Appendix D – Hydrology Analysis

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DEPARTMENT OF PUBLIC WORKS
DEVELOPMENT SERVICES
APPROVED
Esperanza Rios, Associate Engineer
07/06/2020 16:41:31 PM
#[OTH2019-01202]

HYDROLOGY ANALYSIS
FOR HOTEL REDEVELOPMENT
1100 W. BALL ROAD

City of Anaheim
County of Orange

PREPARED FOR:
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MAY 14, 2020

W.O. #4344-1

HYDROLOGY ANALYSIS

FOR

HOTEL REDEVELOPMENT

1100 W. BALL ROAD

City of Anaheim

County of Orange

PREPARED UNDER THE SUPERVISION OF:

TU TRINH, R.C.E. 71555 DATE: 6/3/2020

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SECTION 1

INTRODUCTION

A. PROJECT LOCATION

The approximate 1.0 acre project site "Hotel Redevelopment 1100 W. Ball Road" is located on the southwest corner of West Ball Road and South Flore Street in the City of Anaheim (City).

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.

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 currently vacant, the gas station was demolished. Runoff produced from sub-area A1 will sheet flow toward West Ball Road and continue flowing west to an existing catch basin located at the intersection of West Ball Road and Walnut Street. The 10-yr, 25-yr, and 100-yr storm runoff produced from sub-area A1 is 2.0cfs, 2.4cfs, and 3.1cfs, respectively. Runoff produced from sub-area A2 will sheet flow toward West Street and continue flowing north to an existing catch basin located near the intersection of West Ball Road and West Street. The 10-yr, 25-yr, and 100-yr storm runoff produced from sub-area A2 is 1.5cfs, 1.8cfs, and 2.3cfs, respectively.

Proposed Condition

The project site will consist of the development of a 5-story hotel and 2 levels garage. Runoff produced from the proposed site will drain in the same patterns as in the existing condition to a proposed storm drain system, water quality structure, and storage structure, as shown on the hydrology map.

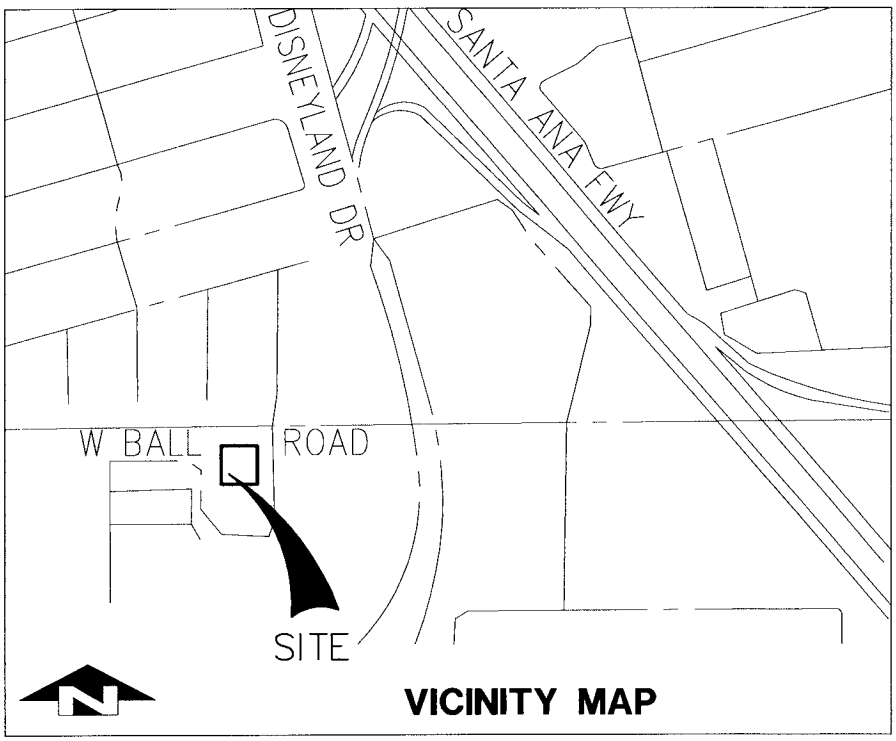
Peak runoff produced from new development area, sub-area A1a, will be collected at a proposed inlet, upper left corner, and then drain into the existing 7'x7' Reinforced Concrete Box in West Ball Road. By proration, the 10-yr, 25-yr, and 100-yr storm runoff produced from sub-area A1a is 1.0cfs, 1.2cfs, and 1.5cfs, respectively. Low flow produced from this sub-area A1a will be treated and

detained in structures as shown on the hydrology map. Peak runoff produced from sub-area A1b will flow on West Ball Road and continue travel west to an existing catch basin located at the intersection of West Ball Road and Walnut Street. By proration, the 10-yr, 25-yr, and 100-yr storm runoff produced from sub-area A1b is 1.1cfs, 1.3cfs, and 1.7cfs, respectively.

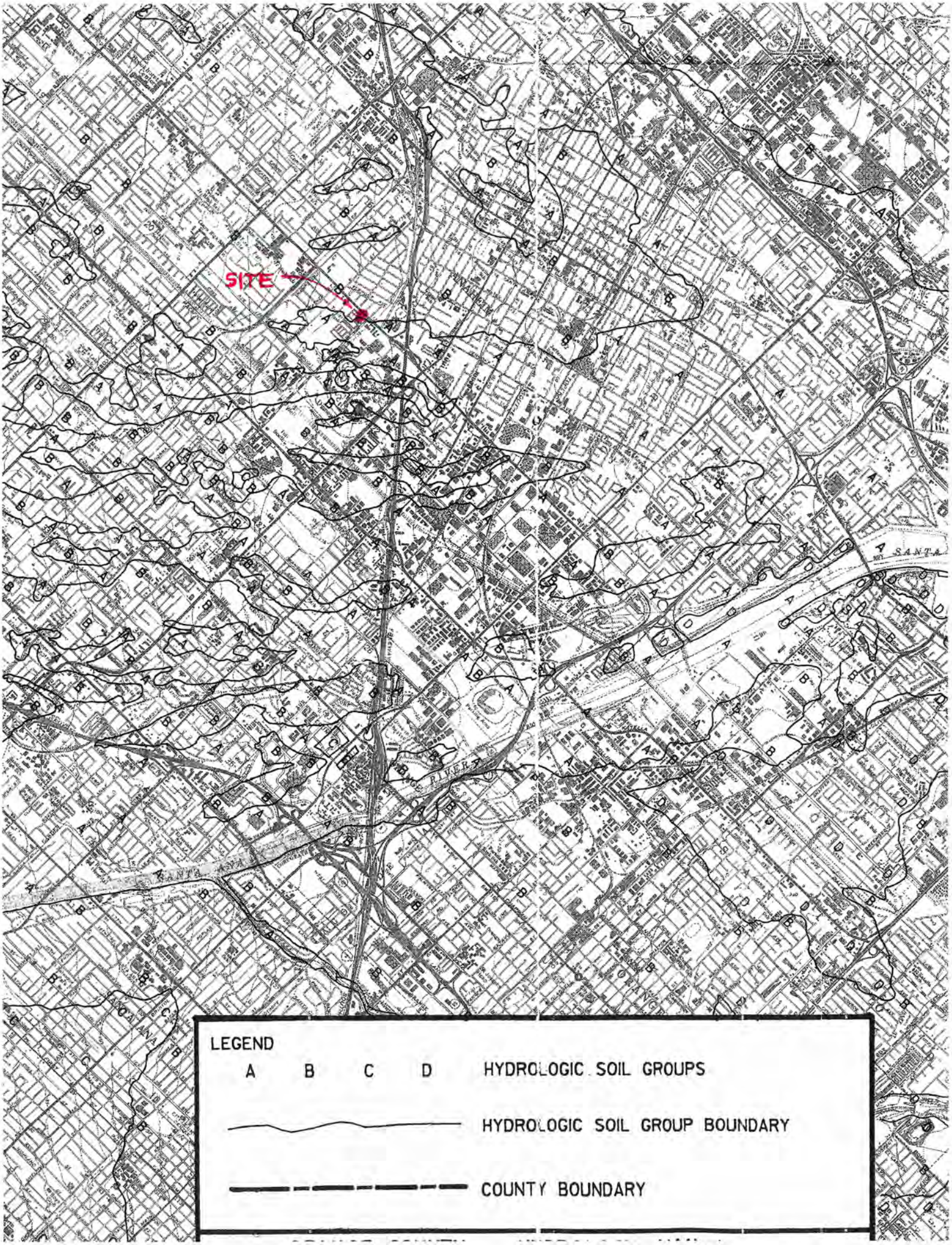
Peak runoff produced from new development area, sub-area A2a, will drain into the existing catch basin in West Place. By proration, the 10-yr, 25-yr, and 100-yr storm runoff produced from sub-area A2a is 1.0cfs, 1.2cfs, and 1.6cfs, respectively. Low flow produced from this sub-area A2a will be treated with a MWS and then detained in structures as shown on the hydrology map. Peak runoff produced from sub-area A2b will flow on West Street gutter and is picked up at the existing catch basin. By proration, the 10-yr, 25-yr, and 100-yr storm runoff produced from sub-area A2b is 0.4cfs, 0.5cfs, and 0.6cfs, respectively.

Total flow rate produced from the site (cfs)	Q10	Q25	Q100
Existing condition – Dirt and A.C.	3.5	4.2	5.4
Proposed condition - Hotel	3.5	4.2	5.4

Per the City of Anaheim Master Plan of Storm Drainage for Anaheim Barber City Channel Tributary Area, dated June 2009, the Hotel Redevelopment project is within Drainage Area 20. The recommended Alternative 3 proposed to install new parallel 12.5’ x 7’ RCB in Ball Road, from Ox Road to ABC Channel. Storm runoff produced from the Hotel Redevelopment is the same and discharged into the same existing storm drain system as in the existing condition.



VICINITY MAP


SITE
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. #4344-1, HOTEL, 1100 W. BALL RD                                 *
* EXISTING CONDITION - DIRT & A.C PAVEMENT                             *
* 10-YR STUDY                                                          *
 ************************************************************************

  FILE NAME: BALL-V.DAT
  TIME/DATE OF STUDY: 18:05 05/05/2020
========================================================================
  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   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 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 =  22
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
========================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.060
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.56      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      1.99
```

```
  TOTAL AREA(ACRES) =      0.56   PEAK FLOW RATE(CFS) =      1.99

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  22
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
============================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.060
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.42      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      1.49
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.49
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =      5.00
  EFFECTIVE AREA(ACRES) =      0.42  AREA-AVERAGED Fm(INCH/HR)=  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.350
  PEAK FLOW RATE(CFS)   =       1.49
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
**************************************************************************
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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. #4344-1, HOTEL, 1100 W. BALL RD                                  *
* EXISTING CONDITION - DIRT & A.C PAVEMENT                              *
* 25-YR STUDY                                                           *
 ************************************************************************

  FILE NAME: BALL-V.DAT
  TIME/DATE OF STUDY: 09:32 05/06/2020
========================================================================
  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   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 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 =  22
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
========================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.56      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      2.38
```

```
  TOTAL AREA(ACRES) =      0.56   PEAK FLOW RATE(CFS) =      2.38

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  22
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
============================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.42      0.30     0.350    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      1.78
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      1.78
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =      5.00
  EFFECTIVE AREA(ACRES) =      0.42  AREA-AVERAGED Fm(INCH/HR)=  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.350
  PEAK FLOW RATE(CFS)   =       1.78
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

```
******************************************************************************
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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. #4344-1, HOTEL, 1100 W. BALL RD                                   *
* EXISTING CONDITION - DIRT & A.C PAVEMENT                               *
* 100-YR STUDY                                                           *
 ************************************************************************

  FILE NAME: BALL-V.DAT
  TIME/DATE OF STUDY: 09:35 05/06/2020
==============================================================================
  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   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0313 0.167 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 =  22
------------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
==============================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.56      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      3.07
```

```
  TOTAL AREA(ACRES) =      0.56   PEAK FLOW RATE(CFS) =      3.07

****************************************************************************
  FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  22
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
============================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap     SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  CONDOMINIUMS               B        0.42      0.30     0.350    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.350
  SUBAREA RUNOFF(CFS) =      2.30
  TOTAL AREA(ACRES) =      0.42   PEAK FLOW RATE(CFS) =      2.30
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)     =        0.4  TC(MIN.) =      5.00
  EFFECTIVE AREA(ACRES) =      0.42  AREA-AVERAGED Fm(INCH/HR)=  0.11
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.350
  PEAK FLOW RATE(CFS)   =       2.30
============================================================================
============================================================================
  END OF RATIONAL METHOD ANALYSIS
```

SECTION 3

HYDROLOGY CALCULATIONS
PROPOSED CONDITION

```
**************************************************************************
            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. #4344-1, HOTEL, 1100 W. BALL RD                                  *
* PROPOSED CONDITION                                                    *
* 10-YR STUDY                                                           *
 ************************************************************************

  FILE NAME: BALL-P1.DAT
  TIME/DATE OF STUDY: 12:50 09/19/2019
========================================================================
  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   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 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 =  22
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
==========================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.060
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.27      0.30      0.100    56
  COMMERCIAL                 B        0.31      0.30      0.100    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
```

```
  SUBAREA RUNOFF(CFS) =       2.10
  TOTAL AREA(ACRES) =       0.58   PEAK FLOW RATE(CFS) =       2.10

****************************************************************************
  FLOW PROCESS FROM NODE       3.00 TO NODE       4.00 IS CODE =  22
----------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
============================================================================
  USER SPECIFIED Tc(MIN.) =     5.000
  *  10 YEAR RAINFALL INTENSITY(INCH/HR) =  4.060
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                  B        0.28      0.30      0.100    56
  COMMERCIAL                  B        0.11      0.30      0.100    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
  SUBAREA RUNOFF(CFS) =       1.41
  TOTAL AREA(ACRES) =       0.39   PEAK FLOW RATE(CFS) =       1.41
============================================================================
  END OF STUDY SUMMARY:
  TOTAL AREA(ACRES)      =         0.4  TC(MIN.) =       5.00
  EFFECTIVE AREA(ACRES) =       0.39  AREA-AVERAGED Fm(INCH/HR)=  0.03
  AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
  PEAK FLOW RATE(CFS)    =        1.41
============================================================================
============================================================================
  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. #4344-1, HOTEL, 1100 W. BALL RD                                    *
* PROPOSED CONDITION                                                      *
* 25-YR STUDY                                                             *
 *************************************************************************

  FILE NAME: BALL-P2.DAT
  TIME/DATE OF STUDY: 12:54 09/19/2019
==========================================================================
  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   30.0     20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 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 =  22
--------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
==========================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
  SUBAREA LOSS RATE DATA(AMC  II):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.27      0.30      0.100    56
  COMMERCIAL                 B        0.31      0.30      0.100    56
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
```

```
 SUBAREA RUNOFF(CFS) =      2.50
 TOTAL AREA(ACRES) =      0.58   PEAK FLOW RATE(CFS) =      2.50

****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  22
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
============================================================================
 USER SPECIFIED Tc(MIN.) =    5.000
 *  25 YEAR RAINFALL INTENSITY(INCH/HR) =  4.824
 SUBAREA LOSS RATE DATA(AMC  II):
  DEVELOPMENT TYPE/       SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE             GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                  B        0.28      0.30      0.100    56
 COMMERCIAL                  B        0.11      0.30      0.100    56
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      1.68
 TOTAL AREA(ACRES) =      0.39   PEAK FLOW RATE(CFS) =      1.68
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        0.4  TC(MIN.) =      5.00
 EFFECTIVE AREA(ACRES) =      0.39  AREA-AVERAGED Fm(INCH/HR)=  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
 PEAK FLOW RATE(CFS)    =       1.68
============================================================================
============================================================================
 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. #4344-1, HOTEL, 1100 W. BALL RD                                   *
* PROPOSED CONDITION                                                     *
* 100-YR STUDY                                                           *
 ************************************************************************

  FILE NAME: BALL-P3.DAT
  TIME/DATE OF STUDY: 12:55 09/19/2019
========================================================================
  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   30.0      20.0    0.018/0.018/0.020   0.67    2.00 0.0312 0.167 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 =  22
------------------------------------------------------------------------
  >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
  >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
========================================================================
  USER SPECIFIED Tc(MIN.) =    5.000
  * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
  SUBAREA LOSS RATE DATA(AMC III):
   DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp          Ap      SCS
       LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
  COMMERCIAL                 B        0.27      0.30      0.100    76
  COMMERCIAL                 B        0.31      0.30      0.100    76
  SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
  SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
```

```
 SUBAREA RUNOFF(CFS) =      3.21
 TOTAL AREA(ACRES) =      0.58   PEAK FLOW RATE(CFS) =      3.21

****************************************************************************
 FLOW PROCESS FROM NODE      3.00 TO NODE      4.00 IS CODE =  22
----------------------------------------------------------------------------
 >>>>>RATIONAL METHOD INITIAL SUBAREA ANALYSIS<<<<<
 >>>>>USE SPECIFIED Tc VALUE FOR INITIAL SUBAREA<<<
============================================================================
 USER SPECIFIED Tc(MIN.) =    5.000
 * 100 YEAR RAINFALL INTENSITY(INCH/HR) =  6.187
 SUBAREA LOSS RATE DATA(AMC III):
  DEVELOPMENT TYPE/      SCS SOIL   AREA      Fp         Ap      SCS
      LAND USE            GROUP   (ACRES)  (INCH/HR)  (DECIMAL)  CN
 COMMERCIAL                 B        0.28      0.30      0.100    76
 COMMERCIAL                 B        0.11      0.30      0.100    76
 SUBAREA AVERAGE PERVIOUS LOSS RATE, Fp(INCH/HR) =  0.30
 SUBAREA AVERAGE PERVIOUS AREA FRACTION, Ap =  0.100
 SUBAREA RUNOFF(CFS) =      2.16
 TOTAL AREA(ACRES) =      0.39   PEAK FLOW RATE(CFS) =      2.16
============================================================================
 END OF STUDY SUMMARY:
 TOTAL AREA(ACRES)      =        0.4  TC(MIN.) =      5.00
 EFFECTIVE AREA(ACRES) =      0.39  AREA-AVERAGED Fm(INCH/HR)=  0.03
 AREA-AVERAGED Fp(INCH/HR) =  0.30  AREA-AVERAGED Ap = 0.100
 PEAK FLOW RATE(CFS)    =       2.16
============================================================================
============================================================================
 END OF RATIONAL METHOD ANALYSIS
```

SECTION 4

HYDROLOGY MAPS

BALL ROAD

EXISTING 7' X 7' RCB

EXISTING 7' X 7' RCB

2
Q_{10} = 2.0cfs
Q_{25} = 2.4cfs
Q_{100} = 3.1cfs
t=5.0

A1
0.56

TOTAL AREA =24394sf
A.C. AREA =16644sf
DIRT AREA = 7750sf
PERVIOUS AREA =32%
USED CONDO =35%

A2
0.42

TOTAL AREA =18295sf
A.C. AREA =11975sf
DIRT AREA = 6320sf
PERVIOUS AREA =35%
USED CONDO =35%

4
Q_{10} =1.5cfs
Q_{25} =1.8cfs
Q_{100}=2.3cfs
t=5.0

1

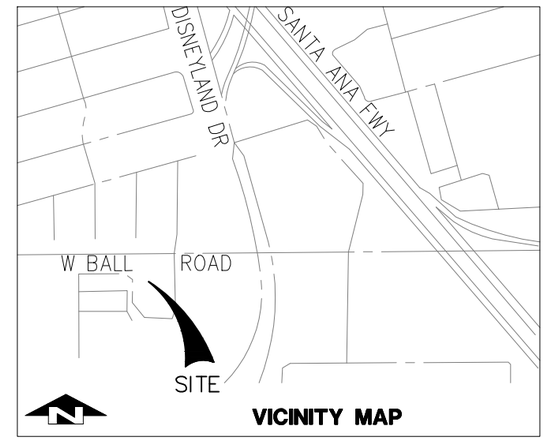
3

WEST STREET

SCALE: 1" = 20'

LEGEND

- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- 1 — NODE NUMBER
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
- Q_{10} =6.0cfs, Q_{100}=8.0cfs, t=15.0, C.B. #1 — PEAK FLOW RATE / TIME OF CONCENTRATION
- ΣQ_{10} =8.0cfs, ΣQ_{100}=10.0cfs, t=15.0 — PEAK CONFLUENCE FLOW RATE / TIME OF CONCENTRATION
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- B — SOIL GROUP



VICINITY MAP

20 10 0 20 60

GRAPHIC SCALE 1"=20'

PREPARED BY:

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

PREPARED FOR:

R3 LODGING
6789 QUAIL HILL PKWY, #731
IRVINE, CA 92603
(949) 287-2003

HYDROLOGY MAP
1100 W. BALL ROAD
HOTEL REDEVELOPMENT

EXISTING CONDITION
(DIRT & A.C.)

W.O. #4344-1

PLOTTED BY: Tu Trinh DATE: May. 14, 2020 04:54:42 PM FILE: F:\1093\Engineering\SY_Hydrology\Ball-Hotel-Existing-Dirt n ac.dwg

BALL ROAD

EXISTING 7' X 7' RCB

EXISTING 7' X 7' RCB

Q_{10} = 2.1cfs
Q_{25} = 2.5cfs
Q_{100} = 3.2cfs
t=5.0

2

A1b
0.31

A1a
0.27

A2a
0.28

A2b
0.11

LIMITS OF UNDERGROUND PARKING (LEVEL 1 & 2)

ELEV.=136.8

BLDG. FF=137.90

BLDG. FF=138.75
GARAGE LEVEL 1 FF= 127.00
GARAGE LEVEL 2 FF= 116.50

Q_{10} =1.4cfs
Q_{25} =1.7cfs
Q_{100}=2.2cfs
t=5.0

4

PARKING GARAGE ENTRY

EXISTING 24" RCP

EXISTING 18" RCP

EXISTING C.B.

WEST PLACE

EXISTING 18" RCP

EXISTING 24" RCP

SD

MWS

DRYWELL

48" RCP

LIMITS OF UNDERGROUND PARKING (LEVEL 1 & 2)

SWITCH GEAR LOCATION

ELECTRIC TRANS. 12'X23' ESMT.

LOW FLOW LINE

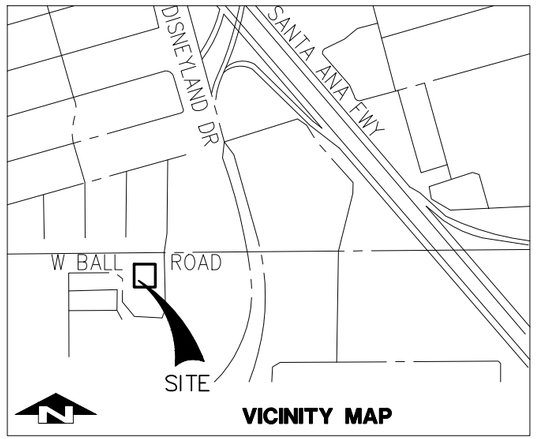
LIMITS OF UNDERGROUND PARKING (LEVEL 1)

LIMITS OF UNDERGROUND PARKING (LEVEL 2)

SCALE: 1" = 20'

LEGEND

- MAJOR DRAINAGE BOUNDARY
- MINOR DRAINAGE BOUNDARY
- 1 — NODE NUMBER
- A / 1.0 — AREA DESIGNATION / AREA ACREAGE (IN ACRES)
- Q_{10} =6.0cfs, Q_{100}=8.0cfs, t=15.0, C.B. #1 — PEAK FLOW RATE / TIME OF CONCENTRATION
- ΣQ_{10} =8.0cfs, ΣQ_{100}=10.0cfs, t=15.0 — PEAK CONFLUENCE FLOW RATE / TIME OF CONCENTRATION
- EXISTING STORM DRAIN
- PROPOSED STORM DRAIN
- B — SOIL GROUP



VICINITY MAP

20 10 0 20 60

GRAPHIC SCALE 1"=20'

PREPARED BY:

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

PREPARED FOR:

R3 LODGING
6789 QUAIL HILL PKWY, #731
IRVINE, CA 92603
(949) 287-2003

HYDROLOGY MAP
1100 W. BALL ROAD
HOTEL REDEVELOPMENT

PROPOSED CONDITION

W.O. #4344-1

PLOTTED BY: Tu Trinh DATE: May. 14, 2020 04:44:36 PM FILE: F:\1093\Engineering\SY_Hydrology\Ball-Hotel-Proposed.dwg

SECTION 5

REFERENCE

CITY OF ANAHEIM
MASTER PLAN OF STORM DRAINAGE
FOR
ANAHEIM BARBER CITY CHANNEL
TRIBUTARY AREA

CITY OF ANAHEIM

Master Plan of Storm Drainage for Anaheim Barber City Channel Tributary Area

---

JUNE 2009

MASTER PLAN OF STORM DRAINAGE FOR ANAHEIM BARBER CITY CHANNEL TRIBUTARY AREA

June 2009

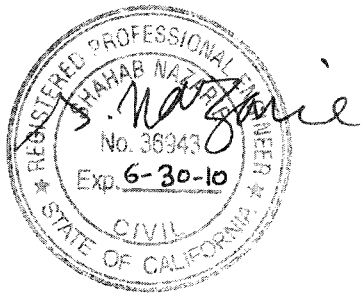
Prepared for

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

By

CNC Engineering
1 Corporate Park, Suite 101
Irvine, CA 92606

Under the Supervision of



Sean Nazarie, 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

7. Drainage Area 20

Drainage Area 20 drains approximately 815 acres and comprises of two general areas: a larger eastern portion and a smaller western portion. The large portion of the Drainage Area is located the east side of the I-5 Freeway and is generally bounded by State College Road on the east, Ball Road on the south, Harbor Blvd on the west and has a northern boundary that meanders along Vermont Avenue, South Street, East Street, and Broadway. Flow from this large eastern portion of the Drainage Area is carried westward across the I-5 Freeway via two underground conduits along Ball Road. The smaller portion of the Drainage Area west of the I-5 is generally bounded by the I-5 on the east, Disneyland Theme Park on the south, Walnut Street on the west and Ball Road on the north. Generally, water flows over land and then through pipes from east to west and discharges directly into the ABC Channel.

8.1 Hydrologic Analysis

The hydrologic analysis was performed for Drainage Area 20 in accordance with the criteria outlined in Chapter 3 and can be found in Appendix C. The hydrology map for Drainage Area 20 can be found in Appendix D. The following table shows the flow rates at the outlet of the Drainage Area for 10-, 25-, and 100-year storm events.

Table 9 – Drainage Area 20 Summary of Hydrology

Node	Location	Drainage Area (ac)	10-Year Flow (cfs)	25-Year Flow (cfs)	100-Year Flow (cfs)
2015	Ball Road at Harbor Blvd	320	318	408	553
2018	Harbor Blvd at Ball Road	443	356	464	634
2016	Ball Road Downstream of I-5	778	652	847	1168
2021	Ball Road at ABC Channel	815	652	847	1168

8.2 Analysis of Existing Improvements

The major storm drain in Drainage Area 20 runs along Ball Road and discharges directly into the ABC Channel. The storm drain varies from 36" RCP east of East St. to a double 7' x 7' RCB at the ABC Channel. Seven storm drain laterals feed into this storm drain within Drainage Area 20. The largest of these laterals is along Harbor Blvd, which consists of a 90" RCP and turns westerly at Ball Road and continues parallel to the storm drain in Ball Road until it crosses the I-5 Freeway and then confluences with the storm drain mainline. The confluence of these two storm drains is marked as node 2016 on the hydrology map. Table 9 above provides a summary of the drainage area and peak flows at this node.

The City's flooded width criteria are not satisfied along Ball Road, Harbor Blvd, Turin Avenue, Avocado St. and Norman Ave.

The existing street flow hydraulic calculations for Drainage Area 20 can be found in Appendices A and B.

8.3 Proposed Improvements

As discussed under Section 8.2, several streets in Drainage Area 20 do not meet the City's allowable flood width requirement. Several of these street segments currently have no underground storm drain improvements.

This report recommends construction of new storm drain improvements to convey the full flow of the 10 year storm along the following street segments:

- Install 450 Ft of 30" RCP in Elder St from Elm St to Santa Ana St
- Install 1705 Ft of 48" RCP in Santa Ana St from Elder St to join existing storm drain at Haven Dr
- Install 480 Ft of 42" RCP in South St from Elder St to join existing storm drain at Barrett St
- Install 490 Ft of 36" RCP in Diana Ave from the cul-de-sac to Verde St
- Install 800 Ft of 39" RCP in Verde St from Diana Ave to Tyrol Ave
- Install 375 Ft of 39" RCP in Tyrol Ave from Verde St to Wayside St
- Install 290 Ft of 39" RCP in Wayside St from Tyrol Ave to Vermont Ave
- Install 1275 Ft of 39" RCP in Vermont Ave from Wayside St to Join existing storm drain at Avocado St
- Install 585 Ft of 42" RCP in Norman Ave from McCloud St to Avocado St.
- Install 435 Ft of 42" RCP in Avocado St from Norman Ave to Turin Ave
- Install 850 Ft of 51" RCP in Turin Ave from Avocado to join the existing Storm Drain at the intersection of East St and Turin Ave.

The remaining street segments that do not meet the flood width requirement currently have underground storm drains but do not have sufficient flow capacity. As shown in Appendix B, in order to meet the flood width criteria, it will be necessary to improve the storm drain capacity in Ball Road and Harbor Blvd.

Alternatives 1 and 2 below provide the approximate sizes of conduits to replace or augment the flow capacity of each existing storm drain, respectively. Alternative 3 is a combination of Alternatives 1 and 2 where the smaller sized conduits are removed and replaced and the larger conduits are protected in place and augmented with new parallel conduits.

Drainage Area 20 Alternative Improvements:

Alternative 1-

- **Ball Road from East St. to Olive St.-** Replace existing 36" RCP and 48" RCP with 10'x4' RCB.
- **Ball Road from Olive St. to Ox Rd.-** Replace existing 48", 51", 54", and 57" RCP lines with 10'x5.5' RCB from Olive St. to Ox Rd.
- **Ball Road from Ox Rd to ABC Channel-** Replace existing 2-7'x7' and 2-8'x6'-2" RCB with 2-12.5' x 7' RCB.
- **East St from Turin Ave to Ball Rd-** Replace existing 36" RCP with 10' x 4' RCB.
- **East St from Santa Ana St to South St-** Replace existing 54" RCP with 72" RCP.
- **East St from South St to Vermont Ave-** Replace existing 84" RCP with 102" RCP.
- **Vermont Ave from East St to Harbor Blvd-** Replace existing 90" RCP with 9.5' x 9' RCB.
- **Harbor Blvd from Vermont Ave to Ball Rd-** Replace existing 90" RCP with 10.5' x 8' RCB.

Alternative 2-

- **Ball Road from East St. to Olive St.-** Install new parallel 51" RCP.
- **Ball Road from Olive St. to Ox Rd-** Install new parallel 96" RCP.
- **Ball Road from Ox Rd to ABC Channel-** Install new parallel 12.5'x7' RCB.
- **East St from Turin Ave to Ball Rd-** Install new parallel 72" RCP.
- **East St from Santa Ana St to South St-** Install new parallel 60" RCP.
- **East St from South St to Vermont Ave-** Install new parallel 102" RCP.
- **Vermont Ave from East St to Harbor Blvd-** Install new parallel 93" RCP.
- **Harbor Blvd from Vermont Ave to Ball Rd-** Install new parallel 96" RCP.

Alternative 3 (Recommended) -

- **Ball Road from East St. to Olive St.-** Replace existing 36" RCP and 48" RCP with 10'x4' RCB.
- **Ball Road from Olive St. to Ox Rd.-** Replace existing 48", 51", 54", and 57" RCP lines with 10'x5.5' RCB from Olive St. to Ox Rd.
- **Ball Road from Ox Rd to ABC Channel-** Install new parallel 12.5'x7' RCB.
- **East St from Turin Ave to Ball Rd-** Replace existing 36" RCP with 10' x 4' RCB.
- **East St from Santa Ana St to South St-** Replace existing 54" RCP with 72" RCP.

- **East St from South St to Vermont Ave-** Replace existing 84" RCP with 102" RCP.
- **Vermont Ave from East St to Harbor Blvd-** Replace existing 90" RCP with 9.5' x 9' RCB.
- **Harbor Blvd from Vermont Ave to Ball Rd-** Replace existing 90" RCP with 10.5' x 8' RCB.

In order to minimize the size of the storm drain improvements in Ball Road., this report also recommends the City consider constructing a retarding basin within Traveler's World RV Park located at 333 W. Ball Road. Refer to Section 3.2 for more information.

8.4 Cost Estimates

Summarized in Table 10 are the construction cost estimates by project location for Drainage Area 20. The cost estimates were prepared as discussed in Section 4.4. The detailed cost estimates for Drainage Area 20 can be found in Appendix E.

Table 10 – Drainage Area 20 Cost Estimate (2008 Dollars)

Drainage Area	Street	Type of Facility	Size	Estimated Cost
20	Norman Ave/Avocado St (from Turin Ave to McCloud St)	New	42" RCP	**$428,000**
20	Turin Ave. (from Avocado to East)	New	51" RCP	**$395,000**
20	East St. (from Turin to Ball)	Replacement per Alternative 3	10'X4' RCB	**$1,408,000**
20	East St. (Santa Ana to South) (South to Vermont)	Replacement per Alternative 3 Replacement per Alternative 3	72" RCP 102" RCP	**$2,924,000**
20	Harbor Blvd. (from Vermont to Ball)	Replacement per Alternative 3	10.5'X8' RCB	**$2,129,000**
20	Ball Road (East St to Olive St) (East St to Ox St)	Replacement per Alternative 3 Replacement per Alternative 3	10'X4' RCB 10'X5.5' RCB	**$8,256,000**
20	Ball Road (Ox St. to ABC Channel)	New Parallel per Alternative 3	12.5'X7' RCB	**$4,806,000**
20	Santa Ana St (Haven Dr to Elder St)	New	48" RCP	**$715,000**
20	South (Elder St to Barrett St)	New	42" RCP	**$222,000**
20	Diana Ave (Cul-de-sac to Verde) Verde St/ Tyrol Ave/ Wayside St	New New	36" RCP 39" RCP	**$705,000**
20	Vermont Ave (from Wayside to Avocado St.)	New	39" RCP	**$491,000**
20	Vermont Ave (from East St to Harbor Blvd)	Replacement per Alternative 3	9.5'X9' RCB	**$8,283,000**
20	Elder St (Between Elm St and Santa Ana St)	New	30" RCP	**$190,000**
TOTAL				$30,952,000

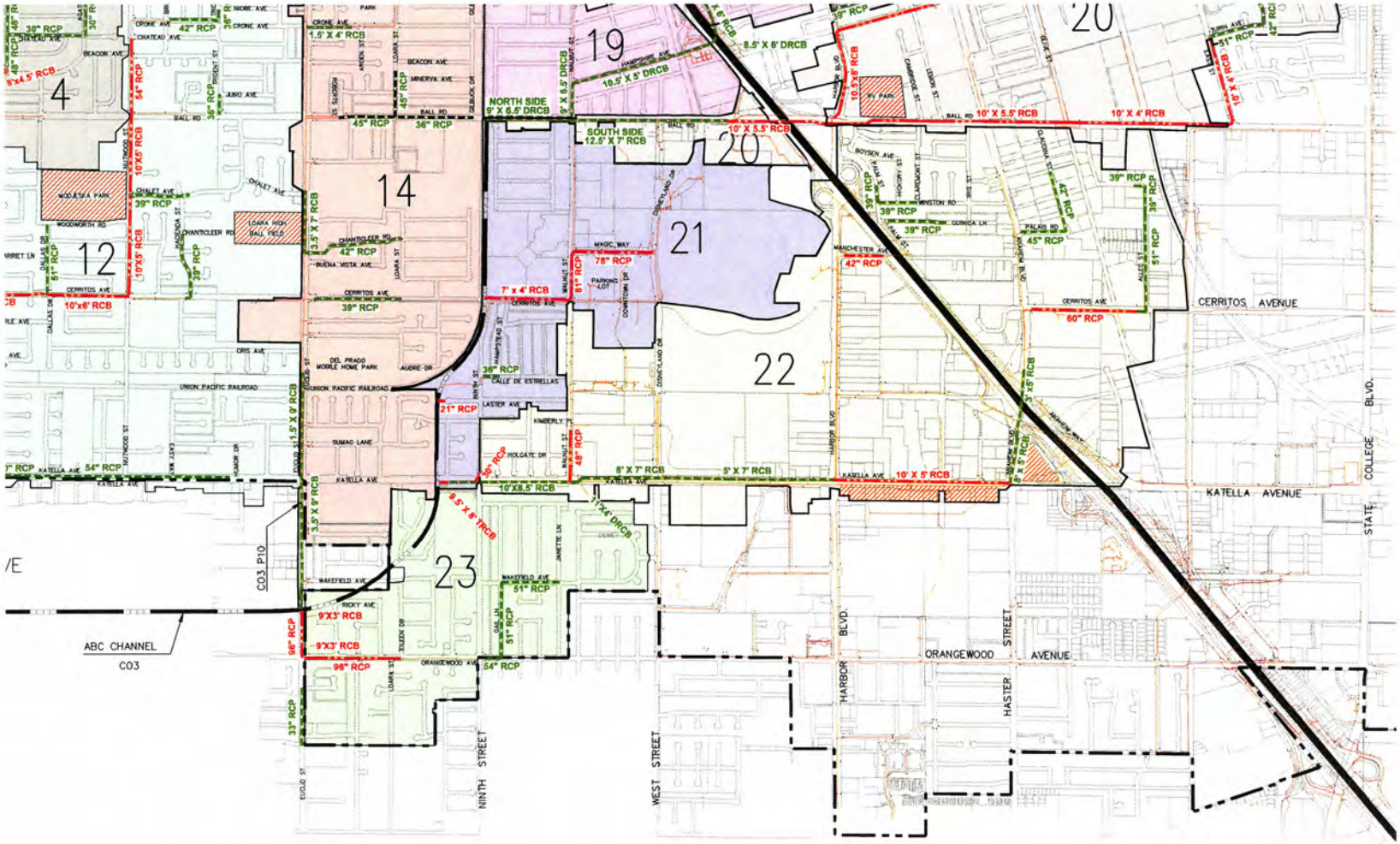


Figure 2
Proposed Storm
Drain Improvements

City of Anaheim Master Plan of Storm Drainage for Anaheim–Barber City Channel Tributary Area

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