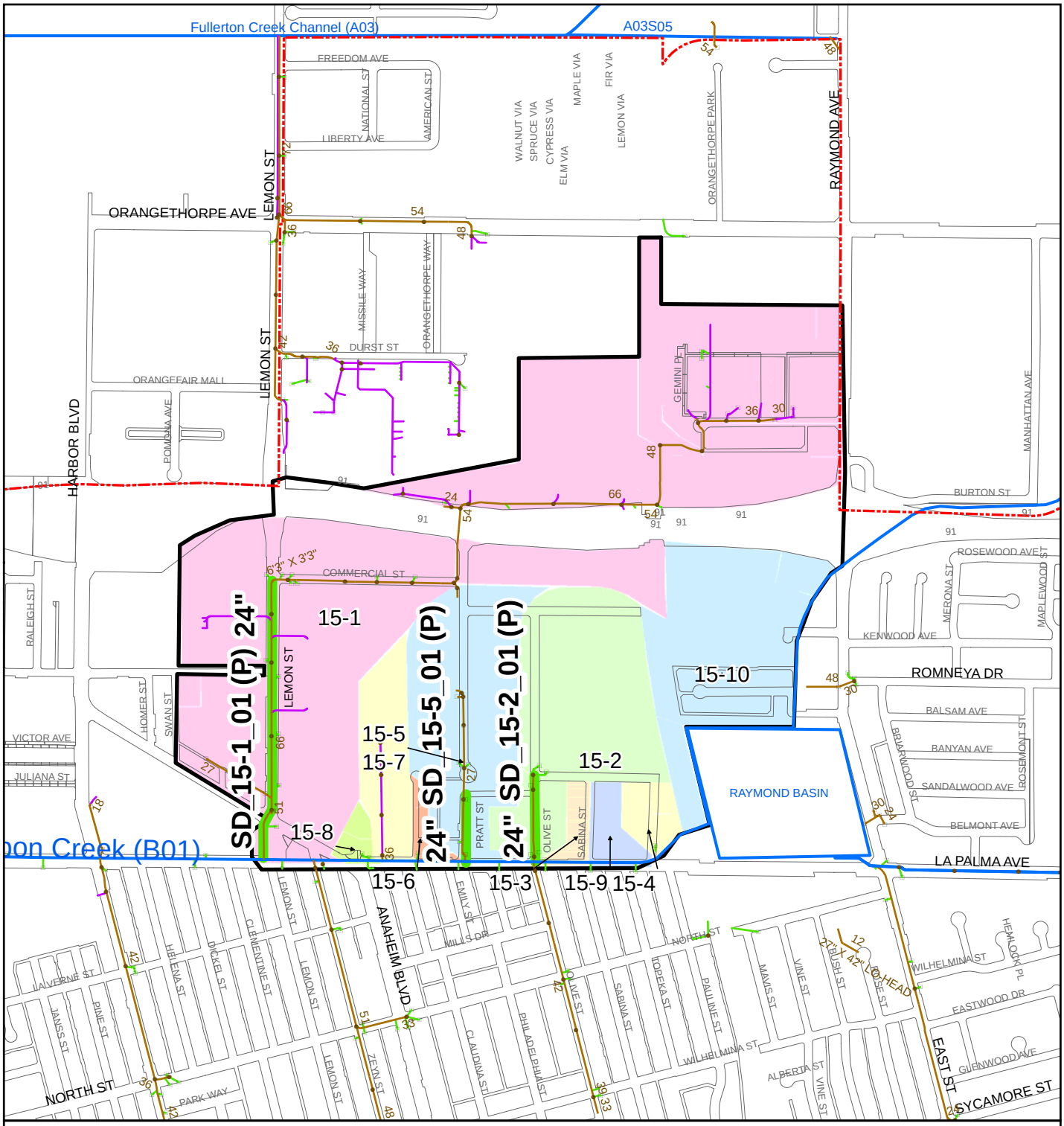
12.4 Cost Estimates

The estimated costs summarized in Table 18 include costs for construction, engineering, design, surveying, and construction management. Pipe costs are per linear foot of pipe and have been increased to include excavation, shoring, bedding, backfill, compaction, removal of excess material, and trench resurfacing. The detailed cost estimates for Basin 15 are included in Appendix A.

Since the construction of the recommended facilities will be spread out over a number of years, the total cost of master plan implementation will be subject to future construction cost increases. Therefore, it is recommended that the funding programs established for implementation of the Master Plan of Storm Drainage make provisions for the increased cost of deferred construction. Inflation factors should be applied to reflect a specific year's total cost over the 2010 total costs. Summarized in Table 18 are the construction cost estimates by project location for Area 15-1, 15-2 and Area 15-5 in Basin 15.

Table 18 – Basin 15 Cost Estimate

Area	Storm Drain ID	Street	Type of Facility	Length (feet)	Estimated Cost (2010 Dollars)
15-1	SD 15-1_01 (P)	Lemon Street	Parallel 24-inch RCP	1,950	$1,439,000
15-2	SD 15-2_01 (P)	Olive Street	Parallel 24-inch RCP	605	$ 455,000
15-5	SD 15-5_01 (P)	Patt Street	Parallel 24-inch RCP	600	$ 453,000
TOTAL FOR BASIN 15					$2,347,000



Legend

- Anaheim City Limits
- Street Right of Way
- 5-1 Drainage Area

Proposed Storm Drains

- Priority 1
- Priority 2
- Priority 3

SD 1-1_01 (P) Proposed Pipeline ID
Drainage Area_Line No. (Proposed)

Note: Priority 2 proposed improvements will parallel existing storm drains unless otherwise noted

Existing Storm Drains

- 30 Anaheim (Pipe size in inches)
- County
- Caltrans
- Private
- Lateral

N

0 500 1,000 Feet

1 inch equals 1,000 feet

Figure 12 Drainage Basin 15

Master Plan of Storm Drainage for Carbon Creek Channel Tributary Area

CH2MHILL

Table 30 – Priority 2 Cost Estimate

Area	Storm Drain ID	Street	Type of Facility	Length (feet)	Estimated Cost (2010 Dollars)	Area Total
13-16	SD 13-16_01 (P)	Loara Street	Parallel 36-inch RCP	910	$ 966,000	
13-16	SD 13-16_03 (P)	Beverley Dr.	Parallel 36-inch RCP	2,200	$ 395,000	$1,361,000
15-1	SD 15-1_01 (P)	Lemon St.	Parallel 24-inch RCP	1,950	$1,439,000	$1,439,000
15-2	SD 15-2_01 (P)	Olive Street	Parallel 24-inch RCP	605	$ 455,000	$ 455,000
15-5	SD 15-5_01 (P)	Patt Street	Parallel 24-inch RCP	600	$ 453,000	$ 453,000
16-4	SD 16-4_01 (P)	Harbor Blvd.	Parallel 36-inch RCP	400	$ 408,000	$ 408,000
16-21	SD 16-21_01 (P)	North St.	Parallel 30-inch RCP	355	$ 306,000	$ 306,000
16-22	SD 16-22_01 (P)	Harbor Blvd.	Parallel 30-inch/42-inch RCP	2,410	$2,735,000	$2,735,000
17-1	SD 17-1_01 (P)	West St.	Parallel 10' by 7' RCB	1.910	$ 6,722,000	
17-1	SD 17-1_02 (P)	North St.	Parallel 10' by 7' RCB	1,135	$ 4,001,000	
17-1	SD 17-1_03 (P)	Citron St.	Parallel 10' by 7' RCB	2,895	$10,217,000	
17-1	SD 17-1_04 (P)	Chartres St.	Parallel 10' by 7' RCB/ 96-inch RCP	1,185	$ 3,665,000	
17-1	SD 17-1_05 (P)	Harbor Blvd.	Parallel 96-inch RCP	360	$ 1,038,000	
17-1	SD 17-1_06 (P)	Lincoln Ave.	Parallel 36-inch to 96-inch RCP	5,430	$11,066,000	
17-1	SD 17-1_07 (P)	Broadway St.	Parallel 30-inch/36-inch RCP	900	$ 884,000	$37,953,000
18-6	SD 18-6_01 (P)	Broadway St.	Parallel 24-inch/30-inch/36-inch RCP	1,885	$1,770,000	
18-6	SD 18-6_02 (P)	West St.	Parallel 36-inch RCP	870	$ 920,000	$2,690,000
28-4	SD 28-4_01 (P)	Via Burton St.	Parallel 36-inch RCP	575	$ 624,000	$ 624,000
28-6	SD 28-6_01 (P)	Romneya Dr.	Parallel 48-inch RCP	400	$ 544,000	$ 544,000
28-8	SD 28-8_01 (P)	La Palma Ave.	Parallel 54-inch/66-inch RCP	2,640	$4,729,000	
28-8	SD 28-8_03 (P)	East St.	Parallel 42-inch/54-inch RCP	1,900	$2,707,000	$7,436,000
29-2	SD 29-2_01 (P)	Kraemer Blvd.	Parallel 24-inch RCP	255	$ 170,000	$ 170,000
29-5	SD 29-5_01 (P)	Red Gum St.	Parallel 42-inch RCP	980	$1,194,000	$3,014,000